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Georges Friedmann

Conservatoire National de Arts et Métiers

Industrial Society

THE EMERGENCE OF THE HUMAN PROBLEMS OF AUTOMATION

(Problèmes Humains du Machinisme Industriel)

EDITED AND WITH AN INTRODUCTION BY HAROLD L. SHEPPARD

Wayne University

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Contents

EDITOR'S INTRODUCTION	9
AUTHOR'S PREFACE TO THE AMERICAN EDITION	17
PREFACE TO THE FIRST EDITION	19
INTRODUCTION	25

Part One—The "Human Factor"

I. TAYLORISM AND THE HUMAN SCIENCES	37
The scientific ambition of Taylorism	
Research and the first reactions of workers	
Towards an industrial psychology	
Scientific examination of Taylorism	
Conclusions	
II. SOME CONTRIBUTIONS OF THE PHYSIOLOGY OF WORK	67
III. FATIGUE	77
Difficulties in testing and measuring	
Hours of work and fatigue	
Rest pauses and hours of work	

IV. THE WORKING ENVIRONMENT	93
Temperature, humidity, and ventilation	
Light	
Noise and vibration	
V. ADAPTING MACHINE TO MAN	102
VI. ACCIDENTS	108
The human element	
Mechanical and human defects	
The importance of the worker's psychology	
VII. CONCLUSIONS	121

Part Two—The Limits of The "Human Factor"

I. PROBLEMS OF MONOTONY	129
(1) <i>Subdivided tasks and monotony</i>	
(2) <i>Some remedies</i>	
(3) <i>Conclusions</i>	
II. RHYTHM	157
Natural rhythm	
The machine and optimum rhythm	
III. ASSEMBLY-LINE WORK	163
Studies of adaptability	
Workers' attitudes	
Collaboration of workers	
Dangers and remedies	
IV. AUTOMATION	173
Dialectics of the division of labor	
Three stages of automation	
Technological requisites of automation	
Extension of this phenomenon	
Effects on the labor force	
Cybernetics and industrial automation	

V.	OCCUPATIONAL SKILL	191
	Laments and fears	
	The degradation of skill	
	The "new artisan group"	
	Statistical data	
	Notes on the development of some industrial trades	
	Skill and intellectual qualities	
	The separation of manual and intellectual labor	
VI.	INDUSTRIAL TRAINING AND OCCUPATIONAL CULTURE	220
	Trends among independent craftsmen	
	Technicist trends	
	Managerial trends	
	Trends in technical education	
	Vocational guidance and adaptability	
	The re-education of the unemployed	
	Unemployment and apprenticeship	
	Scarcity of skilled workers	
	Apprenticeship and humanistic education	
	Aspirations and realities	
	Events and trends since 1945	
	 Part Three—Towards a Social Psychology of the Factory	
I.	THE WORKER AND RATIONALIZATION	261
	(1) Working-class reactions	
	(2) Observations of industrial psychologists	
II.	HUMAN RELATIONS	291
	New trends in scientific management	
	Managers, technical staff, and foremen	
III.	SOME EXPERIMENTS IN HUMAN RELATIONS	304
	The Hawthorne investigation	
	Bat'a	

Two French experiments	
Some experiments since 1945	
IV. THREE ASPECTS, A SINGLE REALITY	351
Integration	
Release of the individual's potential	
Joy in work	
V. THE VALUE AND LIMITS OF	
THE HUMAN RELATIONS MOVEMENT	365
CONCLUSIONS	373
Types of rationalization	
Balance sheet of the human factor	
Final observations on mechanization	
Toward a triple reappraisal of work	
A giant test	
LIST OF ABBREVIATIONS USED IN REFERENCES	401
REFERENCES	401
INDEX OF NAMES	433

Editor's Introduction

ALL TOO BRIEFLY PUT, the chief value of Georges Friedmann's *Industrial Society* is based on at least three of its contributions: (1) its intensive reporting of research in Europe not previously available to English-speaking students; (2) its truly interdisciplinary approach, presenting rich factual material on nearly every aspect of industrial work, and in an organized fashion; (3) its humanistic, or as I prefer to say, its "liberal arts" emphasis.

Within the confines of the academic and scientific disciplines with their high walls separating one from the other (the physicist of the turn of the century who committed suicide because he could not keep up with all the sub-developments in his own field really had nothing to complain about, compared with the situation today), we find a vitiating specialization whose dangers have been described by Alfred North Whitehead in his *Science and the Modern World*. There he dwells upon the consequences of our respective "trained incapacities" or "occupational psychoses," our nearly complete ignorance of "useful subjects subservient" to our own field.

This situation has its dangers. It produces minds in a groove. Each profession makes progress, but it is progress in its own groove. Now to be mentally in a groove is to live in contemplating a given set of abstractions. The groove prevents straying across country, and the abstraction abstracts from something to which no further attention is paid. But there is no groove of abstraction which is adequate for the comprehension of human life. . . .

The dangers arising from this aspect of professionalism are great, particularly in our democratic societies. The directive force of reason is

weakened. The leading intellects lack balance. They see this set of circumstances, or that set; but not both sets together.

I would disagree with the late philosopher and scientist only by asserting that each profession can make progress in its own groove only to a certain extent: it needs to be informed of the developments taking place in other grooves. A chief function of Professor Friedmann's study presented here is exactly this task of exploring and coordinating these several developments. Professor Friedmann's work during the last two decades represents a serious attempt (in my opinion, a successful one) to climb out of the grooves created by the burrowings of such seemingly diverse "disciplines" as industrial engineering, physiology, industrial education, psychology, and sociology.

What does one see when the escape from the restricted abstractions of each specialization is accomplished? The one reality, for Friedmann, is man in an increasingly mechanized, industrial society. Being a firm believer in the unity of science, he manifests none of the professional arrogance characteristic of so many of us who have had the misfortune to be indoctrinated with the point of view that the "other" field's approach is inadequate, while ours "really" provides the answer. This emphasis on the unity of man, and hence the necessity for the unity of the sciences attempting to understand and help him, runs throughout the book. As he himself states, ". . . any aspiration to scientific knowledge of these [industrial] phenomena is illusory if the views taken from these varied angles are not confronted with and enriched by one another. The technological, the physiological, the psychological, and the social are inseparable." Of particular relevance for sociologists is the reference to the Durkheimian neglect of individual psychology, a neglect which Friedmann considers to be the manifestation of an extreme sociological reaction to the inadequacies of physiological behaviorism.* The industrial engineer will find in the study much in the way of provocative observations concerning his role and potential contribution; the psychologist, an increased acquaintance of previously unavailable studies, and a revaluation of his place in the effort to make a contribution

* As a matter of fact, my first knowledge of Prof. Friedmann occurred in the course of some earlier research on criticisms of the Durkheim school by French sociologists.

to the study of man at work. English, French, German, and Russian studies are reported on. And American ones are at the same time intelligently related to these. The marvel is that this task is accomplished without an atomistic presentation, that is, the many researches cited seem to fall in place within a systematic perspective.

The reader has in Professor Friedmann's study an opportunity to acquaint himself intelligently with the several basic problems of work in our present stage of technology, and in so doing, move in the direction of achieving for himself a more *truly* interdisciplinary outlook. The creator of such a broad coverage must by necessity possess what has come to be called a "seminal mind." The fact that Professor Friedmann spent some years as a machine-tool apprentice serves to enhance the value of this broad intellectual perspective.

Unlike so many intellectuals (American as well as European) who express a misplaced concern over the "Americanization" of Europe and other parts of the world, Professor Friedmann realistically prefers to focus instead on a common technical civilization and its problems as they are expressed under different local (national) conditions. The technical environment is a universal phenomenon, a "constitutive fact of civilization." As for the other view, Friedmann considers it a "cheap consolation to certain European intellectuals for the misdeeds of mechanization in their own countries."*

Friedmann's perspective on industrial civilization includes a clear-cut recognition of the peculiar nature of each of the several phases or stages of the never ending Industrial Revolution, and more especially, of their closely related technical and socio-cultural aspects. Each era has influenced the emergence of various machines which "play different and sometimes very numerous roles, and have different effects on man's activity and sensibility."†

For Friedmann, there are four categories of such machines: (1) *production* machines for industry, agriculture, and clerical work; (2) *transport* machines for use on land, sea, and in the air; (3) machines of *communication*; and (4) the *techniques of leisure* ("In an

* Despite such objectivity, it should be noted that Prof. Friedmann, along with other notable scholars discriminated against by recent American visa restrictions, has been unable to revisit the United States since his last trip in 1948.

† From his "Technological Change and Human Relations," two lectures presented at the London School of Economics in October, 1951, and published in the *British Journal of Sociology*, June, 1952, pp. 95-116.

industrial civilization, mechanization of leisure accompanies mechanization of work and is closely mingled with it.”).

We are just entering upon the stage of industry which will be influenced by two major features: vast new sources of power (only one of which is atomic energy), and automation. It is on the latter that Professor Friedmann dwells in the present book. As is so often the case, the social scientists have not yet caught up with the engineers of industry who are busily engaged in the invention of more and more automatic operations, not only in the factory but in the office.

According to John Diebold,* “Automation is a new word denoting both automatic operation and the process of making things automatic. In the latter sense it includes several areas of industrial activity such as product and process re-design, the theory of communication and control, and the design of machinery.” To be sure, ever since the beginning of the steam engine stage of industrialism, some form of automatic controls have been in use: Oliver Evans had an automatic flour mill, in the 1780’s, near Philadelphia, and the first decade of the nineteenth century saw the automatic loom of Joseph Marie Jacquard’s, controlled by punched paper cards, in Paris. But the developments of the last 10-15 years in electronics, communications, and electric network analysis have intensified and made possible a rapid expansion of self-correcting and self-programming machines.

The development of such devices, however, are merely the necessary but not the sufficient conditions for the current “spurt” in the trend toward automation. Just as the assembly line spread like “wild-fire” because, as Friedmann puts it, “the boom in production and in markets accompanying the second industrial revolution required it,” so too has automation recently advanced because of social and economic conditions. In particular these conditions include the further expansion of mass purchasing power, the scarcity of labor, and especially in the United States, the high cost of labor. Of course, there is not much sense in making machines which will produce

* *Automation: The Advent of the Automatic Factory* (New York: Van Nostrand, 1952). “The origin of the word is humble indeed . . . the author found *automatization* both awkward and—from the standpoint of his weak spelling—hazardous. . . . Mr. D. S. Harder, Vice President in charge of manufacturing of the Ford Motor Company, has for some time used the word *automation* to describe the automatic handling of materials and parts in and out of machines.”

more goods if the workers who tend the machines cannot afford to buy the goods.*

I happen to be among the optimists concerning the consequences of automation. The problem of "technological unemployment" could be solved through certain management and government policies such as job retraining, substantial unemployment compensation, and new products-investment or diversification. It seems to me that not only will the consumer be benefited through cheaper and more plentiful (as well as better-made) products, but many of the problems created by the drudgery and monotony of contemporary factory life might be eliminated, or at least mitigated. For Friedmann, the "deskillingization" process bemoaned by so many observers is part of a transitory stage in the total development of industrialism: it does not necessarily follow that the intensive development of industrialism is accompanied by a straight-line increase in a greater and greater division of labor into excessively simple, one-action repetitive labor. Instead, there is a "dialectic" involved. The skills required of the worker in the age of automation will move in the direction of repair work, adjustments, and instrument reading, etc., all of which, to quote Diebold, "can provide challenges, pleasures, and satisfaction very much like those enjoyed by the swordsmith or cabinet maker."

The reader will find in this work of Friedmann's an extensive discussion (Part Two, Chapter Four) on this subtle and somewhat unexpected development. According to him, automation promises to correct those work situations in which the worker has to "submit to the machine's rhythm, which is just what causes tension, fatigue, and tedium." A greater humanization of industry will be made possible.

This is the challenge to modern industry: the humanization of it. Too much of contemporary industrial social science (psychology's and sociology's "human relations.") is devoted to a "creeping manipulation" of the *worker's* adaptation to the *machine*. The present-day technological environment is taken as given. The assumption is that man is a completely flexible object, capable of fitting himself to every contingency. In this respect, much of contemporary social

* A story currently circulating in the Detroit automotive community is about the CIO President, Walter Reuther, being shown through one of the new "automated" factories. A management representative asked him, in referring to the new machines, "How is your union going to collect dues from these robots?" Reuther is said to answer, "How are you going to get them to buy your cars?"

science is actually akin to one of its *bêtes noires*, Taylor's Scientific Management, which attempted to dissect into irreducible elements the natural work patterns and rhythms of the worker, and rearrange them into the most efficient, "one best way." Friedmann's exposition of research into natural work rhythms is dominated by his general concern for recognition of the truly human factor in industry, and the adaptation of the machine to man.

The new tasks required of workers under automation naturally call for fundamental revisions in training and education, because these tasks call for higher levels of ability. Here we can see the intimate connection between such different spheres of life as technology, work, and the school, delineated by Friedmann.

Thus, from the lofty heights of the "grand view" concerning the progress of technology, Friedmann comes down into the factories and workplaces themselves, and intimately acquaints us with the researches and views of the different disciplines on such problems as fatigue, noise, accidents, monotony, etc., and the various suggestions offered for their total or partial solution, such as job-rotation in the case of monotony; the tremendous challenge of modern industry to our educational system, the need for creating truly educated youths destined for jobs in industry; and the widely different attempts in the area of worker-management relations.

But in all of these pages the focus on mechanization in the shops is not an end in itself: it is only that the sciences of man have been able more fully to explore this particular sphere of life. ". . . Industrial mechanization is a giant test which casts a glaring light on the repercussion of social factors upon contemporary man's mental and moral activity. It also shows in what direction a humanism anxious to change *effectively* the condition of humanity, must orient its course and its hopes."

This translation went through several stages before final publication. The original French edition was first translated, in rather rapid fashion, by John A. Spaulding, and then edited by myself, after which Professor Friedmann perused it with me. It then was shown to Mary and Tom Bottomore (now the Secretary of the International Sociological Association, and with the London School of Economics) who also translated the addenda to the French edition, after which

I again edited the entire manuscript for final publication. Their contribution to the finished product cannot be appreciated enough. Their work on the manuscript was a virtual re-translation of much of the original edition. Complete responsibility, however, for any mis-translations is mine. I also wish to thank Miss Sue Marx, of Wayne University, for her library research assistance.*

HAROLD L. SHEPPARD
Wayne University

March, 1955

* Miss Marx performed the important task of checking Professor Friedmann's quotations from English language sources, in order to cite the English wording here. In some instances it was impossible to find the exact page references in the original sources which have appeared in French translation editions. The symbol "Fr." used in the references refers to the pagination of these French editions when we have not been able to find the page numbers of the original English language edition of a given work.

Author's Preface to the American Edition

SINCE THE FIRST EDITION of this book appeared in 1947 there has been little change in the problems of industrial mechanization, and the recent trends have, on the whole, confirmed the analysis and interpretation which is here presented.

For the American edition I have added a few notes and have augmented certain chapters, taking account of recent developments and of recently published literature. Besides, I have added at the end of each chapter a short bibliography, which does not pretend to be complete, but which draws attention to important or representative studies. I have thought it most useful for the American reader, who already has excellent bibliographies of the literature published in the United States, to concentrate on the European literature.

The events of recent years, and above all the atomic arms race, have only increased the doubts and fears to which I drew attention in the first edition of this book. It is evident that, among the ills from which humanity suffers in the 20th century, one of the most serious is the lack of understanding of the structure and effects of the new environment into which men have been plunged during the last century and a half by the rapid development of a technical

civilization. I am well aware of the many imperfections in an individual attempt at an overall view of such complex issues, and I hope therefore that these problems will gain wide attention and will attract *teams* of young research workers.

GEORGES FRIEDMANN

Paris, July, 1954.

Preface

to the First Edition

SINCE THE BEGINNING of the century the human mind has been increasingly conscience-stricken in the face of its own activity and its own creations. And with good reason. The destiny of machine civilization, born of the application of science to society, everywhere provokes uneasy speculation, exacerbated by the material and moral chaos into which humanity has been plunged by two world wars. Philosophers, writers, journalists and poets express and disseminate this uneasiness. Such subjects of discussion as the following are boldly announced on the walls of our city buildings: "What are we to think of mechanization?" "Is the machine for man or against him?" Sensitive essayists devise variations on the theme of the present and the future. At the same time we hear much of humanism. It is certainly desirable that literature, interrupting the egoistic trifling in which it has so long indulged, should wish, today, to divert all its resources to the service of man. But general views, fine sentiments, intuitions, personal affirmations—however elegantly expressed—make no solid contribution toward the construction or advance of a well-founded humanism. The problems of mechanization must be grasped where they arise, observed and even experienced in their true nature. The various sciences from which they derive must be studied in order to judge the evils, and to define the remedies (if such exist) and the conditions under which the latter may operate.

This work constitutes the second part of a trilogy to which I have given the general title of *The Machine and Humanism*. The subject of the first part (*La Crise du Progrès*) was a study of the crisis in the ideologies of progress in western thought from the end of the 19th century to the eve of World War II. Starting with the period of enthusiastic confidence in the application of science and industry to the welfare of individuals and societies, it reached, with Taylor and Ford, the great doctrinaires of technical progress at the beginning of the second Industrial Revolution, and gave an account of the tremendous crisis between the two world wars and the new hopefulness aroused by the immense Soviet experiment. It was, therefore, concerned primarily with the history of ideas and studied the intellectual and moral repercussions (varying with social structures and milieux) of the adventure in mechanization into which humanity has plunged and in which it risks disaster.¹

The second volume attacks the problems of mechanization themselves, restricting itself to the industrial aspect which in itself is a vast and varied field. The investigation and analysis are restricted to the workshops of large-scale industry, that is, to the mutual relations between man and the machines of *production*, leaving to a third volume² the task of studying as a whole the milieu of development of technical civilization, which also includes the technology of *transportation*, *communication* and *leisure* (such as railroads, the automobile and the airplane, the telegraph and telephone, phonographs, talking pictures, radio and television). Moreover, this study is necessarily limited to a certain period of time, since it seeks to grasp the human problems of mechanization produced by the "second industrial revolution," which was distinguished and defined in the preceding volume: the period of transition from the craft workshop or small-scale production, still dominated by the steam engine, to a complex whole, a veritable octopus of techniques, centering about the mass application of electricity to industry, and inseparable from the financial and economic factors characterizing the present phase of world capitalism. Finally, given the great structural differences between the societies of Western Europe and the United States, on the one hand, and the Soviet Union on the other, I considered that it would be methodologically inadvisable to make use of facts derived from both. In any case, I have discussed elsewhere some of the problems of mechanization which I observed in Russia during the period

of the five-year plans.³ The facts selected for this work are all taken from Western European or North American industry.

Interest in these problems, which have always seemed to me among the most important and disquieting of our epoch, concerning as they do humanity's moral as well as its material future, had begun to engage my attention as early as 1930. In 1932-33, I passed through a rapid apprenticeship in machine-tools (lathe, shaping-machine, planing-machine, milling machine), an experience with machinery clearly indispensable in every respect. The facts employed here are almost exclusively direct testimony coming from workmen, foremen, engineers, and from the studies of industrial psychologists specializing in the human problems of industry, frequently men who have themselves practiced the mechanized trades which they were studying. To these have been added a number of observations which I have acquired during periods of probation and visits to workshops, technical schools, or *Bourses du Travail*, in France or abroad.⁴ Moreover, I gave courses in "general culture" for five years to young people in a School of Applied Art in the furnishing industry, the excellent Ecole Boulle in Paris. This afforded me a daily first-hand contact with the difficulties of an occupation to all appearances still a handicraft but increasingly penetrated and almost eroded by mass-production industry, and also gave me the benefit of the valuable experience of its teachers, artists, artisans, and shop foremen, as well as of former pupils who themselves had become producers. The lessons drawn from this period of instruction provided, during the study of large-scale industry which I was pursuing elsewhere, what might be called a backdrop against which the results of the latter stood out by comparison in sharp relief.

Like the preceding work and, if possible, still more clearly, this book shows the necessity for close co-operation, in examining human problems, among all the sciences which deal with man. This connection in fact is illustrated here in the most striking manner in the course of each new problem. Whether the question is one of fatigue, of monotonous "subdivided" work, of accidents, automation, apprenticeship, or skill, the pure mechanics of the engineer, and the different approaches of the physiologist, the industrial psychologist, the anthropologist, the economist, and the sociologist are equally necessary to reveal the human realities which none of them, alone, would make it possible to approach and grasp. The human sciences

are *diverse* in their instruments and in their methods of investigation, but fundamentally *one*, like their object: man. Their respective frontiers are mere working hypotheses, sometimes convenient, often harmful, which disappear at the level of a deeper and more comprehensive knowledge.

As will be frequently observed in this book, social forces are important and effective when it is a matter of activities generally pursued in a group, as is the case with the industrial labor of our modern workshops; and they should not be underestimated. Yet it would be very wrong to think that they exercise a domination which is everywhere and irresistibly confirmed. To the best of my ability, I have tried to respect the character of the problems studied, to preserve their deep complexity and to consider them from the various angles adopted by the different human sciences in order to approach them. My hope is that, pending the collective researches of groups of colleagues to which I constantly look forward, this work may not present too many inadequacies and gaps.

Toulouse, June, 1945.

N.B. A large proportion of my documents, collected in the course of a decade, was destroyed in Paris, in March, 1942, during the German occupation, by a fire the cause of which has not been explained. Maurice Halbwachs, who immediately went to the spot in my absence, could rescue nothing from the debris. As a result of this accident, certain references could not be checked, and for this I ask the reader's indulgence.

Industrial Society

Introduction

IN 1897, MARCELIN BERTHELOT published under the title, *Science et Morale*, a collection of articles and lectures which revealed up to the very end of the century the unbounded hopes and confidence which many men of his generation, and those not the least distinguished, had placed in the application of science to the development of human society. Science has an implicit morality, the true morality, which is also the most effective, most inclusive and most capable of improving mankind. The only problem is to make this morality explicit and to propagate it. The material consequences of the progress of scientific knowledge, one of the chief of which is industrial mechanization, can only be beneficent. "The scientist," Berthelot wrote, "is constantly increasing the heritage and the collective capital of the nations."¹ No uneasiness is felt as to the action of these omnipresent machines on human personality, no shadow mars the grandiose picture of the future of the nations which allow themselves to be led to prosperity by the constant increase of theoretical and practical knowledge, a picture in which this great chemist prophetically includes the tremendous destiny of electricity, the outmoding of agriculture and stock-raising by the synthetic manufacture of foodstuffs, and the revolution of private and international relations by aviation.²

Berthelot's message is like the last echo of the Saint Simonian hymns, the hope which the century of the triumphant bourgeoisie placed in industry as the bearer of greater prosperity and happiness. Industrial mechanization, being one of the most thoroughgoing trans-

formations of civilization by science, could not be suspected by a generation so strongly influenced by Darwin and Spencer. It is noteworthy that none of the great minds of the period, trained in exact observation and studying with such interest the application of the sciences to industry, seriously inquired how machines affect the feelings and minds of those who constantly use them and whether man, as a producer, would not be deeply affected by the new conditions of work.

Yet at the very moment when Berthelot was repeating such ingenuous dogmas, many signs already showed that western man was entering a new period of technical revolution, in the course of which machine industry was to assume unexpected forms and exert unexpected effects.

I have elsewhere described the vast network of changes in the utilization of energy and the methods of production which I have called the *second industrial revolution*. The first revolution was marked by the triumph of the steam engine, of coal—the first “bread of industry”—and by the change from domestic to factory production. The second corresponds to an immense and varied spread of techniques dominated by the wholesale invasion of the workshops by electric power. Though it was fifteen years since Gramme had taken out his patent on a reversible machine, which was either an electric generator if supplied with power, or a motor if supplied with current, the first practical transformers appeared only in 1884 at the Turin Exhibition. From this time electricity could be transported and then distributed and used by the army of machines fed by it. The heat engine, thus challenged, responded by improvements through fractional expansion, and the superheat of steam and turbines. New fuels, liquid and gaseous, in their turn took the place of gasoline, followed by the development of the whole range of internal combustion engines and Diesel engines, in which benzol, vaporized alcohol, the gas of blast furnaces, and the residues of coal distillation increased the range and variety of engines, which now conquered the world. If to these two fundamental features we add the wholesale invasion of industry and agriculture by chemistry, from which Berthelot expected so much, the increasing number of automatic machines used in all kinds of workshops, and the growing industrialization of agriculture, we already have general technological characteristics of a

new period which, as we shall see, also has a new and unique economic and social structure.³

Without the world market, the first industrial revolution would have been inconceivable. This had given the initial impetus and, in turn, the increased volume of manufactured goods stimulated the search for and extension of outlets. The interaction of technological and economic phenomena is also clear when we notice that, while the transformed equipment of the industrial revolutions, especially the second, extended the division of labor by the breaking down of tasks among more and more specialized machines, on the other hand, the increase of unskilled labor around great industrial centers—a vast reservoir of workmen for all tasks and of potential consumers—made possible a new stride in the development of techniques for an ever larger and more standardized production. The development of the market, of needs, of techniques and of occupational psychology are all interconnected. In the midst of this sort of spiral development there was a revolution in the former methods of craft work which still existed around the semi-handicraft machines of the first industrial revolution, which were run and controlled by skilled craftsmen who were members of “trade guilds.”

During the last years of the century, the signs of the transformation of capitalism multiplied. The serious depression lasting more than twenty years, from 1873 to 1895, marked the definitive disintegration of economic liberalism and the end of a period still dominated by free competition, free trade, and faith in the “harmonious” adjustment between the individual’s interest and that of the community. A feverish growth of association and organization now began throughout the world. Vast banking combines, centralized and decentralized, intervening in production on a large scale, indicated that finance was taking the lead in industry within the structure of capitalism. At that time were founded the great horizontal and vertical combinations, the “pools” and “corners,” the mergers of businesses, the cartels and trusts, the “holding companies,” and in France the “Comptoirs.” From the 1890’s the reign of the “Titans” begins in the United States: Rockefeller who combined all the petroleum refineries and confronted the Royal Dutch with his Standard Oil, Carnegie who alone produced as much steel as the whole of England, and J. Pierpont Morgan who founded in 1902 the giant “supertrust”

of the United States Steel Corporation. They were quickly imitated in Germany by Krupp, Thyssen and others.

On every hand associations sprang up for the defense of a group of interests, syndicates for the common exploitation of a market or to struggle against a competing group. As a general rule, the producers united in a pool, a corner, or even a cartel to offset the evils of competition among themselves and within the frontiers of their group. In monopoly capitalism, the capitalism of large units which increasingly supplanted liberal capitalism and marked the economic and social aspect of the second industrial revolution, competition was transferred to the level of powerful national or international groups. The size of businesses and the volume of goods produced had become so great that the system had to organize, so far as possible, to prevent unrestrained competition at all levels with its risk of catastrophe. The trusts, at first in open conflict, busily strangling one another, and fleecing the consumer, and doomed to monstrous alternations of booms and crashes, little by little were forced to change to less crude forms of warfare, under state surveillance and especially in their anxiety for joint self-defense against the rising tide of the labor movement. Henceforth they were like Captains who, after a victory, instead of slaughtering one another, strive, in the face of a common danger, to practice mutual tolerance and the friendly government of the conquered territory. More recently, in the very bosom of capitalism itself, the political forms of fascism have been another sign of this need for organization and for a common struggle against the collectivistic movement supported by the working masses, in order to render it futile, by stealing its thunder, and finally to crush it.

Meanwhile, the world market itself had also developed. Even England, the home of free trade, was obliged to make concessions to Chamberlain's imperialist and protectionist doctrines. National and imperial markets were set up under the shelter of tariffs and in this way the great powers, having at their command large internal or external outlets (thanks to their colonies or, like the United States, thanks to the numbers and quality of their population), were enabled to "adopt grandiose ideas," to saturate the market with products rationally conceived, standardized and manufactured at low prices, and to develop and maintain the demand for them through advertising. Here is a case of the direct effect of economics on the

human problems of mechanization. The new market conditions under monopolistic capitalism led directly to the development of mass production and consequently its psychical and moral repercussions upon an entire class of workers.

Capitalism was reorganized in a new manner in the attempt to eliminate the waste of natural and human resources. During the first industrial revolution the employers' attitude toward labor had been marked by an indifference whose cruel effects on the population were described by observers and factory inspectors of the period: unrestricted utilization of male, female and child labor, exploited without regard to its attrition. American capitalism in its early stage had added to this debauch that of its natural resources, practicing a "Raubwirtschaft" which was arrested on the threshold of the new period. Toward the close of the century, it became evident that the supply of labor was not inexhaustible, and that it was expensive, all the more so as the workers were organizing both to defend their value on the labor market and the elementary guarantees of their well-being. Social legislation was devised and defined. Natural resources also were not limitless, and the concern for their economical use was sufficiently acute in the United States after World War I, to bring about Mr. Hoover's famous study of "Waste in Industry."

While the big businessmen were thus concerned with the use of natural resources and with a more economical use of labor, their ideology tended to change. Instead of justifying themselves solely in terms of gain, interests and dividends ("Get rich quick!"), they laid claim more and more loudly to a disinterested social function and, with growing insistence, called to witness their services to the community. The ideology of *Service*, considerably diffused in the United States and later among the great mass-production industries of Europe, marks a significant turning point in the spirit of capitalism at this period.

Thus, outside the sphere of the international division of labor, the irresistible advance of which the theorists of the free-trade phase had thought they could predict, arose autarchic and complex economies restricted to the area of their internal and colonial markets. There are many reasons for this development which involves the entire transformation of the capitalist system—by the economic division of the world, the transfer of competition to the plane of mono-

polistic and imperialistic groups, the effects of two world wars which stimulated entire countries to become self-sufficient, and by the evolution of fascist states devoted to preparation for armed conflict and, consequently, to a military policy of economic independence. At all events, such is the fact and it has had its effect on the technological background of capitalism.

Especially after 1918 the trend asserted (or reasserted) itself towards autarchy as in Germany, Italy and Japan; towards continental self-sufficiency as in the United States; and toward imperial self-sufficiency as in England, and more discreetly in France. Even such small states as Poland, Hungary, Yugoslavia, and Rumania, between the two world wars, became involved in this development through their tariff and industrial policies. The impact of these events upon the mechanization of production is important. Countries which were until recently more or less exclusively agricultural became industrialized, and as mechanization was there frequently upon new ground, mass-production work developed without the shackles, the necessary amortization of old material, and the routines involved in the progress of equipment of countries long industrialized. Such, for instance, was the case of Italian heavy industry (especially machine industry) in the plains of Piedmont and of Hungarian industry which competed at an advantage with the older Czecho-Slovak industry in the Danube basin.

The great phenomenon, or rather, group of phenomena, going by the name of rationalization helps define the new look assumed by capitalism in this period; it is, itself, only one aspect of the tremendous effort toward organization permeating the entire system, and through which the system is paving the way for socialism. Rationalization, *in a broad sense*, includes all the attempts at organization both inside and outside industry: agreements, associations for more "rational" production and distribution of goods, technical organization of workshops through scientific management, and the reciprocal adaptation of the workman and the task through vocational selection and guidance. Rationalization *in a narrow sense* (and such is the prevailing use of the word) includes only the efforts at occupational organization and selection inside a firm, and is concerned only with the human problems of machine industry.

The activity of Frederick Winslow Taylor and of the majority of his disciples or successors, who considered themselves pure tech-

nicians, in reality has its place in a great economic and social transformation, and it is only as part of this picture that it can be understood. We repeat, rationalization in its details, its spirit, its successive stages, its successes and failures, is not to be understood without placing it in the historical context of which it is an integral part, and separated from which it is no more than a lifeless object. It is no accident that the birth of the first great system of scientific management coincides exactly with the date when, entering its new phase in the final decade of the 19th century, capitalism needed this essential aid to set itself in order and pass beyond its internal self-contradictions. The fact that all his life Taylor presented himself (and actually thought of himself) as an engineer and nothing else, and that he protested his indifference to politics and his neutrality in the struggles of capitalism of his day, merely shows how unconscious he was of the great currents by which the latter was agitated and, moreover, how little this subjective attitude interfered with the economic and social role played by the vast movement of which he was a pioneer.⁴ The determining laws of an epoch sweep along the most powerful individuals in spite of themselves, *volentem ducunt, nolentem trahunt*.

The march toward rationalization was also hastened by the two world wars, which speeded up the rhythm of industrialization by multiplying munitions factories and war-supply industries, mass-production metal industries, mechanized textile firms, and also necessitating an intensive production of raw materials (coal, petroleum, and minerals). The tremendous progress of mass-production industry in the United States, England, Germany and France during and after the first world war, the reorganization of the English collieries, the methodical studies of hours of work and rest pauses, the creation of the Industrial Fatigue Research Board, are all examples of a process the equivalents of which occurred during and after the second world war. Add to this the fact that, between the two wars, evolution toward complex and more or less autarchical economies also favored the most intensive exploitation of equipment and the national labor supply.

Of course, even at the advanced point which we have reached in the second industrial revolution and the progress of technological rationalization, in the midst of the vast transformations of production, there remain numerous and sometimes important islands of

small and medium-sized industry (where the "craft" system of the guild member worker still prevails), and of city or rural handicraft. The peasantry, insofar as it is still only slightly affected by mechanization (as is the case in many regions of France, for geographical, social and psychological reasons), gives rise to ways of life and work antedating mechanization, and, in the villages, small market-towns and small cities, keeps alive such artisan crafts as those of the cartwright, harness-maker, joiner, blacksmith, jack-of-all-trades, which are very numerous in the country districts of Europe. I shall repeatedly have occasion to note the incidence of these handicraft or semi-handicraft sectors in the evolution of present-day problems of mechanization.

Such was the period which had already begun when Berthelot so tranquilly proclaimed his faith in the application of science to society. It is noteworthy that side by side with so many overconfident scholars and philosophers of this period, there were engineers who estimated correctly all the prosperity which industrialization might theoretically produce, but who deduced less correctly the supposedly necessary and infinitely favorable economic and social consequences. Paying no heed to any modifications of structure, not even aware of the problems it involved, and full of sincere good-will (Taylor did not lack it), they thought they could easily impose an almost mathematical order upon the chaos of their times, and through an incessant increase in production, overcome the conflicts between employer and employee and thus raise the success of "industrial science" to the height of that of the mechanical sciences. Their *technicist* mistake, separating the firm from the physiological, psychological, social and moral phenomena of the human group of which it forms a part, though much more excusable, was similar to that of the great error of *scientism*. We may well be more surprised that scientists, professionally dedicated to the complex analysis of reality, so lightly underestimated the interrelations of the various facts of civilization and thus ignored an entire class of economic and moral repercussions, which a clear-sighted observer could have distinguished in the period when their hymns were raised to a continuous and inevitable progress.

Since then, everyone has seen the fruits of this new phase of western society, which are very different from those which the pro-

phetic scientists thought themselves on the point of tasting. Bitter and often lethal fruits. Mingled with the second industrial revolution, the world-wide diffusion of technology and the unheard-of conquests of mechanization, are the feverish struggles of capitalism to achieve equilibrium and discover an internal order, the monstrous activity of the trusts, social and economic upheavals, and sanguinary conflicts surpassing in extent and cruelty anything previously known to humanity. Shaking the deepest foundation and resources achieved by Western civilization, in its preparation and development of a new world, a half-century has finally dispelled a certain overproud form of confidence of intellect in its own development, such as was expressed by the generation of Paul Bert, of Berthelot and even of Pasteur.

As for the application of science to production, that is, machine industry, it has been necessary to realize that, under the impact of this technological evolution, work was undergoing transformations which, at least in the present-day structure of society, were far from favorable to the happiness and dignity of the producer. From one period, that of the first industrial revolution, when a trade still often involved a whole job mastered by a skilled workman who could impart to it, and express in it, the whole or at least a part of his personality, and when certain conceptions of a total pattern existed, we have passed to new forms of the division of labor. It is now split into fragments by standardization, by automatism and by assembly-line production, in vast factories where the degree of interest and skill seem more and more limited. Taking a more realistic and positive attitude, people then began to ask, what were the physical, psychological and moral repercussions on the individual of this technological progress? What new forms were being assumed by fatigue, rest, the relation between the worker and his job, interest in work, apprenticeship, craftsmanship and skill? What perspectives did these developments open for the culture and for the spiritual improvement of the working masses? Science took a part by means of systematic studies conducted by the young sciences of man, physiology, industrial psychology and the social sciences. A *mystical* period of faith in technology, represented by the ideology of scientific positivism, was succeeded by a critical, *reflective* period, in which science applied itself to analyzing and judging its own application to human labor.

Such are, in outline, the questions dealt with in this book. A later work will seek to place the conclusions of the present book in the total picture of technical civilization of which machine industry is merely one of the principal elements. Only then shall we see in its fullness the dramatic struggle of contemporary man with the products of his own genius. Only then shall we be able to form a better judgment as to how far, and under what economic, social and moral conditions, our hopes may legitimately be directed toward the lofty human ideal prematurely offered to the enthusiasm of their contemporaries by the theorists of progress in the course of the 19th century.

PART ONE

THE “HUMAN FACTOR”

Taylorism and the Human Sciences

THE SCIENTIFIC AMBITION OF TAYLORISM

SUCH IS THE ECONOMIC and social setting, sketched in broad outline, in which machine industry evolved during the final years of the last century and the beginning of our own. The first avowedly scientific attempt to study and survey, as a whole, the human problems of large-scale industry is Taylorism. It is Taylorism with which the physiology of labor and industrial psychology found themselves confronted when they gradually became conscious of their own methods and approached the sphere of industrial behavior. From Taylorism thereafter derived all the systems whose ambition was to organize production "rationally" or "scientifically." An examination of the human problems caused by the diffusion of new techniques and the transformation of work must therefore start from this point.

Taylorism was the subject of a detailed study in an earlier work. I considered it successively from various angles and described its technological, psychological, economic and social aspects. For each operation, F. W. Taylor defined *the one best way*. His methods of increasing output, his organization of planning offices and of work-

shops, reinforced by new methods of payment, were meant to inspire a spirit of co-operation between employer and employees. The central feature of the system from this point of view was time and motion study. Thanks to the strictest use of time, the technical perfection of production, a carefully worked out division of wages, and the rational organization of the entire factory, the Taylor system tended to obtain the maximum efficiency from equipment and labor.¹

At the same time, Taylorism was presented as a science of industrial labor, and its founder was commonly designated in the United States as the "Father of Scientific Management." He himself, rejecting the name of Taylor System for his doctrine, accepted only that of "Scientific Management." This title has, moreover, been retained and has indirectly lent prestige to the derivative systems of rationalization. Let us define here this aspect of Taylorism: we shall see how and why it showed these scientific ambitions, before examining how well-founded they were. Indeed, as a preliminary and essential question, it is important to know whether Frederick Taylor really *scientifically* studied the activity of the man working with machines; whether he knew how to pose the problems adequately and how to indicate solutions which have validity with respect to the human sciences. Taylor always emphatically affirmed that he used "science instead of empiricism." As regards the new industrial techniques, his declaration is certainly true. Taylor made very successful innovations by studying work with machine-tools systematically and experimentally. The results with respect to quality of steels, form and choice of the tools, determination of speeds and depths of cut, and fitting up of belts, and transmissions, made possible a considerable increase in efficiency and precision. There is a valuable contribution here to the science of mechanized work, and the way thus opened has since proved indisputably fertile through the developments and progress thus stimulated.

But these are not the limits of the scientific ambitions of Taylorism. Taylor, and his collaborators and disciples, are not content to criticize the routines followed by both employers and workers and to expose the gaps and errors of their empiricism. They lay claim to a much more extensive field. "The best organization is a true science," applicable to all forms of human activity "from the simplest of our individual acts to the labors of our greatest societies. . . ." Scientific Management offers us not merely a science of industrial

operations, but also a science of the relations between the workman and the modern techniques of production. It concerns not merely questions of metallurgy, and of applied mechanics, but it also claims to contribute scientific data concerning the selection of workmen, their psychological motives and incentives, their initiative, their fatigue, and the "real" time necessary to effect an operation, that is, it touches problems which involve the physiology and psychology of work. Moreover, this extension of the scope of the system was inevitable. In discovering technical measures to assure rational use of equipment and men, it could hardly help seeking the best means of getting them accepted and put into practice by the workers.

The extent of Taylorism's scientific ambition may be gauged by the declarations of Taylorians who, during their master's lifetime and after his death, wrote the detailed reports for a wide public which he planned but had no time to complete. The writings of Henry Le Chatelier, an eminent physical chemist and at the same time the first to introduce and expound Taylorism in France, are very significant in this respect.²

According to Le Chatelier, Taylorism is a genuine science. It is "a new and very successful application of the scientific method" (p. 51 of his *Le Taylorisme*). Taylor is to be compared with the greatest pioneers of rational knowledge, Descartes, Bacon, Newton, Claude Bernard and Taine (p. 127). His originality lay in applying scientific method to problems which had hitherto escaped the field of science, and in having shown that the employment of this method led, in practice, to profitable results (*Ibid.*). Of his precursors he clearly most resembles Descartes, for Taylor primarily applied the Cartesian principle of division, the basis of all science, and to do this employed common sense. Descartes "himself was content to use the elementary and oldest known rules of common sense" (p. 123). Descartes and Taylor "certainly did not invent common sense but they did codify it, systematize its most important rules, and make a body of doctrine of it, a science capable of being passed on by education to other men. . . ." (*Ibid.*). And Le Chatelier pushes the comparison to the point of deducing from the work of the American engineer the four rules of the Taylorian method which lie at the basis of science applied to industry (pp. 124 ff.): (1) before any action set yourself a definite single and limited aim; (2) before starting work, study scientifically the best methods to be employed to attain the end

in view; (3) before beginning work, bring together all necessary tools; (4) act in exact conformity with the arranged program. Elsewhere, he is compared with Claude Bernard: by the extension of determinism to a new field and the systematic use of experimental measures, Taylor did for "industrial phenomena" what this creator of experimental medicine did for natural phenomena in general. "Science," he goes on to write in this connection, "as defined by Taine and Claude Bernard, rests basically on the idea of *determinism*: all natural phenomena are connected with one another by necessary relations, *laws*; each of them is a function of a certain number of independent variables or *factors*. Industrial phenomena, cost price or the profit from each operation, are in the same position" (p. 64).

This stress on independent variables and factors suggests a mathematical conception of science confirmed by other passages from Le Chatelier, passages which help to show the reasons for his warm adherence to Taylorism. As he represents it, Scientific Management is primarily mathematics applied to the organization of industrial labor. According to him "the determination of these [algebraic and very complex] functions or laws is the essential object of the application of science to industry" (p. 142). Again, "every industrial result," he writes "is a determined function of certain factors and may be expressed by an algebraic formula" (p. VII). His satisfaction is greatest when, apropos of a technical aspect of Taylorism, he is able to enumerate the "elementary factors," the "independent variables," of a problem. Thus, there are twelve of them for metal-working on a lathe and nine in the functioning of belts. Taylor himself, in his search for the "factors" which a good factory manager should possess, enumerates nine qualities "which make a man sufficiently universal" to fulfill this function.

We are thus confronted with a mathematical form of the current of ideas running through the entire close of the 19th century, both in the United States and Europe—"scientism." It is not surprising that Taylorism should bear its mark. As we have elsewhere shown,³ it developed in the midst of scientism and it is not by accident that in this connection Le Chatelier can evoke Claude Bernard or Taine whose names, with that of Berthelot, are landmarks of the period in France, while the theories of Darwin and Spencer flow beyond specialist circles and reach the great public of the Old and New Worlds. The wide horizons ambitiously set by Scientific Management

find their natural framework in the views of an intellectual generation which thinks that it can indefinitely extend the field of science, thanks to the methods which, in the course of the century, have so signally increased man's power over nature. At the threshold of this study however, we must examine these claims more closely. Is the system of management proposed by Taylor genuinely scientific? Does it contribute methods and results valid not only for the technical problems of metallurgy and engineering, but also for man's work with machines and for "industrial phenomena" as a whole? The answer to this question has first priority for the subsequent study of the human problems of industrial mechanization.

RESEARCH AND THE FIRST REACTIONS OF WORKERS

Whether or not Taylorism was a "science," the reactions which it produced as its first wave spread across American and European industry were varied and sometimes violent. And if, as its founder wished, its object was to bring "harmony, not discord," (*Principles of Scientific Management*, p. 140), during the last years of his life he must have recognized that reality was more complex than his methodical calculations had foreseen. Parallel with the support of powerful firms and in spite of the propaganda of the Taylor Society, signs of opposition appeared, in the decade beginning in 1910, among workers and also among certain technicians. In the Navy arsenals where Scientific Management was applied, an inquiry had to be organized and resulted in a severe appraisal by Rear-Admiral Edwards.⁴ In private industry the trade unions of the American Federation of Labor, a moderate and prudent organization, nevertheless showed their hostility which resulted in the Hoxie investigation of 1915.⁵ Organized by the House of Representatives, the investigation was turned over to a "Committee on Industrial Relations," and submitted the problem of Taylorism to public examination.

The Committee was composed of Robert F. Hoxie, a professor at the University of Chicago, who drew up the report, and experts selected by the employers (Robert G. Valentine) and by the trade unions (John P. Frey, President of the Molders' Union). The investigation dealt with 35 establishments designated by Taylor himself. The Hoxie report ended in "a major condemnation of the Taylor system properly so-called . . . which put the finishing touches to the

federal investigations of 1910 and 1914.”⁶ In particular, the Hoxie report cast doubt on the scientific value of time-study and drew attention to the psychological, moral and social disadvantages of selection by output and of the degradation of skilled labor.⁷

In England, where they were applied for the first time in 1905 by the J. Hopkinson Works at Huddersfield, the Taylor methods were studied by the members of the Iron and Steel Institute and later attracted keen criticism.⁸ In Germany the Director of the Borsig Works noted the hostility of his workmen toward the system. A physiologist, Dr. Sachs, in an article published in 1913 which initiated a flood of polemical controversy with the German Taylorians, described it in terms which strikingly recall those of the militant members of the French General Federation of Labor (CGT), which had just then accused Taylorism of being “organized overwork.”⁹

The reactions of the workers form, so to speak, a first spontaneous commentary by the people chiefly interested in the question which confronts us: Is Taylorism a science of the relation between man and the machine?

The system had been introduced in France by Arbel at Douai, Berliet at Lyons, and Renault at Billancourt, but without following the counsels of prudence given by Taylor. These establishments contained few union members, and yet violent conflicts and strikes quickly occurred. Let us see how time-study was applied by Renault. A time-study man, a very able specialist, made three series of technical experiments (as to tools, the position to be taken, maximum speed, time required for the machining of an article, and rate of pay) and worked for three hours at the pace thus determined. The workman who followed him on the machine had to continue at this pace for eleven hours. “Nothing could be more dreadful than this sustained effort, when one thinks that the maximum speed imposed on the machine by the time-study man had to be maintained, for not only was the machining time longer, but the time-study man’s assistant remained on guard to make sure that the assembly and the speed were satisfactory. The workman therefore had to *adapt his human machine to the rate of the mechanical one*; and workmen incapable of making all the necessary movements with their hands within the measured time aided themselves by using their heads as a third arm.”¹⁰ Renault’s workers, in December, 1912, were insisting that the time-study man work with them, and that as long as he did

otherwise, conditions being different, the standard of time determined by him could not be applicable to them.

Besides, like their American comrades, the French metal-workers accused Taylorism of degrading skilled labor and of making a worker's intelligence superfluous. One of the union members most keenly offended by Taylorism and one of its most ardent opponents, A. Merrheim, wrote: "As we see, personality, intelligence, the very desires of the workers are eliminated, annihilated, banished from the workshops and factories. . . . Through this method Taylor reduces the worker's market value. He replaces it by the mathematical value of the productivity of individuals. He reduces the importance of the fashioning and finishing of products."¹¹ In another connection, E. Pouget denounced "organized overwork" and the loss of all initiative in the worker who was turned into an automaton and a moron by the Taylor system. Apropos of the slide rule perfected by Carl G. Barth which made it possible to determine in half a minute the advance and speed of cutting, he wrote: "Needless to say that in the true spirit of Taylor this slide rule is valuable especially because it makes the worker an automaton, destroys his initiative, renders superfluous any effort of thought or reflection, and in brief makes him an accurate and unthinking extension of the machine."¹² I shall return to the workers' reactions to Taylorism, at greater length, and in more detail, in connection with rationalization.¹³ What has just been said is enough to show that the "science of machine labor" perfected by Taylor was in any case, apart from any other assessment of it, not winning the approval and gratitude of those whom it directly concerned and to whom it claimed to bring easier work and financial satisfaction.

TOWARDS AN INDUSTRIAL PSYCHOLOGY

Meanwhile, various influences combined to direct attention upon the importance of the human factor in industry and to turn in this direction the studies of the youthful sciences of physiology and psychology, the aim of which is to investigate man's physical and mental activity.

During the 19th century, in the *laissez-faire* period of capitalism, when mechanization was growing under entirely anarchical conditions, the worker was treated as a commodity easily replaced and accordingly of little value. The broad outlines of this state of affairs

in France, England, and Germany, have often been described and are well known. The influx, badly regulated or not regulated at all, of women and children into the workshops filled the vacancies and continually replaced the workers whom industry wore out in frightful, unhygienic conditions with neither protective legislation nor limitation of the hours of work.

This period of "economic liberalism" was succeeded, at the close of the century, by a greater effort of organization. The forces of production were thenceforth of such dimensions and of such a complexity that competition assumed new forms. Concentration increased, production continued to rise and the World War of 1914 gave it a further considerable impetus especially in America and Japan, where capital was abundant and equipment at hand. It was at this moment that there matured the first management with scientific aims, contemporary both with a developing scientific positivism and with confidence in progress and happiness through industry. It was at this time that there appeared new bonds linking new firms to one another, large-scale combinations, a new, more flexible banking structure directed toward constant intervention in industry and controlling the entire range of cartels and trusts. The old capitalism, characterized by free trade and free exchange, was eminently industrial. It now increasingly yielded to finance capitalism and monopoly.

In a world in which such powerful forces were aspiring to an ever more abundant production, it was clear that industry would be led to consider more rational methods than those which had so far prevailed. Output had to be increased in order to satisfy growing needs (and in turn, to stimulate them). So the economic system was obliged to obtain the highest possible return from the worker "element."

For in production man is a raw material among other raw materials. "During the 19th century," writes G. S. Watkins on this subject, "industrial development proceeded so rapidly in Europe and America that the necessity of protecting and conserving the human element in production was scarcely recognized. . . . Economy in the application of capital, replacement of worn-out machinery, and conservation of natural resources received careful consideration. Waste of human life, accumulation of fatigue, and destruction of health in industry received no such attention. . . ." ¹⁴ On the eve of the war Thorstein Veblen, one of the best observers of American society,

denounced "the excessively financial and too purely quantitative conception of industry which obtrudes itself between the producer and the material and hinders the community from drawing the best return from human effort."¹⁵

How did this distressing state of affairs attract attention and what attempt was made to improve it? Let us consider the chief causes, starting with physiology and psychology, which prepared the way for developing a science of industrial labor, aiming at gradually introducing into the workshops and extending there the consideration of the human factor.

The boom of productive forces at the close of the 19th century had given rise to the first attempts to organize work. Taylorism, by its systematic rigor and the stir which it provoked in industry, as we have just seen, resulted in objective investigations and informed opinion. Simultaneously, the success it obtained in a number of firms in respect to short-term output opened the way to new studies. The Taylor system proved that "Scientific Management pays," that it brings profits to industrialists. The interest of firms was stimulated. Thus, in 1919, German industry, anxious to resume its place as soon as possible and again compete with the great nations, and fed, moreover, by foreign loans, threw itself headlong into the stream of rationalization, and parallel with this, developed experimental research, the interest of which, however, usually remained directed more towards production than towards the welfare of the worker.¹⁶ The large firms, in order to cope with their own development and the increasing subdivision of workshops and offices, created departments for the selection of personnel and, eventually, for everything concerning the study of work. Their chiefs recognized that output cannot be pushed beyond certain limits without knowing the characteristics of each job and choosing the person to whom it is to be entrusted. Monographs and occupational selection were both responses to these needs, themselves imposed by actual practice, and constituting, as it were, internal necessities of the industrial system.

At the same time, and this was by no means the least powerful influence, the labor movement developed and became organized. Under pressure from the claims which it supported, social legislation gradually evolved in Europe and the United States. Hours of work, the work of women and children, and night work, were all regulated, and laws regarding sanitation were passed. The progressive forces

of bourgeois democracy supported the action of the workers' organizations and swelled the current. The policy of non-interference by the state which had characterized the period of *laissez-faire* was slowly abandoned in this field. Industrial health, which had been left entirely to the whim of the business leaders, became a public matter.

Thus, various causes contributed to create circumstances favoring the scientific study of the new forms being given to human labor by mechanization. The blind, individualistic attitude which had marked the beginnings of capitalist industry was no longer acceptable. In the factories a certain minimum of lucidity and of knowledge, of "rational" organization, became indispensable. The unions, backed by political and humanitarian democracy, no longer tolerated abandonment of the worker like a pawn, a prey to economic demands and to the employers' appetites. Besides, a more understanding attitude could be imposed on manufacturing industry only because it conformed with a common frontier of these interests in the new stage of business. We have seen in this connection that industrialists were sometimes victims of their own devices; by creating works of public health they developed a human interest in what, in their eyes, had been at first only a question of financial interest.¹⁷ There is probably some truth in this remark, though it is difficult, as well as idle, to question in each case the motives of behavior whose fundamental necessity is to be traced to other sources.

While social legislation was being gradually built up, the different influences which we have just mentioned penetrated and stimulated the young social sciences. At the same time the development in the outlook and methods of psychology allowed that science to create more efficient instruments of knowledge and action in the face of the problems set by industry.

Throughout the 19th century, the history of psychology is a struggle to free itself of false or useless entities and questions. The legacy of eclecticism and of a whole scholastic tradition impeded its development as an applied science of the facts of mental activity and of the latter's relation to the biological and social conditions of human existence. Certainly, among the problems confronting the science, those of industry (and of education) have vigorously contributed to this evolution toward the practical.

To approach the field in which working and thinking man is involved, it was obviously necessary to take advantage of the close collaboration of the various sciences which study the functioning of his organs, the play of his gestures, and of his physical and mental activities. But before this co-operation could be achieved, many obstacles had to be surmounted, the heritage of a false positivism.

In fact, Comte's theory of science, which largely contributed to the stimulation of scientific knowledge by unfolding before the mind a broad field of inquiry (since "all phenomena of whatever nature, inorganic or organic, physical or moral, individual or social, are always subject to rigorously invariable laws"),¹⁸ implied an irreducible difference between the various categories of phenomena and laws. Comte, and above all his disciples, had gone a long way in their struggle against "the absurd utopia" of a single key or formula whence all truth should be derived. The affirmation of the different nature of the diverse sciences was very fruitful, one of the great conceptions of the 19th century. Each science has its own laws, and at each stage something qualitatively new arises; geometry, physics, geometry, biology and sociology, each reveals a new manner of existence and consequently a new kind of law. But at the same time (though it would be unjust to blame Auguste Comte himself for this), this affirmation made possible a division of scientific efforts, each science jealously defending its field against its neighbors, each claiming a sort of closed territory where no one else had authority to prospect with the help of *his* own methods, of *his* instruments, and *his* laws. True, Comte had pointed out that complexity increased in proportion to the remoteness of the field from mathematics and, a still truer comment, had insisted that the more complex phenomena are, the more numerous and varied are our means of studying them.¹⁹ But his disciples did not realize that these means of study could and should be borrowed from different disciplines and that such a union is inevitable as soon as one's concern is with the activities of man.

This union was achieved, however, only after a rather slow inner development accompanying the action of economic and social factors, and only gradually was it possible to approach the realities of work by employing multiple methods and points of view. Western science, so deeply marked by individualism, seemed to be jealously defending its divisions. But they had to yield to the weight and urgency of practical problems.

The transition from "rational" to experimental psychology, begun in the eighties, is a complex phenomenon, the outlines of which we should not too sharply delineate, since expressions of the former stage blend with those of the new scientific one. Wundt, himself a disciple of Fechner, exerted a preponderant influence on this transition. The pioneers of applied psychology in the United States, as well as in England and France, are mainly his pupils. In 1879 the first psychological laboratory was established, and in 1881 the first periodical for the publication of experimental research. Often directed (as was the case in France) toward a psycho-physiology which did not exclude a certain mechanistic outlook, the new psychology encountered many criticisms, of which the most resounding were launched by Bergson in the name of intuition and of a "pure psychology." It would doubtless not have recovered from them so swiftly had it not at the same time, thanks to the prominence of individual differences and to the method of testing, by-passed the old metaphysical problems skilfully renewed by Bergson, and undertaken empirical researches, especially in the school and the factory.

Wundt himself, and his disciples, had not sought to orient the psychology of sensation to individual differences. The data obtained from a subject by laboratory psychology were supposed to lead to generalizations and laws of the human mind. A new current of research was required for interest to be especially aroused in the particular characteristics of the individual. The studies made before Galton, those of J. McKeen Cattell, who in 1880 perfected tests for measuring these differences, and those of Kraepelin, Munsterberg, Gilbert, Toulouse, Binet, and Henri, mark out this path. Without the definition and perfection of the method of testing, all attempts to examine the value of Taylorism in a scientific manner would themselves have been insecure and abstract, for it would not have sufficed to declare dogmatically that the Taylorian methods neglected psycho-physiological factors. It was also necessary to test with mathematical precision and by verified correlations the degrees of the individual's adaptation to given conditions of work in order, if the occasion arose, to remove him from them or to modify them.

But, however abundant were the statistical data contributed by the tests, they did not yet make it possible to reach the individual. In the first flush of practical applications, there was a tendency to interpret the mass of these numerical results without reference to

the total personality,²⁰ a fault corrected by various theoretical influences, especially those of Gestalt psychology, of Adler's individual psychology and of W. Stern's depth psychology. After a frantic period of statistical inquiries, the individual was observed much more closely. He was considered as an integrated personality, endowed with an internal organization in which no element may be arbitrarily dissociated from the whole. The psychologist can no more dispense with studying in an individual the complex of his character traits than with studying the variability of character between individuals. Stern, for example, showed how important is a "personalistic" interpretation of the materials supplied by the tests. A scientific study of the whole man is indispensable because of the organic unity proper to personality, whereas the atomization in elementary tests takes one away from reality.²¹

These, and other similar criticisms, undoubtedly affected the development of applied psychology by interesting it increasingly in the *individual*. It was thus led to refine its outlook and its methods. So far as industry is concerned, man at work became a subject of study as an individual, with the special differences characteristic of his mental attitude in the course of, and outside of, work. An American author well expressed these new purposes: "Among the few greatest questions of our age is that which asks what modern industry means to the individual worker with reference to his satisfactions and fullness of life."²²

Psychology applied to industry, thus oriented, and co-operating with the physiology of work, engaged in fruitful researches through the chronophotography of Marey and Mosso's experiments on muscular labor, expanded its activity and obtained valuable results. From the beginning of the century, Kraepelin systematically recorded work curves, and research into the psycho-physiological conditions of aptitude for typewriting²³ opened the path to monographs on occupations and to vocational selection. The studies of Hugo Munsterberg are among those which particularly stimulated the constitution of industrial psychology as a science.

A pupil of Wundt, with a clear appreciation of the limitation of his master's experimental methods, Munsterberg—after having moved to Harvard—was the first to insist on the psychological conditions of output. Accustomed to the language of American business circles, Munsterberg strongly emphasized the facts capable of influencing

both the interest of business management and that of employees. "We must not forget," he wrote, "that the increase of industrial efficiency by future psychological adaptation and by improvement of the psycho-physical conditions is not only in the interest of the employers, but still more of the employees; their working time can be reduced, their wages increased, their level of life raised. And above all, still more important than the naked commercial profit on both sides, is the cultural gain which will come to the total economic life of the nation, as soon as everyone can be brought to the place where his best energies may be unfolded and his greatest personal satisfaction secured. The economic experimental psychology offers no more inspiring idea than this adjustment of work and psyche by which mental dissatisfaction in the work, mental depression and discouragement, may be replaced in our social community by overflowing joy and perfect inner harmony."²⁴ Clearly, applied psychology had high hopes from its very beginnings.

World War I greatly stimulated these researches: they profited, in the United States and in England (where the Industrial Fatigue Research Board was established at that time), by the success of measures recommended for the selection and allocation of military and paramilitary personnel. One may claim that Anglo-Saxon industrial psychology was born in the munitions factories, where research was first conducted into the conditions of production, the length of work periods, rest pauses, and the physical working environment. Germany, France, and Italy at the same time made similar experiments on a smaller scale. Beyond the immediate requirements imposed by the selection of the specialized personnel of the air, land and sea forces, and by the increased production of manufactured goods (as an apparently paradoxical effect of war), the desire grew among investigators to protect the body and mind of man at work; and the means of contributing to this end were clarified.

Psychology, whether introspective or mechanistic, had for a long time been going round and round the abstract problems and so-called "faculties" of eclecticism, and thus benefited from contact with researches developed outside these problems. Thus, industrial psychology was born from a perpetual confrontation with practical difficulties. At the outset it was still embarrassed by many idealistic survivals, entertained by so-called "theoretical" or "rational" psychology, of which it is the negation rather than the application.

"Starting from concrete cases and utilitarian problems, applied psychology (used here in the sense of industrial psychology) begins by showing the futility of the antinomies raised by the psychologists of introspection and intuition between the inner world or world of consciousness and the external world, the psychic fact and the number, the purely abstract subject which they construct for themselves and the living subject."²⁵ Among research workers there developed the notion of an industrial psychology (an important stage on the way to the foundation of a genuine science of psychology) which exists not merely at the intersection of the various sciences of man, but itself achieves the synthesis of their points of view. This is the purport of the resolution submitted by one of its members to the Fourth International Conference of Industrial Psychology: "The problem of human labor must not only be envisaged from the psychological, technological, hygienic, or physiological point of view, but . . . its great practical importance consists in the study which systematically combines all these points of view. Being a union of psychology and technology in co-operation with physiological methods, applied psychology is better adapted than any other science to the study of this problem."²⁶

Thus applied psychology took shape which, applied to industry, became the center from which radiated various studies devoted to man at work. As it progressed it was confronted with the "scientific management" so dogmatically upheld by Taylorism. Thanks to these new researches and points of view, the latter could now be examined with the necessary methods and understanding.

The role of industrial psychology was thus considerable. Without it, the worker in mass-production workshops would never have appeared to so many observers as "a raw material in the midst of other raw materials" and the agonizing problems of the dehumanization of labor, which we shall investigate here, would never have appeared on the agenda of science.

SCIENTIFIC EXAMINATION OF TAYLORISM

(a) *Time-study*

Setting aside the specifically technical contributions (which were considerable) of Taylorism, the scrutiny of which belongs to the competence of engineers (steels for rapid cutting, estimates for the

smooth functioning of machine tools, belts and transmissions, etc.), the chief feature of the system, from which derive the various reforms which it proposes in the organization of work, is an analysis of the movements made by the worker, by the aid of time-study. By methodically breaking down industrial operations they can be simplified and improved, time can be saved and output increased.²⁷ The chief innovation of Taylor consisted in measuring the time taken for each part of an operation instead of proceeding as others (especially Marey) had done before him, to the measurement of the total time of an operation. From a table in his report on *Shop Management*,²⁸ we can judge the time-study method which he advocated before its modification by Gilbreth. Taylor tried to determine with a stop watch the average time for each part of an operation. He then added these times and the "idle time" (rest and other necessary delays), in order to get the total time of an operation. Thus it appears that, contrary to a frequently expressed view, Taylor did not deny the necessity of idle time: but, to discover it, he relied on the results of a worker specially chosen, and stimulated by a bonus. But the worker may deceive the time-study man and he may also deceive himself. Experimental research, physiological and psychological, shows the complexity of the phenomena included under the name of fatigue.²⁹ There is not only a fatigue clearly defined and immediately perceived, measurable by the ergometer and other devices, but also much more subtle forms of fatigue, slow to develop, like that which C. S. Myers calls "industrial fatigue." Thus the "normal" task defined by the timed worker may actually be very far from the normal. Taylor himself had a presentiment of these difficulties, for he writes: "The difference between the best speed of a first-class worker and the real speed of an average worker is very great. One of the chief difficulties for the employee entrusted with setting the daily tasks is wise choice of the limit of the effort required. Should this effort be set as if for a first-class worker? If not, at what point should we pause between the first-class worker and the average worker?" (*Shop Management*, p. 115-Fr.)

Taylor's suggestions and early experiments were developed during his own lifetime by F. B. Gilbreth,³⁰ who combined time-study with *motion-study*. Both function, in practice, to eliminate "unnecessary" movements and to improve those recognized as "necessary." Frank and Lilian Gilbreth subsequently perfected more and more refined

techniques: the study of micro-movements by means of the motion-picture camera and precision stop watches, the combination of which makes it possible to trace the *chronocycle graph* of a movement. By using stereoscopic photographs they also obtained a three-dimensional picture of the complex line followed by the hand (or by any other part of the body), in the course of job, and by the aid of these different data they constructed wire models of the movement on which they could make observations and measurements intended ultimately to determine for a given task the best method to follow, "*the one best way*."

The Gilbreths took the basic movements of different workers. They computed the times, added a fixed percentage for idle time, or *unavoidable delays*, and another percentage to approximate the performances of average workers. In short, the rationalizer breaks down a given operation into a certain number of parts and ascertains, from several workers, the minimal times for each part. Finally, he assembles the most rapid movements in a stereotyped series which will henceforth be imposed, as the standard and only method, on all the workers. The Gilbreths were therefore in the true Taylorian tradition: with improved means they developed Taylor's method of time-study, and following him, pursued the ideal of the *one best way*.

But is the method of time-study of the basic times as rational as the Taylorians believe? Is not the method involving total times more rational? Actually, if an operation is minutely broken down into its elements, the times corresponding to each of these cannot possibly always be useful.³¹ Oscillations occur in work and—especially in the case of a mechanized and rapid task—an identical period of idle time from one operation to another is difficult to achieve. If we try to impose it rigorously, it may create working conditions physically and psychologically harmful to the worker. Conceived in this way, as Lahy observed as far back as 1916, scientific management is "a constant appeal to overwork."³²

Other criticisms have since been made of the analytic time-study of the Taylorians. First, the latter usually combine the introduction of their new, standardized method of work with financial incentives in such a way that it is impossible to discover, in the resultant increased production, what is due respectively to the modified technique and what to the bonus.³³ In addition, industrial psychologists

deny that the *one best way*, a mosaic of movements taken from different workers, represents a result valid for all the workers or even for the majority of them. The results obtained by physiology and psychology, in fact, agree in showing that the living organism is more than an aggregate of elements assembled at random: it is an individual. The latter, writes C. S. Myers, "has characteristics which are not to be found in his isolated parts and his best mode of movement is not necessarily to be derived from a combination of more elementary movements, selected from different operatives on a basis of speed."³⁴

In other words, a series of movements, even if each of them taken separately is excellent, is not necessarily the best for everyone. Personal differences must be admitted. The worker may discover a complex of movements better adapted to his physical and mental needs than the one which it is sought to impose upon him, and whenever this does not disturb the satisfactory operation of the workshop, he should be left free to use it. Besides, *speed* is not the best standard of the efficiency of a movement; instead the *ease* with which the worker performs it should be preferred. When the movements which are to be taught to the workers are fixed, the enhanced feeling of pleasure and the satisfaction in working constitute signs of which a truly scientific management will take note. In the long run, motion-study is just as fruitful if it increases the worker's job-satisfaction even without increasing output, as if it results in an immediate increase in output.³⁵

From this discussion of time-study, grave scientific gaps in Taylorism are already evident; it conceives, perfects, and applies its researches from the engineer's point of view, interested exclusively in output, and never from the viewpoint of the physiologist or psychologist, who study and respect the individual's physical and mental constitution. Though a partisan of the Taylor system, Jules Amar proposed to "humanize" it and noted (1913) that "the psychophysiology of labor is inseparable from mechanical organization."³⁶ For Josefa Ioteyko, Taylorism is marked by the lack of scientific data as to the expenditure of human energy and by a system of rewards which amounts to a "bonus for overwork."³⁷ But it is especially due to the fundamental work of Atzler and his pupils that the gap has been revealed between Taylorian rationalization and an

organization of labor in which are incorporated the data of human physiology.

It should be remembered that in his famous experiments in the carrying of pig iron, Taylor had made use of a "human ox" of exceptional strength, a Dutchman named Schmidt.³⁸ G. Lehmann, Atzler's collaborator, estimated the expenditure of energy and the food required by this worker for the tasks assigned him by Taylor. These figures (expenditure in 10 hours of 5,515 calories; necessary food: 7,651 calories) approach those which Atzler himself determined for heavy manual labor.³⁹ For Taylor's "human ox" such an output was not improbable. But, Atzler adds, it is impossible to accept such indications as standards for the measurement of daily work. "There may, of course, be men who, through unusual physical capacity, can endure over a long period, the demands of a Taylorized firm. But most workers will succumb under the pressure of these labors."⁴⁰ The increased productivity sought by Taylorism is obtained less by rationalization than by *intensification* of work. The performances achieved by exceptional workers are, with very slight reductions, demanded of the mass of their comrades with no guarantee that the latter can maintain this effort for any length of time. Let us quote a further passage from this penetrating study: "Taylor was first of all an engineer; he knew the mechanism of the lifeless machine but not that of the living motor. Thus he was led to turn his attention chiefly to work performance; in his time and motion studies he commits the error of seeking the modes of work which require the least time. . . ." And Atzler adds the following remarks, characterizing accurately the point of view of the human sciences concerning the problems of output in large-scale industry: "While Taylor, with no exact knowledge of the human organism, tried to extract maximal output, we, on the contrary, demand optimal output. The process of work must be so arranged as to be adapted to the special nature of the human motor. This is the case where maximal performance is obtained not by 'the shortest' but by 'the easiest' way. Here, accordingly, is a problem which the engineer cannot solve, but only the physiologist."⁴¹ Arnold Durig, scrutinizing in the same spirit the doctrines of rationalization from Taylor to Gantt, Gilbreth and Ford, comments on the equivocal quality of these systems which "are all conceived in the mind of the employer and all of which, more or

less vigorously, represent themselves as being conceived for the worker's benefit." Gilbreth's contribution especially seems to him like "the most extreme and refined technique for extracting high output."⁴²

Otto Lipmann, in his turn, discussing the *one best way* from the psychological angle, reaches similar conclusions. He admits that in a workshop it is generally useful to standardize the methods of work of a workman occupied in repetitive tasks. In working always in the same manner, he is psychologically less burdened than if he has to reflect each time or find his own way of working; the organization of work can therefore not be left either to tradition or to caprice.⁴³ This means that when we take into consideration the whole individual (here one feels the influence of the *Gestalt* theory), we cannot abstractly cut out from it the working movements and isolate them from the needs of the personality considered as a bio-psychological whole. The movements supposedly "useless" for a well-defined task may actually not be useless from the point of view of the total individual. Obviously, if they are suppressed, a certain amount of physical energy is saved. But by the very inhibition of this movement, the expenditure of mental energy may be increased and consequently also the worker's inner tension.⁴⁴ "We must not," writes Friedrich Sander, "consider man at his work exclusively from the mechanistic angle, however necessary it may be, nevertheless, not to lose sight of the mechanics of the body in movement. For the body in movement is only a part, encompassed by the material and mental totality of man at work, who thinks, feels and desires. Any conception of working movements one-sidedly based on a mechanistic foundation—and economy of movement is of this sort—necessarily conflicts with the superior laws of the total physical and mental organism."⁴⁵ Lipmann thus brings out clearly the opposition between Taylorism and the physiology of labor when he notes that the former aims at the greatest output for minimal expenditure of time, while the latter seeks the greatest output for a minimal expenditure of energy in work, that is, with the most favorable speed and the movements requiring the least energy.⁴⁶

(b) *The scientific study of motion*

Criticism of Taylorian time-study does not mean that physiologists and psychologists (as Lipmann expressly says) reject any sort of

general study, any general principles for selecting and, if need be, standardizing movements. But when made by them, the scientific study of motion constantly has in mind the operator's physical and mental needs. Applying this study to the problems of mechanized industry, they stress not economic efficiency, but human efficiency, as Farmer clearly declared when enunciating the principles that should guide us in this field:

(1) Time and motion studies should be undertaken only to reduce fatigue and not to increase output. If they help to define a good working procedure, in most cases they will also result in an increase in output. But if the latter is directly aimed at, the whole experiment is falsified, and what claims to be a piece of scientific research degenerates into an ordinary process of speeding-up.

(2) The basic principle of motion-study is rhythm and not speed: the best series of movements will be the easiest, not the swiftest.

(3) Time-study should serve to analyze an operation in order to improve it from the point of view of human efficiency, and not to standardize it and then impose this standard. Moreover, other things being equal, workers should be allowed to define the sequence of movements which they consider and adopt as the most convenient.

(4) The analysis of time and motion forms part of a vast field of studies of the human element in industry, and can be conducted only in connection with other fundamental problems.⁴⁷

Scientific time-study thus defined is therefore sharply distinguished from what followers of Taylor recommend and apply. The latter are obsessed by the *fetishism of time* and therefore with dividing into (more or less valid) elements the work operations. The time-study of the industrial psychologist, on the contrary, in no sense considers the speed of an operation as the essential criterion which justifies its study and improvement. The so-called "idle times" of Taylorism, which are the variable times discovered through micro-time-study, are often the most interesting, because they reveal to the observer the periods of appreciation, control, and judgment—in short, the periods of psychological activity. To persist in studying only the speed of the limbs in motion is to neglect other elements very important for output, for example, the excessive spread of attention, or the inadequate supply of raw materials.⁴⁸ In teamwork, the speed of the worker given the hardest task must regulate that of his comrades. Taylorian time-study, often applied furtively, and in any case

without the consent of the union organizations, functions to reduce piecework wages, or to obtain more speed for less or equal wages. Whatever its originator's sincere intention may have been, the impartial observer notes that it actually serves, in most cases, the advantage of the employer and leads to increased profit and the exploitation of the workers.⁴⁹ Industrial psychologists, for their part, only agree to introduce time-study openly and by agreement with the workers. Furthermore, their aim is only to eliminate idle times and unnecessary fatigue, while avoiding any disadvantage whatever to the worker. We shall consider later their actual success in this purpose within the framework of the social conditions of industry in which they work.

The distance between the two points of view is therefore, in any case, considerable. Industrial psychologists want to apply time and motion study while taking into account the physiological and psychological as well as the economic factors. They are concerned to train workers and teach them methods of work chosen experimentally as the best, but they grant the worker the right and opportunity to adopt another method if he prefers it and can prove that it is equally efficient. This explains Myers' severe comment (1920) upon Scientific Management, apropos of this part of the doctrine: "To aim at pressing all workers into the same mould is not only to destroy individuality and to encourage needless monotony, but also to run counter to known psychological principles. It is the outcome of so-called 'scientific' management, mechanically formulated by the engineer, in which the mental factors of personality, sentiment, and sympathy are sacrificed to purely physical considerations."⁵⁰

(c) The need for physiological foundations

Through the faults of time-study, an essential part of the doctrine according to Taylor himself, the scientific weaknesses of the system are more readily seen.

Above all, from the physiological point of view, the experiments of Taylor's followers in regard to different occupations (pig-iron carriers, navvies, masons, etc.) are conducted by breaking down the work into sections, or in other words, by a method of discontinuous recording. Such a method is far from attaining the value of the continuous recording defined very exactly for the first time by Marey. "How much less instructive," he wrote, "is an arithmetical expres-

sion than the graphic curve which traces all the variations of a phenomenon. Both in physiology and mechanics, our proper aim will be to have a graphic expression of the work, in order to have not merely the total value but also to know the form under which it has been produced."⁵¹ Taylor was content to study the duration of industrial movements by the aid of a stop watch but not their physiological conditions, their direction and their adaptation, as Marey wished to do—as was permitted by his graphic and chronophotographic method, defined as early as 1885⁵² and since improved. Under his influence the researches by Fremont on the work of the blacksmith and those of Imbert on various occupations were clearing the path upon which the physiology of work has now entered.⁵³ By applying to time-study the motion-picture method, Frank Gilbreth only turned in a slightly different form to Marey's chronophotograph. But he did not use it in the service of biological and psychological rationalization and, fundamentally, took his stand with his master on a narrowly technological line.⁵⁴

Since Taylor was content with so simple and insufficient a technique for observing the organism at work, it is not surprising that he completely overlooked the scientific problems of fatigue and, what is still more serious, that he even made wholly incorrect and practically dangerous statements on this matter. His chief observations, confined to the sustained labor of carriers of pig iron, were entrusted at his direction to his pupil, Carl G. Barth. "The writer, however," Taylor writes, "was quite as firmly convinced as ever that some definite clear-cut law existed as to what constitutes a full day's work for a first-class laborer, and our data had been so carefully collected and recorded that he felt sure that the necessary information was included somewhere in the records."⁵⁵ Barth was to deduce this law from the observations transmitted to him under the form of elements of curves. "In a comparatively short time Mr. Barth had discovered the law governing the tiring effect of heavy labor on a first-class man. And it is so simple in its nature that it is truly remarkable that it should not have been discovered and clearly understood years before."⁵⁶ In fact, it consists in the statement that there is an inverse relation between weight of the load to be handled and the duration of loading: for each of the movements accomplished by him and for a definite weight the worker can be burdened during only a definite part of the day. Nothing is said of the signs recorded

as indications of fatigue. As for physiological considerations, they amount to the following: during the time of labor “. . . the tissues of his arm muscles are in process of degeneration, and frequent periods of rest are required in order that the blood may have a chance to restore those tissues to their normal condition.”⁵⁷ That is all.

Experiments with shovel labor were accompanied by still more significant comments. Thousands of observations were made, by the use of a second-counter, on different soils, with various materials to be shoveled (coal, coke, cinders, ores). It was found that the output is maximum when the shovel load is 9.75 kilograms, or 21.5 pounds.⁵⁸

But did Taylor base his mechanical observations on physiological data? Was he interested in knowing whether or not the increase of the shovel-full increases fatigue in a similar or even greater degree? Did he have measurements made of respiratory indications, or of oxygen consumed? Was he interested in knowledge already acquired in his own time (above all, thanks to Chauveau's classical work) on the expenditure of energy by the human motor?⁵⁹ Not a bit. Here is what he accepted as a criterion of fatigue in what he called “the science of shoveling”: “At the end of the day,” he said to the laborers, “I do not want you exhausted or anything like that, but properly tired. You know what a good day's work is. In other words, I do not want any loafing business or any overwork business. If you find yourself overworked and getting too tired, slow down.”⁶⁰ Science cannot be content with such a criterion “compounded of confidence and of approximation.”⁶¹

We are thus justified in saying that the “law” of fatigue enunciated by Taylor for sustained effort is, in itself, “of a simplicity approaching poverty.”⁶² Moreover, it covers only a highly specialized and limited field of work activity, that of handling materials. In all of Taylor's work, there is nothing about the complex forms of fatigue, especially of *nervous* fatigue, which is more and more frequent in jobs where attention is called into play by the feeding, watching, and regulation of machines. The “laws” of fatigue enunciated by Taylor leave the workman no guarantee against over-exertion, whether due to excessive hours of work (without a rest pause) or to its too rapid rhythm. In short, we should not be surprised at the absence of any physiological basis in a system aiming at the greatest pos-

sible output with the least possible expenditure of working *time*. A physiological Taylorism would have been a contradiction in terms.

(d) *The need for psychological foundations*

In the field of industrial psychology the errors and gaps in Taylorism are equally grave, and by reading the statements to which Taylor attached scientific value one discovers as vague and elementary an empiricism as that of the physiological "laws." His observations on the determination of the rate of bonuses furnish a good example of this: "A long series of experiments," he writes on this subject, "coupled with close observation, had demonstrated the fact that when workmen of this caliber⁶³ are given a carefully measured task, which calls for a big day's work on their part, and that when in return for this extra effort they are paid wages up to 60 per cent beyond the wages usually paid, that this increase in wages tends to make them not only more thrifty but better in every way; that they live rather better, begin to save money, become more sober, and work more steadily. When, on the other hand, they receive much more than a 60 per cent increase in wages, many of them will work irregularly and tend to become more or less shiftless, extravagant, and dissipated. Our experiments showed, in other words, that it does not do for most men to get rich too fast."⁶⁴ Clearly such observations as these have nothing in common with a scientific study of psychological incentives in industrial work. Not a trace of such a study is found in the writings of Taylor and his collaborators. To be content to say that "scientific management" consists in determining the incentives of reward and punishment, "the good big plum" and "the whip," and in strengthening them by a "close, hearty co-operation"⁶⁵ with the management, clearly indicates a lack of penetration and even of any sense of the psychological problems of work. To call all forms of reduction of output "shirking" (forms which are so different in their more or less conscious and voluntary nature, and their personal, economic and social motivations), shows lack of contact with the worker's mind and of any curiosity about it.

To these weaknesses are added others. Thus one is the less surprised that the Taylorians have overlooked psychological problems of practical importance, which are essential to scientific management. For the man-machine complex with its reciprocal relations to function at its best in all cases, its elements clearly must be

adapted to one another: in particular, the worker must be fit to do the work entrusted to him. The first question, therefore, is the vocational guidance of young people who are candidates for a trade, and the selection and re-grading of adults engaged in it.

Now, in Taylor's work there is no trace of interest in vocational guidance. As for selection, we have seen that he had no suspicion of the importance of the psycho-physiological studies which the sciences of man had nonetheless begun to emphasize while he was still in the midst of his activity. The type to select for carriers of pig iron, he writes, is the man who is ". . . so stupid and so phlegmatic that he more nearly resembles the ox in his mental make-up than any other type. The man who is mentally alert and intelligent is, for this very reason, entirely unsuited to what would, for him, be the grinding monotony of work of this character."⁶⁶ For the selection of checkers of ball bearings, he suggested a method which implies determination of the reaction-time of each worker.⁶⁷ Usually the procedure is much simpler: the wages of a worker who improves are raised, those who fall below a certain average are discharged and replaced by scientifically selected workmen.⁶⁸ But Taylor does not say by what methods and criteria this "selection" is made. Apropos of Gilbreth's experiments with bricklayers, Taylor recalls that one of the essential elements in the method of scientific management is "the careful selection and subsequent training of the bricklayers into first-class men, and the elimination of all men who refuse to or are unable to adopt the best methods."⁶⁹ Thus the shovel-workers of the Bethlehem Steel Company received each day white or yellow slips depending on whether or not they had accomplished the task assigned by their instructors. "So that whenever the men received white slips they knew that everything was all right, and whenever they received yellow slips they realized that they must do better or they would be shifted to some other class of work."⁷⁰

Whether the question was one of carriers of pig iron, masons or shovel-workers, Taylor was therefore concerned only with the physical aspects of work and aimed only at increasing speed. He seemed not to suspect the importance of abilities and, consequently, of physiological studies for a scientific solution of the problems of individual output and of collective efficiency. We have just seen how the methods of the Taylorian system of time-study are falsified by this defect. Times considered "idle" from the immediately utilitarian point of view may,

in fact, be periods of activity, fruitful in the long run if considered in connection with the total demands and the physical and mental abilities of the organism. Thus the occupational selection developed by industrial psychologists aims at determining by what characteristics, in each trade, the different degrees of ability are shown. Then, on the basis of these important signs, it determines what tests must be given and by what means. Taylorian selection, on the contrary, amounts to a crude differentiation through output, the application of which is possible only in a well-supplied labor market such as that of the United States at the period when the system flourished.

This failure to appreciate the psychological factors in work is at least partially explained by the nature of the jobs to which Taylor exclusively confined his observations: handlers of pig iron, shovel-laborers, and navvies. These are all forms of hard physical labor which, in his own day, had begun to yield to mechanization. These heavy tasks are increasingly done by pneumatic, hydraulic or electric cranes. For the "human oxen" in modern industry there are substituted, according to circumstances, semi-skilled workers and some skilled mechanics whose job is to supervise and regulate the machine. Taylor studied the special case of sorters of bicycle ball bearings, not jobs involving tools or fitting which demand higher psychological abilities and a quite different adaptation. Thus it is that his elementary observations on fatigue place its origins in the muscles and never in the nervous system.

But the narrowness of Taylor's horizon is related, above all, to deeper reasons. Taylor assigned little importance to occupational intelligence and its changes as a function of technological progress. Let us not forget that for him, "The full possibilities of functional foremanship, however, will not have been realized until almost all of the machines in the shop are run by men who are of smaller calibre and attainments, and who are therefore cheaper than those required under the old system."⁷¹ He followed the path leading to the increasing division of labor, but at the same time refused to make any effort to find compensation for the increasing specialization by permitting the workman to increase his technical knowledge and to reflect on the subdivided tasks imposed upon him by rationalization. In Taylor's type of factory the worker must follow strictly the instructions on the slips prepared by the planning departments without having collaborated in any way, and without understanding by what means

and for what reasons they were established. Since this was the underlying tendency of his system, how could Taylor's interest have been directed to the study of the psychological factors of job activity? But, on the other hand, lacking this interest, how could he hope ever to obtain that "close, hearty co-operation" with the personnel, that "voluntary collaboration" of the workers⁷² which he so clumsily and vainly desired, while denying himself in advance every means to a sympathetic and human understanding?

CONCLUSIONS

This brief confrontation of Taylorism with the sciences of man allows us to evaluate the scientific pretensions of the system. Putting aside its considerable contributions, which derive strictly from applied mechanics and metallurgy, one cannot label as science what is only an improved system for increasing the immediate output of equipment and labor. Time-study; the confusion of human labor with the play of inanimate mechanisms; the ignorance of the physical and mental functioning of the organism and its own demands; the procedure adopted to stimulate and reward effort; the lack of vocational guidance; the selection by output, and finally the empiricism of generalizations elevated to the status of "laws"—everything proves that we have here a system created by a man who was doubtless a great technician but who could not see beyond the confines of his engineer's universe. Neither he nor his followers had any conception beyond that. Nothing was more foreign to them than the necessary and constant collaboration of the technician with the physiologist and psychologist to make a really thorough, penetrating study of the problems of industry. This self-sufficiency of the technician characterized the attitude and solutions which we shall call *technicist*. How bold are the vindications which, in the style of Le Chatelier, represent Taylorism as a true science of industrial organization and how complacent the assurance with which the eminent physicist ventured, in 1928, to declare that the problem of fatigue "has remained at the stage where Taylor left it."⁷³ Le Chatelier was also, in his own way, a victim of the deterioration resulting from scientific specialization.

But let there be no mistake. Taylorism has, in fact, entered many factories in America and Europe. Its technicist influence circulates there, under other names, in the shape of all the systems of indus-

trial organization derived from it, and which, with varying success, have tried their fortune in industry for several decades.⁷⁴ The rationalization of the engineers has developed in spite of criticism which often did not get beyond the circle of specialists. Moreover, it developed not *in spite of* but just *because of* its omissions and errors; a system of increasing the efficiency of equipment and labor, directed at the maximum, immediate output of both, and giving precedence to economic success over the worker's physical and mental welfare, corresponded to the needs of a definite stage of world capitalism.

Not that the sciences of man in their biological rationalization neglect the economic aspect of problems: their studies also are practical and even aspire to achieve, better than Taylor's rationalization (constructed from the engineer's restricted point of view), methods of work which are "the best" for the firm and for the individual. In each given case they try to find the *optimal* solution which, based on physiological and psychological functions, balances respect for the worker, as an operator and as a man, with care for efficiency and output. This defines exactly the primary concern of the *human factor* movement, which has arisen from the criticism of Taylorism and from the beginnings of industrial psychology which gradually formulated its position by its opposition to the former. The expression, "human factor," now current in industrial psychology, will signify for us the movement which is also an important stage of the application of science to industry. The tasks it proposes for itself, confronted with the disturbing evolution of mechanization in our contemporary society, are complex and difficult. We shall see their outlines and results more clearly in connection with particular problems.

First, let us note that as a result of this criticism of Taylorism we face again the *unity* of man which Taylor tried deliberately to ignore in the worker, by considering him essentially as a mechanical factor. This defense of man, of his physical and moral unity threatened by the crushing ascendancy of the second industrial revolution, is proclaimed and undertaken by the scientific "human factor" movement.

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* This supplementary Bibliography (as well as the others that follow several of the chapters below) does not pretend to be exhaustive, within the limits imposed on it, but only to present some orientation. As indicated in the new Preface, I have considered it preferable to emphasize, on the whole, the European literature.

Some Contributions of the Physiology of Work

THE IMPORTANCE ASSUMED by the researches into the physiology of work is by no means fortuitous. The development of the study of material energy prepared for the application of its data to human energy. Since Lavoisier, the mechanical, calorific, electrical, and chemical forms of energy had in turn been the objects of fundamental discoveries, while as early as 1785 Coulomb began the scientific study of human work by linking it both to the physical sciences and to biology. Thanks to Claude Bernard, general physiology had accepted the disciplines of the experimental method. Gradually, research turned towards the most complex forms of energy, and the attempt was made to fathom the laws of the supply, expenditure and functioning of the "human motor." For this there was required a knowledge of all the functional apparatus set in motion in the course of work.

The very expression, "human motor," however, suggested some confusion with certain tendencies of Scientific Management. In the industrial worker the latter had seen primarily the *motor* and very little of the *human*. It was because they failed to appreciate bio-psychological necessities that the technicians were able to present their studies of fatigue as laws of physiological science. Le Chatelier has

an intuition of the inadequacy of the Taylorian procedures in this field: "It is not certain," he writes, "that engineers, being strangers to questions of physiology, are perfectly qualified to pursue such studies; perhaps it would be more reasonable to leave this to the physiologists, as chemists are left to study methods of analysis later to be employed in factories."¹ But elsewhere he seems to believe and to imply that Taylor had advanced in the course of his observations to a "study of the human motor."² Within the orbit of technicism certain researches into the physiology of work have not taken a proper perspective with regard to Taylorian rationalization.

Against the latter, however, was developed the idea of *biological* rationalization. Chauveau's work in France, followed by that of Marey, Imbert, Amar, Laugier and his followers, by that of Atzler and his collaborators in Germany, by A. V. Hill, Henderson and Dill in the United States, and the publications of the Industrial Fatigue Research Board in England, together with many others, contributed to its definition.³ Biological rationalization tries to define the optimal conditions (those of least expenditure and fatigue) of the human motor. They may happen to coincide with those fixed by technicist rationalization which aims exclusively at output, but this coincidence is by no means necessary. On the other hand, biological rationalization tries to adapt the physiological surroundings of labor, the *working environment*, to the needs of the organism. These studies are by no means as numerous as the importance of their object merits. "Technical progress properly so-called and the application of the physical sciences to industry have advanced at a much more rapid pace than the application of physiological science to work done in industry by the living mechanism."⁴ Many physiologists, considering the number of richly equipped laboratories devoted to the testing of machines, regret that even today so few testing laboratories exist for the human motor.

Occupational physiology begins with the study of the organism at work, of the conditions and limitations of its functioning.⁵ The researches bearing on the comparative expenditure of the nervous system and the muscular system do not yet seem to have led to any well-established results. Mosso thought that he could affirm that, in fatigue, nervous exhaustion is produced at the expense of muscular tissues, because the only organs which do not alter in weight in the course of inanition are the nervous system and the heart. But per-

haps the metabolic portion (that subject to change and the variations of which in weight are measurable) is very small in comparison with the total nervous substance. On the other hand, the chemical composition of the nerve cells which form the reserves under attack during prolonged work is not even today sufficiently well known.

The work of Gautier on the leucoma discharge of the albumoid substances has established the great importance of waste products of muscular activity passing through the circulatory flow of the organism which, modifying the body fluids, exert considerable influence on the behavior of man at work. To their action must be attributed the characteristic effects of fatigue, as has been shown especially by the experiments of Pfluger and Oertmann.⁶ By washing with a .007 solution of marine salt, a frog's muscle long subjected to electric stimulation is again made capable of contraction. Contractions have even been obtained in a frog's body the blood of which has been replaced by such a solution. One of Gautier's experiments is particularly noteworthy: a dog is put to sleep with morphine and blood is injected into him from a dog at rest; there is no result from the injection. But if the injected blood is taken from a dog whose muscles have just been tetanized for a sufficient length of time by an electric current, the sleeping dog will display all the signs of violent fatigue, his heart will beat quickly, the respiration will be accelerated, etc.

From these experiments, of which we mention only a few of the most notable, an important result follows for the study of industrial fatigue in man. The fatigue of an organism is not a local phenomenon, but tends to be generalized. Even when its origin is strictly local (as is often the case with mechanized work in which limited groups of muscles are used), its effects are nonetheless transmitted to the whole organism by the system of body fluids.

As a matter of fact, the study of these cases of fatigue in which only a restricted group of muscles is involved had led Edgar Atzler to an observation important for the knowledge of the physiological effects of mechanized labor: the distinction between *central* (nervous) fatigue and *peripheral* fatigue, especially characterized by circulatory and respiratory reactions.⁷

When a large group of the muscles of our body is excited for a long period, the resulting fatigue is mainly *peripheral*. But when the number of muscles involved is reduced, signs of *central* fatigue appear and increase, whereas peripheral fatigue is reduced. The fact is

explicable by the phenomena of activation of the nervous centers. If a single muscle, through the same nervous centers, is subjected to repeated excitations, it is as though the nervous substance had not had time to be reconstituted between two excitations, too rapidly succeeding one another. The muscle itself suffers less than the nervous centers; and the result is a relative increase of central fatigue. When an effort of this sort—required of a restricted group of muscles—is repeated and prolonged (for instance, in the case of worker fixing screws every few minutes on an automobile motor assembled on a moving belt), two physiological effects result, singly or together:

(a) The worker has to strain his will, to increase the intensity of his actions.

(b) Other nervous centers (B) in his organism have to become involved and supplement the center (A), at first the only one activated. This intervention has bad physiological effects for them, also. On the one hand, their anatomical structure does not dispose them as naturally for this use as (A). On the other, they are retarded in the reconstruction of their energizing substances and in the elimination of waste.

As subdivided work is prolonged, an increasing number of nervous centers is therefore involved in this process and suffers from too frequent activation, up to the point where a definite breakdown at last occurs.⁸ These results are a condemnation of all repetitive subdivided work, if performed without careful physiological control and the corrective of physical culture and sport.

It may be objected that in highly specialized tasks, which are multiplied by the growing division of operations, a limited group of muscles may achieve a sort of perfection. Must this be abandoned? Even in such cases, Atzler remarks, "we must consider such a unilateral employment of muscles as something unnatural, especially when, under the pressure of factory organization, the work is done for a long period and at maximal intensity."⁹

Research on respiration in the course of work¹⁰ was concerned at first with its various types, which it was desired to explain directly by the surroundings and by the forms of activity to be performed (Imbert). Breathing was supposed to adapt itself to the person's activity, either through being set in motion by automatic centers or through the action of the will. In reality, personal psychological dis-

positions intervene between the functioning of the organs and the milieu. The milieu itself exerts no mechanical control. Respiration reflects all the affective and mental changes in the course of work, and the different phases of attention. Also, experiments made on a person in a laboratory (like those of Amar, recorded in pneumograms and tonograms)¹¹ are liable to indicate the person's mental disposition developing in the special conditions of the experiment.

This intrusion of psychological activity between the biological aspect and the individual factors is evident also in important experiments made on the circulation of the blood in the course of work. In such cases, in which it would seem that automatic action was much more powerful than in breathing, the mental state of the person still predominates. Thus Dumas' and Tinel's researches on cerebral circulation show that in the brain, circulatory reactions depend more on the person's state at the time when the stimulus occurs than on the character of the stimulus itself. Circulatory variations may be perceptibly affected by an emotional state, one of fatigue or any other vegetative-neural modification of equilibrium. Here, too, the personal factor appears: an appearance the more remarkable that it occurs here in fields of bodily activity which seem wholly submerged in the obscurity of vegetative life and removed from consciousness.

Accordingly, one sees that the person's disposition, state of mind and emotions intervene at the very source of work in the completely organic reactions which work provokes. And these psychic interventions, let us remark, may involve psychological and social effects even on the apparently solely physiological phenomena of work. It is proper to call to the reader's attention here the connection discovered by the physiology of work between the task and the worker's total personality.

These remarks hold equally true for Atzler's research on biological rationalization, aiming always at determining the conditions under which a maximum output is possible with a minimum of expenditure of the worker's energy. The research on work with a crank is famous. Atzler determined there the *minimal expenditure* of energy for a task performed with a crank, depending on the quantity of work produced, the spoke of the crank and the height of its axis above the ground.¹³ Slight changes in one of these factors may considerably alter the output. In the same way, Atzler systematically studied the optimal

speeds for work with a crank, the raising of weight, walking with or without a burden, the various kinds of handling of materials, and the movement (by pulling or pushing) of trucks.

For all these cases, Atzler grouped his results in tables which show the *optimal* conditions under which the work promises the maximum output for a minimal expense of energy. Thus it seems to be a question of a *relative* maximum and not of an absolute figure obtained without taking account of physiological factors. It may be objected that the tasks studied here were purely manual. But the simple effects involved re-appear in combination in the course of most of the mechanized and non-automatic operations of large-scale industry. The effect of Atzler's important research is to call attention to the physiological factor which technicist rationalization had so completely misjudged.

"This research on the subject of physiological rationalization," he notes apropos of this theme, "requires much time and money. But the wealth of numerical results thus obtained form a solid basis for any sort of rationalization whatever. The technique used gives us a way of measuring accurately the external effects of work; the elements of gaseous change are likewise known in a perfectly precise way. The results of these experiments will thus be valid for many years; in whatever manner the forms of labor may evolve in the future, we shall always be able to come back to the elementary forms of work to rationalize its more complicated forms."¹⁴

This last remark is far-reaching: it demonstrates the utility of biological rationalization for the study of more advanced industrial operations, whether mechanized or semi-automatic. Moreover, Atzler desired to formulate a number of rules valid for various forms of movement and, as he had remarked, adaptable to complex tasks:¹⁵

(1) The muscular mass demanded by a given task must be in exact proportion to the external work required. Thus, for heavy labor, powerful muscles must be employed; for light labor, light muscles.

(2) For work of long duration in systems in constant motion, muscles must be chosen whose moment of force is relatively high, for example, for a heavy grindstone.

(3) Bodily movements not accompanied by external work must be as slight as possible; thus, the external work being equal, it is more economical to use a jack than a lever.

(4) Intermediate movements should not be suppressed completely and in all circumstances. Actually the muscular system rests during the period of these intermediate movements. When their share in the labor total is too small, the muscle is overtaxed, works in an uneconomical way, and is quickly tired.¹⁶

(5) A process of work should be performed with a minimal expense of energy.¹⁷

(6) The rhythm of work should be relaxed. In general, it is preferable to work quickly with introduction of long pauses, rather than the reverse. Breathlessness, palpitation of the heart, and a rising body temperature betray too rapid a rhythm or an excessive effort in a healthy man.

(7) The energy spent in maintaining a body position necessary for the performance of a task should be reduced to a minimum. For instance, when the upper limbs only are working, the worker should be able to sit; or again, an arm which is extended for long periods should be supported.

(8) During a monotonous task, the muscular group in action must be relieved by another as often as possible. Thus the blood circulation is kept active and fatigue resisted. For instance, it is useful, during a monotonous task, to rise in order to fetch raw materials.

(9) Static work (the bearing of loads, work in a crouching position, etc.) should be eliminated as far as possible, because the blood circulation in muscles working statically is reduced.¹⁸

(10) Weights should be carried so that their center of gravity is perpendicularly above the surface of support of the body.

(11) Clothing assigned to workers must not hinder movement. If it is too heavy, it will cause a waste of energy.

If these rules were carefully applied, they would constitute a primary means of delaying the development of fatigue in the most natural manner possible.

But it seems that biological rationalization must be integrated into larger experimental research which will increase the field of study of conditions of work. This is the tendency of such physiological and industrial-psychological teams as Elton Mayo directed at the Hawthorne Works of Western Electric, in Chicago.¹⁹ Given responsibility for a large-scale inquiry by the management of this vast telephone equipment company, he studied first a group of six women

workers, chosen at random, making telephone relay batteries on an assembly line. Five of them did the assembling, the sixth prepared the pieces for her companions and stocked the assembled batteries. The purpose of the experiment was carefully explained to the girls, and they willingly consented to take part in it, despite a first reaction of timidity. It was explained to them that the investigators were trying to determine the effects of certain changes in working conditions such as rest pauses, refreshments in the middle of the morning, and reduction of the length of work. They were particularly advised to work at an "easy" rhythm and under no pretext to compete with one another in speed. The experiment lasted two-and-a-half years.

It is noteworthy that the equipment of the room where they worked was identical with that of the usual workshop, except, of course, for the addition of the necessary measuring apparatus.

Observers were always present, ready to notice any incidents. Throughout the study they tried to make careful note of the organic changes occurring in the workers, as well as changes in their mental attitude and variations in their output. Most of the graphs were made in terms of output.

To the measurement of organic changes were added periodic medical examinations. Mayo notes the difficulty of introducing directly into industry the results of experiments carried on in the laboratory on the physiological conditions of work and fatigue. In industry the latter is rarely caused solely by physiological conditions. Such indications as the proportion of lactic acid or of alkaline reserves in the blood, the pulse, and gaseous interchanges do not make it possible to discover with sufficient clearness the lack of equilibrium in work. The investigators at Western Electric, accordingly, tried to observe systematically changes in the mental attitude of the workers with regard to their work and to those who supervised them, foremen and directing personnel.²⁰

In limiting ourselves here to the physiological aspects of the study it may be observed that, after having reached the indication of the *pulse product* (which comprises both the arterial tension and the number of heartbeats), Mayo stressed the importance of organic equilibrium in the worker.²¹ There is high output when the worker is in a *steady state* and the diagrams prove that a well-trained person, with a lower and more regular "pulse product," does the same work as her less well-trained companion.

The work of Oswald Ulbricht and of Jan Dolecal,²² likewise, in connection with psychology, led to a widening of the research into biological rationalization. Noting that the most economical shape of a machine with respect to physical energy may not be the most economical in mental energy, they reconsidered Atzler's experiments. The latter led to the definition of the optimal conditions for labor with respect to the expenditure of physical energy. The importance of this objective index is great and should not be underestimated. But from the point of view of the working individual, it is as important, and even more important, to consider the conditions which he, subjectively, regards as the best. Now, this psychological optimum does not always—as appears from the experiments systematically pursued by Ulbricht—coincide with the physiological optimum objectively defined as a minimal expense of calories. Thus in crank work, for the weights of approximately 6.65, 13.32 and 20 pounds, the optimal length of arm of the crank is respectively 24, 27 and 36 centimeters, according to Atzler's objective calculations (*physiological optimum*), and 28, 31 and 34 centimeters according to the subjective opinions of the workers (*psychological optimum*).

With this consideration of the personal tendencies and, accordingly, of the individual psychology of each worker, a new variable is introduced into the scientific study of the problems of labor. Laboratory physiology, interesting as its results may be, and at the risk of considerably diminishing their bearing, cannot claim to be separated from the living realities of the workshop. This aspect of biological rationalization must be kept constantly in mind when we try to derive practical applications from it. Under the pressure of technological necessity, the physiologist working in the laboratory has to simplify the problems of work and even abstract from it aspects which do not fit into his methods of approach. With rare exceptions, it has so far been impossible, in Western European and American industry, to bridge the gap between theory and practice by adding centers of scientific research to the workshops of large firms, at the work place itself. Only these, however, would make it possible to locate the *physiological optimum* in the real situation from which it is inseparable.²³

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Fatigue

DIFFICULTIES IN TESTING AND MEASURING

THE PHENOMENA GROUPED under the name of fatigue should be among the first to receive the attention of students attempting to explain, by experimental study, the human problems of mechanized industry. The inadequacy of Taylorism and its substitutes, as we have seen, was especially striking in this field. Through time-study applied on the basis of Taylorian principles, the worker is robbed of his own rhythm, and a rhythm is imposed on him which is declared to be “favorable” to intensified production—all without any consideration of psycho-physiological conditions. The “law” enunciated for the carriers of pig iron should be enough to show how poor it is for a serious study of fatigue in muscular labor. As for the study of fatigue in the various forms of mechanized labor, it is simply omitted. Whatever restricts production on the worker’s part is called “shirking.” To recognize fatigue, Taylor waited for the appearance of signs of physical decline among the workers and, what is more, among workers specially *chosen* from the best. The numerous studies devoted to the phenomena of fatigue in industry permit us today to measure the inadequacies of the technicist systems better than at the time of the first scientific reactions against them.

Fatigue, from the point of view of the individual considered as an

isolated atom in production, certainly sums up and concentrates in its manifestations most of the human problems of mechanization. If, in each single task, we could succeed in learning the limitations of the organism, the causes which may threaten, maintain or restore its physical and mental equilibrium, the realization (at least the *theoretical* realization) of the worker's well-being would be considerably advanced.

Some of the directions taken by the physiology of labor in the study of fatigue have just been noted. In connection with functions apparently wholly organic, such as the circulation of the blood and respiration in the course of work, it has been noted that they themselves are actually affected by psychological states. If it is true that there is nothing strictly individual in man but his automatic reaction to the stimuli of his physical milieu (a remark made frequently by sociologists of Durkheim's school in order thereby to stress the full extent of what is collective or indirectly affected by the collective),¹ we see how far we must go to find the frontiers of "pure physiology."

In any event, seen through the maze of reflexes set in action during the phenomena of fatigue, these frontiers seem very broad. Certainly, there are general and constant directions in these reactions, but they cannot be foreseen with any precision. Weariness seems to attack first the most complex and recently acquired functions, in conformity with a more general biological law. Such is the case with the lowered threshold of the patellar reflex after intense cerebral overexertion; or again with the disappearance of differential sensitivity which is replaced by a sensitivity much more confused and semi-affective. Head calls it *protopathic*, because it involves pain.² Fatigue lowers this threshold and thus makes the worker more sensitive to pain. Fatigue is also shown by the experiments of Kraepelin and Aschaffenburg to affect profoundly the psyche. Using the associational method, they proved that the reactions roused by key words remain numerous but tend to become less and less intellectual, more and more reduced to external verbal similitudes, or, in short, to motor elements.³ Attending an investigation conducted by industrial psychologists in an English glass-works in Middlesex, I observed, on their suggestion, a phenomenon of the same kind during studies devoted to improving the work of checking bottles (a very important one in an automatic glass-works). I noticed after repeated experiments that the level of exactness in verification had been lowered

among the tired workers. They were less particular in their selection of bottles and seemed no longer aware of some of the finer defects.⁴ Here, too, fatigue destroys whatever is most complex and most recently acquired.

It also affects the reaction time and prolongs it considerably. Now this time, far from being an invariable index, is a characteristic varying with individuals but to some degree constant for each individual, as Gemelli has shown. Fatigue, then, penetrates the deepest of the psychic qualities without our being able to deduce its effects from purely physiological changes. Nothing can reveal them but observation of the work itself and its variations. In other words, industrial fatigue is capable of detection only on the basis of physiological manifestations at a higher level. The study of these manifestations was not sufficient really to introduce the consideration of man himself into the scientific organization of work. Or, rather, the science of work is led toward the psychic and wholly individual realities by means of the physiological changes themselves.

The experimental study of work curves either by Mosso's ergograph or by dynamometers or dynamographs which are not restricted to a definite group of muscles should be noted here. Kraepelin was one of the first to prove, by systematic laboratory experiment, the variations of output in the course of a period of work.⁵ The very diverse oscillations of these curves should permit the definition of types of workers according to the particular outline of their effort, the length of the periods of warming-up and decline, and the type of attention. Such research, if sufficiently advanced, might eventually result in a sort of psychological typology of individuals in their relation to work.

But this would be to remain satisfied with too abstract a statement. Actually, these reactions to effort themselves vary not only from one individual to another but even in a given individual, according to the work undertaken, its conditions and duration. The test by ergograph or dynamometer (although even in this case the roots of effort are traceable deep down into psychological life) is too abstract. Subjected to a *tapping* test, a person may show a quite different speed ability from what he will show confronted by a prolonged work of wrapping, feeding a machine or by assembly-line work. We can clearly not be content with this personal typology, but must relate it to workshop conditions and actual circumstances. Individual

differences attain definite value only on this enlarged plane; each individual's fatigue and effort must be studied in connection with the length of work, the length and position of the rest pauses, repetition, rhythm, etc.

In another connection, many psychologists—who do not necessarily belong to the *Gestalt* school of thought—stressing the importance of *ensembles* (or wholes) in mental life emphasize the complex character of fatigue. A single psychological phenomenon cannot be considered in isolation. In various ways it involves all the tendencies of the personality. These statements, having become the public property of modern psychology (especially in Anglo-Saxon industrial psychology), have even affected some who have elsewhere had reservations as to the doctrines of *Gestalt*, Adler's "Depth Psychology," or Stern's "Personalism." They have been confirmed by experimental research devoted to human labor. This is by no means merely a reaction of the organism to certain stimuli, needs or instincts, like the reflex forms of activity. The manifestations of disequilibrium in work to which the name of fatigue has been given prove the complexity of the propensities involved in it.

These manifestations are, in fact, so varied that the word "fatigue" today seems like a tag used to cover very different phenomena.⁶ The influences they involve are so many that up to now it has been impossible, with any degree of efficiency, to devise tests for them. Is this to be wondered at? On the contrary, it rather seems strange that certain authors have hoped to define tests which would have more than a particular value for the conditions and individuals for which and whom they were devised. Thus, the opinions of specialists as to tests of fatigue are generally highly critical, as are those of Dr. Dhers at the close of his "Critique of Fatigue Tests."⁷ Earlier, C. S. Myers had already shown "the impossibility . . . of defining industrial fatigue in a way which will warrant the application of any of the various tests that have from time to time been devised to measure it."⁸ He had stressed the difficulty found in passing from the experiments on the physiology of work to conclusions valid for industry, where the whole man is suddenly involved. "Whatever the value of this laboratory research into muscular and mental fatigue, its slight efficiency is shown in its practical application, for the conditions of experiment in laboratories are far indeed from those of daily work. Muscular fatigue in shops cannot be isolated, as in the laboratory,

from such active influences as skill or intelligence, and these themselves depend on the normal functioning of the superior nerve centers."⁹ Even Myers, in this case, is far from mentioning all the factors which condition fatigue.

Dr. E. P. Cathcart, who has long specialized in such problems, reaches no less critical conclusions. "Fatigue," he writes, "is a normal physiological condition which may become pathological, and it is this aspect of the problem which must first be considered. What is meant by the term, and can the degree of fatigue be measured? The answer to the latter part of the question will be attempted first. In spite of the enormous amount of work which has been done on the subject, the reply is in the negative. Here, for instance, in Glasgow, we have tried for years to devise a really reliable test and, in common with all other workers, have come to the conclusion that no test has yet been devised which will permit of assessment of the state of fatigue of any subject. It is questionable, with the means at present at our command, if it will ever be possible to measure fatigue."¹⁰ Cathcart justifies the failure of direct measurement of fatigue in industry by referring to the number of variables involved and the great difficulty of keeping constant the conditions surrounding the phenomenon under special study. In fact, the test of fatigue was a utopian enterprise just because it required simplicity and abstraction of a phenomenon, contrary to the teaching of psycho-physiological research which we have emphasized. Here, even in the young experimental sciences, appears in greater or less degree the influence of the old positivist views as to the structure of reality, capable of thwarting the results of experimentation itself.

The failure to construct fatigue tests did not prevent an attempt to approach the phenomenon more closely by indirect means. Thus Elton Mayo, having described the state of research into "fatigue," in his turn concludes that it is primarily a convenient term to connote a set of phenomena, and urges rational action upon such phenomena through hours of work, rest pauses, physical conditions of the industrial milieu, vocational guidance, etc.¹¹

HOURS OF WORK AND FATIGUE

Precisely this industrial action had been begun during World War I. in England, by the investigations of the Health of Munitions

Workers Committee, the forerunner of the Industrial Health Research Board. Everywhere, research into fatigue benefited by the fact that it could serve the interests of business. The struggles of the workers in developing the labor movement contributed largely to compelling the introduction of social legislation and the first measures of industrial hygiene. But the development of mechanization forced industrialists not to extend the working day too much, to replace its extensive quality by an intensive quality, and so far as possible to fill "its pores," given the importance of the fixed capital thereafter invested in mechanical equipment.¹²

Now, since the machines had to function more and more rapidly and output had to be greater and greater, it was all-important to seek carefully the causes which might diminish production and affect the quality of work. Was it by accident that these studies increased at the time of the war of 1914-1918, clustering about the arms industries which were functioning with accelerated rhythm and in countries where the labor supply was relatively less abundant? It is a fact that indirect studies of fatigue developed more rapidly in England than in the United States—for instance, studies in the variations of quality and output, in loss of time, in labor turnover, in accidents, in the energy expended during industrial operations, and in sickness and mortality.¹³ Through these effects, all bearing on production, the investigators tried to attack fatigue. The social sciences, therefore, could penetrate the factories only through the mediation of profit. We shall see how far they were able to go along with profit.

The British studies in industrial psychology, originally purely utilitarian, since they began in the munitions factories, cast light on several important aspects of the relations between the worker and machine labor. Myers and his collaborators distinguish two forms of muscular activity:

(A) A sudden contraction of the muscle, called *clonic*, corresponding to an intense consumption of energy, the formation of toxic wastes and a loss of heat. This is the sudden effort of hard physical labor.

(B) A quite different form of activity: the *tonus*. In this the expenditure of energy is insignificant. It consists purely of the muscles getting into form, a process which itself conditions attitudes. The *tonus* is connected with the general orientation of the organism, with

postures and with the rhythms which determine it. It is a factor of order and equilibrium.

The standard apparatus—from ergographs to the most varied sorts of dynamometers—can measure only the first of these forms of muscular activity. But the fatigue corresponding to the *tonus* is slower to appear and more difficult to perceive because of the inhibition exerted by the superior nervous centers upon the inferior centers.¹⁴ This is the phenomenon particularly emphasized by the English psychologists. The following are a few of their observations with important consequences for work problems in mechanized workshops.¹⁵

The inhibition exercised by the superior over the inferior nervous centers tends to maintain a reserve of muscular strength. Thus, when the former get tired and relax their control, there may follow (and, in fact, there often does follow) an increase of muscular work, but at the same time the co-ordination has diminished and the activity is disorganized. The difficulty for a person performing a repetitive and prolonged task is to maintain the same mental attitude toward his work, suppressing all nervous impulses which might conflict with the tendency activated by the task. No physiological observation permits us to suppose that the inhibition consists in draining all the energy into the channel of the activated tendencies. A task is performed quite as much by inhibitions as by activations. Thus, as fatigue is longer postponed, the less energy is employed in these inhibitions, in other words, the longer the interest in the work. But in the case of mechanized operations in which the worker feels no interest, the organism has to count, for its own defense, on the reflexes of economy in expenditure. Do these latter always appear at the same point of exhaustion? By no means. Their appearance varies with individuals and circumstances, with stimuli and with the intimate disposition of the person with regard to his work. Myers notes that in an exhausted muscle certain *stimuli*, applied to its surface, may yet re-animate its contractions when it had become incapable of working.¹⁶

Consequently, the cessation of expenditure of energy by no means necessarily occurs at the moment when the sensation of fatigue and the desire for rest appear. "Pain and discomfort are largely instrumental in inhibiting further activity. But these are protective only. If they be disregarded, or if such feelings become blunted, further activity is possible. Moreover, increased interest, excitement, the in-

fluence of emotion or suggestion, may, as is well known, either prevent fatigue from manifesting itself or evoke revival of muscular or mental activity."¹⁷

The fatigue measurable by the ergograph quickly responds to the sudden effort of the muscles. To the diminution of the *tonus*, the increasing lack of co-ordination of the gestures, the connection and rhythm of which become broken up, there corresponds a much more subtle and profound fatigue.¹⁸ Skill and ability maintain themselves, if at all, by dint of voluntary attention, which is at once exhausting and only temporarily effective. Interest in the work decreases. With the more definite forms of tedium, obsessive ideas emerge and, finally, anxious and neurotic states. Such is exactly the form of fatigue described by English psychologists under the name of *industrial fatigue*.¹⁹

From that time the total inadequacy of the position taken by Taylorism and its successors has become clearer with regard to human labor in industry. Industrial psychology proves the importance of rhythm, of the relations between actions, of the adaptation of the *whole* man to work of *long duration*. Industrial fatigue is just as likely to appear after two days as after two months: "If industry tends to develop this fatigue it is doubtlessly because industry subjects the individual to effects of motor or mental accommodation which often do not correspond exactly to the spontaneous play of his attitudes or of his personal rhythms."²⁰

Man, with the whole of his personality, is again introduced into a truly scientific management of labor. The abstract worker conceived by the Taylorians—a crude composite of laziness and desire for gain—yields to a complex being, both body and mind, in whom an all-important act such as work involves the whole personality.

This mental conditioning of phenomena long regarded as essentially organic has gradually been recognized by psychologists and even by physiologists. Today it is generally admitted that work is permeated with emotions, interest and thought. Elton Mayo expresses this conception by postulating as the background of fatigue, not a strictly physiological phenomenon, but an interference in the form of external industrial situations.²¹ This "interference of any kind with the individual's capacity to attend to what he is doing" provokes in him disequilibrium and what is called fatigue. The Western Electric investigators, having analyzed the organic changes

observed in the team of working girls, then in order to cast light on an important residue of unexplained facts, invoked as the cause of fatigue "changes in the mental attitude." Just at this point the company's management, its attention drawn to these psychological elements, undertook a vast program of interviews among its 29,000 workers and clerks.²²

Having recognized their aggregate influence, the psychologist's task is to detail the psychological functions affecting work. In analyzing them, Lipmann distinguishes *capacity* for work (*Leistungsfähigkeit*), corresponding to the maximum output of a given individual under the most favorable conditions, and *ability* in work (*Leistungsbereitschaft*) which itself has an objective aspect (degree of preparation for a definite task), and a subjective one (will to work).²³ Ability in work depends primarily, in each individual, on his general tendency to develop activity, or what is commonly called his energy. It is also affected by many influences: among others by age, interest in the proposed work, and various financial incentives. But the totality of relations between the task and the worker, as Paul Plaut shows,²⁴ intervene here to a far greater degree: apparently purely technical facts like the output of a shop in terms of equipment and labor supply, are actually modified by value judgments reflecting the worker's mental attitude to his work.

We shall consider these observations in detail later on. As for industrial fatigue, they help us understand (what the experimental investigations also showed) that its effects may be cumulative. The recuperation effected by daily and nightly rest is insufficient. There is no time for the worker's equilibrium to be re-established before the next work period again acts upon him. Because his reserves of energy are not being recuperated, a *residue* of general organic and psychological effects of the work results. The idea of *residual fatigue* today seems the most important for the practical study of mechanization. Thanks to machines and to the progressive disappearance of the handling of materials, heavy physical tasks rarely cause a sudden and clonic fatigue at regular intervals. When they do exist (as, for example, in certain operations of puddling, stamping, and embossing), the introduction of the eight-hour day reduces the dangers of gross fatigue with immediate effects. But, on the other hand, there remain those of long-standing residual fatigue and slow exhaustion—organic and nervous—of man by his work.

Thus it appears that the chief objective is not to determine output or even to make psycho-physiological measurements *at the day's end*. Even though well-established tests might prove the lowering of certain functions at this time, they might be restored to their normal level by rest. It is pertinent, above all, to track down and prevent residual fatigue by discovering how the organism absorbs the effects of industry over a long period, by determining the "co-efficient of absorption" of the organism for its different tasks.²⁵ The techniques of such investigations do not seem to be perfected yet. But by analyzing causes which affect fatigue and by offering the means of acting upon them, the science of work, nevertheless, even now shows how consideration of the "human factor" may be effectively introduced into the workshops.²⁶

REST PAUSES AND HOURS OF WORK

Residual fatigue being at the center of the effects of mechanization, rest pauses in the course of work periods acquire considerable importance. Nevertheless, they were not, at first, studied from this angle, but rather by examining the effects on output of reducing the working day. To shorten the latter is, in effect, to increase the rest pauses between successive working days. Daily hours of work and rest pauses accordingly spring from the same problems and the same experiences.

The movement for shortening the working day was begun before the sciences of man had defined their methods and started their practical action. During the 19th century, at the time of the first industrial revolution and the appearance of steam engines, there was, at first, a marked tendency to prolong the working day. Legal and natural barriers, such as existed under the regime of the guilds, were destroyed and budding industrialism spared no excess in this regard. The workers' investigations of the period describe the exploitation of labor and the reactions which it aroused.²⁷

Soon the progress in the construction of machines, and also in the skill of workers, made it possible to increase the speed and intensity of labor. For almost half a century, in English industry which remained the prototype of this evolution, the lengthening of the working day went hand in hand with the intensification of work. But at a certain point, the two developments began to conflict. Indeed it

is obvious that, for industrial labor which is more and more regular and uniform, repeated daily and soon hourly and by the minute, a point must be reached where the length of the working day cannot be increased without injuring the intensity of output—a point, that is, where the *extensive* dimension (length) must be sacrificed to the *intensive* dimension (output). Then the increase of intensity necessarily involved a reduction of hours. Capitalism was led by the very consideration of its profit to accept and even to desire a reduction of the working day.²⁸ This is the same spirit in which it has at times favored scientific research into labor problems.

F. W. Taylor in his *Shop Management*, and Frank and Lilian Gilbreth in their studies of fatigue, had already drawn the attention of technicians to the effects, frequently favorable to production, of a reduction of the working day.²⁹ Besides, in the case of checkers of bicycle ball bearings, Taylor had noted the effect of ten-minute pauses after an hour-and-a-half of work, two in the morning and two in the afternoon.³⁰ But these remarks, and especially those which he makes on the subject of rest pauses in the handling of pig iron, are not well founded and are of a purely empirical nature.

The first systematic research in this field appeared in England. As early as 1893, in the Salford Engineering Works, Sir William Mather had reduced the working week from 53 to 48 hours and had had notes made of the weekly output. The latter had slightly increased in spite of the net reduction in hours. Next, such modifications and confirmations were made at the Woolwich Arsenal (a reduction of $5\frac{3}{4}$ hours per week). At the Zeiss Optical Works at Jena in 1900, the daily working hours were reduced from 9 to 8. Other things remaining the same, the hourly (piecework) wages of the workers rose by 16.2% and the consumption of power by 12%. At the Engis Chemical Works at Liège, the reduction of daily working hours from 12 to 10 increased output.³¹

In England, World War I gave a strong impetus to such research by giving rise to the "Health of Munitions Workers Committee" (H. M. W. C.), the research of which later linked up with that of the Industrial Fatigue Research Board (I. F. R. B.). The conditions were then provided for broad investigations of lasting value. Thus, in one of the great English munitions works, employing nearly 10,000 workers, observers were, for a period of two years, able to record methodically the accidents, the quantity of spoiled work in the products, the

causes of absenteeism and finally, what interests us most in this connection, the output of large groups of men and women workers performing standardized operations under conditions which remained constant (except for the length of the working day).³²

Let us examine somewhat more closely the English research, considering the rest between two working days as a longer pause, the introduction of which raises problems similar to those of rest pauses during the work period itself. The reduction of the work-day from 12 to 10 hours reduced by 70% the accidents in a machine construction shop, on the average, one instead of three. The longer the working day (i.e., long uninterrupted periods), the greater was the waste. One firm, having wished to run its machines for 15 hours a day, noted that in four months the waste had doubled while the output had diminished by 10%. As for sickness, bad timekeeping and absenteeism in general, "nominal" must not be confused with "real" working hours, the amount of the latter being derived by subtracting the hours of absenteeism from the former. The results obtained by the H. M. W. C. in the principal munitions works are convincing. Let us quote from them merely the table given below³³ in which it will be noted that, at the beginning of the experiments, the workers were still working 74.5 hours weekly, or more than 12 hours daily:

<i>Nominal Hours</i>	<i>Real Hours</i>	<i>Index of Hourly Output</i>	<i>Weekly Output</i>	<i>Index of Weekly Output</i>
74.5	66.0	100	$66 \times 100 = 6600$	100
63.5	54.4	121	$54.4 \times 121 = 6582$	100
55.3	47.5	157	$47.5 \times 157 = 7458$	113

The reduction of nominal hours from 74.5 to 55.3 thus increased the index of weekly output from 100 to 113. On the other hand, production certainly did not increase as soon as the duration of work was reduced. A period of adaptation was necessary. In fact, output reached its new equilibrium more rapidly after an increase than after a reduction of the working day, that is, output decreased more quickly through the introduction of overtime than it afterwards increased again through the eventual removal of overtime.

The general conclusions of the I. F. R. B., extending after the war those of the H. M. W. C., so far as concerns the hours of work may be summarized as follows:³⁴

(1) Any reduction in the working day results in diminishing the number of accidents, defective work, sicknesses and absenteeism.

(2) The reduction of the working day from twelve to ten hours increases the hourly and daily output.

(3) The reduction from ten to eight hours increases still more these effects except for certain operations the speed of which depends on that of the machines.

(4) Below eight hours the reduction of the working day, though still increasing the hourly output, does not generally increase daily output.

In this research the English psychologists, by their very silence, imply that hourly and daily output is connected with only a certain number of psycho-physiological conditions, the sum of which constitutes the "human factor," and not at all with social and psychological conditions capable of affecting the worker in and outside of the workshop. They have the same point of view in the experimental study of rest pauses during working hours.

The latter were one of the most successful ways in which workers in rationalized shops have benefited. Here again, the appeal to psycho-physiological investigations was keenly stimulated by economic interest and the desire to substitute the *intensive* for the *extensive* dimension of work. The one-hour pause for lunch is generally granted. Elsewhere, in most work not subject to obligatory rhythm (such as that of the moving belt), the worker spontaneously takes pauses, whether authorized or not. But their effect is far better if they are authorized; the increase in output in these two cases is in the ratio of five to one.

The best confirmatory evidence here is the work curve, which shows the variations of output in terms of duration and of the position of pauses, all other things being equal. Generally, the curve rises at the beginning of the period, when the man is warming up, and then diminishes as a result of fatigue. Most of the investigations recommend placing the pause near that time when output attains its maximum.³⁵ Conversely, it has been noted that *expectation* of a pause creates a stimulus and increases production.³⁶ At any rate, it is always useful to distribute the pauses in terms of the work curve. Investigations of this sort, studying the effects of the pauses on the worker's health, have been rare.³⁷ Most have as their object the variations of output. From this economic point of view, three chief elements have been

stressed: (a) the frequency of pauses; (b) their length; (c) their distribution in the working day. For each, the respective conclusions may be summarized as follows:³⁸

(a) Repeated starts must be avoided, for they require each time a new effort and may reduce the interest in the work.

(b) The length of pauses should be limited, in order not to lose the advantage of drive acquired during the course of production and the warming up of the human motor.

(c) Pauses are most useful when placed at that moment in the day when output begins to diminish. The work curves, after the rise corresponding to warming up, become stabilized and then register a decline when the first fatigue sets in. At this point the worker often becomes aware of this decrease in output which is made apparent by a slowing up of the rhythm. A brief effort of the will follows, which makes output rise again, but only for a time. In short, the curve descends by zigzags. Thus the pause is most useful when inserted at the beginning of these fluctuations.

Of course, the work curves to a certain extent reflect the individual characteristics which must be taken into account in the distribution of work and rest, if it is wished fully to consider the human factor. But they are not always readily discoverable.

When the work is monotonous, the usefulness of pauses is especially clear: increases of from 5 to 13% have been obtained as a result of the introduction of ten-minute pauses in the middle of the morning. The checking of small mass-produced articles, the telephone operator's work (switchboard), are not directly subject to the rhythm of a machine, but require constant attention and a series of voluntary acts. In tasks of this sort, rest pauses have caused an appreciable increase of production. It is the same with all operations (increased in number by mass production), in which the imposed rhythm exceeds the natural rhythm of the human body.³⁹

But these psychological conclusions encounter difficulties as soon as the attempt is made to apply them in workshops. These difficulties often arise from the fear of innovations and from the strength of inertia so widespread in industry, and may then, as Rex Knight remarks, be overcome by the use of tact. When the manufacturer, tempted by increased output, hesitates to leave his machines idle, the industrial psychologist recommends to him the combination of teamwork with pauses. In this way the workers will rest, successively, while the

machines run uninterruptedly. In the press shop of a great shoe concern, output increased by nearly 50%. Three women work at a press (instead of two as formerly); every hour one of them rests for twenty minutes, and this gives each a pause every three hours. The fixed capital is not increased; there is merely the employment of an extra worker, an investment for which the employer is compensated by an increase in output.⁴⁰ Similar compromises between the human factor and the economic need for profit are recommended by other investigations. In the glass industry, thanks to additional relief girls, it is possible to give workers performing very rapid mechanized operations twenty-minute pauses every hour.⁴¹ In other cases, the formula accepted by the industrialists is to operate the machine less rapidly at fixed intervals while some of the operators rest.

It is thus clear that rest periods, according to the business or the occasion, are not always applied in the same spirit: their use may be motivated more or less with reference to the human factor or to the demand for profit. Recent investigations dwell on these different motivations and their consequences. It is not surprising that the effects of pauses are inexplicable in purely physical or physiological terms. Fatigue itself contains personal and social elements and it is these which the rest pause affects. *Moreover, the workers' own interpretation of the rest pause reacts upon its effects.* If they see in it a disguised form of *speed-up* they will react with distrust and fear. If, on the contrary, they see in it a genuine and sincere interest of the management in their welfare, their reaction will be positive and will re-enforce their interest in the work.⁴²

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The Working Environment

BUT, HOWEVER UNDERSTANDING the attitude of management may be, interruptions of work alone are not enough to combat residual fatigue: the physical working milieu must be systematically studied. What the industrial psychologists call its "environment" must be broken down into its principal elements, including ventilation, temperature, humidity, light and noise. These conditions as a whole make up the physical milieu of the work and exert a good deal of influence upon it. In many cases, by making it better adapted and more agreeable, one can help to humanize a task. Its experimental study is therefore indispensable in order to improve upon the crude empiricism which still reigns in many workshops, and a true adaptation of the work to the man must be scientifically established in the daily life of the industry in question. But these are not characteristics peculiar to mechanized operations; therefore, we shall only touch upon them briefly.

TEMPERATURE, HUMIDITY, VENTILATION

First of all, there are the atmospheric influences: temperature, ventilation and humidity. They have given rise to many studies and may be said to be, today, one of the best explored areas of industrial psychology. From this point of view, the chief cause of fatigue seems to be the stagnation of air which prevents the normal caloric interchanges between the working body (radiating the excess of

heat produced by physico-chemical interchanges) and the environment. The body's temperature rises above normal, the superficial blood vessels dilate in order to increase the flow of blood and its cooling by the air. Perspiration increases and discomfort is produced if the humidity is too great, and in each case it is important to maintain a certain cooling capacity of the air: for each type of work there is probably an optimal combination of temperature, humidity and ventilation, though these limits are by no means always clearly defined. The invention of the kata-thermometer by Leonard Hill constituted an important advance for measuring the cooling capacity of the air in industrial buildings.¹

Other research has shown the exact connection between the different elements of the physical milieu and output. Vernon obtained remarkably exact conclusions as to the effect of ventilation after research extending over six years in sheet-metal plants.² The published diagrams also show the close relation between the curve of temperature and that of output. Accidents themselves are not unrelated to atmospheric conditions.³ Of course, it is important to avoid a standardization of the conditions of the physical milieu which might be as harmful as the worst negligence. Each form of labor has its corresponding unique physical milieu. The difficult labor of such "thermic" departments of industry as metal-casting and steel-making, press-forging and power-hammering, and glass-making, demand intense ventilation. Light, sedentary labor such as assembling, light engineering, the shoe industry, and textiles (after the introduction of the self-acting mule and of the continuous spinning frame) profit most by a moderate temperature and ventilation. General recommendations can only be given with reservations, and the I. F. R. B. includes these: "the air in a room should be:

- (a) Cool rather than hot;
- (b) Dry rather than damp;
- (c) Diverse in its temperature in different parts, and at different times, rather than uniform and monotonous; and (what is intimately connected with this diversity)
- (d) Moving rather than still."⁴

LIGHT

Among the elements of the physical milieu, light is one of those most affecting relations between the worker and his work. Yet how

many workshops solve their problems of lighting rationally? To be sure, the elements of these problems are not simple. As in all the problems of the human factor, for that matter, two points of view can be distinguished: one may modify the light or, leaving it as it is, "modify" the worker. In other words, one may, after due study, correct the defects of lighting or else, by selection, install in the shop only workers capable of tolerating them. For the industrialist this is a mere question of return. But this point of view may be very dangerous. A. Hudson Davies and the I. F. R. B. showed with what reserve the worker's judgment should be relied upon, for the adaptation of eyes to a given lighting by no means precludes all the visual damage which may ensue⁵ "The pupil of the eye automatically opens or closes to control the amount of light passing to the retina, while the retina in turn adapts itself, establishing a kind of equilibrium with the light stimulus and responding rather to changes in the stimulus than to its absolute magnitude. Since, in addition, no simple relation exists between the magnitudes of stimulus and sensation, judgments which do not depend on simultaneous comparison with a surface of standard illumination (as in the various forms of photometers) are quite valueless. Illumination layouts in factories must therefore be controlled and verified by instruments."⁶ Otherwise (even after an attempted selection of personnel), harmful adaptations to an insufficient illumination would be permitted, as observed by Weston and Taylor. In a printing shop during winter afternoons the intensity of illumination slowly fell to .2 candle power, without anyone thinking of switching on the electric lights, though this quantity was below the minimum required, even with the greatest accommodation, by keen sight. The workers declared that they were "used to the light": as a matter of fact, they were suffering from visual fatigue and their work was irregular.⁷

Research in the matter of artificial light is the indispensable complement to research in natural lighting. The latter is often conditioned by the defective architecture of a workshop or of adjacent buildings. The piercing of light openings in an existing building is not easy. On the other hand, managements have little excuse for not making the best use of artificial light, inasmuch as numerous studies show a fall in output and an increase in mistakes towards the end of the day due to bad lighting. In the already cited case of the typesetters, it was possible to raise output by 10%, thanks to the

investigators' suggestions.⁸ Probably people will come to make increasing use of intense sources of illumination. For the moment, their price and the dazzle effects, as yet too little known, are prohibitive. This is also what Ruffer notes in detailing the chief conditions of good lighting. Such lighting should:

- (1) So far as possible leave no shadows.
- (2) Not show too great inequalities.
- (3) Cause neither reflection nor inconvenient dazzling.
- (4) Be adapted to the purpose and nature of the building.
- (5) Be sufficiently strong and economical.⁹

Winckler advises semi-indirect lighting, with the additional use of low-tension lamps for the most delicate work. It has been possible to work out tables for each occupation, indicating the character of the optimum lighting. The choice between natural and artificial lighting especially requires very careful study.¹⁰

Such studies, showing the action of lighting on output, continue by showing its effect on the rate of accidents. Out of 81,000 industrial accidents reported to a large American insurance company, 23.8% were due to inadequate lighting.¹¹ R. E. Simpson well demonstrated both this aspect of the "human factor" and the profit which the industrialist may obtain by taking it into account.¹² In an American factory employing 1,000 workmen he made the observations shown in the following table:

	<i>Change in Lighting</i>	
	<i>Before</i>	<i>After</i>
Annual cost of lighting (in dollars)	\$1900	\$4,700
Annual current used per job	40 watts	100 watts
Accidents per year	425	170
(Cost of accident compensation)	\$15,000	\$6,000

The reforms achieved in this factory consisted, first of all, in rational lighting of places of work and the addition of proper reflectors. They cost \$5,000. But we must also take into account the general improvement of safety precautions in order to interpret the considerable lowering of the number of accidents. Nevertheless, it is clear how rapidly the expense of the newly installed lighting system (\$5,000) could be paid off: \$6,200 were saved annually (taking into account the increase in expense for electric power). This is a new example of the coincidence between consideration of the "human factor" and business interest.

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- (3) Cause neither reflection nor inconvenient dazzling.
- (4) Be adapted to the purpose and nature of the building.
- (5) Be sufficiently strong and economical.⁹

Winckler advises semi-indirect lighting, with the additional use of low-tension lamps for the most delicate work. It has been possible to work out tables for each occupation, indicating the character of the optimum lighting. The choice between natural and artificial lighting especially requires very careful study.¹⁰

Such studies, showing the action of lighting on output, continue by showing its effect on the rate of accidents. Out of 81,000 industrial accidents reported to a large American insurance company, 23.8% were due to inadequate lighting.¹¹ R. E. Simpson well demonstrated both this aspect of the "human factor" and the profit which the industrialist may obtain by taking it into account.¹² In an American factory employing 1,000 workmen he made the observations shown in the following table:

	<i>Change in Lighting</i>	
	<i>Before</i>	<i>After</i>
Annual cost of lighting (in dollars)	\$1900	\$4,700
Annual current used per job	40 watts	100 watts
Accidents per year	425	170
(Cost of accident compensation)	\$15,000	\$6,000

The reforms achieved in this factory consisted, first of all, in rational lighting of places of work and the addition of proper reflectors. They cost \$5,000. But we must also take into account the general improvement of safety precautions in order to interpret the considerable lowering of the number of accidents. Nevertheless, it is clear how rapidly the expense of the newly installed lighting system (\$5,000) could be paid off: \$6,200 were saved annually (taking into account the increase in expense for electric power). This is a new example of the coincidence between consideration of the "human factor" and business interest.

Adapting Machines to Man

THE STRUGGLE against the noise of machines is merely one aspect of a much larger effort which would make it possible to adapt machines to man's needs and to his physio-psychological constitution. During the first industrial revolution and the beginnings of the second, it was only a question of their productive efficiency. Apparently, the mechanical difficulties to be solved were for a long time so great that engineering science could not dream of further complicating them by the consideration of an "accessory" factor: that of the man entrusted with working the machine. Most often it was not even noticed that the output of the machine depended also on the operator's comfort. Yet the study of accidents led the makers of machines to ask themselves certain questions of a physiological and psychological nature.¹

"From a mechanical standpoint," Angles noted, "machines are usually well designed. On the other hand, there is too often little or no consideration of their suitability to the person who will mind them. The attitude of an engineer towards a machine working under laboratory tests is very different from that of the worker who has to mind it for eight hours a day, week in, week out, and who soon discovers its capacity for producing undue fatigue."² For the engineer, even the modern engineer who is not overwhelmed by the difficulties of technical problems, the machine is a mechanism he can transform according to his own purposes, but which presents certain inviolable

necessities. On the other hand, daily experience in workshops makes the engineer believe that the adaptation of human life to the environment leaves so large a margin that it is needless to consider it—a one-sided way of looking at matters, the inadequacy and danger of which industrial psychology has shown, since it involves useless fatigue for the worker and a diminished output, part of his effort being spent on his adaptation to the machine. “From these observations,” Gemelli and Galli remark, “industrial psychology has derived the basic idea that in making machines and work instruments, the adaptation to one another of man and the machine must be taken into account, with the aim of making human labor easier and less painful.”³

Studies of typewriters are among the earliest in this field. The interdependence between bio-psychological necessities and the manipulation of the machine is here especially obvious. The shape of the frame, the arrangement of the keyboard in parallel or divergent rows of letters, and the release mechanism allowing the lowering of the next key, the rapidity of which determines all reductions in the number of errors, have been experimentally studied, especially by Lipmann.⁴ Lahy showed, by photographic recording of very rapid movements, that the intervals between the striking movements is never less than $3/100$ of a second, a figure apparently representing the limit of speed of voluntary movements for different fingers and hands. Elsewhere he showed the existence of a “wasteful contact” consisting in the finger’s pause at the end of its descent—the time during which the key is lowered thus being prolonged. This wasteful contact, observable in all persons, nevertheless varies with individuals. The makers of these machines should take this into account, so as to minimize the errors of striking which result from it.⁵ But industrial psychology must start by criticizing existing machines and establishing for each of them the technical program which will best utilize the psychomotor abilities of the operators, as defined by scientific study.

One often finds badly adapted machines in workshops, although the recommendations of physiologists and psychologists for the construction of one or another abound in the literature. Edgar Atzler’s observations on physiological rationalization⁶ have direct bearing upon this subject. Lipmann and Angles quote examples of these psycho-physiological analyses of machines.⁷ It has been possible to effect improvements in the case of railroads, thanks to the experience of engine-drivers backed up by the studies of specialists. Individual

characteristics and limits of attention have been neglected there. Certain electric locomotives used in the United States show a complete disregard for the human factor. One of them, using high- and low-tension current, three-phase, rotating transformers, ventilators, etc., besides the brakes and recuperators, forced the driver simultaneously to watch six dials, three hand levers and pedals.⁸ Such a thing is completely wrong and dangerous. Improvements today seem particularly imperative in the leather, tobacco, textile and laundering industries. In cotton spinning, Weston and Adams have thrown light on a series of constructional errors which impose fatiguing, artificial and dangerous attitudes and movements.⁹

The study of these investigations, especially those of Legros and Weston, Miles and Angles, Wyatt, and Lossagk,¹⁰ reveals that certain cases of neglect of the human factor are especially frequent:

(1) Machines and, even more frequently, work places are too high or too low. If the structure of a machine is of cast metal it is hard to improve it, and to raise the worker by a platform or some other means would involve additional risks. When the machine is too low, of course, improvement is even more difficult.

(2) The space provided around the machine for the assembling of manufactured products is inadequate, and the worker has to bend down to pick them up when they fall.

(3) The machine requires too frequent use of the left hand and for too important movements; in other instances, ill-placed and ill-designed pedals allow the worker the use of the right foot only, or even the tip of the foot. Do the engineers who design these machines have any idea of the fatigue for the worker resulting from the impossibility of changing his foot? Do they even dream that psychologists have often noted the unconscious movement of the right foot, still pressing the pedal, among women workers eating in the canteen? I had the opportunity of working¹¹ on American milling machines (Cincinnati Milling Machine and Cincinnati Grinders) on which important changes had been made. The operator of the milling machine can easily see how the tool works at the same time as he operates the machine's controls in a position that is not in the least fatiguing. The cutting time is thus reduced by 10% and the idle time by 27%. Ferrari gave a good instance of the reforms which may be introduced in the workshop by the engineer himself, after careful study of equipment and of the conditions of work. He regularized

the flow of raw materials and, having inspired confidence in the workers by an improvement of the safety arrangements, distributed the control levers more conveniently, established a short pause as the article just machined was removed, improved the shape of tools to make the grasping of them more convenient, and provided a signal on the stopping of the machine, whereas it used to happen that the worker would watch a machine which had already stopped.¹² But there is also a limit to these improvements, which may reduce some faults of construction, but cannot take the place of a preliminary collaboration of psycho-physiologists with engineers concerning design and construction.

These remarks are confirmed by the studies of Langdon and Wyatt, especially on the feeding of machines and the resulting rhythm.¹³ These careful observers noted that many companies feel obliged to operate their machines too fast. A tension results which, over a long period, certain people find intolerable, a manner of selection which is neither swift nor economical. It would be better, whenever possible, to adapt the machine's speed to the worker's capacity; this is not difficult, at least in the case of machines driven by electric motors. For groups of machines one may provide a graduated scale of speed at which it is possible to place workers with abilities differing within certain limits. For instance, if twenty machines were all regulated to a speed index of 100, they would be staggered in groups of four at 90, 95, 100, 105 and 110. As for the weekly variations in the capacity of *each* individual, these cannot be met by measures of this sort introduced on the spot by the engineer; the very structure of the machine must therefore be modified to adapt it to the varying output capacities of the worker. "There are many devices which are suitable for this purpose; and at least one firm of machine-makers is now fixing a cone-pulley to their machines. This, like the variable resistance on electrically-driven machines, makes a change in speed a simple matter, so that variations in human capacity or material conditions can be met with comparative ease."¹⁴

Moreover, the feeding of machines forces the worker to divide his attention between the mechanical operations which he performs directly and the possible causes of trouble in other parts of the machine. This ability is very important for a number of mechanized tasks. Wyatt and Langdon have described an apparatus which detects this trouble, and they suggest automatic stops or signals which

permit the worker to foresee disturbances in the machine. Thus he can give all his attention to the work of feeding.¹⁵ Here again the original construction of machines is clearly involved—not their improvement by workshop expedients.

Furthermore, such adaptation never occurs without direct effects on output and thus on the interests of the firms which undertake it. During a long investigation in a factory, Miles and Angles had the opportunity to test some changes of this sort which were finally adopted when an 11% rise in output was ascertained.¹⁶ None of the measures proposed by Weston and Adams for the construction of looms “in collaboration with the worker” were accepted without having undergone this output test.¹⁷ But practical studies of this sort are not numerous today because it is not always easy to convince the industrialist of their immediate advantage for himself.

Other machines used by man, however, have been much more favored. The evolution of the bicycle is a good illustration of what sensible consideration of the “human factor” can do to adapt the machine to man and to make it truly a tool for his *service*. The bicycle, Legros and Weston tell us, “. . . has been successively modified, first mechanically, so as to obtain high efficiency, then psychologically so as to reduce the risk of falling and difficulty of balance, and finally physiologically so as to reduce vibration and to enable the force exerted by the rider to be more efficiently applied.¹⁸ Does not the automobile offer a yet more impressive example? No expense has been spared, and great reserves of ingenuity are expended annually to humanize it. The “automobile shows” in all the world capitals every year present minute additions to the driver’s physical and psychological comfort. Here everything is studied so that man shall suffer as little as possible from the machine. The greatest care is given to the location, slant and size of the pedals, and the necessary movements for use of the levers and controls on the dashboard and steering wheel are also investigated. Yet, in this case we have to do with a machine which is often used only for leisure purposes. Is not at least as much attention deserved by machines devoted to production, on which the worker earns his living, which he operates daily over long periods and under trying conditions, and on which in the long run, he stakes his physical and mental health?¹⁹

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Accidents

IN THE RECIPROCAL ADAPTATION of man and the machine, accidents reveal a sudden, sharp inadequacy, a dramatic moment of crisis in this complex of flesh and metal. The number of accidents is higher than is generally believed. For instance, in England during 1925 there were 944 fatal accidents in factories and 1,136 in mines; 158,749 non-fatal accidents in factories and 179,602 in mines. Nor do these figures themselves indicate the total number of accidents. To them must be added so-called "minor" accidents, rarely indicated by the official agencies and in fact hard to estimate. In 1920, the year in which this assessment was made in Great Britain, the number of "minor" accidents in that country totalled 1,400,000.¹

Technological progress, the constantly increasing intensity of production, the overwhelming flood of the second industrial revolution, were all accompanied by a growing number of accidents. Great humanitarian associations were founded and sympathetic voices raised. They were fortunate in being able to back their campaign with the private interest of many industrialists. In fact, as we have seen, business leaders, under the new conditions of mechanized labor, had perceived the technical necessity of changing the *extensive* dimension of the working day to an *intensive* dimension. This change meant that more attention had to be given to the worker's safety. The famous American "Safety first" movement was accompanied by

another, "Safety pays." The results achieved by the "Safety first" movement were and are considerable. It is not diminishing their importance to say that a large proportion of them was due to the fact that "Safety pays," that is, that an effective policy of accident prevention has a favorable effect on business output. The results obtained, in fact, soon showed that this movement cannot be considered as a purely humanitarian matter, nor as one of "social ethics."²

Paying no heed to noneconomic considerations, the technicist literature tries to prove that industrial rationalization directed according to its views does not cause an increase in the number of accidents. Its conclusions, however, are far from being generally admitted. Thus the reports of German labor inspectors conflict with the documents published by union organizations and also with the absolute increase in the number of accidents.³ The American Engineering Council, after investigating firms in which the prevention of accidents had been organized with special care, between 1922 and 1925, noted that their average production had increased 14.4% per working hour, due to rationalization, while the frequency of accidents decreased 10.4% (but their gravity increased 2.5%). The International Labor Office, studying these figures, considers that they "are probably more favorable than those which could be recorded in the total number of American businesses, all of which tend to the greatest economy of the labor supply."⁴

THE HUMAN ELEMENT

Here, again, the technicist view of the problem has gradually been superseded by one which is more humane and more accurate. Physiology and industrial psychology have shown why the struggle against accidents was often difficult in the conditions of rationalized industry and of intense and mechanized labor. The industrial psychologists employ indices which prove the complexity of the variables involved. The *frequency* of accidents is expressed by the number of accidents occurring during a given time among a specified number of workers. This index, therefore, serves at the same time to evaluate the total importance of the causes of accident in a business. It is the *propensity* to accidents (an individual, psychological, or rather, psycho-motor aspect of the problem) that has most recently claimed the attention of investigators. The *risk of accident* takes account of the totality of factors causing accidents and especially of the technical

characteristics of the work considered. This index is higher or lower depending on whether the work is more or less "dangerous." Finally, the *gravity* of accidents is expressed by the proportion between the time lost by workers as a result of accidents and the total working time at the workshop.

Let us first look at some studies of industrial accidents. They all tend to stress the conflict between technology and man, it being clearly understood that in this case "man" means the total personality of an individual, including his physical and mental disposition and his reactions to a milieu. Thus, after a study of the Luxembourg factories of the Arbed and Terres Rouges companies, Dussier concluded that the perfecting of safety devices cannot, by itself, prevent accidents. Carelessness, lack of foresight, inattention, awkwardness, often seem to reduce the effectiveness of the best technical arrangements. In this firm a remedy for this state of affairs was sought by developing the vocational guidance of apprentices and by developing pictorial propaganda against the most dangerous forms of carelessness (a propaganda program begun with apprentices and continued in the workshops). Moreover, the engineer concerned with the safety of the personnel periodically visited the shops, immediately investigated each case of accident and informed the different departments of the most serious and significant ones. Under his direction compulsory conferences were arranged between engineers and foremen, on the one hand, and on the other between foremen and workers.⁵

Dr. F. Ritzmann, on his part, basing his case on the studies and documents of the International Labor Office, stressed two sorts of causes of accidents: imperfection of technical installations and material; and imperfection of personnel, under which head he included not merely the producing workers but the foremen, shop chiefs and even managing personnel. Among material causes Ritzmann threw the blame principally on the safety devices, floors, staircases, lighting, and inadequacy or poor distribution of rest pauses. But after all, these causes would account for only 30% of the accidents. The human causes—at the different levels of the personnel—are more important but more complex and difficult to correct, because here we encounter the obstacle of individual differences of reaction to given instructions. Ritzmann noticed in certain individuals a lack of good faith or good will and an inability to carry out instructions.⁶ The conclusions of Farmer and Chambers are more precise. They

emphasize the importance of "aestheto-kinetic coordination" (defined by ability in sensory-motor tests) and call attention to the need, on the part of those making technical studies, for investigating accidents psycho-physiologically.⁷ Unsuitability for mechanized work is too frequently recognized only after the event, in mutilated or crushed bodies. Ritzmann mentions a firm in which a quarter of the workers incur three-fourths of the accidents.⁸ Such cases are numerous.

In these sudden breakdowns of the man-machine complex, the easiest causes to discover are those due to the technical faults of machines. We have seen that those who design machines even today pay attention almost exclusively to the needs of production, without understanding clearly enough that these must themselves be reconciled with the psycho-physiological needs of the worker who will be entrusted with running the machines. When such compromise proves difficult, the designers very rarely assign first place to the workers' needs. It thus often occurs that control levers, mechanically well conceived, are not so from the safety point of view. A complete review of the machine should then be undertaken, and the more urgently if the "accident risk" index has been found to be high. This review may lead to the creation of a new machine which will benefit generally from the progress of automation, thus reducing man's intervention and the dangers of operation. Such a review will not merely protect the worker against dangerous positions or movements. Its task is always a radical reform of the machine, eliminating the underlying causes of accident which it contains. Here again we encounter the industrial psychologist's effort to adapt to man machine-construction itself.

But the studies also show that it would be rash to base too much hope on the merely mechanical improvement of machines. By investigating the causes of accidents it becomes clear that they are very rarely due solely to the crude collision of man and metal. We are confronted by a complex problem of which technical defects are but one aspect. Moreover, do not these defects arise because man is not adapted to certain arrangements of the machine? Again, therefore, we come back to the human factor behind them. If the levers and controls of many of the first rapid machine tools caused accidents when the worker was trying to follow the progress of the tool on the worked metal, this was clearly because of the abnormal atti-

tudes which they forced him to adopt and the tension they demanded of him; their position and dimensions were therefore modified by taking into account the operator's physical and psychological needs.

MECHANICAL AND HUMAN DEFECTS

This is so true that, according to current authoritative estimates (by A. Stephenson and Sidney J. Williams), only a third of workshop accidents can be regarded as caused by the machines. About a third of this number, or 10% of all accidents, is due to the lack of mechanical protection. Therefore, the source of nine-tenths of the accidents is to be looked for in man's constitution and behavior when confronting the machine.⁹

For instance, if the safety devices are often inoperative it is because they are not automatic, because they are only attached to the machine as though not a part of its functioning—just the opposite of the perfectly safe presses where the “ram” cannot be lowered while a finger is still on the disk. Under the stimulus of piecework, and of rationalization which compels him to work at an intense rhythm to obtain the average daily wage, the workman will be led to neglect all precautions which *depend on himself*: glasses, gloves, mask, etc. The designer of machines does not sufficiently understand that these precautionary measures often impede and, so to speak, handicap the worker paid for piecework. Taking into account the worker's disposition (much influenced, by the way, by the economic and social structure of which the business is a part), industrial psychologists try to base safety as far as possible on automatic apparatus, and to obtain it in spite of or against the will of the worker himself. This pathetic contradiction is only to be explained in terms of social conditions.

Kafka, studying the psychology of braking on electric trams (or streetcars), decided that the movement intended to avoid a danger should be like the organism's natural reflex of defense.¹⁰ But to other investigators this rule still seems inadequate. Defense reflexes may be baffled during the “instant of panic.” The majority of the most recent safety devices are intended to occupy the hands or feet at critical moments so that they shall be kept from dangerous positions. In the London Industrial Museum (Home Office Industrial Museum and Exhibits), I have seen highly ingenious applications of the principle of automatic safety in the machine—in kneading machines and a

whole series of stamping presses and typographical machines. In certain milling machines where only one hand is occupied and the other is in danger of being seized by the tool or the gearing, the construction is so modified as simultaneously to employ both hands on two different levers for the satisfactory operation of the machine. This automatic safety through the "two hands" system is also employed in stamping machines in the paper, shoe, felt and other industries.

Propaganda for safety aspires to win the mass of workers. It tries to reach them even in the trade school and in evening courses, and, once they are engaged in production, to keep alive in them the fear of danger. The search for incentives has been methodically pursued by inquiries seeking the reasons for relaxing care and movements of safety, and by drawing attention to them in the propaganda. But however adroit and impressive these methods, experience teaches us that certain workers are unaffected by such warnings, either not understanding their importance or ignorant of how to apply them. Thus is shown the existence of a group of workers specially prone to accidents, a group the extent of which must be defined and its characteristics studied.

The work of Marbe has drawn industrial psychologists' attention to the question of "propensity" or susceptibility to accidents. Examining at regular intervals the work of the different classes of pupils in a school, Marbe has shown that a small number of them accounted for the vast majority of injuries.¹¹ After thorough industrial research, Marbe was able to establish the following law: the more numerous the antecedent accidents, the greater the chances of accident for an individual.

English inquiries have led to similar conclusions. One of the first was that of Greenwood and Woods (1919), conducted in munitions factories. That by Farmer and Chambers is noteworthy because it was systematically carried on for five years at the Portsmouth Arsenal. On the basis of extensive statistics, Newbold confirmed the fact that in each group of workers, accidents are distributed among a small number.¹² These verifications stress the importance of vocational guidance and selection in rationalized industry where tasks, often very rapid, demand well-defined psycho-physiological qualities. Counter-indications are nervous instability and inadequate motor co-ordination. The first available man cannot possibly be assigned such tasks without the risk of grave consequences for the worker and his comrades, and for production. The statistical study of accidents car-

ried on by Stephenson proves also that the persons most inclined to accidents are also the least efficient.¹³ His inquiry, carried on among 140 apprentices whose average age was fifteen-and-a-half years, showed that young men discharged because they had been judged incapable of acquiring the necessary skill during their apprenticeship had also been the victims of twice as many accidents as their comrades who were capable of average output. But in that case, do not the safety campaigns, addressed indiscriminately to *all* workers, do more harm than good to certain persons not inclined to accidents, by arousing in them fear and a sort of suspicion of the machine? The question has been raised by English psychologists,¹⁴ but the facts known at present make a sufficiently precise answer impossible.

Among the psychological characteristics playing a part in accident proneness, Moede emphasized thoughtlessness. In more advanced studies "of the psychology of persons frequently injured in the course of work," Lahy and Korngold proved that the frequency of accidents should not be ascribed to constitutional awkwardness. Those most liable to accidents among a group in which dangers are equally shared by all are the ones who prove incapable of adaptation, and manifest a sort of disorder in their defense-reaction mechanism. They panic easily and feel this inner shock as a "moment of terror."¹⁵ Eric Farmer, in his study of accident proneness and the individual differences shown by it, also recognized the importance of emotional instability. Having given apprentices psychological tests, he studied their activity in industry for several years. Thus he could compare the results of these tests with the curves of accidents which they underwent, and found that young people afflicted with emotional instability (revealed by the psycho-galvanic reflex) were more inclined to accidents than their comrades. On the other hand, no correlation was established between intelligence and the frequency of accidents.¹⁶

As is to be expected, defects of sight are the cause of many accidents. In one factory under study, out of seventy-one workers who had sustained the most accidents, twenty-three had vision reduced by half for one eye and twenty-three others showed abnormalities in accommodations and co-ordination of images. Artificial lighting often has an unfavorable effect: there are twice as many accidents during the autumn and winter months as during those of spring and summer.¹⁷ Ventilation, temperature, and humidity, are equally involved:

thus, in coal mines, the number and seriousness of accidents are related to the cooling capacity of the air.¹⁸ A slight increase in output (involving phenomena of fatigue and disorder of the psycho-motor mechanisms) may provoke a considerable increase in accidents. And conversely, the reduction of the working day toward normal limits has a favorable effect. During the war of 1914-1918, in the English munitions factories, the number of accidents fell 25% when the working day was lowered from twelve to ten hours.¹⁹

Inexperience and the ability of young workers to realize danger also often play a part. In many workshops it is wrong to set young men on tasks which some older workers do not want. This is an absurd procedure which a really rational organization of production condemns and which workers' solidarity also condemns—though the latter is powerless since it cannot control the movements of all the personnel. Vocational guidance, the systematic education of apprentices for safety requirements, and periodic selection tests, would be the only means of coping with risks and considerably reducing the proportion of accidents.

The effectiveness of psychological methods has been demonstrated wherever they are based on serious analysis of occupations and abilities. Thus the S.T.C.R.P. (Société des Transports en Commun de la Région Parisienne) scientifically organized the choice of its personnel under the direction of Lahy, using both medical inspection and psychological selection. For drivers, the latter included a series of tests the results of which for each candidate were compared with the average results for a large number of subjects. The tests were concerned with the estimation of distances and speeds, of darkness and dazzling light, the practical field of vision, reaction time, muscular and emotional propensity to fatigue, range of attention, and emotional character, intelligence, and memory. For drivers in service, medico-psychological examinations were repeated at more frequent intervals with increasing age (every five years up to forty-five, every two years from forty-six to fifty, every year after fifty-one).²⁰

On many occasions the management of the S.T.C.R.P. has stressed the benefit it derived from the application of these methods. After the use of selection, the length of the training stage for drivers could be reduced, and in place of 20% only 2% of those in training were eliminated as unsuitable during the course of instruction. The period

of training for drivers—formerly fifteen days—fell to nine days. The annual average number of accidents per driver decreased from 1.50 in 1923 to .61 in 1936, a reduction of about 60%. The number of accidents per 100,000 kilometers fell from 7.70 in 1923 to 2.63 in 1936, a reduction of 71%. Finally, the number of accidents in terms of passengers carried decreased from one accident per 105,200 in 1923 to one accident per 212,300 in 1936, a reduction of 50%. These figures clearly indicate the necessity of psychological selection for dangerous jobs.

The latter, contrary to a widely held opinion, do not necessarily consist in difficult and highly technical operations. Quite the opposite. One curious trait of the man-machine *complex* is that these weaknesses of man are the more evident the smaller and more automatic is his part in production.

The first reason for this is that repeated and automatized tasks are also those in which the intense rhythm is most often likely to surpass the individual's normal psycho-physiological capacity. It is these which, usually, are least well-paid, and in which attention is most rudimentary and fluctuating. It is these also in which women are often employed as a result of the decline in workmanship brought about and maintained by industrialization. We have seen that nervous instability is a characteristic frequently brought to light in groups of the "frequently injured." Now it often occurs that, on their first contact with machinery, women are afraid of it. Out of 110 working women whom I had the opportunity to question on this matter, belonging to three different English factories (glass works, hardware and automobile accessories), forty-five answered very clearly in the affirmative—a limited study which only corroborates the systematic observations of industrial psychologists.²¹ Often young working women manage to overcome this sort of antipathy, but at the cost of a repression which does not occur without a considerable expense of energy. On days when, for one reason or another, a lapse occurs because of this repression, the defensive reactions are disordered and accident threatens. We are not stating that this is a matter of biological, inevitable, definitive limitations, but simply that in many cases it is a matter of one of the inferiorities inseparable from the conditions of life imposed upon women from century to century in the different classes of society. Are not these inferiorities

reduced when the conditions of life change, when woman finds herself emancipated and on an equal social footing with man? Where social reforms of this sort have taken place, industrial psychologists have observed no "instinctive" and generalized antipathy for machines among women.²²

In any case, in those social groups where women are emancipated neither as citizens nor as paid workers, many of them—when assigned to machine tasks of this sort without a psychological examination to determine their suitability for monotonous labor—certainly have to overcome a repulsion.

On the whole, these observations are valid also for accidents due to too intense a rhythm of work: the semi-automatic motions little by little established by the repetition of movements are then disordered. It is important to note that these accidents are often due to the eruption of feelings, of affective stimuli which outweigh the concern for safety though this is instilled in the worker by experience and propaganda, and confirmed by reason. It may, above all, be the stimulus of immediate gain, the more desired by the worker the more insufficient his piecework wage at a normal and safe rhythm seems to him. Thus, for an increase in earnings the worker by degrees takes exceptional risks, and all the more readily the less he feels himself an organic part of the social community as producer and as individual. An analysis of the stimuli which the safety posters try to activate shows how difficult it is to find in the wage-earner, especially the worker in rationalized industry, psychological approaches to convince him effectively of the necessity of safety precautions.

Here, then, we see the emergence of elements of the social milieu which intertwine with the immediate causes of certain accidents. Interesting studies by psychologists (especially in the United States) have brought to light the connection between output and family conditions, personal and domestic life, and the most intimate anxieties of the worker. Accidents and a rupture in the regimen of work are alike affected by this complex of external conditions. For instance, the worker stimulated by piecework wages, and driven to take risks, is clearly affected by his financial situation, his material condition, and that of his family.

THE IMPORTANCE OF
THE WORKER'S PSYCHOLOGY

From this group of observations on the causes of accidents in repetitive and rationalized work, it appears that in this sort of task, efforts at first conscious are gradually supplanted by semi-automatic movements. Accidents occur when, under the influence of the most varied immediate causes, a defect emerges in motor coordination—a defect directly explicable by fatigue or the elements of the physical environment (lighting, ventilation, temperature), an unusually high rhythm, etc. But no sooner do we analyze closely the tendencies which have thus disordered the semi-automatic coordination of movements than we discover, behind the worker, *the man* with all his psychological and social traits, more or less fit for the work entrusted to him, and involved in a network of psychological, family and social relations. It is now less than ever possible to overrate the *material* element in the causation of accidents at the cost of the *human* element. Causes of a social and psychological nature exert a considerable effect here.²³

So it is not surprising to note that farsighted industrialists are trying, so far as possible, to secure the worker's collaboration in the prevention of accidents, which cost a great deal in the immobilization of equipment, the payment of insurance, and the training of substitutes. Employers try above all, therefore, to show the worker that propaganda for safety constitutes a field of common interest. Moreover, it is hoped, if the opportunity is taken, that this collaboration will spread and neutralize other motives of conflict. In the words of Hoover's famous report on *Waste in Industry*, "Good-will and co-operation with respect to safety—which is a non-controversial subject as between employer and employee—lead to good-will and co-operation in other more delicate problems of shop management, such as hours of work and wages." To assure this collaboration, Hoover does not hesitate to recommend the creation of a "workmen's safety committee" in the factory, whose delegates will sit side by side with those of the management.²⁴ In this field responsibility and a share in active work must at all costs be given to the workers, in order to gain their real support.

This point of view is likewise that of the I.L.O. in its investigation of *Social Aspects of Rationalization* (1931). The I.L.O., with

justification, restored the study of accidents to the complex of problems of rationalized work. The accident rate cannot be reduced unless the necessary measures are taken for a truly rational organization of industry. The following are some of the norms expressed in this connection by the I.L.O. In a properly rationalized business "the speed of work should be determined by the average of the production that can normally be obtained, especially avoiding such an increase in the rapidity of work as might involve premature fatigue of the workers. The speed of work and the wages for piecework should not be determined with an eye solely to the immediate increase of production, but taking equally into account the need to maintain the workers' permanent health. Examination of the literature shows that in many cases this elementary requirement is not observed."²⁵ Among other investigations, the report of the I.L.O. cites those of labor inspectors in Germany. In a certain German firm the workers refused to accept new rationalization measures, and the personnel had to be changed *four* times in succession.²⁶ Elsewhere, many workers were dismissed for having been unable to keep up with the rhythm of the conveyor belts. This is not much different from the rudimentary selection by output which Taylor advocated.

Moreover, even if the precaution has been taken of studying the new methods scientifically, these may involve a lowering of productivity and a recurrence of accidents unless they correspond to the worker's own rhythm. It follows that "firms in which increased production is obtained by means of an increased number of accidents may be considered as having been imperfectly rationalized."²⁷ The I.L.O. itself, dwelling on the costs and losses caused by accidents, tries to convince industrialists that it is to their interest to organize efficient safety measures and to gain the co-operation of their workers in these efforts.

Such measures imply that those who initiate them understand the worker's alienation within the factory, and understand, even when he does not express it, his feeling of being a stranger there. This mental attitude may have—and in fact does have—an influence in certain accidents. In 1932-1933 I collected on this subject the testimony of workers in large rationalized firms of the Paris region (mechanical construction industries), in instances numerous enough to insure that it was not a matter of exceptional cases. There is no doubt that voluntary accidents (not very serious ones, usually) did

occur there—because at the end of the month money was too short to pay an insurance premium, to send the children on vacation, or to pay an overdue instalment of rent. The fact was confirmed by psychologists who, during the depression of 1930, had the opportunity of making observations in a large French automobile company. On the other hand, in 1939, on the eve of a war whose importance many workers felt, a new inquiry into the same question among a group of metal workers in nationalized (aircraft) factories gave negative results: the workers knew of no accidents of this sort.²⁸ Clearly, voluntary accidents—with the risk which they inevitably entail for the worker—can occur only if he disagrees with the general interests of his company, refusing it his technical *potential* and his human loyalty.

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Conclusions

FROM THE EXAMINATION of Taylorian procedure and the study of the concrete problems of man at his work, we have gradually recognized the outlines of a new attitude and of new points of view. Whether it be an effort to track down the causes of fatigue, a question of the hours of work, of its physical environment, of the adaptation of machines to man, or of accidents, on each occasion scientists concerned with the realities of industry and involved in them diverge from the *technicist* perspective, according to which speed and output are the sole criteria. They never lose sight of the organic and psychological constitution of the worker, and for them the basic requirement is that of his physical and mental welfare, whose unity they know is rooted in the indivisible whole of a personality. Even when considered in the intense rhythm of rationalized production, the worker is still in their eyes a man and a person.

However, the significance of industrial psychology, laboriously constructed from practical inquiries into the human factor, was not immediately recognized. Certain countercurrents appeared within psychology, often inspired by old positivist and intellectualist theories, tending to depreciate the role and range of this young science. Some place industrial psychology outside of the scientific field because it aims at "applications."¹ For others, who support industrial psychology apart from psychology, it is connected with the latter in the same general relation which connects science and technology: physics and

applied mechanics, botany and agriculture, astronomy and navigation, etc.² Clearly these conceptions imply an abstract opposition between the categories "science" and "technology," disregarding all the reciprocal links which bind one to the other in the history of the human mind, and in the actual origin of inventions. Thus attached to general or theoretical or pure psychology in a one-way relation, "applied psychology" is alleged to have no theoretic value. Without going as far as this in the way of distinction, many industrial psychologists are willing to consider their researches as only a field of application of psychology: "Like every other Natural Science," writes C. S. Myers, "Psychology as it developed gave birth to several Applied Sciences. From it arose Psycho-pathology and Educational Psychology, which are the very foundations of Psychological Medicine and Pedagogy. The most recent example of Applied Psychology is Industrial Psychology, which is concerned with the human factor throughout industry."³

In America, Witmer, among others, refused to admit this schematic separation of theory and practice, science and technique. He pointed out that it is, for example, practical needs which led to the perfecting of such apparatus as the chronograph, without which contemporary physiology and psychology would be unable to achieve important theoretical results. Pure sciences and their applications advance abreast: what impedes the former retards the latter, what aids one group aids the other.⁴ But even this is saying too little by comparison with those who, examining closely the relation between science and technology, and on the other hand, refusing to subordinate industrial psychology to a psychology which would be "theoretical" or "rational," henceforth accord the former a theoretical value and emphasize that, not content with presenting problems, it often solves them in practice, with needs and applications as its point of departure.

For Lahy, "so-called applied psychology or industrial psychology is only general scientific psychology. Not only does it not differ from theoretical psychology, but, born of the latter, it goes beyond it, transforms it and is on the way to replacing it as the product of its necessary evolution, as a synthesis of theory with a new practice."⁵ Wallon, studying the relations of psychology and technology, vigorously emphasizes the value of research in industrial psychology for theory and for discovery: "The evidence which applied psychology gives of its value consists in the fact that it not only makes action

more efficient, and not only improves or creates techniques; but that by its results and methods it throws open fields where knowledge may be added to knowledge. With the advent of applied psychology, empiricism and oracular prophecy give way to science."⁶

What is certain is that this theoretical debate, on which we will lay no stress here, by questioning the foundation and the very value of industrial psychology, affects the study of the "human factor" in the workshops. If those scientific tendencies should prevail which minimize applied psychology by reducing it to a technique with no theoretical value, the result would be to place the study of the human factor in the hands of technicians without sufficient psychological qualification. Then we should relapse into a new form of "technicism," as was often the case in Germany between the two world wars.

From this point of view, English industrial psychology has represented, in Western Europe, a new type and a characteristic achievement. The English industrial psychologists have insistently resisted technicism and stressed the physical and psychological needs of man at work, needs inseparable from all rationalization. Everywhere they demonstrate the misunderstanding of these needs. By an ever increasing division of labor, many industrialists and technicians think that they will be able, without trouble, to reduce the number of movements and increase output. But these apparently useless movements are linked with the rhythm and relaxation of the organism. This division of labor, mechanically imposed with no preliminary study of its physiological and psychological impact, will actually go counter to the ends which it claims to attain by causing tedium and a reduced output. Industrial psychology, therefore, owes it to itself to contribute to the worker's physical well-being by avoiding for him the various forms of fatigue, and to contribute to his mental well-being by combating irritability, tedium and anxiety. While retaining for him the advantages of mechanization, it should strive to eliminate its harmful effects.

But simultaneously, Myers and his collaborators stress the interest of industry in introducing a truly scientific rationalization: they try to prove to the industrialist that the "human factor" pays. This is how Welch and Miles describe the introduction into a factory, under the control of industrial psychologists, of fifteen-minute pauses devoted to gymnastic exercises, in order to offset the harmful effects

of attitudes taken by the young working women during the course of their work: "A substantial improvement was made not only in the quality and quantity of the output, but also in the general health and well-being of the girls."⁷ Even if the methods introduced cause a modification of equipment they should, in a relatively short time, produce an improvement in output.⁸ Moreover, the National Institute of Industrial Psychology in London, one of the chief centers of English industrial psychology, by its very organization implies this parallelism of scientific research and of service to private firms. The Institute answers requests from the latter when they aim at improving specific matters, their internal organization or, more generally speaking, "industrial relations" (that is, relations between the workers, the supervisors and the management), and it indicates the reforms to be made. In this aspect it functions as a firm of consulting psychologists and requires payment for its services. At the same time it pursues its scientific research without special or immediate application. Its annual reports show that the paid services do not, generally, suffice to balance the Institute's budget, and it has also received financial aid from the state.

This twofold aim, the worker's well-being and the output (and thus profits) of the business, is particularly clear-cut in English industrial psychology, but underlies much research conducted in other countries. It rests on the latent faith in a sort of "economic harmony" between the interests of the firm and those of the worker. The meaning and causes of this fundamental ambiguity will later on appear more clearly from the results obtained. The very expression, "human factor," now current, shows that industrial psychology recognizes the importance of man in production but only as a *factor* among others, with which it must come to terms.

The orientation of industrial psychology, as it appears from these studies, has yet another characteristic. When studying fatigue, hours of work, rest pauses or some other concrete problem, the psychologist concerns himself with the physiological and psychological influences which may affect the phenomenon. For example, the research of the Industrial Health Research Board on rest pauses implies that their practical effect depends on the physical and psychological state of the worker, considered as an isolated individual, an atom in the workshop. The question is not raised here of knowing whether this same man works in the same way in the different workshops through

which he passes, depending on the relations with his comrades, his foremen, his employers, his union organizations—in a word, whether the methods and output of his work are not related to conditions broader than the organism's own psycho-physiological characteristics. Always present is the postulate of an individualistic psychology which can be better understood and judged only by the study of other aspects of the "human factor."

Yet, even within the limits so far explored it would be wrong henceforth not to recognize the reaction of the social sciences to the contemporary evolution of large-scale industry. This, after all, is itself a product of human genius coming to grips with Nature to revolutionize the environment and conditions of life. Developed within the economic framework of our civilization, it obviously has effects which may be fatal for the conscience and dignity of the worker. The efforts of science, the path of which we shall now continue to pursue, arouse genuine emotion insofar as they appear as a defense reflex of the human spirit, taking their stand at the point where the spirit itself is most dangerously menaced—and menaced *by itself*.⁹

PART TWO

THE LIMITS OF
THE “HUMAN FACTOR”

Problems of Monotony

(1) *Subdivided tasks and monotony*

AMONG THE PROBLEMS of mechanized industry this is one of the most important, one of those most laden with human consequences. The advance of the division of labor has only extended its range.

BEFORE THE MACHINE ERA

From the beginning of the manufacturing period, Adam Smith was concerned about certain results of the division of labor, though he was an apologist for it: "The man whose whole life is spent in performing a few simple operations, of which the effects are perhaps always the same, or very nearly the same, has no occasion to exert his understanding or to exercise his invention in finding out expedients for removing difficulties which never occur. He naturally loses, therefore, the habit of such exertions, and generally becomes as stupid and ignorant as it is possible for a human creature to become."¹ Adam Smith proposed elementary instruction as a remedy: let the new factory worker at least know how to read, write and count. At the time of the first industrial revolution, few writers and social reformers failed to point out subdivided work as among the evil effects of the new means of production. Buret and Sismondi

vigorously denounced the effects of the division of labor. "By this division," wrote the latter, "man has lost in intelligence, vigor of body, health, and cheerfulness, all that he has gained by way of the power to produce wealth. The soul develops by the variety of its activities."² Fourier, in his own language and using his own bizarre categories, had clearly denounced "the false, parcelled-out, repugnant, lying industry" of his days and the psychological disadvantages of the division of labor. "Health is inevitably injured," he wrote in *Le Nouveau Monde Industriel*, "if man surrenders himself for twelve hours to a uniform task, weaving, sewing, writing or whatnot, which does not successively exercise all parts of the body and mind. . . . It is worse if the active or inactive work is continued for months or for whole years. Various factories producing chemicals, glassware, or even textiles are a form of slaughter for the worker through the mere continuity of the labor. He would be in no danger if only short two-hour periods were assigned, held only twice or three times weekly."³ Proudhon's reflections on machines, often quite confused (since he did not hesitate to see in them "the protest of industrial genius against homicidal subdivided work,")⁴ nevertheless contain in his own peculiar style vigorous denunciations of the effects of subdivided work: "After having infinitely divided and subdivided labor in the interests of production, we have made each of these segments the object of a particular occupation from which the routine-ridden, stupefied worker finds no escape. . . . But soon the monotony of labor makes itself felt with all its accompanying disgust: the so-called worker becomes conscious of his degradation; he says to himself that he is but a cog in the immense structure of society; despair gradually takes possession of him; for lack of positive knowledge his reason becomes unhinged; his heart is corrupted and the man ends in utopian dreams, the follies of illuminism and the rage of impotence."⁵ Marx and Engels, from 1847, made a powerful criticism of the consequences of the division of labor among the ranks of the capitalist regime: "Owing to the extensive use of machinery and to division of labor, the work of the proletarians has lost all individual character, and, consequently, all charm for the workman. He becomes an appendage of the machine, and it is only the most simple, most monotonous, and most easily acquired knack, that is required of him."⁶ There is no need to add to these quotations. Those we have made were only intended to show that the

question of the monotony of work has attracted the attention of economists and social philosophers since the beginning of the first industrial revolution—in general, for the purpose of bitterly reproaching it. From the angle of their own particular doctrine, they proclaimed that the machine empties labor of all intellectual content, and looked longingly back to the time of artisan industry when the worker himself *finished* a beautiful object and when he could devote thought and feeling to his task.

Before studying contemporary scientific investigations, one should at least remember that monotony is not the sad privilege of mechanized industrial labor. Adam Smith protested against it even in the period of hand industry. Retracing our steps to a still earlier period, were not many manual tasks monotonous though accomplished by pre-mechanical techniques? The polishing of arrows by primitive peoples may require millions of movements which *seem to us* identical. Many tasks in agriculture such as sowing, harvesting by the sickle or the scythe, winnowing with a flail were (and still are, in many European peasant communities in which old techniques persist) repetitive and monotonous labor. Spinning with a wheel or a spindle, weaving on the old handloom, and basket-making offer other examples.⁷ We are used to contrasting the work of artisans with mechanized labor; but were not the journeymen and the apprentices assisting the masters often given repetitive tasks of slight interest? But is the monotony of these artisan tasks comparable to that of the subdivided, mechanized labor of modern large-scale industry? Let us note at this point that there the laborer yields to free and natural rhythms, and not to such as are forced on him by rationalization and the machine. Besides, even the artisan's assistant and the apprentice participated fully in the completion of a piece of work.

However this may have been, in those industries where manual work was already minutely divided up, subdivided work and monotonous tasks were numerous even before machines were introduced into the workshops. In his famous description of the manufacture of pins (1776), Adam Smith enumerated eighteen different operations "which, in some manufactories are all performed by distinct hands, though in others the same man will sometimes perform two or three of them."⁸ Many factories toward 1850, according to Dubreuil, were still organized on this model: "I may say that my own father, *at the age of six* or about 1854, was already working at making pins

at the time when they were entirely made by hand, a method of division of labor through which their manufacture was already reduced to a few elementary operations: straightening the brass wire, cutting it into equal lengths, making the point, rolling the wire into the shape of a spring to make the head, cutting this spring into lengths of two whorls, putting these two whorls at the end of the pin and hammering it out to give it rounded shape. . . . After these elementary operations it was finally necessary to stick these pins into strips of paper on which they were sold and continued to be sold, I believe, as late as 1890.”⁹

No one, then, can deny that human labor involved many repetitive and subdivided operations before the time of mechanization. Long before, one may even discover attempts at rational organization of labor like those of Vauban, and of Perronet, in about 1760, and of Eli Whitney, the American mechanic who, as early as 1798, foresaw mass production. These forerunners of “rationalization” are of interest to the historian of technology, but only the era of the industrial revolution, when western societies were resolutely entering the nineteenth century, gave these problems their social significance and generalized the anxieties which they arouse.

EARLY SCIENTIFIC INVESTIGATIONS

Scientific studies of monotony also originated in the practical needs of business. Industrialists appealed to scientists to help them combat the decrease of output. One of the commonest instances seemed to be the repetition of movements in many new forms of industrial work. English psychologists were among the first to undertake the systematic study of these facts. English large-scale industry, the oldest in Europe, was also for a long time one of the most conservative: the traditionalist spirit so widespread in Great Britain is often encountered in it. World War I, requiring immediately a more efficient organization, developed the division of labor and increased subdivided operations. Begun in the munitions factories, the studies were pursued after the war by the Industrial Fatigue Research Board.

Vernon, a veteran of the team of English psychologists, then Wyatt, Bedford, Fraser, Ogden, and May Smith, published important studies of the psychology of repetitive work. From the start of this research, Vernon established that monotony, like fatigue, has an effect on output: “The results of the experiments described in the course of this

report [on the effect of rest pauses introduced into repetitive work] suggest that monotonous activities of the type under consideration cause a considerable reduction in output, which is most apparent about the middle of the spell of work."¹⁰ In practice, the fight against monotony is therefore thrust upon the industrialists, the more so that another ill effect is added to decreased output, high labor turnover. But monotony is as diverse and complex a fact as industrial fatigue. Developed as it is by the objective methods of technological progress, it also depends on the worker's subjective attitude toward his work. It is often discovered in workshops that a single subdivided task is differently estimated and experienced by different individuals. In addition, the feeling of monotony is bound up with the entire industrial milieu. A subdivided task which elicits many complaints in one factory because it is considered tedious, is accepted in another and even accompanied by certain signs of interest, due to other working conditions and a different environment.¹¹ The monotony of work cannot be separated from this total setting. Repetitive work is, as May Smith says, "a thread of the total pattern, but it is not the total pattern."¹² Monotony of work is therefore a far more complex phenomenon than it seemed at the start. Let us try to define the range within which it operates and the elements conditioning it.

First of all, it would be wrong to think that all tasks in mechanized workshops which seem monotonous to a visitor are actually felt as such by those performing them. Many occupations, as Otto Lipmann notes, seem uniform if viewed from the outside. Actually, they involve small changes of raw materials, machining and rhythm, which are very apparent to the worker. In most cases a task must be performed—and for a long time—before it can be judged.¹³ Observations of this sort can often be made with regard to mechanized tasks. In an automobile factory I had occasion to observe men working at the stamping in hot metal of crankshafts and other parts for motors. Each standardized operation seemed at first sight very simple. First, the pieces of metal were caught by the power-hammer which bent them, and then, kept at white to red heat and held with pliers, they were turned under the press several times and stamped. The whole operation lasted not more than fifteen seconds. In informal discussions and in their union meetings, the workers stated that they did not find this work tedious. Besides, it is a fact that a certain worker will have a preference for a certain machine and will dislike being

transferred to another, the operations of which seem no more monotonous than those of the first. As May Smith says, the emotional setting of work must be taken into account. "The worker on repetition processes may be repeating a very limited number of movements, but his emotional life may be quite varied; he has to adjust to superiors, to equals, to subordinates; if he fails to please the first he may find sympathy and support from the others; . . . When such situations arise—and they are not rare—the focus of interest would go from the monotony of the work to the emotion aroused."¹⁴ And after having given other examples of this variety of affective tone in monotonous work, May Smith concludes: "Days vary in length, as every worker knows, and ten hours of one day are shorter than eight or nine of another. The work remains the same; it is the general situation and individual emotional changes that vary."¹⁵

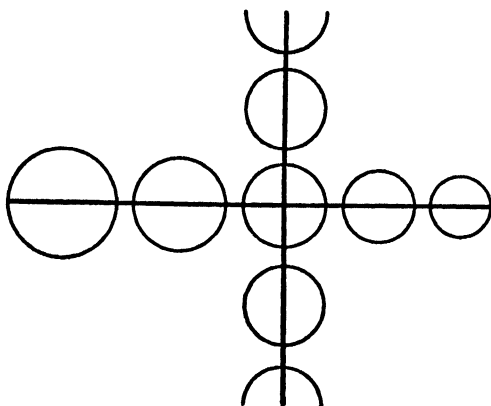
Such studies strongly emphasize the effect of the workshop and the environment on the feeling of monotony. But are these influences restricted, as May Smith and other investigators of the English school think, to the field of individual psychology? Are not the relevant factors more complex?

TOWARD THE ELIMINATION OF MONOTONY

It is already clear how these studies tend to reduce the *objectivity* of monotony, and to seek for its causes not in the technical characteristics of the work accomplished but in the worker's consciousness. An interesting attempt of the same general kind to analyze the psychology of conveyor-belt production has been made by Hans Rupp.¹⁶ In the course of such production, as is known, every worker does a task linked in time with those preceding and following him, up and down the belt's length. But he is equally bound in his consciousness to the identical operations which he himself has to repeat. Thus, the motor is gradually assembled until it is complete, while each worker repeats the same operation (to fix a certain bolt, fit a certain part to the structure, etc.).

In the diagram on the next page, applying to the third worker on the belt, the horizontal line symbolizes the first of these processes and the vertical the second.

But for the worker himself, is this in fact only a simple repetition? Rupp analyzes with great insight everything which unites a



group of subdivided movements with the totality of the worker's personality. First of all, the relation with the immediate past and future: for the worker whose day begins at eight o'clock, to screw on carburetor screws at nine o'clock or at a quarter to twelve is not at all the same thing. A rest pause is coming, the day is approaching its close, it is the beginning or the middle of the week, one has done little or much work. Several psychologists, like Rupp, point out the advantage there is in placing the completed work where the worker can see it.¹⁷ In this way he can enjoy the completion of each unit or estimate what has already been done. Thus, in any mass-production work, it is better to divide raw materials or machined objects into bundles or equal piles in order to make the work more attractive. In this way each new operation (since it forms part of different "group") is given a slightly different psychological tone.

Let us follow this subtle analysis: for Rupp the various stimuli (the inner structure of the subdivided work, connections with the past and future, position in the working day and the working week, etc.) may, taken together, replace in the worker's mind the interest of a more complete and varied task. Rupp does not hesitate to write: "After all, it makes no difference whether the aims envisaged by the worker consist merely of the grouping and construction of a whole chain of uniform, subdivided tasks—or of the organic construction of a more important work. The structural pattern of the assembly line may, up to a certain point, take the place of the construction of a more important and more significant work."¹⁸

But is this study, so skilfully aimed by its author at the rehabilitation of subdivided work, thorough and convincing? A man working for eight hours on an assembly line rarely benefits from more than two or three pauses under the actual conditions of large-scale industry. The motives of interest pointed out by Rupp—as we shall later see by the results of important studies in different industries—are not sufficient in themselves to overcome the feeling of monotony and give variety to operations repeated a thousand times. Rupp invokes curves of production which really do show changes according to the time of day. But these are only variations of short length, incapable of lending interest to highly fragmentary operations.

Influenced by the Gestalt theory, Rupp has skilfully tried to apply it to the psychology of repetitive work. This, indeed, may at different times have a different internal structure, though outwardly it always seems identical to the observer following the worker's acts and movements. But on this point the theory has carried Rupp further than experience would seem to warrant.

The Gestalt theory here serves the needs of rationalization: it proposes subtly to seek new stimuli in internal diversity, and the multiform bonds with the *totality* of psychological life. It proposes to exploit new attractions and impulsions for work repugnant to so many workers. The industrial psychologist would in this way set free latent tendencies and thus make more agreeable to the workers these fragments of standardized work to which they are restricted by technical progress. By dividing the assembly line into strictly limited operations, the whole of which each worker must be able to comprehend, showing the amounts of articles produced, and introducing rest pauses, industrial psychology would help the worker to transcend monotony. The increased production based in this way on these stimuli would involve no increase of effort and fatigue at all but, in favorable conditions, would reduce them.

In this must be recognized one of industrial psychology's subtlest attempts to serve output. Moreover, it is a significant example of the influence of a theory which is "in the air" in scientific life (in this instance, the philosophy of structure) on practical research.

There is no need at all to discuss here the apology for assembly-line work which it implies, and all its theoretical implications. Let us recall merely that the structural analysis of repetitive and subdivided work posits important principles: the difference between

periods of work according to tendencies activated in the personality. Rupp does not—or will not—see anything to foster interest but tendencies and stimuli of secondary importance which resemble so many tricks suggested to the business head by the industrial psychologist in a furtive attempt to reanimate the dwindling interest of the workers for subdivided, monotonous tasks and to increase their output. It remains to be seen if there are not other tendencies and stimuli to be found, more vigorous, and more deeply rooted in the worker's personality.

Another aspect of this dissolution of subdivided work into the psychological and the subjective is the search for individual differences. Even in his day, Munsterberg noticed that the feeling of monotony is less associated with any particular sort of work than with the special dispositions of the worker. His tests, though still elementary, tried to discover the ability to receive identical impressions and consequently, as he thought, to detect persons who experience repetition "with undiminished interest."¹⁹ Although still very simple, this was a first step along the new path. In order to understand individual differences better, their origins must be sought in job training. Kraepelin and his students had shown that swiftness in learning a movement by no means implies the ability to repeat it. The two abilities even seem to be in inverse ratio to one another. Learning opens paths, and diminishes unfamiliarity and the person's awkwardness. But "swiftness in becoming trained and swiftness in becoming fatigued accompany each other. Besides, swiftly acquired progress is short-lived."²⁰ These are the results obtained by comparing work curves with one another. Using the very useful terms coined by German psychologists it may be said that *Übungsfähigkeit* (ability in performance) and *Übungsfestigkeit* (stability in performance) are in inverse ratio to one another.

A TYPOLOGY AND

A PSYCHOLOGICAL CRITERION

These conclusions have been confirmed by the research of the English school, especially that of Wyatt. One of his most suggestive studies was made in collaboration with Frost and Stock in a candy factory where apprenticeship and the stimuli of repetitive work were studied.²¹ There Wyatt and his collaborators methodically observed the reactions of a dozen young women working at wrapping, packing

and weighing, manual operations ancillary to the mechanized production of candy and forming its complement in the current technical conditions of many such firms. The researchers noted great differences between the productivity at the beginning and at the end of training. In a trade school it is common to be able to predict an apprentice's value from the start of his training, but this prediction often turns out to be contradicted by his reaction to the practical conditions of production in the workshops. "Suitability for repetition work," Wyatt writes, "is partially dependent on temperamental characteristics."²² Among the latter he cites psychological stability, perseverance, a phlegmatic nature and calmness. Mediocre intelligence would be best able to adapt itself to monotonous working conditions and find satisfaction in them. The output of work of this sort and a worker's attitude toward it depend, in particular, on:

(a) The value attached by the worker to the repetitive task. This element, stressed by Wyatt, occurs repeatedly in many studies and should be strongly emphasized. The following is a case in which this feeling appears in a very simple form, reflecting the worker's place in the succession of operations. The wrapping of candy in the factory mentioned was done mechanically and a certain number had to be "unwrapped" because they were poorly wrapped by the machines. This monotonous work, considered useless, was done grudgingly and slowly by those charged with it. In contrast, the preparation (consisting in operations just as monotonous) of boxes destined directly for trade, aroused a far higher interest and achieved a far higher output. The *value* thus attached by the worker to a monotonous task cannot be sufficiently emphasized; it is an element whose variations deeply modify the psychological conditions and techniques of such work.

(b) The continuity of the work, on which depend the rhythm and consequently the escape into daydreaming. Moreover, some workers have a negative attitude toward short, frequent interruptions which break the rhythm of work.

(c) The complexity and variety of tasks which, though repetitive, may occupy both the hands and the mind.²³

The results of this typical study, together with many others of the same sort, showed the importance of a psychological study of the different types of workers, seen from the angle of their reaction to repetitive, monotonous work. What characterizes the worker spe-

cially adapted or unadapted to repetitive work? What different types of mind can be defined with reference to this sort of work?

In a valuable report on the study of "the influence of monotonous and constrained work on the personality structure,"²⁴ Wunderlich distinguishes three types in this respect: *First*, those whose entire personality has to be interested in their work and who need to become absorbed in it. When their thought and attention are not thus absorbed by their work they feel a growing discomfort which they call "tedium" or some similar term. *Second*, for others, in monotonous work distraction may serve as a diversion. But they cannot coordinate the psychological series of ideas and images thus aroused with the physical series of movements demanded by their monotonous work; the two series are reciprocally inhibitive. In short, they are incapable of automatic action. *Third*, others can completely automatize their processes of work. The mind, wholly independent, may wander at will without the performance of physical movements being any less certain. It is for this type of mind that monotonous work is least unpleasant.²⁵

These distinctions of Wunderlich's are confirmed by the principal studies made in this field, especially by those concerning one of the most widely disseminated forms of repetitive work: assembly-line work. Gemelli and Galli, in a study to which we shall refer again, draw attention to a whole category of workers to whom work at an obligatory rhythm (if well chosen) is better suited than work at a free rhythm.²⁶ Lipmann, in turn, shows that the most disagreeable tasks are those demanding a contrasted attention.²⁷ Wyatt, at the end of his research, concludes that for a worker engaged in repetitive work, general intelligence is a characteristic predisposing a person to tedium.²⁸ He gave further meaning to this conclusion by noting that special victims of tedium are those who cannot sufficiently automatize their work to profit simultaneously (without reducing their output) by such compensations as conversation, daydreaming, etc. In short, the least susceptible to tedium are those who manage to perform monotonous work in a reflex fashion, that is to say, by the intervention only of their inferior nerve centers. "Quicksilver" temperaments, to use Wyatt's metaphor, suffer from monotony more than patient, submissive ones. The studies, therefore, lead us to the need for an occupational typology such as that of Henri Laugier and his collaborators.²⁹

Moreover, they show the limited value of the usual distinctions made concerning susceptibility to monotony. Many managers and technicians empirically affirm that intelligent people cannot endure monotonous work. Here, for instance, is an opinion of Pound in which this relation is implied: "Indeed, automatization has now reached a point where individual capacities of workmen count for so little that large employers of labor find less keen minds cheaper than keen minds in many berths, because the less keen mind presents fewer labor complications to the boss, is more easily satisfied, feels labor-strain less, and is less trouble all round."³⁰ This is evidence of a state of mind characteristic of one who speculates on the worker's degradation (even to the detriment of industry). De Fremenville, for his part, notes that if monotonous mass-production work is repugnant to the French worker, it will be possible to assign it to foreign workers.³¹

True, many documents show the role played by general intelligence. The testimony which I have personally accumulated in the course of my inquiries is in agreement. Confronted with a new, repetitive, subdivided task, the most intelligent and developed minds are less capable of resistance than their fellows; their output decreases, and they try to change assignments. I made special observations of this kind among groups of workers at the Bourges Arsenals and at a munitions factory at Saint-Etienne. These findings only corroborate larger and more methodical inquiries.

Such an inquiry is that of Viteles, who notes that among "mechanized" packers and cashiers (women), the labor turnover was highest for those who had high marks in tests of intelligence.³² Wyatt, Fraser and Stock introduced the notion of regularity: the production of the least intelligent workers (in the wrapping of soap and chocolate) is more regular and shows less falling off in the middle of the work period than that of the more intelligent workers.³³ But though they find the work more tedious, the latter have a better average output than that of their less intelligent comrades, so that one would be wrong in identifying satisfaction in work with efficiency, in all cases. Clearly, Wunderlich has contributed toward throwing light on this very problem by his sketch of a typology. General intelligence is in proportion to susceptibility to monotony, because it seems characteristic of the first type of persons which he distinguishes: those whose minds are too energetic, whose needs of

invention and reflection are too active, for them to be able to become wholly absorbed in simple, repetitive work.

The conclusions from these studies do not permit us to accept, as it stands, the interpretation of certain psychologists who see in susceptibility to monotony an *instinctive* reaction to the limitation of work. Thorstein Veblen had already made this the subject of a brilliant essay.³⁴ In the same spirit, Miles and Eyre think they have discovered among animals a general tendency hostile to the restriction of activity and refer, on this subject, to Pavlov's "reflex of liberty." This resistance is supposed sometimes to be so strong as to lead to the animal's complete exhaustion.³⁵

There is no doubt that modern industry offers many cases of the limitation of activity through specialization and mechanized labor. Various, sometimes refined stimuli, vainly seek to make this limitation acceptable to the workers. The stimuli may lower their resistance, but cannot entirely destroy it. If the workers in a shop undergo a constantly increasing division of labor, constant time measurement, a Taylorian discipline enforcing a few stereotyped movements (*the one best way*), and fines when the fixed speed is not attained, they offer a resistance expressed with the elementary force of an instinct: "Output gained by these methods is obtained at a terrible cost in human energy and happiness."³⁶ A psychological hypothesis the Freudian relationships of which are clear: ultimately it amounts to saying that man tends naturally toward activities which differ with individuals but all of which are universal in character. Subdivided work (since it represses these tendencies) is therefore biologically contrary to his nature, and the division of labor which has continually increased since the decline of handicraft amounts to a less and less tolerable expedient. Rationalization attempts at most to compensate, by material advantages (bonuses) or other incentives, for the constraints of subdivided work.

This idea has proved seductive and may perhaps cover the cases of certain individuals. But as yet it has not, to my knowledge, been experimentally confirmed; and besides, with respect to the actual result of the inquiries, it seems far too general and dogmatic. For instance, it ignores individual differences of behavior in the face of the same piece of work, the types experimentally disclosed by such work as that of Wunderlich and Wyatt. It is now, apparently, impossible to speak of one instinct of man with regard to monotonous

work. Monotony itself seems often a merely subjective refraction through the varied prisms of the individual personalities, their attitude with regard to a given kind of work, and the *value* they assign it.

Lossagk also has contributed to this differentiation of abilities³⁷ by measuring the estimation of time by persons occupied in activities of different complexity: (1) First the subject is asked to look at a point marked on a white wall and to concentrate his attention on the passage of time. (2) Then he performs a repetitive task, but one which does not permit him to measure time; in the actual case this was to place and displace wooden pegs *without being allowed to count them*. (3) Finally, the person is asked to observe his own estimation of time while cutting out and pasting a drawing. The results of these experiments have shown that the estimation of time varies with the persons—especially depending on whether they are more or less intellectually developed, more or less accustomed to monotonous work and to daydreaming independently of the movements involved in their work. It also varies in the same person at different times.

Such laboratory experiments as those of Lossagk certainly are performed under abstract conditions, very different from industrial ones, and with a very restricted number of individuals. But on the other hand, the phenomenon studied is more clearly isolated and grasped under these conditions. So it seems to me worthwhile to note its chief results.

The tendency to overestimate time intervals shows great susceptibility to monotony among those who cannot absorb their minds in anything but their subdivided, repetitive work. Conversely, a tendency is observed to underestimate time intervals by those whose mind is absorbed by other interests during this sort of work. Thus, these evaluations cannot be used as a general criterion without taking individual differences into account. Moreover, variability in the estimation of time on different occasions by the same person seems to be an important indication: it is slight in those accustomed to repetitive labor, who no longer regard it as unpleasant.

Thus, to obtain a psychological criterion of susceptibility to monotony, one would have to combine the two indices: the overestimation of time intervals and the great variability of responses on different occasions. Lossagk offered these results as suggestions rather than as conclusions. However that may be, they agree with the

inquiries of Wyatt, Fraser and Stock³⁸ and do not contradict Wunderlich's typology.

THE WORKER'S EXPERIENCE

In industry, work curves permit us to approach this problem from yet another angle. They show the struggle on the part of certain workers to maintain output at a certain level. The characteristic zigzags usually appear after two hours. The feeling of tedium expresses the increasing difficulty felt by the worker during this struggle: on one hand, the wish for change, often marked by fidgeting, by yawning and by expressions of discontent; on the other, the wish to maintain output and wages (if it is piecework) at their customary figure. The struggle seems sharpest during the morning session, as if there is a long road to travel. On the other hand, it diminishes toward the end of the day as freedom approaches.³⁹ The worker's attention, while often distracted and occupied with a group of ideas and mental images having no relation with work, still remains fixed on the time: how much more time until the hour of leaving? Mental activity, in subdivided work, is rarely such as to be able to distract him from this. This obsession with time is itself creative of *tedium*, which is, as it were, the subjective aspect of repetitive work.

When time rates are paid, the various kinds of incentives introduced by piecework are eliminated, and there stretches before the worker's mind a monotonous and dull expanse of time, in which no psychological coloring is given by the quantities of objects produced, and the feeling of tedium is heightened. Another observation to similar effect is that the way of conveying to the worker the raw materials of his work may affect the feeling of tedium. It is better to vary their quantities than to pile them up beside the worker; and if they are brought by a conveyor, its speed must be strictly controlled. This is why it seems better to divide these quantities of repetitive work into limited tasks, the progress and completion of which the worker can see at any time. The working day is thus more easily got through, like a long text to be memorized which one has cut up into pieces. The research of psychologists has indicated, also, that tedium more readily appears in semi-automatic tasks where the mind is neither wholly absent from the work nor entirely absorbed by it (Wunderlich) or, again, in mechanized tasks requiring constant attention because dangerous incidents may unexpectedly occur.

Otto Lipmann, who makes this observation,⁴⁰ has expressed especially clear views on the problem as a whole, and these are also consonant with the chief results obtained to date.

It is incorrect to call the changes caused by mechanization, in its *totality*, the triumph of monotony. It is more correct to say: "*Certain* processes of work *may* produce an impression of monotony in *certain* workers."⁴¹ Lipmann notes that many occupations may seem uniform if viewed externally by a hurried visitor or even by a scientific investigator. Actually, small changes in the quality of materials, the way of treating them or the rhythm of the machine escape their notice—changes which are of importance to the worker and which may modify his mental attitude. On the other hand, we know that monotonous work is not disagreeable to all: when such work "does itself," so to speak, many profit by it to think of whatever they are interested in—their families, the union, holidays, etc. Those repetitive tasks, on the contrary, are disagreeable which demand constant attention, because the worker in them is always exposed to serious incidents which cannot be foreseen; for instance, the operations of feeding presses or machine-tools, where safety devices are not automatic.

When work of this sort, both absorbing and tedious, causes fatigue, it decreases the quantity of work accomplished (output), if its speed depends on the worker. Otherwise, it lowers the *quality* of the work.⁴²

Clearly, then, the worker's attitude towards tasks of this kind indisputably shows his degree of suitability. So Lipmann doubts that the latter can be discovered until the worker has done this work for a fairly long time. "One may," he writes, "completely identify oneself with work one has practiced for a long time; one may ultimately enjoy it for internal or external reasons after having first turned away in disgust."⁴³ Here Lipmann agrees with Wyatt's study, noting that the apprentice's value may be predicted at the start of his training but that this prediction is often refuted by his personal reaction to the special conditions of repetitive work.⁴⁴ *Übungsfestigkeit* (stability in performance) is here again distinct from *Übungsfähigkeit* (ability in performance). This means, further, that it is hard, in the case of certain mechanized and monotonous tasks, to depend on vocational guidance to designate the most suitable. The only effective method is selection in the factory after a considerable

experience in the work studied. The evolution of mechanization, therefore, has practical effects on the problems of determination of abilities. In the case of certain occupations, it prevents our knowing them *in advance* and forces us to study them in the *actual exercise* of a trade. Furthermore, as has been shown, these abilities are not always measurable by the quantity of production; in considering subdivided and repetitive work we have to employ a more complex analysis of the worker's behavior.

(2) *Some remedies*

Scientific studies, though still incomplete, have thus cast some light on this essential (and very disturbing) aspect of industrial mechanization. Remedies of various kinds have been proposed in the effort to reduce its unfavorable effects on the worker.

WAGES, RHYTHM, DAYDREAMING, AND REST PAUSES

The wage system may hasten or retard the appearance of the feeling of monotony: piecework payment has a much more favorable effect than payment by time. I had the opportunity to note that, for women doing mechanized work in a ball-bearings factory,⁴⁵ the former of these methods of paying wages was effective through demonstrating to the operators of these automatic machines that the quantities of their work *varied* from time to time, variations to which psychological importance is attached since they are reflected in differences in the daily earnings. Thus, a certain variety in the time-coloration is effected: the time intervals are no longer so identical with one another as they would be if the wages were fixed once and for all by the day without regard to effort and output. Such are the impressions I received from these workers. Experimental work such as that of Sachs had shown in 1920 the importance of this element.⁴⁶ Wyatt, Fraser, and Stock arrived at similar conclusions in their study of workers in a chocolate factory.⁴⁷ They especially dwell on the variation of *wages* from one time to another; but the variation in *number of articles* produced by the worker, if it can be made apparent, seems no less important. Only piecework can be divided into a series of varied tasks and not seem like an indefinite, endless activity.⁴⁸

Here rhythm also may play a part. When a machine works at a

definite speed, if the rhythm of work happens to be well adapted to the worker, it will be able to provide a stimulus at weak moments.⁴⁹ In any case, movements thus made rhythmic have a pleasant effect which offsets monotony.

The distinction of *types* more or less liable to feelings of monotony suggests that, under the present social conditions of large-scale industry, daydreaming permits a whole class of workers to escape monotony. As we have seen, the latter may be avoided if the mind is wholly absorbed in the work or if it is not absorbed at all. On the contrary, monotony finds a fertile field among all tasks and individuals (both elements, objective and subjective, are indispensable) where the mind, though not wholly absorbed by the work, cannot free itself entirely from it. Consequently daydreaming cannot be heedlessly rejected but is often a "remedy" in all cases where—for individual or social reasons—the worker does not feel for his subdivided work an interest permitting him to transcend its limits. It also follows that workers of an introspective tendency may be more capable of monotonous work. On the other hand, the extroverts attracted by reality and outer change will be less able to get accustomed to it. Here is another result of variation in type.⁵⁰

Certain industrial psychologists have called attention to a social disadvantage of daydreaming, and their observation throws an odd light on their attitude as mediators; daydreaming emphasizes the worker's grievances and, especially if he is already depressed, crystallizes around them all his irritation with the conditions of his life. According to Elton Mayo, the worker whom mechanization had freed from attention to his work often indulges in "pessimistic revery" about his disappointed hopes. This dissatisfaction tries to find expression outside the workshop in collective action, and industrial peace is endangered by it.⁵¹ Wyatt, also anxious to secure the psychological bases of class collaboration, notes that monotonous work makes all the more necessary a "healthy industrial atmosphere." The undesirable dreams threatening the co-operation between capital and labor must be nipped in the bud.⁵² In any case—and this is all that we wish to recall here of their remarks—Mayo and Wyatt point out some undoubted effects of subdivided and repetitive work and social conflicts in large-scale industry.

Wisely distributed rest pauses can also make possible a successful fight against monotony.⁵³ Besides the major pauses, the best

placing and duration of which is determined by the experimentally obtained work curve, certain psychologists suggest introducing short pauses for conversation. Many workers occupied in mechanized labor, when questioned, testify to the importance they attach to conversation and their regret at being prevented from it by certain new techniques. Old miners who had worked with the pick are especially emphatic on this point.⁵⁴ The impossibility of talking with companions is very disagreeable to them.

Undoubtedly, whenever they are not prevented from doing so by noise or by restrictive measures, workers engaged in repetitive and subdivided work talk together, a custom which experience has proved to affect output adversely.⁵⁵ In contrast, short and more frequent pauses, by diverting this need for distraction, may increase the average output for the day. Elton Mayo checked this⁵⁶ in a spinning-mill and, according to Wyatt's opinion, "there is not the least doubt that a rest of ten minutes' duration, introduced about the middle of the work spell, tends to neutralize the unpleasant and unfavorable effects of repeated activity, and is capable of producing an increase in output varying from 2 to 10%"⁵⁷

VARIETY IN WORK

But the investigators' chief effort has been aimed at the target to which the problems of monotony would naturally lead them: to the study of job rotation. The suggestion of this remedy for the evils of large-scale industry is not a new one. Even in his day Fourier, in his phalanstery, extolled the role of the "love of variety" [*la papillonne*]⁵⁸ which made each member of "Harmony" move from task to task. "The chief source of happiness among the members of Harmony is the frequent change of program. Life is a constant torture for our workers who are obliged to spend twelve and often fifteen hours on end in dull toil." And Fourier drolly adds: "Cabinet ministers themselves are not exempt: we see some complain of having passed a whole day in the bewildering chore of setting their names to thousands of vouchers. Such worries are unknown in the social system of Harmony; its members . . . inevitably bear with them and discover happiness everywhere."⁵⁹

Lacking those means of reform which Fourier (strangely farsighted in this as in so many other respects) possessed in his ideal city, experts have tried to use empirically the current techniques

which they noted in the large-scale industry of Europe and America, and to put them to the service of variety.

Thus, R. F. Hoxie, a severe critic of Taylorism, set down to industry's credit the constant dynamism of its techniques which transform work and multiply the internal changes in production. The scientific study of time and motion, Hoxie remarks, is opposed to the persistence of identical, repetitive, subdivided tasks. It is opposed to the hardened arteries of standardized work and to monotony. "No sooner is a new and better method discovered and established, and the conditions of work and pay adapted to it, than an improvement is discovered, involving, perhaps, new machinery, new tools and materials, a new way of doing things, and a consequent alteration of the conditions of work and pay, with perhaps a complete reclassification of workers. Change and more change is the special purpose and mission of this essential instrument and central feature of scientific management."⁶⁰ Dubreuil observed, to the same effect: "We must not forget the permanent efforts of research which, sometimes from one week to another, upset the methods employed and so constantly modify repetitive work. This is a fact which usually escapes the occasional visitor who, seeing repetitive motions made, may honestly believe that the worker has been making and will make them for a long time."⁶¹

Yet the changes inevitably occurring in rationalization through the very current of industrial technology itself are subject to many hazards, and psychologists have not thought it sufficient to rely on this empiricism. Not content with waiting for changes, they have striven to create them and, after study, to show under what conditions their effects seem to be most favorable.

To do this, it was important to compare the effects of uniformity with those of variety in a given set of operations. English investigators, especially Vernon, Wyatt and Fraser, have devoted a series of remarkable studies to this subject.⁶² For some of the operations studied, such as the wrapping of soap, a higher output has been given by uniformity (or assembly-line work) than by variety. But work curves also show a greater irregularity in output.⁶³ For other operations (such as the folding of handkerchiefs, and the assembling of bicycle chains), Wyatt and Fraser decided that there is a marked advantage in variety. The workers' output curves, when doing this

work on an assembly line, show a definite lowering in the middle of morning and afternoon periods—a characteristic sign of the presence of the feeling of monotony. They also show that change of work is most favorable when occurring after an hour and a half. A chain of three workers was putting covers on tin-plated cigarette boxes. By changing their position by threes (six changes daily), Wyatt, Fraser, and Stock noted an output increase of about 10%.⁶⁴ As an interesting detail, the announcement of a change of operations for the afternoon raised the output during the morning period. The studies, of course, prove that the effects of variety and uniformity depend on the nature of the work involved, on the worker's individuality, and also on the frequency and location of the changes.

The difference between two methods, A and B (constituting the *variation*), has some importance. Weygandt, who has studied monotony especially in intellectual work, in generalizing his observations, is of the opinion that unless it is from the more to the less difficult, a change of activity will not be favorable.⁶⁵ Thorndike, on the other hand, specially dwells on the difference (whatever its direction) that must be felt between A and B.⁶⁶ But these changes must not be too frequent, nor irregular, or they in their turn will affect output by requiring wasteful "starting-up." The impetus acquired during the first assignment, what Wyatt and Fraser call *the swing of work*,⁶⁷ must on no account be lost.

Among the fundamental elements of change, rhythm must not be forgotten. In one of their works, a study conducted in a candy factory, Wyatt and his collaborators noted that the output of a woman improved when she was taken from the vicinity of a less swift companion to that of another who was more swift, and *vice versa*, in short, when a positive or negative change was made in what might be called her rhythmic environment.⁶⁸

Such work changes as have just been mentioned may often be effected without great disturbance in the life of the workshop. Certainly many managers seem indifferent to these effects of mechanized labor. They still think that division and automatization of work increase output in all cases, with all workers, and they let it be understood that whoever cannot put up with it (very few, in their opinion) has only to seek work elsewhere. Such opinions are widely held (we have, alas, noticed them not only among industrialists but among

certain "technicist" engineers, by no means psychologists), and Morris S. Viteles has emphasized their diffusion among leaders of American industry.⁶⁹

Psychologists, then, have had the undoubted merit of opposing these theories, and, though not defeating them, of at least occasionally minimizing their ill-effects. In fact, they have managed to persuade managers that production *may not* be increased through uniformity, and to show them under certain conditions, the practical advantages of variety. They have proved to them that reorganizing shop methods, as required by the introduction of more variety into labor, "pays"—and furthermore that these measures, though sometimes difficult, are not at all impracticable. "In most industrial departments," write Wyatt and Fraser, "there are operations of a widely different nature which might be organized so as to provide the workers with a certain amount of variety of occupation."⁷⁰ In the large enterprise of the Bat'a firm at Zlin, in place of a real organized alternation among teams, a training shop had been built through which all newly hired workers passed; here they did in succession all the operations required for the complete manufacture of a shoe.⁷¹ This workshop, besides its obvious importance for the all-round training of skilled workers, prepared for the changes in method and work which rationalization is constantly introducing. But though it helped to adapt workers to the required variety, it did not go beyond this by methodically bringing it about, as is required by the conclusions arrived at by the social sciences. And the organization of work-changes to remedy monotony remains in reality a measure very seldom permitted by business leaders.⁷²

THE REAPPRAISAL OF WORK

Since the extrinsic measures capable of combating monotony are so difficult of realization, certain psychologists have debated whether it would not be possible to change subdivided, repetitive tasks intrinsically by, so to speak, instilling them with interest through various stimuli. This effort has not appeared out of thin air: it is based on results obtained by scientific studies showing the close relation between work and the worker, in the whole range of his personality and psychological complexity. British psychology persuaded me to follow this method which rediscovers the psychology behind the technical, and the worker himself behind the work. May Smith, in

stressing the link between the most varied elements of the industrial environment and the feeling of monotony—which, she says, is no more than “a thread of the pattern”⁷³—restores the problem to a wider frame of reference.

No work is tedious in itself because it is repetitive. It might even be said that varied work may seem monotonous if the worker's general disposition is such that he feels no interest in it. Having had the opportunity to discuss this subject informally with workers, I have assembled testimony supporting this seemingly strange assertion.⁷⁴ Tool-makers of a large automobile construction firm of the Paris region (questioned individually) told me that, though varied and requiring skill, their work bored them and seemed monotonous. Many of them were young fitters from twenty to twenty-five years old, intelligent, with good technical training. They attributed this state of affairs to their belief that their efforts were of no profit to themselves in spite of the most complicated bonus system devised by the management. In this toolroom, the faking up of mistakes was a regular thing. There was no attachment to the work, no feeling of responsibility. Similar answers were given me at Birmingham (1933) in a factory making automobile parts, where an attempt had recently been made to introduce the Bedaux system, which had caused grave tension between the personnel and the management.

Certain psychologists, in fact, having realized the relativity of the feeling of monotony, carry their analysis no further. They dissolve it in the individual and wholly “subjectivize” it, a dogmatism the reverse of that which finds work everywhere monotonous *in itself* and for all individuals. However, having recognized the relativity of monotony as depending on temperament and intelligence, Elton Mayo adds⁷⁵ that it also depends on “the social or personal [I would say psychological] aspect of the industrial group” in which the worker under consideration is employed. Investigating, therefore, the psychological problems of mechanization he, in his turn, stumbled on elements foreign to the technical process of mechanized operations: whatever “surrounds” the work and the worker. But like many industrial psychologists, he stopped short at this point and, paying insufficient attention to the actions of various groups in which the worker participates, relapsed into the quandary of individual psychology or was satisfied with general comments on the “morale” of the enterprise.⁷⁶

Other investigators take a further step. Since some studies reveal the importance of psychological elements and the value attributed to his work by the worker, it is important to go beyond this judgment and reveal the conditions of interest and the stimuli favoring it. The work must be made interesting, Wyatt writes at the close of his study of "tedium in industry." Even when a task is repetitive, it need not seem monotonous if the worker feels that it *has value* for him. This, according to Wyatt, is how this value may be nurtured: "Knowledge frequently creates and extends interest, and instruction regarding the preparation, production, distribution, and use of industrial commodities would create new and varied points of contact between the operator and her work."⁷⁷ This appears to be an all-important observation with regard to the present conditions of so many rationalized workshops where, the division of labor being highly developed, semiskilled workers are found to be ignorant of the precise use of objects manufactured in bulk by their machine. This is particularly frequently seen in automatic and stamping machine-tool shops. The work is minutely prepared, divided up and distributed by the planning departments; instructions are set out on work tickets, and the workers receive them without any information about the finished product.

Knowledge of the finished product, of its technical and commercial aspects, might certainly be a strong factor of interest and an antidote to monotony. But for this remedy to have practical value, a wide reorganization of training would be necessary which would pose tremendous social, pedagogical and budgetary problems in public technical instruction and in company training courses.

Nevertheless, Wyatt wants to give a yet broader base to the worker's interest. After referring to the *esprit de corps* existing in English regiments, universities and schools, he ponders on why this might not be similarly produced in industry, as a means of linking the worker more closely with his factory. Why not, indeed? Why shouldn't he be proud to belong to some well-known firm, appreciated by the public, as sometimes happens in certain small localities where "The Works" are spoken of. This *esprit de corps* should be developed by every means, for instance, by games and sports. American industrialists have tried it on a vast scale and the paternalism of their social services has been very assiduous and dominating. Then, in this ideal industrial environment, Wyatt goes on, "there is no reason why the

workers' attitude toward their firm should be very different from that of the pupils at a public school, or of university students, or of soldiers in a regiment toward their respective communities. Loyal and enthusiastic workers, surrounded by a sympathetic and friendly atmosphere, feel a satisfaction which reduces tedium to small proportions."⁷⁸ If Wyatt's excellent intentions could change social and industrial reality, the problem would indeed be near solution. But these intentions presuppose a community for which the workers might feel loyalty and enthusiasm, a system of production in which they would actually feel the atmosphere of sympathy and friendship about them, and in which their work, even when subdivided, would be enhanced by an intellectual, psychological and social value.

Just as in the case of job rotation and the other remedies suggested by psychologists against monotony, we already perceive the limits of theoretical vision and of the practical efficiency of the "human factor."

(3) *Conclusions.*

We have reached the end of this study, much too short considering the immense and dramatic importance of the facts of monotony in present-day industrial conditions. Yet it suffices to show how inaccurate are most current ideas concerning the monotony of mechanized work. Thus, one often hears it said that the increased number of unskilled laborers is wholly justified, as most workers ask for nothing better than tasks in which their sense of responsibility will not be enlisted. Henry Ford emphatically stated that the great majority of workers are made for such tasks. They don't want to think. They want to be directed. Ford is ironical about the tender hearts which pity the workers forced to monotonous labor. For his part, he tells us, he has not managed to find among his personnel candidates for positions requiring responsibility and initiative. "The average worker, I am sorry to say, wants a job in which he does not have to put forth much physical exertion—above all, he wants a job in which he does not have to think."⁷⁹ Ford never wondered how much the workers wanted to think *on behalf of* the Ford Motor Company. But his dogmatism is matched by that of others who, in their own way, justify the effects of mechanization and what they call "scientific management." "This," H. B. Drury says, "is most practical and actually most praiseworthy because it is adapted to a

state of civilization in which men, as a general rule, are clearly not of an intellectual, ambitious type.”⁸⁰ Others, like de Freminville, make national discriminations and think the ability to do the degraded work of laborer is less common in France than abroad. But they seem to take heart at the thought that France will be able to employ foreigners for the mechanical tasks unwanted by Frenchmen.⁸¹

These technicians refer to a general correspondence between the workers and the subdivided, repetitive tasks imposed upon them. Needless to say, here again they fail to understand the problem's psychological complexity, as revealed by the social sciences. Ford, for instance, did not hesitate to write: “I have been told by parlor experts that repetitive labor is soul- as well as body-destroying, but that has not been the result of our investigations.”⁸² In fact, we have seen to what degree it is perfectly true to say that certain types of mind suffer from being constrained to monotonous work. As for those who, far from complaining of this, seem to dislike work requiring more initiative, they still do not justify the generalizations which technicians wish to make about them. How many of them hesitate to leave mediocre, subdivided, segmentalized tasks simply because they *have never had experience in more responsible work*? At the end of their study, Wyatt and Fraser very properly declare: “It is frequently asserted that operatives accustomed to uniformity in the methods and conditions of work are reluctant to change to a more varied form of procedure. This attitude is merely another illustration of the inertia produced by long-established habit and the desire to live along the lines of least resistance. There is little doubt that operatives who have had experience of both uniform and varied conditions of work, generally prefer the latter, and the results obtained in this enquiry support this view.”⁸³

On the other hand, it cannot be admitted, either, that subdivided work inhibits among *all* workers an “instinct” which would direct them to creative tasks. This is a theoretical interpretation accepted by many who are unfamiliar with industrial life, but it is contradicted by the existence of individual differences, which are revealed by psychological studies. The very much varied reactions to monotony cannot be classed under one instinct, however broad.

Without admitting this overall explanation, or failing to recognize the gamut of susceptibilities to monotony, many experienced psychologists look to automation as the best remedy for the hu-

man problems of subdivided labor. Otto Lipmann categorically favors the complete automation of mechanized (*geistlos*) work whenever possible. Let the operator's mind be wholly free and directed to other thoughts! His labor will be only the more tolerable.⁸⁴ Wyatt and Langdon, having specially studied the monotonous operations required for feeding machines, come to a similar conclusion. Only certain types of individuals can completely adapt themselves to the rhythm of the machine which they are forced to serve; for others, these conditions are intolerable. "Perhaps the chief hope of escape lies in the possibility of complete mechanization."⁸⁵ Leon Walther, basing his view on the study of a food products firm, carries pessimism still further. "The only consolation which I could give the worker is, I think, to make his work as unconscious as possible so that his mind might be occupied with something else. The direct stimulus of enjoyable work, which is disappearing as a consequence of the contemporary industrial revolution, must be replaced by an indirect stimulus: the shorter working day, reading, and music, if possible, in the workshops. But for this, one must have a truly unoccupied mind. The tendency of the psychology of work is toward this, by employing automatic devices so familiar to man in his daily life."⁸⁶ This attitude indicates that scientists of good will are giving up in despair all hope of humanizing the semi-automatic tasks, which are so widespread, and so dangerous for the worker's dignity at the present stage of large-scale industry and which, it seems, will not be eliminated from it soon.*

* A more optimistic note is sounded by Viteles at the end of his study of the "problem of boredom" (paper read to the Society for Advancement of Management, New York, November 3, 1950): "From one point of view, despite the intensification of repetitive work by machinery, the situation may appear better today than in the past. The working day is shorter; the standard of living is higher; facilities for recreation and for education are available to the workers in progressive industrial firms; the public authorities provide for the worker, in his leisure time, opportunities for living far greater than anything which was formerly provided."

Moreover, the job enlargement movement which, according to C. R. Walker (cf. Recent Bibliography), at present affects about half a million workers in the United States and which makes a frontal attack on the problem of subdivided, repetitive work, suggests a new path along which remedies may be sought. Cf. my article "Vers un élargissement des tâches industrielles?" in *Technique, Art, Science*, April, 1954.

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On the introduction of music into work-places in which repetitive jobs are involved, see:

- Kerr, W. A., "Experiments on the Effects of Music on Factory Production," *Applied Psychol. Monogr.*, no. 5 (Stanford University Press, 1945).
- , "Psychological Research in Industrial Music and Plant Broadcasting," *Journ. Psychol.*, XVII (1944).
- McGehee, W., and Gardner, J. E., "Music in a Complex Industrial Job," *Pers. Psychol.*, II (1949), 405-417.
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Let me indicate, finally, some older researches on uncompleted tasks, the importance of which for industrial psychology and in particular for the study of repetitive, subdivided, and monotonous work, I had originally omitted:

- Zeigarnik, B., "Über das Behalten von erledigten und unerledigten Handlungen," *Psychol. Forschungen*, IX (1927), 1-85.
- Ovsiankina, M., "Die Wiederaufnahme unterbrochener Handlungen," *Ibid.*, XI (1928), 302-379.

Rhythm

NATURAL RHYTHM

IN WORK OF ANY KIND, repetition has an inevitable effect on the rhythm of operations. Closely connected with monotony, therefore, is the study of rhythm which, through the medium of the assembly line, leads us to the human problems of automatic machinery. One sees here, so to speak, the two aspects of a single great problem: it is important not to forget this when they are distinguished for convenience of observation or description.

The physiology of labor, itself, in its criticism of technicist rationalization, shows that rhythm in man should be regarded as a quality of his bio-psychological constitution, certain needs of which are not to be denied. "Among factors affecting the output of labor," writes Arnold Durig on this subject, "rhythm must also be included. Rhythm is a reality which is at the heart of nature. We see it in the 'whiplash' of infusoria, as well as in the vibration of the epithelium of the lungs. Our hearts beat in rhythmic sequence, breathing implies a rhythmic alternation of inhaling and exhaling; the muscles of the intestine perform rhythmic work. In whichever direction we look, we encounter everywhere the presence of rhythm. Indeed, the very impulses originating in the ganglionic cells of the central nervous system follow a special and, to be precise, a very rapid rhythm, which is not identical when we merely imagine performing a movement and

when we actually perform it. The movements of our bodies in walking are rhythmical. . . . Just as in the lower animal species, so we find rhythm in the earliest life of the child and throughout man's life; we find it everywhere, in all descriptions of primitive peoples, as far back as the beginnings of history."¹

The study of rhythm through the ages and through the labors of man has been made in Karl Bücher's classic volume, *Arbeit und Rhythmus*,² published a long time ago, in which the types of rhythm were not analyzed precisely; nevertheless, it had the virtue of showing the role of rhythm in work through successive civilizations, from the beat of oars on ancient galleys punctuated by the music of the flute, to the weaving mill, the forge, even to the gestures of building workers and those of cigar makers. Moreover, Bücher noted many songs and chants with which workers accompany their repetitive tasks.

In fact, in Greek antiquity, the most disagreeable, monotonous work was made rhythmic by the sound of music. Movements were governed and orders given in the shipbuilders' yards by the flute, fife, and pipe. Old songs had persisted in all callings, for each occupation. "The airs with which Calypso and Circe accompanied themselves while spinning and weaving were known by all women. Others were sung when cereals were crushed or ground. Harvesters, millers, fishermen, oarsmen, bath attendants, all had their refrain. With the culture of the vine the Greeks introduced the song of the wine-press into Egypt. Like dancing and gymnastics, manual work was set to rhythm and made cheerful."³

Many historians, studying the arts and crafts of the past, have intuitively felt that the rhythm of labor was combined with the profoundest pulsations of life. Michelet, always so close to the realities of labor, was not the last to notice this relationship, especially among weavers. The hand weaver, he noted, weaves as he breathes, slowly or quickly; he acts as he lives; the craft conforms to the man. And in a well-known and sensitive passage, he cited the *Lollards* of the Middle Ages. In manual work directed by the workers' own impulses, the work is permeated and elevated by thought: "The lifeless tool which is given movement, far from being an obstacle to spiritual movement, becomes its aid and companion. The mystical weavers of the Middle Ages were well known by the name of *Lollards*; because, in fact, while working they 'loll'd' [mumbled], singing some cradle song in a low voice or, at least, mentally. The rhythm of the

shuttle, thrown and drawn back at regular intervals, became associated with the heart's rhythm; in the evening it often happened that a hymn or a lament was woven together with the cloth, to the same rhythm."⁴

This spontaneous reaction of so many artisans, translated into spontaneously rhythmical movements, answers certain basic needs which industrial psychology has recently begun to bring to light, for it rediscovers them in the operations of modern industry. Miles and Eyre, basing their statements on experimental study, recall that for each individual there is a normal and well-defined rhythm of activity.⁵ Link, following studies made in munitions factories, makes several distinctions: certain workers do well at rapid machines; others achieve a higher output at machines which turn slowly.⁶ The aptitude for repetition is undoubtedly allied in the individual with the character of his natural rhythm. It is associated with the pause, at the end of which a new cycle of operations begins, and with the possibility for every worker of thus inserting, as it were, his own natural rhythms into this cycle. This correspondence between the rate of repetitions and the worker's ability to endure them has considerable influence on the conservation of his strength and the onset of fatigue.

The observation of rapid work by the motion-picture camera seemed certain to cause rationalization engineers to grasp the importance of these natural rhythms. Unfortunately, studies made in this way by even the most alert technicians, such as Frank and Lilian Gilbreth, maintain Taylor's hypothesis of the *one best way*: the best and *the only* best way of working, which is also *the same* for all—a technological rationalization which neglected to base itself on a physiological rationalization and which leads to a (provisional) *maximum* rhythm, often differing from the optimum one.⁷

THE MACHINE AND OPTIMUM RHYTHM

In affirming the existence of natural rhythms varying with the individual, industrial psychology took the opportunity to react vigorously against certain errors of Taylorism and of the doctrines of pseudo-scientific management which followed it. Against the dogmatic methods of standardization it presents the results of many studies which stress individual differences, and especially differences of rhythm. It is very clearly apparent that the psychologist is here

opposed to the engineer, whose horizon, for reasons easily understood (not the least of which is his economic dependency), is restricted to output: "He [the psychologist] readily agrees with the engineer that from a mechanical standpoint there is often one best way of, say, assembling a clock or a magneto. But to carry over this idea to the minute movements of the workers is contrary to all human considerations."⁸

The optimum rhythm attempts, so far as possible, to approach natural rhythm. It gives greater ease to movements and changes their pace by doing so. It lessens the effort demanded by choice or by necessary decisions. Thus, in a chocolate factory the women engaged in wrapping, hindered by the poor placing of the chocolates, had at every moment to make a difficult choice between the different sorts of products. A better organization of operations permitted the worker "to distribute the chocolate so that her work is based on the rhythm of movement more than on a series of voluntary decisions."⁹ Generally speaking, an easy, gradual change in the direction of the movement of hands and feet is preferable to any in a straight line. Thus, when a task requires the hand to move successively through the three points of a triangle, a curving, longer movement, passing through all these points is easier and much less tiring than straight lines would be. If the work involves broad sweeping movements, it is very advantageous to make its rhythm accord with the body's rhythms and equilibrium. Owing to these precautions in a laundry,¹⁰ the work of girls operating the mangles became much less tiring; their formerly awkward and irregular gestures acquired a sort of plastic perfection. Optimum rhythm often has the added result of increased skill and progress.

In an important piece of work on the feeding of machines, Wyatt and Langdon studied problems of rhythm in connection with the speed of the machine.¹¹ Their study, covering different products (bonbons, chocolates, starch, buttons, cartridges, etc.), showed that the speed of machines often exceeds the optimum rhythms—the industrialist believing, quite wrongly, that this great speed increases output. Let us consider the case, studied by them, of a factory making steel chains. The workers had to feed a rotating dial which made thirty-seven revolutions in a minute, in other words, they had to repeat thirty-seven times per minute a fairly complicated cycle of operations. Six workers were observed for three weeks and the dif-

ferences in their output at different times of day were noted.¹² This output was relatively low: 64.3% of the maximum on the average, with peaks not exceeding 68.2%. The workers (even the most skillful) did not manage to keep to the rhythm of the machine for more than ten seconds, in spite of efforts which quickly produced in them a state of tension and fatigue. Failing to follow the dial's rotations each time that it passed within their reach, they felt a sort of emotional disturbance. When questioned, they talked at length of the effort required of them, but very little of the tedium: "they had to work so hard and there wasn't much chance to be bored."¹³

In short, these results prove that, in this case, as in many others, the difference between the machine's speed and the worker's capacity is too great for comfort and efficiency. A lower speed would have increased output and added to the pleasure of the work.

Wyatt and Langdon very rightly distinguished in their study¹⁴ between the feeding and the watching of machines, which present different problems. The former of these usually implies a closer and more constant connection between the man and the machine. But feeding itself may involve operations which the worker regulates to suit himself and others in which he has to subject his rhythm to the machine's demands. In the second case the subordination of the worker's natural tendencies imposes a form of discipline which may become tedious or even harmful. The uniformity of movements required by the machine becomes an interference with human aptitudes, a conflict which increases every time the machine surpasses the worker's natural rhythm.

When studying the effect of rhythm on output, one should distinguish between work where the rhythm is chosen and that subjected to a rhythm imposed externally by mechanical devices such as a metronome or conveyor belt.¹⁵ Otto Lipmann, moreover, distinguishes between the "column" and the "group" of workers: the former accomplish the same operation all at the same time; in the second case they do different tasks (as for instance, in a team working on the assembly line, or a group of stenographers typing different texts).¹⁶ Arnold Durig, who makes the sharpest reservations with regard to this sort of work, grants that it is still preferable to the total anarchy of individual tasks, because it more easily permits the establishment of a rhythm.¹⁷ Moreover, in the case of stenographers it has been shown that collective rhythms favor output. The operators, working

as a group to a common rhythm, achieve greater speed.¹⁸ In a cigarette factory, rhythm permitted increasing the number of boxes filled per hour from 680 to 800. For wrapping chocolate, the increase noted was 38%.¹⁹

Studies of this sort are numerous. They show that well-chosen rhythms make work easier, at least subjectively, and counteract the feeling of monotony and fatigue. However, industrial psychologists are careful not to suggest that rhythm is a general remedy for the disadvantages of subdivided work. Above all, they emphasize the importance of the natural and varied rhythms which industry, with its empirical and technicist outlook, rarely takes into account. Assembly-line work has increased the range and gravity of this aspect of mechanization.²⁰

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Assembly-Line Work

IN MODERN INDUSTRY, assembly-line work is the most widespread form of working to a compulsory rhythm, and it has steadily gained ground over the past few decades. This modification of industrial production, the progress of which has been overwhelming during the inter-war years, was produced by the need for simplifying "material handling." Through various devices such as belts, chains, and inclined planes, the elements of work, methodically sorted, are brought to the worker instead of the worker going to them. "Walking," Ford remarks, "is not a paying operation." In "conveyor-belt production" (*Fliessarbeit*, as the Germans call it), the elements of production, raw materials, parts, half-finished products, assembled parts, are never at any time stationary.¹

The accounts of assembly lines at the Ford Works, where the work is broken up into a host of simple operations, are well known. In 1929, merely for the assembling of a chassis, forty-five operations were required. The worker who puts a part in place does not attach it. The one who puts a bolt in place does not affix the screw, and sometimes even the man who puts the screw in place and the one who turns it are two different workers. The total length of conveyors for the River Rouge Works was more than twenty-six miles. The enormous expansion of production, associated with efforts at rationalization, was bound to give all forms of assembly-line work a tremendous vogue and to make of them one of the important features

of the "second industrial revolution." Various devices which there is no occasion to mention here were introduced and increased in the workshops. The assembling and transporting conveyors excited the ingenuity of engineers who tried to adapt them to every sort of location and production.²

STUDIES OF ADAPTABILITY

Industrial psychologists brought their research to bear, so far as this new method of labor was concerned, chiefly on the adaptation of the workers who were employed in it. As Gemelli and Galli observe: "Time and motion study presupposes another problem, more specific and perhaps more important: that of the adaptation of human rhythm and activity to the rhythm and rapidity of the machine. Human activity can be adapted to that of the machine only within certain limits. But what are these limits? Is there an optimal degree of adaptation? Industrial psychologists have oriented their researches in this direction."³

Gemelli and Galli themselves tried to define these limits and the different types of adaptation for assembly-line work. Their experiments were conducted, successively, in the laboratory and the factory, and consisted of a methodical comparison between output and the quality of work to a compulsory rhythm (on a conveyor belt) and of work to a free rhythm. "Is work done on the conveyor belt really superior to free work? Does it really produce a higher and better output? Has the worker's task been made easier by it or does this form of work force him to a greater expenditure of energy, so that after some time the phenomena of over-strain appear with the whole train of well-known consequences?"⁴

The same operations were performed by thirty-seven young workers employed in the factory and were carried on for twenty days. Each experiment included twenty minutes of free work followed by five minutes pause; twenty minutes of conveyor-belt work and five minutes pause; a second period of free work and five minutes pause, and finally a last period of work to a compulsory rhythm. Thus the experiment lasted ninety-five minutes. It was found that among the persons studied, output increased daily, and much more in the compulsory than in the free work. The quality of assembly-line work was not lower. On the contrary, the number of errors in it was smaller because of the assistance given the execution of the work by autom-

atism. Moreover, these results also confirmed subjective testimony. To most of the workers (twenty-two against thirteen; two indifferent and apathetic), working to a compulsory rhythm seemed preferable and less fatiguing.⁵ Thanks to it, they declared that they were less uneasy, once they became accustomed to the rhythm of the flow of work elements and were assured that they would not be taken by surprise. They also mentioned, as we have seen in other forms of repetitive work, the pleasantness of "freedom" of mind and of day-dreaming. But thirteen workers (a little more than a third) did not find working to a free rhythm as hard and distressing as their comrades; on the contrary, they thought that work on the assembly line was more tiring, owing to the fear of not being able to keep up with the belt.

Taken in detail, the observation of individual differences confirms the existence of these two extreme types, with many intermediate types. Gemelli and Galli's researches seem to be a defense of working to a compulsory rhythm and must be carefully examined, for they were primarily laboratory experiments conducted under different social, economic and even psychological conditions from those of the workshops. But they have the virtue of drawing attention to the place of compulsory rhythm in assembly-line work and to the individual differences which must be taken into account in this connection. Moreover, the maximal output was not obtained from all workers by the same speed of the conveyor belt.⁶ As for the experiments conducted in the factory with workers at stamping presses, they were less important and did not include systematic comparison of the two sorts of work. According to their results the optimal output occurred, depending on the individual, at different speeds of the machine. The workers adapted themselves more or less well to the rapidity of the machine's rhythm, but each of them worked less well at maximal speed.⁷

From these data, Gemelli and Galli attempted to derive views about assembly-line work which were much more optimistic than those of other psychologists. Having first acknowledged the individual differences in adaptation, they write: "Work on the conveyor belt is a 'straitjacket' only for a minority of workers. The majority prefer it, and it actually requires less physical effort and is therefore less fatiguing. The ideal would be a factory where there are necessarily individuals who belong to one or the other type, to employ on the conveyor belt only those workers who, after a preliminary examina-

tion, show a greater output in this form of work (they are the great majority).”⁸ They also recommend introducing into the workshops machines turning at different speeds, in order to promote workers to more and more rapid machines in proportion to the progress of their training. On the other hand, the machines themselves should be so built that their speed would remain within the limits in which the worker produces most, best, and most easily. This is a problem of the *adaptation* of the machine to the man, in addition to others of which we have spoken above. Tables showing variations of output in terms of speed immediately make clear this range of optimal speeds.

Whatever reservations must be made as to the method of this study, we must remember that the number of workers adapted to assembly-line work is greater than is generally believed. The study by Wyatt and Langdon, mentioned elsewhere, supports this. These two authors in their conclusions emphasize that “the proportion of experienced operatives who seemed to be reasonably satisfied with their work on machines or conveyors was fairly high.” But they observe that it would be less so except for a previous selection which is the more rigorous the higher the level of performance required for feeding the machines.⁹ Inept workers had been dismissed or sent to other work. Wyatt and Langdon, in their turn, took up the comparison of assembly-line work (compulsory rhythm) with bench work (free rhythm), but this comparison was studied under the conditions of industry itself. One hundred and ninety-eight workers observed and questioned by them gave reasons for their preference for one or the other. From the detailed analysis of these data it appears that an aptitude for uniformity is a true criterion of suitability for assembly-line work.¹⁰

WORKERS' ATTITUDES

Other studies have been concerned with the analysis of assembly-line work no longer seen from outside, but from within, as it appears to the worker. German psychologists have especially applied themselves to this study and, basing themselves both on the Gestalt theory and on direct investigations with workers, have shown the insufficiency of the purely technicist point of view in this sort of work. If output is increased in assembly-line work, is this above all because, as Ford and so many engineers after him affirmed, it is a question of “producing without storing”?

For the worker caught in the flow of an assembly line, occupying a place in it from which he can take in the other operations, the work assumes a larger meaning. He sees what has already been done, what is done after him, and immediately perceives the *necessity* of the subdivided task which has fallen to him. He sees his comrades in their adjoining places. "He is no longer restricted solely to a small part having no significance of its own."¹¹ To Hans Rupp, the consciousness of this solidarity seems so important that he asks workshop managers to take it into account. The assembly line must be well lighted and so arranged as to let the worker grasp this total meaning. Note that here, at the root of problems of assembly-line work, as for other forms of repetitive labor, we find again the essential element of the *significance of the task for the worker*.¹²

The rhythm of the assembly line may be determined by the management, by the workers themselves (collectively) or, in certain cases, by each worker individually. The psychological impact of the practical conditions of compulsion cannot be neglected in speaking of "ability" for assembly-line work. Many laboratory experiments do not take it into account. Consequently, they cause us to fail to recognize that this ability which is certainly variable as between individuals, is nevertheless not a biological constant. It depends, Rupp notes, on wages, on relations with the management, on the degree of training, and on "the positive attitude with regard to society."¹³ Seen from within, the psychological problem of assembly-line work, therefore, soon leads us beyond the individual's bio-psychological frontiers and emerges into larger perspectives.

In other cases (such as that of the assembling of a motor on the conveyor belt), the rhythm is fixed collectively by the workers' labor. For instance, the motor advances whenever all have finished their task. Sachsenberg has noted that it is under such conditions that the stimuli of emulation are most effective: none of the workers wants to be the last, the one through whose fault the anticipated rhythm is not followed. Then the state of mind is like that of a football team in which each member is responsible for the entire team.¹⁴ The collective stimulus, insignificant when the rhythm is imposed from above, is apparent here. "Each one feels himself to be a member of the whole and responsible for the whole." Here it is only a matter of a stimulus uniting the worker to his comrades and, to be exact, there is no evidence of a real *participation* of the workers in a decision

concerning the conveyor belt. Yet, one cannot stress too much the drift of these observations. They emphasize, in assembly-line work, the importance of the feeling of solidarity even when this is exercised on the small scale of an assembly team.

When the work is done in a semi-free rhythm, results are different. This is the case with assembly-line work in small electrical equipment, bulbs, magnetos, etc. Each worker has in front of him a pile of parts on which he is to work and which he passes to his neighbor when the operations he has to perform are finished. He may work more or less quickly as he pleases. Possibly the only constraint to which he is subject derives from the sight of a delayed pile of parts and from the reproach of his neighbor, whose work is no longer supplied. Here the stimulus of flow is much weakened and, in the last resort, this sort of work approximates large-scale operations with no conveyor belt.

Still considered from within, assembly-line work does seem, according to the opinion of a good many workers, to have the advantage of economizing, in a swift series of operations, voluntary decisions and the interruptions which they occasion. In the Wyatt-Langdon study this advantage was often mentioned by workers who prefer assembly-line work to free rhythm and comes second in importance among the motives referred to.¹⁵ Among other studies, various German ones, such as those of Duecker, Graf, and Kottgen, show in summary that, while output is the same, fatigue in assembly-line work is less or at most equal to that of work to a free rhythm for the majority of industrial operations considered.¹⁶ Rupp, in turn, denies that in assembly-line work the stimuli involved necessarily lead to a greater expenditure of energy and, consequently, to a greater effort. It would, he says, be a serious mistake to think so. "[Such a conclusion] may give birth to a very dangerous slogan directed against assembly-line work. It must be stressed with the utmost vigor: higher output is *not* necessarily associated with a greater effort! A greater output may be less fatiguing and a small one may be exhausting."¹⁷

Whatever the apologetic tendencies of certain of these German studies, in the matter of assembly-line work, certain conclusions nonetheless have been obtained. Ordinary rhythmic work, as has already been seen, can economize choices and decisions.¹⁸ As another illustration, let us consider a bunch of cyclists "paced" by their

leader. The latter is much more quickly exhausted than his comrades who yet do the same physical work as himself. In fact, they let themselves be semi-automatically led, without having to make any decisions; the leader, on the contrary, himself decides on the distribution of effort, chooses the way, and avoids obstacles. In assembly-line work the belt, so to speak, plays the part of leader. It carries the workers along, constantly gives them an impulse, and spares them voluntary acts. The study of this form of work shows that the automatic character of their work is not necessarily disagreeable to all the workers. This was to have been foreseen, since this is only a particular case of repetitive and subdivided work. But when the belt, as often happens, make automatic an already previously minutely subdivided task (the work of wrapping, packing, or assembling) it seems, indeed, to diminish the effort, and to economize energy, at least for those who are not allergic to *all* repetitive and monotonous work and to every separation of their task from their personality. At the end of their study, which, moreover, highlights all the creditable aspects of assembly-line work, Wyatt and Langdon do not conceal their misgivings.¹⁹ "Only certain types of individuals are able to behave as mechanically as the machine on which they work, and a number certainly find such conditions almost unendurable. Perhaps the chief hope of escape lies in the possibility of complete mechanization"; that is, in the diffusion of automatic machinery where man plays the part of guide and supervisor.

COLLABORATION OF WORKERS

From the point of view of workshop organization, the advantage of assembly-line work "consists in its great clarity, its order, in the equal distribution of human effort, in the concentration of work in a minimum amount of space and the rapid passage of parts through the factory."²⁰ Moreover, it tends to reduce the frequency of accidents, for, once work has been thus broken up, it becomes easier to mechanize the dangerous operations. The conveyor-belts also make it possible to avoid the dropping of parts and delays in the handling of materials. In many industries, assembly-line work seems like an historic step in the division of labor towards the mechanization of operations and automation.

The psychological analyses of assembly-line work, which have been mentioned above, foreshadow the fact that workers' opinions of it

are quite variable and depend on how it functions in the workshop. Among the technological conditions, the speed of the conveyor, which determines the synchronism of operations, is clearly the most important. Dubreuil, who worked on American assembly lines, mentions in this connection that one should summon workers' delegates "to collaborate in determining a normal speed, just as it is desirable that in other cases they should share in setting the wages for piece-work."²¹ This is obvious, but the realization of this pious wish seems very exceptional today, unless we call "collaboration" the changes obtained by workers as a result of strikes. Moreover, this is confirmed by the International Labor Office, basing its views on many studies, reports of labor inspectors, etc. The I.L.O. also wishes that workers might be consulted in regulating the speed of the conveyor.²² A German inspector mentions a case (1927) in which "the rapidity of the belt is determined by the wish of the workers."²³ My own observations in different countries (even in factories where permanent contacts existed between the management and representatives of the personnel) have never taken me to assembly lines organized with the preliminary collaboration of the workers. But their opinion should be considered not only for the speed of the line, but also for the division and synchronization of work.

A French industrialist, Charpy, later Managing Director of the Forges et Acières de la Marine et d'Homécourt, before the first World War, at the Saint-Jacques Works (Montluçon), made an experiment in industrial management which was interesting on more than one account.²⁴ Starting with a rational division of the functions of production and of supervision (on which I will not dwell), it was based on a work rhythm fixed in agreement with the workers and always open to modification during the day, according to the urgency of the work, the state of the orders on hand, and physical and climatic conditions. "The workers," Charpy wrote, "willingly adopt this style of work. They quickly realize that rhythmic work causes them less fatigue for a given output. . . . The rate at which they work is regulated, with their own agreement, in each particular case, and may be modified without difficulty at any time in the course of the working day. Thus one may be sure of avoiding the tendency to overstrain which is one of the heaviest reproaches that can be made against regulated work. . . . This irregular pace is infinitely more logical and more humane than continual production at the highest

possible speed, which is often thought to be associated with the Taylor system and which rouses serious objections from the physiological point of view."²⁵

DANGERS AND REMEDIES

This original experiment, in spite of the authority by which it was sponsored, had no imitators in French and foreign industry. The workers' adaptation to the conditions of assembly-line work remains, in most cases, empirical and compulsory. Those who cannot keep up with the rhythm of the endless iron belt are dismissed.²⁶ Certain psychological studies, even in Germany, take us a long way from the optimism of Rupp and Kottgen. Streine dwells both on the effects of monotony and the discomfort resulting from the exclusive, prolonged activity of a small number of muscles.²⁷ Mayer-Daxlanden calls attention to the nervous effects of assembly-line work. His observations of American industry lead him to underline the appearance of "industrial neurosis."²⁸

To offset these different consequences, the introduction of rest pauses has been suggested, during which assembly-line workers would refresh themselves by simple physical culture exercises. Workers on an assembly-line all think highly of conversation as an antidote to tedium, wherever the shop noises do not make it impossible. When questioned, they often make conversation their chief reason for preferring the conveyor.²⁹

Changes in work play an important part. In a mechanized biscuit factory in Paris, I watched a team of eight women placing rusks in the oven and removing them. The first of them watched the texture of the bread slices, put aside the small pieces, watched the belt which sometimes swerved and the pace of which they had to follow. This was repetitive work calling for constant attention, but sufficiently mechanized and elementary to permit daydreaming or conversation. In removing the rusks, those too white or burned had to be set aside and every defect of baking noticed. There, again, the worker's personality was clearly only partly absorbed by this supervision and the task was one which might easily engender a feeling of monotony. Yet the women did not find it monotonous. In these workshops, thanks to the enlightened work of a planning engineer, the management had introduced systematic job rotation. The workers divided their week, by teams, between placing rusks in the oven, taking them

out, weighing them and packaging them. Such measures are at present rare, as they are thought to be disturbing and expensive. I have seen no examples of them in large-scale, machine-making industry.

Assembly-line work, therefore, in spite of its novel characteristics, seems to share in the general problems of subdivided work and the conclusions at which we have already arrived. Here, too, appear individual differences requiring training and selection, in order not to maintain at such work men who may suffer from it more than others, and sometimes be permanently affected by it. Scientific studies and analysis point out remedies to humanize these tasks; remedies which go beyond physiological or psychological solutions — systematic changes of work, the full consent of the workers to technological measures of rationalization, and giving psychological, intellectual, moral or social meaning to subdivided work so as to make possible its association with the deepest tendencies of the personality, to transfer the workers' interest to it and thus to benefit the work. Assembly-line work, a necessary aspect of a period of technological transition, deserves neither a wholesale defense nor an emotional denunciation. It is a *fact* of industry, which is disturbing because the conditions of its humanization have not been achieved.

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Automation

DIALECTICS OF THE DIVISION OF LABOR

WE HAVE SEEN how the division of labor, pursuing its own inner dialectic, created ever more highly specialized functions. The work becomes increasingly subdivided and each operation, thus restricted, is entrusted to a machine replacing the tool held in the hand. Man's role in the direct production process as a creative activity decreases. Choice, preparation, and decision are increasingly located outside the workshop. Intelligence seems gradually to recede from the operations of production and to become concentrated in the design, conception, and execution of machines, and in the Taylorized planning departments. The assembly line marks an historic stage in this evolution.

But mechanization is not yet complete. The hand of man has a part in some operations: putting a piece of metal on a press, removing it, replacing it. This intermediate period is full of unpleasant tasks for the worker. He is only half, only a quarter, engaged in the operation, but he is engaged in it, just the same, in the role of a substitute for the machine in tasks which the latter has not absorbed. Today, man is certainly not entirely a creator of techniques and a supervisor of machines. He is forced to share in operations devoid of any intellectual quality, but which, on the other hand, produce at every instant a nervous tension and usually make de-

sirable the separation of work and thought, and escape through day-dreaming. When the worker's last productive movements are entrusted to pinions, gearings, and shafts of metal, total automatism (or "automation") begins. The division of labor, in the course of its development, seems to be moving towards this goal.

In this sense, the progress toward automation casts light on the whole history of mechanization. For economic reasons the human motor, in most cases, has fewer advantages than motors moved by sources of natural energy. Once the outlines of subdivided operations are drawn by the division of labor, the new techniques permit the joining of artificial mechanisms with the human motor when conditions make the innovation profitable to the owners of the means of production. In the first industrial revolution of capitalism, the chief source of energy was steam, and machines were exclusively kinematic: typical of this period was the machine-tool moved by means of driving-belts, which were themselves driven by shafts connected with the driving rods of a steam engine. Automation appears and matures in a period much richer in varied techniques, that of the second industrial revolution, which employs new forms of energy and the most delicate devices for substituting them for the movements and judgment of man (electricity, photo-electric cells, etc.).

It is incorrect to say, as has often been done, that mechanization has been developed *for the purpose* of reducing the efforts of men in production. Actually the history of technology shows that in many cases machines were ignored or abandoned for a time when manual labor remained more profitable for the industrialists, with no consideration of the difficulty of the tasks thus retained. The business leaders who adopted the mule-jenny or the first tipping wagons in blast furnaces were certainly not guided by humanitarian motives. But man is sometimes expensive. He tires quickly; his output is limited, after all, by his physiological constitution. In conjunction with the "factory legislation" gradually attained by the workers' struggles and accepted by the employers' interests, machines have in fact often lessened human effort. Likewise, only the study of the development of labor, and of the economic and technological conditions of production, enable us to understand the appearance of automation in each particular case. In itself it constitutes a new stage in this strange evolution through which man, little by little,

retires from the operations of industry, ceasing, as the philosopher would put it, to be the *object* in order to remain solely the *subject*.

Automation announces its approach far back in the history of technology. Its progress may be followed, for example, in the turning-lathe. The first machine-tools where the worker made the object revolve about itself, in order to fashion it, were the potters' wheels. Today, turning is used only in the cutting of materials. The first pictures of work done between fixed points show us the worker as both motor and operator. The Egyptian artisan, using a bow-drill, employed only his two hands; the turner, for his part, using one hand to make the bow move and the other to guide the tool on the object, often also had to employ one of his feet.¹ We see how important the role of the human body then was: the whole man was engaged in production and his body served simultaneously as motor, transmitter, and natural tool.

Later on, the division of labor appeared at first in a rudimentary form. No longer was the same individual the motor and the operator. One of several workers moved a large bow and then, by a crank and a series of transmissions, caused the object to be shaped to move continuously. The turner, henceforth freed from his motor task, could work standing and use both hands on the tool. It was a long time again before important progress was made to reduce man's muscular effort in turning: the invention of the tool support which seems to have been spread in the West towards the end of the eighteenth century, and which permitted the worker to govern the position, pressure, and depth of the tool's cut with reference to the object to be hewn.

At this point the operator's role was still important in lathe-work. His skill had been freed, so to speak, and emphasized by the technical progress which liberated him from the crude tasks of motor impulsion and of holding the tool on the object. The share thereupon devolving upon him opened a large field to occupational skill, to initiative, and in short, constituted the essence of lathe-work: the tool's advance and the movement of the object.

At this stage in the evolution of the turning-lathe, the control of the tool was guided by groups of minor mechanisms which, in the contemporary state of technology, could easily be combined so as to reduce the intervention of man. These modifications were in the direction of automation.² Compare, for instance, the ordinary lathe

for traversing and thread-cutting, one of the commonest machines in workshops, with the corresponding machines used in mass production. Some of these semi-automatic lathes still carry only a single tool, but are controlled by levers; the worker's labor is to that extent simplified. Such is the case with the Boley precision lathe. Others allow of several tools. Here again, the lathe seems to have been one of the first machines to have benefited by these improvements. The makers wished to avoid the disadvantages both of putting down and restarting a job and of changing tools. In the ordinary lathe, the resetting of the part in place for each new operation usually causes a certain eccentricity (because in replacing the part on the lathe, the axis is changed). The precision lathe keeps the piece fixed during all the operations. But the assemblings and disassemblings required for changing tools take much time and are also, themselves, likely to cause errors.³

The "revolving" tool-holders assemble the tools so as to make them act successively. Technological progress here has consisted in the grouping on a single machine of several tools which automatically take their positions before the object to be machined. The types of turret lathes are very numerous. Usually there is an adjustable check for each tool which restricts its action. The degree of automation of these devices is quite varied, from the lever, moved by the worker's hand, which causes the lathe's rotation and consequently the action of each tool, to the release which frees the action of the cluster of tools for an indefinite cycle of operations. "Many of these machines have now only a distant kinship with the ordinary lathe from which they are descended; some are automatic for the time which corresponds to the production of a part; others, which have a certain number of parallel spindles grouped about an axis and a corresponding number of tool-holders, are indefinitely automatic; the revolving holder is made up of the total system of spindles which offer themselves successively to the operator for the working of the part."⁴

The complete automation of the lathe has no practical value, of course, except for mass production—especially for the making of small objects like screws, bolts, nuts, parts of clocks, etc. Simultaneously with the elimination of the intervention of the worker, an effort is made to increase the profit from these delicate and expensive machines through high output. Their production is increased by

making them, for instance, act on several parts mounted side by side. At the same time, the method of action of these machines has been perfected by equipping them with various tools, which makes possible the performance of a whole range of such operations as piercing, tapping, boring, milling, thread-cutting, sawing, etc. This complex machinery is valuable for mass-production screw-cutting and for small electrical devices. It is not unusual, in mass-production shops, to find automatic lathes performing from ten to twenty different operations. ~~By its inner dialectic, technological progress tends to reconstruct on a new plane a new form of the unity of work in the shape of automatic multipurpose machines.~~

THREE STAGES OF AUTOMATION

The relations between division of labor, manufacture, assembly line, and automation now appear more clearly. The division of labor as it tended to take shape in hand industry atomized the unity of the artisan's handicraft. When Adam Smith described the manufacture of pins in his day, each part of the work, each task in it, would have been ready for mechanization if economic conditions and technological progress had been equally ready. Mechanization, once begun, sought to entrust to the machine the crude labors previously performed by the human motor at the cost of great expenditure of energy. The hand, however, retained its importance and its privileges. Man was first eliminated in his purely motor functions. Such was the case in the textile industry. But he continued to regulate closely, during this stage, the direct work on the material. The further the division of labor developed in the manufacturing period, the easier it was for inventors to make kinematic combinations capable of taking the place of man's natural organs and of moving in the direction of automation. In the footwear industry, for instance, such subdivided operations as paring, rounding, pasting the inner sole, gouging the heels, putting in incised work, fixing the heels in place, turning, finishing, and cutting the lasts, could soon be assigned to automatic machines.

Present-day industry offers, variously distributed according to regions, industries, economic conditions, and the financial resources of firms, three kinds of machines which also mark three stages of automation, with a number of intermediate forms. First, the *dependent* machines where feeding, control, and regulation constantly de-

pend on the hand of man: these are the machines widely disseminated in the workshops by the first industrial revolution and retained to the extent that the latter has been prolonged and survives. In the second place, the *semi-automatic* machines, an example of (which we have analyzed in) the turret lathe.⁵ Finally, born of the perfecting of the first two, *automatic* machines (independent) in which the worker is eliminated in the role of operator. Other functions appear, such as supervision, control, and especially regulation. The worker can thenceforth manage several machines. In certain shops, a team of weavers supervises several hundred automatic looms. The modern chemical industry offers many examples of tasks, sometimes delicate ones, consisting primarily in supervising measuring apparatus (for pressure, temperature, density, etc.). Muscular work is here insignificant or nonexistent.

The closer we come to automation—without, however, reaching it—the more the share of labor left to man seems, in itself, stripped of all intellectual or technological interest. There only remain a few repetitive operations, very simple ones, already foreshadowing those of the machines which will sooner or later replace them. The machine seems to have drawn man to itself to cover its deficiencies. Then it dominates him completely and imposes its needs upon him. “[Man] supplements without loss whatever human faculties the machine lacks, whatever imperfection hampers the machine in the satisfaction of its needs. If it lacks eyes, he sees for it; he walks for it, if it is without legs; and he pulls, drags, lifts, if it needs arms. All of these things are done by the factory worker at the pace set by the machine and under its direction and command.”⁶

Mass-production work, so common in large concerns, performed by cheap workers, women, unskilled laborers and, in France, North-Africans, often comes into this category; for example, pressing, stamping, and the feeding of machines. Examination of this last task clearly shows the advantages of total automation and the contribution it may make to the humanization of industry.⁷ In non-automatic machines the worker has to bring forward, by various devices, dials, moving belt, etc., each object to be machined. He has to submit to the rhythm of the machine. On the other hand, the automatic machine is fed for long periods and its output is assured. The worker supervises and intervenes only when the store is exhausted. He no longer has to submit to the machine's rhythm, which is just what

causes tension, fatigue, and tedium. The most disagreeable work seems, therefore, to be that in which automation is, so to speak, stopped in its tracks, for possibly very different reasons: technical difficulties of automatization, neglect or ignorance of their interest by hidebound industrialists, low wages of unskilled workers in a given region or industry, etc.

Other machines make clear the sort of intervention which automation expects of man. As far back as 1893, d'Ocagne had described all the technical principles on which calculating machines are based.⁸ From this description it is clear that if calculating machines reproduce intellectual work, the operator must prepare it. His tasks differ according to the operation to be performed and require a sustained attention. His nervous system is inserted in the gaps of automation. Here, as in the movements of the linotype operator or the supervision of the telephone switchboard, the share of human labor is reduced to a minimum. But the responsibility in a cycle of operations inexorably released by the automatic devices only makes the attention more acute, intense, and susceptible to fatigue.

Automation may, therefore, be variously regarded. It liberates, to the extent that the worker is freed from unpleasant tasks and especially from certain muscular ones. In this sense, (Edgar Atzler) points out that there is an advantage in making automatic to the highest possible extent all muscular tasks, so that they shall cease to be "cortical" and become "medullary."⁹ A detailed psychological study of semi-automatic tasks would be valuable in permitting us to determine exactly which ones demand something more than reflexes—tasks in which man's personality is not involved and yet from which it is not completely free. These bastard forms between traditional trades and new skills seem the most irksome, and least compatible with the individual's harmonious development and equilibrium. Man is, so to speak, half absorbed by mechanization and yet derives no benefit from it.

Assembly-line work, as we have seen, is in this category for certain types of mind unadapted to it. It also fills gaps in the progress of mechanization. Man is entrusted here with operations which, though sufficiently divided to be performed by teams, are still too complex to be capable of being translated into mechanical combinations. In a production process already mechanized for the most part, operations which are still manual have to be accomplished to a

rhythm agreeing with that of the factory as a whole. The assembly line became disseminated only when the boom in production and in markets, accompanying the second industrial revolution, required it. But it would not technically have been impossible, even in the period of hand industry, to establish conveyor-belt work. Present-day industry offers many examples of very simple devices which allow the worker to receive the work directly from the operator preceding him and to pass his to the one following him. For example, there is nothing more easy than to have piles of pins passed from one worker to another through a system of inclined planes. In the example of the division of labor, so penetratingly analyzed by Marx, that of the manufacture of a coach,¹⁰ the introduction of conveyor-belt work would have been *technically* possible at the close of the eighteenth century. But *economically* it was not possible except in the framework of rationalization and mass production. Assembly-line work in many instances is like a signal revealing the present deficiencies of technology, wherever it causes the hand of man to perform highly subdivided operations which mechanization has been unable to conquer.

TECHNOLOGICAL REQUISITES OF AUTOMATION

Maurer has investigated the technological conditions necessary for this progress towards automation to be accomplished, and has tried to define their limits.¹¹ We shall not dwell here on his attempt to rediscover the Spencerian law of evolution in the progress of machines, the passage from homogeneity and diffusion to heterogeneity and concentration.¹² What is one to understand by "homogeneity" when it is a matter of mechanical combinations? Actually, the Spencerian law interprets, among other things, the division of labor, but takes no account of dialectical transformations such as the reciprocal action between the division of labor and mechanization. The latter could not take shape and spread until the former had sufficiently developed. But the very imperfection of the first machine-tools, capable of performing only one operation, reacted in turn upon the division of labor and accentuated it. For a long time the machine's specialization had this influence on the division of labor, and both transformations have reciprocally stimulated one another until at last the technological progress thus acquired permitted the recon-

struction of new kinds of work unities on the basis of multipurpose machines in the framework of the "rationalization" movement of capitalist economy begun at the close of the last century. Such are the complex transformations of which the schematic application of biological laws to the history of technology can give no account. Extrapolations from one field of reality to another always run the risk of concealing a mere play upon words.

On the other hand, efforts at definition are by no means useless. "In very abstract terms," Maurer writes, "a machine is formed of kinematic or non-kinematic mechanisms associated and combined so as to perform a certain work."¹³ These combinations may either be modified at will by the hand of man, regulating the action, speed, cut, advance, etc., of the tools, or are fixed in advance and adapted to a definite kind of work. In these combinations of mechanisms—more and more autonomous and complex wholes absorbing all sorts of auxiliary functions—which man creates while himself withdrawing from production, the actions he reserves for himself seem ever slighter. Even in the transitory form of semi-automatic machines, working is regulated by very brief impulses, as is the case in the Boley precision lathe (controlled by levers). This is the case, again, in the so-called automatic type. In addition to this human participation, there also intervenes what Maurer has called "*la vie de relation*" (responsiveness) of the automatic machine. This is characterized precisely by an autonomous activity which takes the place of human intervention. "The [automatic] machine must modify its rhythm and its movement, that is, must change its response according to the external or internal circumstances which influence it. To meet these requirements it must possess active senses, responsive to predetermined operations; the impulses received by these senses must then be transmitted to the motor mechanisms. Finally, to balance this complex and intelligent whole, there must be other devices for supervision, control, and reflex action which can release, if the need arises, this or that security or control operation."¹⁴

Let us examine a little more closely the conditions of success in this undertaking of man to *eliminate himself*. The worker controls, regulates, and combines the actions of dependent machines. These interventions themselves are linked to very definite *circumstances* of production. Can they be replaced by mechanisms? To succeed

in this, the maker must, so to speak, list all these *circumstances*, and the judgments which they require and which are immediately translated into movements of the worker, and then create the equivalents of these circumstantial judgments in the form of mechanical combinations. Assuming the favorable economic conditions mentioned above, the progress of automation is therefore limited at any given moment by the complexity of the intellectual operations involved in the course of a piece of industrial work. On the other hand, it is theoretically limited by the state of technological progress. These limits, at the present time, thanks to the development of the physico-chemical sciences, have been considerably widened and leave a broad field to the inventor's activity.¹⁵

The discoveries in the field of electrical phenomena especially have aided this development of industrial techniques. The "responsiveness" of automatic machines required more flexible connections than kinematic ones, which are increasingly outstripped by contemporary automatism. If we glance at the history of technology, we see first *hydraulic* automatism, of which there are many examples in Greco-Roman antiquity and which Descartes praises in his *Traité de l'Homme*.¹⁶ Little by little, this disappears before a *kinematic* automatism of which the masterpieces by Vaucanson, in the eighteenth century, are characteristic examples. The automatism of our day seems destined to be *electric* and even *photo-electric*. It is tending to replace man's nervous system by an energetic device capable of giving an equivalent impulse at the desired moment. Modern automata choose subtle intermedia, often simpler than human organs. In many cases the substitution of artificial energetic liaisons for human interventions seems theoretically possible. As a matter of fact, what man most often grasps in the course of industrial work and what determines his action is the perception of a difference: this it is which the "automatic senses" of the new machines will register and translate into mechanisms.'

For instance, in a steam engine, a pressure-gauge or thermometer makes an impression on the mechanic's eye, and he responds to this impression by a movement which changes the heating or the admission of steam, or regulates the escape valve; similarly, the reading of a scale or a dynamometer causes the perceived differences to be translated into movements. But each of these variations may cause the same result by acting on a suitably selected energy system. For

example, the difference of pressure in the pressure-gauge, instead of acting upon our eye, will release an electric current; the mercury of the thermometer, reaching a certain level, will complete a circuit; the pendulum's needle will intercept a light ray acting on a photo-electric cell. The submarine torpedo itself is also a sort of automatic machine maintained at a constant level beneath the water; for this purpose it contains a reservoir of compressed air separated from the water by a mobile partition, which in turn is subject to differences of pressure and which thus regulates the progress of the torpedo. In the automatic telephone, electromagnets exert the chief action on the responsiveness of the apparatus, permitting it to select independently of all human intervention the lines which are open, and to indicate them to the person using the telephone by an appropriate signal.¹⁷ It is along this path that researches are now being conducted which lead to the pilotless ship and plane.

Progress seems to enjoy here a very wide field. The registering of differences by automatic devices now concerns the most varied senses: a difference of color, translated into one of temperature between differently colored light rays may, thanks to very delicate thermometers, release an automatic device. Similarly, different musical timbres may be automatically registered by multiple resonators adjusted to one another in advance.

EXTENSION OF THIS PHENOMENON

Even in countries of a traditional and occasionally hidebound industry, such as England, and in others, like France, where the motley variety of manufactures and of methods of production, and also the inertia of many business leaders and their lack of enterprise in the face of risks, are often opposed to the modernization of equipment—even in such countries the movement towards automation has seemed to assume greater proportions since the beginning of the world economic crisis (1929). The latter did not, as is sometimes supposed, halt the attempts at rationalization. As a result of his statistical studies François Simiand was able to assert that, on the whole, these efforts seem to be pushed forward more energetically during the periods of crisis, which he calls "B phases."¹⁸ Periodic visits to workshops in the different branches of production on the whole leave the impression of an already perceptible penetration.

There is no large-scale production in which automation has not already absorbed at least several important operations.

In modern glass-works, for instance, automation has penetrated all the operations, from the fusion of the mixture of sand, soda and limestone at a high temperature to the withdrawing of the finished bottles from the mold. If certain manual tasks here and there remain, they seem anachronistic (as was the case with the Rockware Glass-works, Middlesex, at the time of my visit in 1933), and, to the casual observer, the workers who perform them seem like the "stopgaps" of mechanization; for example those who, between two automatic machines, seized molded bottles, still red, with hooks and deposited them on a conveyor belt, or the employees in charge of checking and packaging. Operations of control, which involve complex judgments, are less readily translated into mechanisms. Automatic devices long ago penetrated the cotton-spinning industry. The first alternating spinning-frames, exemplified by the mule-jenny, were a combination of relatively simple parts which left the worker in control of all the movements of the apparatus. Soon these machines gave way to *self-acting* mules in which all the movements are controlled by semi-automatic devices. Today, self-acting mules are in their turn being gradually replaced by entirely automatic "continuous" spinning frames in which the twisting and winding are simultaneous. In the preparation of cotton, in carding (especially combing and stretching), automatic machines which the worker has only to feed and restart are common today.

In weaving, automatic looms have a considerable production capacity and, owing to the safety devices which disconnect the machine at the least accident, may be grouped in large numbers under the supervision of a woman who is warned of anything wrong by the stopping of the loom. The following are some of the chief automatic devices: the shuttle-guarding disconnecting gear which stops the loom when the shuttle is not driven home or remains in the space between two lines of warp threads; the shuttle-guard which prevents the shuttle from flying into the air (a frequent source of serious accidents); the warp-protector which stops the loom in case a chain thread breaks; the weft-fork, which causes disconnection when the woof is broken or stops unrolling from the empty quill.

In all such light industries as garment-making, glove-making, shoe-making, the fancy-goods industry and brush-manufacture, automatic

machines seem to have found an especially favorable economic and technical field. In large fancy-goods industries, workshops may now be seen entirely equipped with automatic machines for the cutting of brushes, piercing, the production of combs, pumicing and polishing, etc. The manufacture of cigarettes has rapidly become automatized. As early as 1932, the French state-controlled cigarette monopoly had adopted a machine with high production capacity, producing eighty-five packages per minute, in which all operations including counting the cigarettes, and making and sealing the packages, were performed by automatic mechanisms. The automation of painting operations (until recently done by hand by skilled workers), has done away with jobs which were unhealthy. Various apparatuses have been perfected for different industries. In a large oil plant I saw an entirely automatized shop in which every barrel, attached to a lathe, presented its surface to a fixed spray-gun while rotating.

Let me further mention, among the many remarkable automatic machines, those adopted in certain large refineries. Two machines, forming a group, without any human intervention or intermediate manipulation, change the bars of sugar, molded or cut, into sealed, checked and carefully weighed packages. The first breaks the sugar into pieces and collects packages of about a kilogram (or 2.2 pounds). The second puts in the exact weight and places covers on the packages. Each machine, controlled by an electric motor, follows an automatic course in such a way as to give maximal flexibility to the group in its functioning. The industrial output of the group is twenty-five packages of one kilogram per minute, or, in eight hours, twelve tons of broken, packaged and weighed sugar. Three workers, two of them for the breaker, one for the weigher, suffice to supervise this pair of machines, which quickly pay for themselves in such conditions of production.

The field of automation, widened by the use of increasingly subtle electric and other devices, therefore, extends well beyond what could be foreseen from a utilization of mechanical devices only. But the economic and financial determining factors must not be forgotten, if the practical chances of the movement in the present industrial system are to be estimated. Under what conditions is it desirable to substitute for human senses the senses of an automaton? If the machine obtained is too costly with respect to its output and to the total sum of wages saved, it will offer no financial advantage (for

instance, the automation of machine-tools is at present profitable only in mass production, with standardization of machined parts and more and more perfect specialization of the machines). Even if the human labor which it would supplant is, in itself, dangerous or disagreeable, the prototype of the automatic machine will not be reproduced and used in the workshop.

Theoretically, the automation of human labor is always possible if the machine builder has first carefully observed all external incidents to which the machine is intended to react, and if he has conceived mechanisms capable of translating these responses exactly.¹⁹ Automation, therefore, also encounters in its progress the complexity of intellectual operations still required by work from which man has not yet been eliminated. Having said this, how can one deny that automation constitutes a new stage in the dialectics of mechanization? The history of technology and of modern industry bears this out. The movement, moreover, exists not only in the techniques of production but also in those of communication, transportation and the use of leisure. In all these, man is ceasing to be an actor and is becoming increasingly a sort of demiurge who conceives, initiates and supervises. ✓

EFFECTS ON THE LABOR FORCE

If production (strictly defined) is considered, the progress of automation might radically change current labor problems. The simple, monotonous functions of the army of unskilled workers, appendages of strictly specialized and semi-automatic machines, would gradually disappear. In workshops equipped with automatic machines, new functions would predominate, those of machine-minders, or regulators, highly trained workers capable of supervising a series of delicate machines and of averting all difficulties in their operation. ✓

It should be recalled that a whole range of delicate, careful work is involved in the construction of these machines, that of fitters. Their professional skill, often excluded from the production factories by semi-automatism and its semiskilled workers, finds compensation here. The royal road to industrial mechanization would, therefore, ultimately lead to the elimination of semiskilled labor, and the concentration of "man's share" in the hands of skilled fitter-erectors and regulators of automatic machines. It would see the birth of a

"new artisan class" through the development of technology and its dramatic effects.

Automation carried to its ultimate conclusion and expressing all its potentialities *may* tend towards the humanization of large-scale industry. Not only does it give birth to new skills and inject into them a new concept of work, through the creation and regulation of this delicate and precise equipment, but the worker entrusted with the simple task of supervising a group of these machines, *if he enjoyed an adequate general and technical culture*, might recover a function of an intellectual quality clearly superior to that imposed today on semiskilled labor in the phase (semi-automatism, and assembly-line labor) which precedes and prepares the way for automation. In spinning, the worker on a continuous frame, freed from minor tasks (such as cleaning, replacing threads, preparing the removal of the bobbins) *may* become the skilled supervisor of a group of machines, knowing their structure and their role in the series of operations. In weaving, old journeymen warpers now express their satisfaction at working at machines provided with an automatic disconnecting gear which, when thread breaks, now averts their having to look for it on the rolling drum, perhaps a dozen yards away. Automation frees them from a "subjection," to use the term which I have often heard them use, to the machine and lets them turn their attention to the essential aspects of their work. Undoubtedly, supervising may be fatiguing, since, in abolishing muscular labor it demands, in different degrees, a mental tension which industrial psychology is beginning to study. But the worker—and this is considerable progress—ceases to play the part of an appendage to a machine, bent to its rhythm, and his functions of control may be intelligent ones in which interest in the job is reinstated.

Such are the conclusions to which the psychological and technological analyses of automation lead; but they are only theoretical conclusions. Their practical value is already under fire owing to the persistence of unemployment. The theories of labor mobility, such as that of Ford (according to which workers "shifted" from one industry by technological progress may find work in new occupations), are brutally refuted by facts, and have sufficiently shown their weakness. Under present industrial conditions (even when industry "benefits" by the boom of armament programs), technological progress does not mean transferring to other jobs, but unemployment

ment for millions of young, able-bodied men. The economic benefits of automation do not seem separable from a system under which those who actually produce, while working shorter hours, would nevertheless all enjoy the right to work in the calling (or callings) for which they have been trained, and would also enjoy the means of consuming the products of this system, according to their needs. Moreover, to what extent are the *possibilities* of automation for the humanization of industrial occupations really utilized today? We shall be able to judge this better after having examined in its broad outlines the evolution of trades and of occupational training.

CYBERNETICS AND

INDUSTRIAL AUTOMATION

Norbert Wiener and the American exponents of cybernetics are attempting to elaborate a theory of the relations and similarities between the functioning of living organisms and that of automatic machines. The term "cybernetics" which, according to its Greek root, means the science of control, was already used by Ampère to designate that part of political science concerned with methods of government. According to Wiener, who adopted the term in his well-known book, published in 1948,²⁰ it is the science of communication and of action-release mechanisms. The ideas of the writers on cybernetics have taken three principal directions, which are rather different and correspond to three types of communication.

(1) That which takes place inside a machine and which brings into play only elements of inert matter, i.e., strictly physical change. This type of communication is the subject of studies concerned with automation, calculating machines, autoregulators and feedbacks, the servomechanisms which interest us in the present context.

(2) That which takes place inside a living creature. Under the influence of cybernetics, an important school of thought and discussion bearing on the relations between the functioning of the brain on the one hand, and that of calculating machines and servomechanisms on the other, is developing.

(3) Communication in society. Here the exponents of cybernetics aim at applying their speculations to economic and political questions and to social life, which all involve feedback circuits.

In addition to many stimulating reflections on these two types of complex organism (living organisms and automatic machines), there

is in the literature on cybernetics a great deal of dogmatism, naiveté and pretentiousness in the matter of "applying" these ideas to economic, political and social facts. Wiener's book, *Cybernetics and Society* (Boston, 1950), is an example of this. In this book, Wiener is not at all interested in the norms, ends and means of human action, and he continually discusses ~~man~~ in terms of mechanical analogies. Moreover, he does not even attempt a positive analysis of society. Finally, as an American critic²¹ has rightly observed, Wiener and his friends, in their sensational denunciation of new scapegoats for the ills of society (especially men of letters, sociologists and psychologists, humanists, etc.) and in their indiscriminate rejection (on the basis of very inadequate information) of all that has been accomplished by the social sciences, are taking a path which may be very dangerous for intellectual and cultural values.

Even on the question of the relation between the brain and machines, which may give rise to some fruitful observations, we should note the warning given by the well-known physiologist, A. Fessard, "not to let ourselves be diverted by the metaphysical intoxication which seems to have led some thinkers away from a strictly scientific path."²² In fact, cybernetics, in the rigid formulations of its most dogmatic exponents, constitutes a reincarnation, in the middle of the twentieth century, of scientism and technicism. I shall deal with this aspect of cybernetics in another book.²³

With regard to the theory of communication inside machines, the notion of "feedback" presents a new and suggestive point of view in the development of servomechanisms from the time of James Watt's fly-ball governor (1780). Any apparatus in which the variation of an effect beyond certain pre-established limits leads, by a feedback process, to a modification of the cause, and this in turn to a change in the effects, belongs to the category of servomechanisms. Its application in industry, apart from the many varieties of thermostat, is becoming increasingly frequent and accurate. We may add to the examples already given, the various types of apparatus controlling the flow of liquid in turbines, and the automatic regulation of the thickness of sheet metal in rolling mills.

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Occupational Skill*

WE COME NOW to another point of view concerning the evolution of machine industry and its consequences for human labor. It will not be surprising to rediscover here, seen from a different angle, the same great problems which we have already encountered.

LAMENTS AND FEARS

The laments are many and various. The worker is degraded by the machine. He has become an automaton. Occupational knowledge and skill become worthless to a man who now has only the same elementary movements to repeat. The machine is the ruthless destroyer of the old crafts. In place of the splendid array of handicrafts, each one of which gave man the opportunity to reveal his personality and in which contentment enriched his work, there are only industrial armies of unskilled workers miserably drilled in a few movements of machine operation.

The reality, however, is more complicated. And such statements must be listened to with great suspicion when—as often occurs—they are made by authors who lack any contact with industrial labor and the sciences of which it is the subject.

There is no doubt about the degradation of skilled labor, nor

* For recent developments, cf. *Où va le travail humain?* Part 2 (Chap. IV), and Part 4.

that it has been going on for a long time. Adam Smith already noted it in the days of hand manufacture, towards the end of the eighteenth century. But the phenomenon increased considerably in the mechanized workshops of the first industrial revolution. Few documents dealing with this subject are more significant than Andrew Ure's *The Philosophy of Manufactures*.¹ This author makes clear how far the matter had progressed from the division of labor in Smith's time to that in his own. Adam Smith thought that in manufacturing, the division of labor was the great principle of improvement. In a pin factory which he studied, when a worker specialized in some operation, such as cutting the brass wire into equal lengths, he became more skilful and produced more. Thus limited, certain operations became easier; others, like the manufacture and attachment of pin heads, became more difficult. From this Adam Smith concluded that "one may naturally assign to each of these operations a worker whose wages correspond to his skill."²

Such was the state of things in the period of hand manufacture. It has changed greatly in the mechanized workshops. There it is no longer a matter of adapting the tasks to different degrees of skill but, on the contrary, of avoiding doing so whenever possible. Ure already pointed out this very important tendency in the practice of the capitalist industry of his day (a tendency which I intend to call the *by-passing* of the older occupational skill) and he accompanies this statement with suggestive comments: "Wherever a process requires peculiar dexterity and steadiness of hand, it is withdrawn as soon as possible from the *cunning* workman who is prone to irregularities of many kinds, and it is placed in charge of a peculiar mechanism, so self-regulating that a child may superintend it.

"The principle of the factory system, then, is to substitute mechanical science for hand skill, and the partition of a process into its essential constituents, for the division or graduation of labour among artisans. On the handicraft plan, labour more or less skilled, was usually the most expensive element of production—*Materiam superabat opus*; but on the automatic plan, skilled labour gets progressively superseded, and will, eventually, be replaced by mere over-lookers of machines.

"By the infirmity of human nature, it happens that the more skilful the workman, the more self-willed and intractable he is apt to become, and, of course, the less fit a component of a mechanical

system, in which, by occasional irregularities, he may do great damage to the whole. The grand object, therefore, of the modern manufacturer is, through the union of capital and science, to reduce the task of his work-people to the exercise of vigilance and dexterity—faculties, when concentrated to one process, speedily brought to perfection in the young.”³

The efforts at “rationalization” contemporary with the second industrial revolution, which got into its stride towards the end of the last century, strongly emphasized these tendencies, as the best-qualified observers note. Robert Franklin Hoxie, in the report of his celebrated study of Taylorism in the United States, was one of the most forthright. “It [Scientific Management] intensifies the modern tendency toward specialization of the work and the task; is destructive of mechanical education and skill; splits up the work into a series of minute tasks tending to confine the workers to the continuous performance of one of these tasks; tends to eliminate skilled crafts; deprives the worker of the opportunity of learning a trade; degrades the skilled workers to the condition of the less skilled; displaces skilled workers and forces them into competition with the less skilled, and narrows the competitive field and weakens the bargaining strength of the workers through specialization of the task and the destruction of craft skill.”⁴ After World War I, the Belgian mission sent to study “Industrial Labor in the United States” (the title of its report),⁵ gave interesting information concerning this degradation of craft skill and the hostility to Taylorism aroused by it among American workers.

The latter, grouped in the unions of the American Federation of Labor (A.F.L.), realized very clearly how much technological progress, as it was used in the new organization of the factories, threatened to take from them. This was well expressed by John P. Frey, a highly skilled worker who figured in the Hoxie study: “Such being the case, it is clear that no more decisive blow can be struck at the union movement than by separating craft knowledge from manual dexterity. . . . If we do not wish to see the American worker reduced to a great semiskilled and doubtless poorly organized mass, a new mode of production must be sought to preserve the working and living conditions won by the unions.”⁶ A somewhat ingenuous wish highly characteristic of the conservatism of the A.F.L. The latter hoped that without a profound change in society a new mode of

production might be devised which would maintain the standard of living of skilled workers. The working-class aristocracy, which at that time exclusively made up the American unions, showed great hostility to Taylorism, which was destroying the old occupational groupings, their boundaries, stability, and tricks of the trade, the surviving remnants of handicraft in the psychology of labor, and was developing a class solidarity in place of a trade solidarity. In this new stage its material gains were endangered: new gains might be created which from then on would make one group of all workers, skilled and unskilled alike.

However that may be, this reaction significantly reflects the degradation of many of the old skills. The Hoxie Commission's fears, expressed in its conclusions, are therefore not surprising: "Neither organized nor unorganized workers find in Scientific Management an adequate protection for their standard of living nor progressive means for technical education and opportunities to establish a system of industrial democracy which would allow the workers gradually to secure partial influence in the actual direction of businesses. . . ." More recently, André Philip was led to equally gloomy reflections: "The modern worker no longer has any initiative in his work: the choice of tools, the choice of methods to be followed, are decided without him and he has only to apply passively the detailed instructions of the planning department; any attempt at originality on his part, any deviation, no matter how slight, from the fixed program would indeed be enough to disturb the whole equilibrium of production."⁸

THE DEGRADATION OF SKILL

In its technical evolution and industrial organization the United States has, in many respects, led the great European nations, and the boldness of its methods and initiative has lent much to the myth of an "Americanization" which was a cheap consolation to certain European intellectuals for the misdeeds of mechanization in their own countries. Actually, industrial mechanization represents, as Marcel Mauss said, *facts of civilization* common to all countries of developed capitalism. So it is not without value to examine first, the tendencies shown, in advance of others and with unusual clarity, by American industrial evolution.

As far back as 1912, Samuel Gompers, the leader of the American

Federation of Labor, in studying the effects of the new industrial system on the conditions of labor, noted that semiskilled workers "are constantly recruited from the ranks of the skilled workmen who find their occupation gone by reason of new tools, methods, inventions."⁹ In every industry this observation characterizes the introductory period of a highly developed rationalization of mechanized production, and it could not well be otherwise. Let us take the lathe as an example. When the parallel lathe became common in mechanized construction shops of large- or small-scale production, it did not, in this way, supplant skill. The worker was a journeyman with an apprenticeship, often of several years, behind him. He was master of his machine and retained a degree of initiative as to the method of work, the choice of tools, the lengths of cut and speeds. Hand tools, such as the hook-tool, the turning-chisel, and the diamond-point chisel, give special contours which cannot be mechanically obtained. Using his auxiliary tools freely, he retained a semi-handicraft share in his work. As we have often observed in small machine shops, the machine at this stage preserves an individual character and the worker is attached to it by personal bonds: he has *his* machine, *his* tools. In such cases an artisan outlook still flourishes. These tools have been made and used by himself alone, they are at his elbow. The worker keeps them by his machine without needing to go to the storeroom to look for communal, anonymous tools. In machining, and especially in tooling, the turner is a genuine tradesman.

But as soon as mass production governed by rationalization arrives, a new kind of turner appears and multiplies in the workshops. These are semiskilled workers doing simple, subdivided, repetitive tasks on the lathe, tasks in which the tooling is determined and all the details decided by the Planning and Time-Study Departments. Here, initiative, the personal bond with the machine, the use of the hook-tool and the diamond-point chisel, disappear. The cut is always mechanically made. Thus the share of manual labor grows less and less in proportion as mass production and "scientific management" are introduced. How many tasks requiring skill have been banished from large-scale industry in this way! We can only mention some typical cases.

Until recently the soldering of radiators with their many tubes fitted together by hand required much skill and patience. A machine has been perfected which makes it possible to construct more than

a thousand radiator interiors in eight hours. Placed on a conveyor, they pass through a furnace where they are soldered into place by the action of the heat. Here is yet another series of operations not requiring the intervention of skilled workers and which eliminates in particular that of tinsmiths. The progress of electric soldering makes it possible to substitute a group of small forges and stamped parts for large parts cast and machined by journeymen. For the straightening of camshafts when they leave the furnace, or for the tempering of tools, touch, technical experience and "judgment" are more and more eliminated in large-scale automobile industry, and replaced by automatic processes.

Such examples abound and, no matter what is said, not only in metal-work and mechanical engineering. Does the reader suppose that many examples cannot be cited in the woodworking industries in which old skills have been increasingly eliminated? The vertical shaper, the band-saw, the planing-machine, the various kinds of mortising machines had dealt them the first blows. I have met young cabinetmakers with a diploma from a good trade school who were forced to accept employment to run semi-automatic machines making cabinets for radio sets. In many firms the sculptor-artisan has given way to the "molding cutter" working with a machine, the former mason to the cement worker, the painter to the "spray-gun" handler, the baker and pastry-cook to the supervisor of the mechanical kneading-trough and of the electric conveyor-belt oven.

Even in the toolrooms of large-scale mechanical engineering industry, measures of rationalization imposed on the workers which are considered unjust or vexatious may react not upon the skill, but on the conscientiousness demanded by all skilled work. The first injustice felt by the skilled worker, that in his wages, is decisive. Good toolmakers of the Etablissements Renault, former pupils of trade schools, have told me how important for them was the date of the application of a new system which they felt injured them. From that moment they shammed and "faked," like the others. Where skill exists it may be intentionally degraded under the influence of the economic and psychological conditions of the company. Under the influence of these conditions, also, young skilled workers who, after apprenticeship and a brief period in production, have been employed as foremen or in technical offices, are immediately brought to a stop in their careers and "reach their ceiling." They will neither be able

to go beyond the mediocre employment they now occupy nor change their trade. They are barred from higher employment by the lack of sufficient technical knowledge in their training—knowledge reserved for engineers—and are given no means of acquiring it. Here again, skill, “put into cold storage,” so to speak, deteriorates. The distinction which rationalization increasingly makes between the functions of management and those of production tends to make of the technical experts who direct production a caste which is entirely cut off from the middle- and lower-grade technicians who, in France, for example, come from the schools of arts and crafts, trade schools and technical high schools (*cours techniques complémentaires*). For these, the already slender chances of gaining access to important technical functions seem still further reduced. “The recruiting of the managers” (the I.L.O. writes, to the same effect), “is no longer made from below; the system of labor, unlike political systems, far from becoming democratic is being feudalized. The possibilities of social advancement offered by work conscientiously done and occupational competence painfully acquired are decreasing more and more, and are tending to disappear.”¹⁰

THE “NEW ARTISAN GROUP”

However, the line of evolution is not quite so straightforward. Other influences must be taken into account. Rationalization of production, when carried out strictly and really dynamically, requires constant improvement of quality, more and more advanced studies of materials, and a steady progress in precision. This is connected with the complexity and multipurpose character of the new machines, especially the automatic ones. Clearly these machines, which, thanks to the principle of the capstan lathe, combine as many as eight or ten formerly distinct operations, are highly delicate and demand parts precisely adapted to one another. The makers of these machines must be very skilful mechanics and so must those who run and regulate them. The operator’s function is a highly skilled one; he must understand how his machine works, and this alone requires highly developed intelligence and technical knowledge.

Thus, production itself is increasingly mechanized and standardized, and the number of skilled men it requires is reduced. But these wonderful machines have to be *constructed*, then kept up, regulated and repaired. They must be tooled, and their work must be set up.

All these tasks are so many newly budding skills, and it has been said accordingly that one skill is only replaced by another; formerly this skill was expended on *objects* to be produced, now it is expended on the *machines* required to manufacture these objects in great quantities, machines more and more delicate and complicated, equipped with increasingly precise tools. "The more mechanized industry becomes, the more complex and scientific become the *tools*, the greater is the need in their construction for intelligent, trained and skilled workers who must at the same time possess manual dexterity."¹¹

In this sense the toolrooms and repair shops are nurseries of new artisans who add to their skills a certain versatility and, in order to be able to respond to the unceasing, ever changing movement of modern techniques (some of which in industrial labor, often cover several trades, such as those of joiner, electrician, mechanic, blacksmith, molder), have to be capable of acquiring training in several trades. In this connection Ford has well said: "The old jibe about 'a jack-of-all-trades' is out of fashion. No knowledge now comes amiss to a man in doing his work. So many formerly unrelated lines of work now enter into the production of the simplest article that a man must be made versatile in spite of himself. . . ." And Ford concludes: "An ability to work at a wide variety of tasks with an understanding of what he is doing is a necessary characteristic of the new kind of general workman that modern industry needs."¹²

Other highly interesting technical developments tending to re-establish manual dexterity appear in mechanized workshops; for example, in die-making shops, small electrical milling-machines or grinders which can be held in the hand are used to hollow out metal. This work is reminiscent of that of the wood carver; the "metal carver," confronted with his material, has to employ a new method of attack. Elsewhere, powerful drilling-machines to which the part has to be carried are replaced by portable drills. The modern smith has certainly quite a different task from that of the traditional artisan whose only tool consisted of his hammer wielded on the anvil with the art and touch of a hand slowly trained by patient apprenticeship. But stamping, in large-scale industry, still has a considerable place for manual skill. No one could doubt this who has watched a modern smith controlling a heavy power hammer, pounding a large mass of

incandescent metal, changing it with a few blows, turning it, piercing a rim, hollowing out a ring, then drawing it out with marvelous precision. In all such cases the machine merely seems placed at the disposal of the old skilfulness.

Such is the viewpoint of those who defend the idea of a "new artisan class," of the apologists for mechanization which, according to them, brings new forms of skill to large-scale industry, with new kinds of satisfaction in work, and which thus compensates for the destruction of the traditional occupations. Ford has very forcefully presented this defense, and in France it has been echoed by Dubreuil and de Fremenville, among others. "Far from reducing the skilled worker's field of action, mechanization has rather extended it," writes the latter, who is one of the best-known engineers among French "rationalizers." Standardized production required the creation of tools and plans of all sorts which would have been impossible when each object was individually produced. Mass production "implies the constant search for greater perfection and the incessant invention of new means of producing better, and more economically, with less fatigue."¹³

This would explain why large-scale industry requires a considerable number of skilled workers. The factories in which highly standardized work is done are often those which complain the most about the shortage of skilled workers. The part played by multiple, multi-purpose machines is stressed, machines which diminish, or often even eliminate, the part of the human operator and which can be entrusted only to a highly trained personnel. The high degree of manual skill which is needed to construct these automatic or semi-automatic machines and the tools they carry is also emphasized. For instance, what has become of the skill needed by the boilermaker who would hammer sheet-copper for hours at a time? Is it lost? Not at all: it has simply been replaced by the construction of the stamping *finished* by yet others who perfect them first with portable grinders and then with the file.

For most trades, occupational skill, instead of being destroyed, has only been transferred. In short, the planning of new models, the improvement of manufacturing processes, the creation of new tools, the upkeep and repair of equipment being used, and the determina-

tion of methods of work, none of this can be done by mass-production methods. All these activities are so many opportunities and demands for skill.

STATISTICAL DATA

Such is the highly attractive technological panorama presented by the defenders of the new artisan class. If, in the special conditions of the capitalist system, industry corresponded exactly to this picture, technological progress would reduce the total number of workers engaged in production and increase the proportion of skilled workers, the new artisans. The total number of human working hours would be reduced by the machines, but an important proportion of the remainder would be skilled labor.

It is true that at first sight, certain statistical data do not contradict this argument. In precision mechanics, in electro-technology, in the construction of machines and apparatus or the manufacture of wire and cables, even in the automobile industry, the proportion of skilled workers scarcely decreased between 1914 and 1915 in Germany, that is, in a country and at a time when rationalization certainly flourished. This proportion, 29.9% in 1914, became 29% in 1925.¹⁴ In mass-production firms the number of skilled workers was one in five. In England, in 1913, an industrialist noted that in his mechanical engineering firm into which many machines had been introduced, 36.7% of 1256 workers were skilled men. In 1928 this proportion was still 34.9%, while the number of employees had risen to 1807.¹⁵ In France, in several medium-sized factories, I have found similar figures, for instance, at the Somua mechanical construction works at Saint-Ouen.

Yet, are these figures in themselves convincing? They convey limited and rather specialized data, data dealing with industries in which "precision workers" are obviously numerous, such as small machine shops and machine construction, or medium-size firms producing in small quantities. The partisans of the new artisan class, judging by the statistical data most favorable to them, claim no more than 20% of skilled workers in rationalized mass-production industry. Must they not recognize in this fact alone a considerable decline in skill?

More than this, they themselves suggest that the trend towards the creation of new forms of skill is taking place only because of a sen-

sational swallowing-up of the traditional "arts and crafts." I had the opportunity to study this paradox in greater detail elsewhere, in the case of Ford. Around 1910, at Detroit, in the foundry which cast the first automobile piston cylinders for the "Model T," all the work was done by hand and required a large proportion of skilled molders. In 1924, after the introduction of mechanical casting and the conveyor belt, in these same shops only 5% were skilled molders and foundrymen. ". . . the remaining 95 per cent are unskilled, or to put it more accurately, must be skilled in exactly one operation which the most stupid man can learn within two days." Ford elsewhere congratulates himself on the fact that the new technical means have "eliminated human art from this operation."¹⁶

In a paper by de Fremenville, there are some comments which cast a strange light on the transfer of skill. The skilled worker, one reads, "is freed from purely mechanical tasks, which it has become possible to have performed by men of the crudest ability, only to devote himself to more delicate work, the creation of ever more varied and ingenious machines."¹⁷ But is the area of this delicate work as extensive as that of those "purely mechanical tasks" which rationalization has multiplied, and which are performed by laborers for whom *craftsmanship* is dead?

As a matter of fact, other statistical data give us information on this subject which is scarcely reassuring. In a small, typical Midwestern American town with 9,000 workers in its machine shops there remained, around 1928, only some sixty or eighty apprentices distributed between building and foundry work. "High speed steel and specialization and Ford automobiles have beaten the mechanics' union," said a foreman in *Middletown*. "You had to know how to use the old carbon steel to keep it from gettin' hot and spoilin' the edge. But this 'high speed steel' and this new 'steelite' don't absorb the heat and are harder than carbon steel. You can take a boy fresh from the farm and in three days he can manage a machine as well as I can, and I've been at it for twenty-seven years."¹⁸ The manager of one of the chief machine construction shops stated that 75% of his worker personnel could be taken straight from farms or secondary schools. In glass-making, hardly a month was needed to train 84% of the personnel (not including the foreman); six months training for 4%; a year for 6% and three years for the rest (6%). The new methods of manufacturing and organization were less of a test of

skill among foundrymen than among mechanics. Yet, whereas in 1890, 47% of the workers, including the foremen, had behind them a solid apprenticeship of from three to six years, this group has dwindled by half (24%). Sixty per cent of the castings were made by workers who cast mechanically after having been "trained" in a couple of weeks.¹⁹

Julius Hirsch, following a study in the Ford Works, reported the facts contained in the following table:²⁰

Percentage of workers	43%	36%	6%	14%	1%
Length of training with Ford	Only one day	One to eight days	One to two weeks	A month to a year	Up to six years

It will be seen that 79% of the personnel of this giant concern were initiated into obviously very subdivided operations in less than a week. Ford attests that "the rank and file of men come to us unskilled; they learn their jobs within a few hours or a few days. If they do not learn within that time they will never be of any use to us."²¹

This state of affairs is not peculiar to American large-scale industry. Although in France, as elsewhere, *qualitative* statistics of the labor market, kept up-to-date with the *development of industrial occupations*, are lacking for the country as a whole and even for the departments, the average proportion of genuinely skilled workers who have had a methodical and complete training, as given me by good observers "on the spot," engineers employed in mass-production mechanical engineering, varies from 5 to 10%. Moreover, this situation corresponds to the wishes and efforts of the partisans of "scientific management." In their eyes the satisfactory worker, from now on, is the worker who correctly performs the orders of his work schedule. Gilbreth considers that when the worker has become capable of this achievement, "whatever his age, his training is over."²²

NOTES ON THE DEVELOPMENT OF SOME INDUSTRIAL TRADES

At this point it will be helpful to glance at the development of several industrial trades up to the beginning of World War II.

These trades have constantly adapted themselves to technological changes, mechanization, and automatization. All too often in such countries as England or France, where industry is long established,

people have tried to ignore this development and its impact upon the skilled crafts. The economic depression of 1930, in spite of the many declarations in favor of artisan business, nevertheless did not interrupt technical rationalization and, after methodical studies, François Simiand was able to assert that this had increased, on the whole, during the periods of crisis which he calls "B phases."²³

To be sure, there are trades which show stability, especially those in which craftsmanship is indispensable. There the principal role is played, not by the (not very complex) machines, but by varied, delicate and precise manual dexterity, as for instance in the turning of bronze (for candelabra, chandeliers or gold-plating) in which the machine—the "unsupported" bronze-founder's lathe²⁴—and the processes of manufacture have changed little since Henry II's time, according to the apprentice-masters who teach the skill. But these stable trades are very few and are closer to applied art than to industry.

On the whole, as Rousseau and Devillez accurately remark,²⁵ many old trades are outmoded and the patterns in which they were set seem obsolete today. For example, comparing in machine construction the work done by turners, machine fitters and winders in 1920 with that done in 1936, these names are seen to describe really very different tasks. The proof is clearly given by Rousseau and Devillez and further confirmed by the appearance of new trades: in workshops (electric-welders, blow-pipe cutters, supervisors of welding-machines, of electric furnaces for the treatment of special steels, etc.); in the planning offices (technicians responsible for designing tools, for time-study, and for progress planning); in toolrooms (workers using machines for filing, screw-thread checking and marking, etc.).

But these new tasks account for "perhaps only 20% of the total manpower of a normal shop." Elsewhere, in a comparative study of work done formerly and at the present time in a medium-sized factory by turners or fitters or winders, Rousseau and Devillez themselves also report that the old trades have greatly deteriorated. The worker at a center lathe or capstan lathe, among his chief tasks, had to:

(1) Assemble the parts and tools, run the machine, and supervise the dimensions of the parts. (2) Choose the tools and determine the cutting conditions (projections, speeds, cutting angles).

(3) Sharpen the tools. (4) Oil his machine. (5) Calculate the screw-wheels in advance, etc. (6) Carefully determine the dimensions of the parts to be assembled. What of all this is left to the automatic lathe worker, the worker on a turret lathe or even the turner in mass production? He has only to assemble the parts, measure their dimensions and sometimes (except in the first case) regulate the tools. Let us consider fitting, in manufacturing; it included various tasks. The worker tried the parts by inserting one into the other, fitted them with a file, "finished" with file and scraper the machine-produced parts, ran the bearings and scraped them. Finally, he assembled all the parts and checked the whole. In the manufacturing shops of machine construction, fitting in the strict sense of the term has practically disappeared: the use of limit gauges has dealt it a heavy blow. In the electro-mechanical industry the winder, a skilled worker, has surrendered his most delicate work (welding and setting) to specialists and is now only an unskilled worker, following the instructions of a card and doing his work with tools already set up.

Thus the old engineering trades have deteriorated and "new" ones occupy at most one-fifth of the manpower.²⁶ How many industries have the same story to tell! Only a few can be mentioned here.

In paper-making, for instance, cutting, folding, gumming, tasks more and more completely mechanized, make less essential the thorough knowledge of material and the *paper-maker's* training. Take a food industry, rusk-making: to prepare the dough for rusk-bread the mechanical kneading-troughs are now watched by skilled pastry-cooks. I questioned one of them: he had had a long training, and had worked in high-class establishments at spas. He liked such work better than his new occupation. "It was finer and more varied." He did not frankly admit that his abilities were unemployed but added: "Of course here, too, one must know pastry and watch the temperature. But if everything is carefully weighed and of good quality, the eggs, the fat, the flour, and the yeast—a laborer can do the job as well as I can. I'm there merely for the snags." Another pastry-cook elsewhere, second in charge of the men, supervised semiskilled workers and laborers. It was his task to create new kinds of cakes and tarts. But his job consisted even more, now, in watching the different machines in his kitchen. He told me that, as a pastry-cook, he had had no training in mechanics but has taken an interest

in the machines in the various places where he had worked. Thus he had been able, little by little, to add a "mechanical training" to his "pastry-cook's training." The outlines of new trades appear behind the old ones, those which are an inheritance from the period of handicraft. In the pastry-cook's case, as in many others, we seem at present to be passing through a *period of transition* in which mechanization still has to rely, for the skilled tasks which it requires, not only on technical knowledge but also on an older knowledge of materials of the craft. This is true of the pastry-cook's trade. Dating from this period of transition, however, the craft is becoming less common and is restricted to a number of workers who, according to the estimate of the managers of this firm, form about a quarter of their entire personnel.

In a large munitions and bicycle factory at Saint-Etienne, deterioration of the old crafts has been rapid and obvious. The gun machine shop which at full output (1937) could make 150 weapons daily, contained only one skilled worker (the mechanic) for twenty unskilled workers, called "machinists." These can be trained in a few days. Only some thirty years ago the gunsmith could make a complete gun unassisted; this sort of worker is disappearing. The owner of this large firm, who half a century back himself began as an artisan gunsmith and survived this period, a *self-made man*, an elderly man greatly admired and respected, told me categorically in reply to my question that he was installing machines wherever he could. At the *Bourse du Travail* I was assured that almost no apprentices were taken any longer. Moreover, since the wages of skilled workers hardly surpass those of "machinists," there is no incentive for families and young people. Bicycle factories often employ for the manufacture of spare parts semiskilled workers, frequently women, whose training has taken less than a month. The enamelling of the frame, formerly done by skilled workers, is carried out today by unskilled workers using spray-guns.

Changes of the same sort are found in the textile trades, though these have been stable for so long. In spinning cotton, for instance, the beating, carding, combing, and stretching have been mechanized. Several machines for combing or stretching are attended by a woman worker who only has to feed and restart them. A month's training is enough for this work. In "spinning" proper (the above operations being only the "preparation" for it), the spinner, work-

ing on self-acting "spinning-jennies" and at continuous frames, has far less responsibility than the former spinner—but also a far less difficult task. Having in succession been apprentice, second and then first piecer, he becomes a spinner. Towards the age of fifty-five the aging worker's eyes are often weakened, and he is demoted to first piecer. The spinner's trade still implies some knowledge of materials, and experience with temperature and humidity, whose effect on textile fibres is so great. But it no longer requires initiative. It would help if the spinner knew his machine (from courses in the assembling and stripping of the frames). But in most spinning-works which I visited, he is strictly forbidden to touch it. On continuous spinning machinery a woman worker currently runs 400 spindles.

The general opinion of (cotton) spinning technicians in the Lille-Roubaix region is that the skill of foremen has developed and improved. But at the same time it has been possible to assign a less skilled type of worker to increasingly exact and automatic machines. The replacing of self-acting spinning-frames by continuous ones has permitted the employment of semiskilled women workers, "continuous frame workers." The class of former spinners is disappearing. The apprentice or "girl," after some years in the shop, becomes a good continuous worker. In fact, the workers say, a year would amply suffice for this training which consists rather of several routines, for all the maintenance and regulation of the frame (formerly the work of the spinner) is monopolized today by the mechanics. The worker merely watches the machine, feeds it raw material and fastens broken threads. Some very fine "numbers" of thread are even today, in certain shops, not made by the continuous frames, but their absorption by the new techniques is only a matter of perfecting and adapting the machine. In weaving, where safety devices free the trade from the slightest operational accident, the old weavers—who used to know their material, and the structure and qualities of the fabric—have disappeared from the shops, which have been invaded by automatic frames. One often sees a worker running from fifteen to twenty frames or even more. In the collective agreements signed since 1936, weavers are usually considered as semiskilled workers; only the mechanics, fullers and colorists are termed skilled. Women weavers are trained in the normal working of their frame and have little technical knowledge. At the least difficulty, they are seen to call for the mechanic.

In the clothing industry, machines have rapidly displaced the old trades: cutting machines (already long established), button-holing machines, and pressing machines. The last, perfected about 1930, practically superseded the skilled trade of presser which required an apprenticeship of at least eighteen months. In the Lille region, pressers have been taken from all kinds of trades, from young unemployed building workers or carpenters, who have been trained in two months. Cutting has hardly changed at all. On the other hand, the dress-makers (or female machinists) have no longer anything but subdivided work. At Lille, an important center of this industry, the secretary of the garment-makers' union, very much abreast of the larger problems of his trade, said to me, "Formerly women were proud to turn in work well done, *their* work. Now one of them does nothing but stitch the lining of sleeves, another the back seams, another the collar, another puts on the vest pockets, etc. Today the responsibility for work is less; it is all on the assembly line. One piece is no more interesting than another to them. The machine would be welcome if it just reduced our difficulties. But the employers want too much from it. So the machine destroys our trades and keeps us from doing good work. But those who still have work are well satisfied; there are many who are on the street."

The building industries also show a new condition of the labor market. The use of reinforced concrete and the new urban style of building have eliminated many crafts. Carpenters, plasterers, masons, joiners, painters, plaster molders, stucco workers, have been very differently affected. Some new skilled crafts (such as frame-makers, cement-mixers, etc.) make their appearance, but do not correspond to the old skills, as is shown by the unemployment figures which are high in the building trades, even among technically well-equipped men. Excavators, bucket-cranes, shovel-cranes, and pneumatic drills have mechanized digging: the digger who, contrary to all appearances, is skilled (having to dig narrow trenches, slope ditches, or make vertical cuts, etc.), has gradually been eliminated. This was arduous work which, of course, it is good to see disappear, but if some mechanically trained men have shown up in the building yards, many more workers with no real training have accompanied them.²⁷

In the face of this holocaust of skilled trades, the workers' unions have tried to protect the trades and, at the same time, the wages of semiskilled and unskilled workers. Glove-making in France offers a

typical example. Skilled workers have been unable to hold their ground, except for cutting and shaping (which consists in folding lengthwise the cut-out pieces of leather in two parts, corresponding to the upper and lower parts of the hand). Such machines as the "switch" (Grenoble region) have modified the technique of cutting. Glovers' unions have struggled more or less successfully to gain a complete training of about two years to be given in the workshops, under the joint control of workers and management. But while defending the old trade, the unions have to take account of economic realities. The latter only too clearly show the increasing number of "semiskilled workers" compelled to perform subdivided tasks requiring little training, whose living wage has to be protected. Thus many collective agreements try to retain the old terms of the trade ("spinner," "weaver," "turner," "miller," "gunsmith," "cutter," "presser," etc.) even when their meaning has changed, and to adjust the wages paid for this work in agreement with those of occupations which are still skilled. A very comprehensible policy, but not without disadvantages, for young people and their families have no incentive to apprenticeship or to undergo the inevitable loss of earnings for several years. On the other hand, wage-levelling is often done by employers not to the advantage of the new unskilled workers but to the detriment of the skilled workers. Of course, this is seen only where there is no lack of skilled men and under a peacetime economy; it reflects deeper social conflicts and helps hasten the degradation of certain skilled trades.

The downfall of many old trades is certain; in the midst of mechanized, subdivided tasks, prepared by planning departments, which invade the workshops and yards, training no longer seems required except to solve incidental problems arising through a poor preparation of material or an accident to the machine. Occupational intelligence, concentrated as much as possible by the management, remains to counter the gaps or risks of mechanization. Without speaking of those who make and those who regulate machines, who have been mentioned elsewhere, new skilled tasks appear here and there; in passing we noted some, which for the most part imply knowledge of the new machines introduced into one or another special branch of production. This *mechanical training* is still often coupled with the old *handicraft training* applied to processed materials.

Very few of the subdivided tasks of the new "semi-skilled workers"

could not thus be improved by knowledge covering a variety of techniques. Unfortunately, it would be fruitless to ignore the fact that (except for a few clear-sighted and educated employers who are aware of the social implications of their activities) most business leaders seem most interested, above all, in eliminating skilled workers. They are driven to it by important social trends in which economic and psychological motives are mixed. The economic ones perceptibly reduce the amount of their payroll. And psychologically, by introducing more highly perfected, automatic equipment (and thus eliminating skilled labor), they are also conforming with the powerful current of technological progress. Finally, many industrialists prefer to do without or "to depend as little as possible" on skilled workers.

To sum up, for a variety of reasons, it is just as if they were trying to eliminate skilled labor and even to by-pass it (by the internal organization of the workshops) in cases where it might still have a place. It is not unusual to hear that the semiskilled worker well accustomed to a certain task or machine works more quickly than a skilled worker set the same task. This is a current opinion among engineers. As one of them at the Renault works confided to me, a man who "loves his machine and is a finicky worker, will always want to stop it for a mere nothing. He will decrease output." But, as American industrialists have bluntly declared since 1900, the machines must fill their quota.²⁸

This is no longer a mere statement of the fact of degradation of skill. It is an apologia for it.

In his *Cours d'Economie politique*, François Simiand quotes the opinion of a business leader who is highly devoted to propaganda for rationalization: "This very day, in contacts with artisans, blacksmiths, and locksmiths, I recognized with deep admiration the share of technical knowledge and human experience possessed by these true artists, and reflected that it would be a national loss, a decrease in national capital, to force such men to work in a shop where they would perform an automatic task." And Simiand, agreeing with this opinion, adds that in these old trades there is "to a certain degree and under certain circumstances not an inferiority but a superiority which should be preserved."²⁹ "Superiority"? Certainly. But is there anything more than a *pious wish* in this value judgment concerning the observable facts of modern large-scale industry?

SKILL AND INTELLECTUAL QUALITIES

We shall return later to the characteristic reaction of workers to rationalization. The rarity or disappearance of those problems which stimulate skill, and the loss of initiative, seem to have been felt especially by them. A system requiring little of the worker's personality but rapid and precise reactions, and which also lowers his prestige among his comrades, inevitably tends to eliminate valuable satisfactions which until recently were associated with his work. "How much of the time are your thoughts on your job?", a young and alert smelter of Middletown was asked. "As long as there happens to be any new problem about the casting I'm making, I'm thinking about it, but as soon as I ever get the hang of the thing, there isn't 25 per cent of me paying attention to the job."³⁰ A journeyman printer interviewed by English industrial psychologists protested against the suppression of any appeal to the imagination which is the result of rationalization: it requires only obedience to instructions. It is from this, he said, and from an excessive subdivision of labor, that many of the defects of present-day industry arise.³¹ French workers, especially those who knew the shops before the advent of mass production, often express similar regrets. An old journeyman mechanic accustomed to speaking his mind, told us that during the early days of rationalization in the Delahaye automobile works he had taken the liberty of warning a shop supervisor that in his opinion the instructions of the planning office contained an error. "Mind your own business," he was told. "And the result?," the mechanic concluded. "A hundred crank-shafts good for scrap iron."

After a remarkably elaborate experimental study of "occupational skill and specialization" conducted simultaneously in four firms, Mildred Fairchild decries the failure to use existing skill. "... Failure to utilize men's capacity for skill development is like failure to utilize the capacity of a waterfall flowing past one's factory doors, or of the coal in one's bins to its fullest extent. It is a waste of natural ability directly at hand, whose use would be advantageous to everyone concerned."³² Fairchild concluded that where a high degree of skill exists, it is the worker's main source of satisfaction. In most individuals there are both aptitudes and potentials of skill (variously oriented) which may be activated to equilibrate and expand the personality. That is, the skill of which we are speaking, char-

acteristic of the old crafts, is much more than simple motor ability. Furthermore, even for the latter, as Gemelli has shown, it is inaccurate to speak of *one* manual dexterity which is advantageous to its possessor, regardless of the type of work or machine involved.³³

The skill of a journeyman depends on psychological qualities. His attention is aroused by various objects and problems; sometimes it is active and in control, sometimes dormant. Sometimes his reactions are reflex, but more often conscious and intelligent. These latter, however, are much more rare in the unskilled worker, whose attention, sometimes even subconscious, is fixed on a few subdivided operations and whose movements, repeated in rapid rhythm, have to be very precise.

If the work of a welder, for example, be closely observed, it is evident that he is faced with varying physical phenomena throughout its duration and, consequently, with difficulties which he must solve instantly under penalty of affecting the quality of the welded assembly, phenomena which a physicist would call calorific conductivity, expansion, capillarity, surface tension, oxidation, structural changes, internal tensions, etc. The welder "must know them, foresee, combat and, in short, conquer them."³⁴ Intellectual qualities are so necessary to this work that it has been capable of mechanization only at great expense and in such mass-production labor as the welding of radiators. It is hard for the machine to replace the journeyman's hand, a hand guided by attention, experience and judgment. Whenever man's brain, in all its power, is engaged, it is very hard to translate its delicate procedures into artificial mechanisms. Skill, therefore, as against mechanization, preserves certain strong positions wherever the intellectual qualities involved in it are sufficiently varied and subtle. Besides, as its defenders rightly observe, technical progress not infrequently re-creates skill under new forms in mechanized shops.

The intellectual qualities of skill, as witnessed by numerous psychological studies, are essential for practical success. In the work laboratory of the French state railway system, comparing the average bio-typological profiles of the apprentices in the jobs of repair worker, mechanic and fireman, Laugier and Weinberg showed that it is in "technical intelligence" that the difference between apprentices who fail and those who succeed is especially high.³⁵ Tests of intelligence are more useful than purely psycho-motor tests (ac-

curacy, speed of movements, etc.) in helping to predict success in the apprentice schools. One important detail is that the superiority of intelligence tests appears even in a comparison between young workers with respect only to shop work, and excluding theoretical courses. Of course, the conditions of manual work in the apprentice shop and in production are different. Yet it is right to conclude, as a result of these experiments, that "contrary to an opinion widely received, the role of intelligence in the performance of skilled manual labor seems to be even more important than that of such functions as involve accuracy, rapidity, etc."³⁶

Now, it is precisely against the system of individual initiative that technicist rationalization was constructed and developed. Though Taylor tried to defend himself against this charge, it is incontestable that Scientific Management and its variants actually destroy all individual initiative in many workers. It was thought that rationalization could find a basis in the worker's specialization, carried to the highest possible point, at the same time that it deprived the worker of any participation in the workshop as a whole and, still more, in the pattern of production in which his activity plays a part.

Emphasizing the considerable role of intellectual qualities in the various manifestations of skill, industrial psychologists deplore the strict restraint which makes them useless by suppressing all initiative on the worker's part. Otto Lipmann states the advantage there would be in at least consulting skilled workers on the choice of organization and production methods. From the psychological point of view, immediate output may suffer, for the workers in a given shop do not all achieve their best output by identical methods. The worker should be granted a certain degree of influence upon the structure of his work and not be transformed into a sort of automaton, strictly governed and directed from without.³⁷ This principle should be infringed only very rarely for imperative technical reasons and, even in such cases, the unalterable human demands of body and mind should be taken into account. Unfortunately, the trend of rationalized labor towards "despiritualization" (*Entseelung*) takes a totally different course.

THE SEPARATION OF MANUAL AND INTELLECTUAL LABOR

The skilled worker is thus not only characterized by motor abili-

ties. Psychology has now shown that his value consists substantially in intellectual qualities, which his work constantly calls into play. So the question of skill is central, since it forces us to ask what becomes of these qualities in a worker under the actual conditions of modern industry, what advantage his intelligence is to him today, and even whether "rationalization" wants to call upon it.

That is, the future of occupational skill is in fact dominated by the increasingly pronounced dichotomy between the functions of management and of production. We saw that the technicist doctrines of rationalization regard this distinction as a basic principle and even consider it one of their chief claims to fame. The name which they often give to the planning departments in factories is characteristic and eloquent of this fact: it is the *Thinking Department*.

In mechanical engineering the technical department fixes production times, including those of preparation and of cutting, and determines what class of workers is capable of performing a given task. Consequently, it is the office which studies all the details: what type of machine is to be used, the length and depth of the cut, the machine's travel, the tool's number in the supply shop. If work planned in this way is not enriched or given significance from any other inner or outer source, what happens to initiative and judgment, and what is the fate of those intellectual qualities which sustain all occupational skill? When Taylor was making his first experiments at Midvale Steel, on rationalized work with machine-tools, Shartle, one of the journeymen mechanics undergoing these experiments, sometimes used to disturb them by asking questions. One day Taylor, irritated, told him: "You are not supposed to think! There are other people paid for thinking around here." Shartle was unconvinced: "I never would admit to Mr. Taylor that I was not allowed to think. We used to have some hot arguments just over that point."³⁸ Yet Taylor's statement was perfectly consistent with the logic of his system.

Since skill is closely associated with judgment, selection, and initiative, is it surprising that by this concentration of functions it has been increasingly degraded or even supplanted? A single office is charged with thinking, instead and in place of almost all the workers, by a sort of proxy which they are forced to confer (though many industrialists very paradoxically still want to receive technical suggestions from them). Although the statistics and qualitative esti-

mates of the labor supply in large-scale industry may not be accurate, they are sufficient to show that this is certainly the fate of skill in the case of those semiskilled workers who now constitute the great majority. The steady trend of "scientific management" is to cause semiskilled workers to perform all operations which *can* be performed, without calling on the worker's intelligence and personality.

On this matter, Taylor made no secret of his opinion and, as was natural, he basically associated this new technical division of labor with the financial interest of business: "The full possibilities of functional foremanship, however, will not have been realized until almost all of the machines in the shop are run by men who are of smaller calibre and attainments, and who are therefore cheaper than those required under the old system. The adoption of standard tools, appliances, and methods throughout the shop, the planning done in the planning room and the detailed instructions sent them from this department, added to the direct help received from the four executive bosses, permit the use of comparatively cheap men even on complicated work."³⁹ In this connection, Taylor recalls with satisfaction that his personal action at Bethlehem Steel in the machine shop caused a rise from 25 to 95% in the number of workers with elementary skills, chosen from among the laborers and specially trained. In short, technicist rationalization, wherever possible, tries to increase the training of an élite of "new artisans" and to diminish that of the majority of the workers, who are transformed into common laborers. Underlying this is an intention closely associated with the financial interests of each firm: the lowering of the total cost of manpower, the rapid amortization of equipment by increased production, and the acquisition of new and better equipment.

Economic (and social) determining forces, therefore, again make themselves felt indirectly on problems which might be thought to have only a psychological and technical character. Moreover, various authorities recall the fact to us, sometimes brutally. Among them is C. H. Harrah, then manager of the important Midvale Steel Works, who stated before the House of Representatives: "Our rule is to cause our machines to break up as soon as possible. For instance, a power hammer mustn't last more than two years. If it is not done for within this period, I complain to the foundry foreman because he does not get from it the full output which it ought to yield. The same thing in the construction shops. If a lathe whose natural life

is two years is not used up by that time, I blame the mechanic who is responsible. We have absolutely no regard for machinery or for men."⁴⁰

Technicians try to justify this state of affairs by declaring that the degradation of skilled trades is made necessary by the taste of most workers for mechanical work requiring no responsibility. Wallich, a German disciple of Taylor, declares that the system "leaves to purely mechanical work only a mass of people unfit for any intellectual activity and who, besides, would most often be hostile to it."⁴¹ H. B. Drury writes in the same tone: "We are inclined to think that scientific management is the more practical, and, for the present at least, the more commendable, in that it has adapted itself to a state of civilization in which men as a rule are obviously not of an ambitious, intellectual type."⁴²

Ford was not behind the rest in using these arguments. We discussed their value with regard to psychological observations. It is obvious that these general affirmations as to "a type" of mind (when psychological attitudes with regard to repetitive work are most varied and complex, and differ with the individual) have no scientific value. They despise psychological science but are equally ignorant of social reality. Ford, deploring the fact that most of his workers seek occupations "in which they do not have to think,"⁴³ never wondered why everything points to the fact that they hesitate "to think" for the Ford Motor Company, the interests of which they certainly do not consider identical with their own.

The conscious efforts of rationalization being thus explained, we are not surprised by the data contained in methodical studies of the relation between discontent and intelligence among the workers of large-scale rationalized firms. Scott and Clothiers measure the former of these two "factors" by labor turnover, the second by school marks and the assessments of schoolteachers.⁴⁴ In the toolroom of a mechanical engineering firm (a shop in which most of the workers are still skilled craftsmen), the turnover is 89% among the least intelligent, 80% among the most intelligent and 60% among the average. Discontent, therefore, seems to affect even those whom a relatively skilled form of labor should have satisfied. In the mechanized foundry where, with few exceptions, most workers are unskilled, the average are the most discontented. In inspection work, a fundamentally rationalized and monotonous occupation composed of several sub-

divided operations and generally performed by women, the turnover increases with intelligence and reaches 100% for the most gifted. Considering the whole factory, we find that the average turnover is 30% for the least intelligent, 50% for the average, and 75% for the most intelligent. This attitude of the workers is sufficiently well known to some American industrialists to cause them to set up a sort of barrier at the entrance to their shops. Their offices make the workers, upon employment, take tests which exclude the most intelligent. The U.S. Rubber Company has even pushed experimentation so far as to employ young girls deficient in intelligence who, in the framework of "scientific management" applied to this business, have given excellent results.⁴⁵

Taylor viewed the problems of management with a sort of simple, ingenuous cruelty. But his sincerity is undoubted. He certainly had not foreseen all the ways in which his technical reforms would be exploited under the economic and social conditions of the world of today, and the modifications of his reforms produced by these conditions. Technician rationalization, in the view of its advocates, requires, by means of the increased division of operations, a specialization of the worker and the breaking-up of many of the former craft occupations. The management, in mass production, undertakes all the theoretical and technical preparation of the subdivided operations. Taylor and his successors have emphasized the value of this system for business; but business has actually gone much further: it resolutely commits itself to the degradation and suppression of occupational skill wherever that is possible and profitable. On the other hand, one never sees the management of a firm attempting to enrich a subdivided and mechanized task through technical knowledge by means of which it may be integrated, made clear, and assume significance; or through systematic job rotation, gradually showing the worker the totality of a process of manufacture. This would make a significant whole of these subdivided operations and permit their combination with advanced instruction for the benefit either of the work or of the worker.

This is why, when one questions the workers of large-scale industry, one so often finds that they are ignorant of the name and even of the exact purpose of the part which they machine daily by hundreds and sometimes thousands. Of fifteen workers at the Lucas works at Birmingham (a firm producing magnetos), only one could answer

our questions correctly. At a cloth mill at Sedan in France, the workers did not know the quality and name of the material they were weaving. Yet they were women who had worked a long time (from five to twenty years) in the factory and who had seen many different types of product pass through it. They had no conception of the structure of the fabric, its weaving or the "weft-threads" and, of course, were helpless at the slightest problem in their loom. Here again the economy of skill achieved by the firm was considerable, since a single mechanic sufficed for some hundred looms. I was able to make similar observations in a large automobile works, a paper factory (specializing in envelopes) also very ingeniously rationalized, and in a rusk factory. For instance, it is desirable that the "cutter," "folder" or "gummer" should know and be interested in different sorts of paper; but as a matter of fact, taking the total manpower of a modern paper factory into consideration, knowledge "about paper" has strikingly decreased in comparison with the artisan period, and mechanical knowledge is monopolized by a few mechanics and new craftsmen.

In the rusk and pastry factory, similar observations were made: in six months unemployed workers from various occupations were changed here into semiskilled workers who supervised the different machines, preparing and working over the dough. The trained bakers or pastry-cooks, knowing the former craft, are of less and less use. The machine itself determines quantities, cooks, divides and distributes accurately. Knowledge, instinct and touch—at least in many cases—are embodied in it. Thus, in making the rusk-bread, the firm I studied used a group of machines of Dutch construction (a divider, a spiral roller, a distributing cylinder, etc.), at which only semiskilled workers were employed; their task (and the purpose of their instruction) was to note anything abnormal either in the dough or the machine. "Anyone can do the work," the manager stated. Yet he preferred to assign it to workers who had previously done similar work for his competitors. "In this way they sell us their knowledge at the same time." There are only about twenty skilled workers among seventy-two workers in this shop. "Even that is too many. For example, we have a trained pastry-cook at the mold; an unskilled worker would do. What we need more and more in the way of skilled employees are mechanics." Everywhere throughout mass-production industry, the same tendencies are found: knowledge of the material

being worked (dough, glass, leather, metal, paper, textile fibres, fabrics, etc.) is less and less in demand as mechanization advances. But, on the other hand, mechanical knowledge has been concentrated through rationalization among a few élite workmen, and the requirements of profit attempt whenever possible to *by-pass* this new occupational skill.

The efforts of technicians and the interests of private industry, combined, explain the speed and extent of this development. The humanitarian desires of Congresses or the apologies of the theorists of rationalization, unfortunately, are of little value. As Arnold Durig writes,⁴⁶ "when all is said and done, the entire effort is always directed towards the following aim: how to obtain the greatest output and the greatest profit from the expensive labor force operating upon the inanimate machine."*

* The trends outlined in this chapter have continued in the same direction, and I have described elsewhere (*Où va le travail humain?*, Part IV) the double movement of polarization which, on the one hand, is increasing the number of workers "who are simply dexterous, chosen among the unskilled workers and specially trained," as Taylor says, and on the other hand, raises the technical level of an élite of skilled workers. This development has been accentuated by the diffusion of automatic or semi-automatic, multipurpose, and high precision machines, which have involved not only new, highly qualified tasks (machine builders, mechanics, tool makers, maintenance staff), but also, in a number of cases, require for their supervision, workers who have to possess the qualities of conscientiousness and a sense of responsibility rather than technical knowledge, strictly speaking. Thus, there have emerged in the workshops new forms of individual status and value characterized by relatively high wages. At the time of this writing (1954), there are not yet any researches on statistically significant samples which would enable a comparison of these two groups of workers to be made (by industrial sectors). The only material available is from impressionistic accounts and sample inquiries relative to certain firms.

Moreover, the speed of work in the jobs carried out by these specially trained unskilled workers has led psychologists increasingly to consider speed as a form of skill. On speed as skill, see D. Cox, *Women's attitude to repetitive work* (London: 1953), pp. 20-21; and cf. Recent Bibliography.

It should be noted that the job enlargement movement, if it were to develop, would have by no means negligible effects on the evolution of occupational skill (Cf. C. R. Walker, Recent Bibliography).

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Industrial Training and Occupational Culture*

SEEN AGAINST the background of mechanization of the development of crafts and of the transformation of skill, what has happened to apprenticeship as a method of training workers and preparing them for their crafts? What forms does it take, what are its tendencies and aims? Only in the light of the actual conditions of the occupations can these problems be examined.

TRENDS AMONG

INDEPENDENT CRAFTSMEN

Apprenticeship, as a matter of fact, reflects in its variety that of the economy and of the crafts themselves. In all advanced industrial countries a great variety of sectors of production is found to exist, from the small artisan business, sometimes the family workshop, to "mammoth firms." Every one of them, in its own way—and at least

* This chapter on training describes first a state of affairs and problems related to the years just before World War II. The chief elements of these problems, and the direction of their development, reflect underlying needs and have survived the upheavals of an abnormal period (1939-1945). As soon as these eddies had passed away, the same problems reappeared, as clearly marked and in almost the same form.

for some time—has tried to find in this very variety a kind of flexible protection against the effects of industrial crisis and unemployment: hence the different policies of “craft defense.”¹ But these policies do not seem to have had much effect on the actual division of the different sectors or on the progress of industrial concentration. Moreover, in the Third Reich, declarations of principle were followed by far-reaching practical measures of compulsion demanded by the rearmament programs, which seized upon craftsmen and small traders as a reserve of industrial manpower, and shifted craftsmen by the thousands to the workshops of large-scale industry.

So it is not surprising to find, even today, craft trends in the methods of apprenticeship. In the first place, they are justified for all crafts which have retained their manual techniques, such as most art and applied art crafts. Bronze turning, the example of which we have quoted, has every reason to preserve unchanged its former training procedures. Elsewhere, curious survivals are discovered in the crafts directly threatened by large-scale industry, which, as they give ground, defend themselves by a kind of nepotism. Thus a “union of carriage workers” was formed, a private group which jealously protects the old crafts of coachbuilder. These craftsmen, who are very skilful, are few in number—some fifty in Paris about 1936—and many of them work (privately) for large garages where they make and superintend all the repairs. “We don’t wish to have apprentices,” one of them said to me: “it is only too clear where that would lead: to a lowering of salaries and the death of the trade. With us the trade is passed on from father to son. It’s for this reason that I myself can build an entire coachbody.” In such old crafts as that of “bootmaker” other instances would be found of this sort of artisan aristocracy, which manifests a lively distrust of workers’ unions and the interests which they defend.

However, it is not easy to guarantee this sort of protection for any length of time. The framework gives way under the pressure of large-scale industry and of economic and technological changes. Training schools for the trade of boot and shoemaker looking to the placement of their pupils, are so conducted as to take these realities into account. The old trade becomes atrophied for want of outlets. Mass-production industry wins the market here, too, and semi-skilled workers increase in numbers. Accordingly, the schools introduce the new machines into the training shops side by side with the old craft

training. In a good school of shoemaking in Paris, real bootmakers are still produced, workers who can make the "uppers" and soles of footwear, who can go from last to shank, and make a light frame, who are both leather stitchers and dressers. They know the secrets of "stretching," the elasticity of leather which is so treacherous for the unskilled worker, and are able to do a complete finished job themselves, a *whole* shoe, fitting the foot's individual contours. The Principal (himself a supporter of handicraft production, like many men affected in some particular line by the dramatic events of a period of transition) told me, "These men are still able to do high-class work and love work that is well done. But the first fool that comes along can use a machine within a week." Accordingly, though he brings into his workshop stitching machines, ruffing machines, etc., he gives no large place to work on machines in the use of the apprentices' time. This only breaks up the operations of manual work and he wants, above all, to make it possible for these young people, eventually, to be at home in a machine shop of large-scale industry, and to be able to "find their way about" there quickly.

Craft influences in apprenticeship have been retained and sometimes even emphasized by the very influences which at the same time were trying to retain and emphasize the artisan sector of production, in the midst of the economic and social difficulties of the period between the wars. In France and abroad, legislative measures ameliorated the financial situation of craftsmen, freeing them from industrial taxation, organizing in their favor endowment funds (such as the *Crédit artisanal* in France) which provided financial advances for setting up in business. Moreover, the law is not too rigid; it does not prohibit the use of machines in artisan firms, for the preparation of raw materials and the finishing of products. In most European countries, "craft renaissance" movements have sprung up, varying according to national temperament and political system. Their effect upon apprentice-training is undeniable: they have contributed towards retaining certain forms of the old trades. Remarkably enough, the Walter-Paulin bill in France (October 3, 1937), which organized artisan apprenticeship, preceded the decree of the 24th of May, 1938, concerning vocational guidance and training in industry.

TECHNICIST TRENDS

These trends which still reflect the techniques of the artisan period

and, under various economic and ideological influences, seek to continue them, are confronted by countertendencies which we shall call, without confusing the two, technicist and managerial.

The *technicist* trends are characterized by the desire to train, as quickly as possible, workers able to carry out the directions on their instruction card. With the exception of a tiny élite of skilled workers (submerged by the prevalent tendency to concentrate the thought involved in work in the Thinking Department), training is supposed to correspond to the new disciplines of "scientific management." Let us at this point recall, for its significance, F. B. Gilbreth's statement: "Training a worker means merely enabling him to carry out the directions of his work schedule. Once he can do this, his training is over, whatever his age."²

We have seen, above, that wherever technicist rationalization has penetrated in a vigorous way, it has deeply affected the old structures of apprenticeship and trades. The technicist spirit (that is, the spirit which sees these human problems of industry from an exclusively or primarily technical viewpoint) as a matter of course tends to reject all types of apprenticeship which still have the spirit of the old crafts, but it also excludes as superfluous and *unrealistic* that apprenticeship which links general culture with occupational knowledge and wastes time trying to acquaint young people with machines not of the latest model. We have frequently observed these opposing trends, for instance, in discussions on "worker promotion." Let us examine what this generous-sounding phrase means.

One of the technicians who have been its defenders in France properly points out that, through the increasing division of labor, industrial evolution leads to the multiplication of semiskilled workers, harnessed to subdivided tasks, which appear and disappear, and are always changing in harmony with the incessant flux of technical progress: "These tasks are always in process of transformation because they are subject to a 'ripening' which leads to their mechanization. In other cases, these tasks are replaced by others resulting from the breaking up of other work."³ Thus is posed the question of the continual re-adaptation of the unskilled worker to his changing task. This "retraining of unskilled workers ought, therefore, to be permanent."⁴ Its duration and cost should be reduced to a minimum. "The worker who had been promoted would be subjected to regrading at frequent intervals and, at least until the age of forty, would have to

renew his training at each successive grade with a definite purpose in view.”⁵

Moreover, the worker promotion movement is directed against the broader forms of apprenticeship. The latter encumbers the workers with “luggage for which they rarely have any use.” Worker promotion would make it possible to “relieve technical education of all useless encumbrances” and “to reduce State expenditure on education.” The worker promotion movement most certainly does not regard apprenticeship as being a combination of technical training and the only intellectual provision with which the young worker is equipped at the beginning of his career. “Man does not live to work but works to live.”⁶

Let me reiterate, at this point, my opinion that worker promotion is the most characteristic of *technicist* conceptions. This utilitarian doctrine notes the disappearance of the crafts and buries with them, for the great majority of workers, every sort of methodical and complete apprenticeship. It expresses the real trend of rationalization and mass production. The aim is to obtain the greatest possible output as quickly as possible from semi-skilled hands doing subdivided tasks. Hijmans mentions operating times ranging from 25/1000 of a minute to five-and-a-half minutes. Thanks to these methods, untrained workers, after only eleven weeks, attained an output of 95% of the “normal” output in the first instance, and of 74% in the second.⁷ These observations, quoted as examples of the basis of worker promotion, certainly prove that the tasks examined in them are subdivided, the first being only a movement lasting 25/1000 of a minute, or repeated forty times a minute—the other, more complex, a cycle extending to five-and-a-half minutes.

Worker promotion is merely a method aiming at an immediate result, that of “regrading” semi-skilled workers as frequently as possible without having given them any fundamental training, which is considered a useless encumbrance. Let us note in passing that it makes no difference to the advocates of this method that the work may be subjectively robbed of all value for the worker. In this sense, this doctrine may be said, from the point of view of apprenticeship, to reflect technicist rationalization very faithfully. It is the latter’s logical complement. The unskilled worker who is “promoted” as quickly and cheaply as possible whenever there is a variation in the subdivided and repetitive tasks, is still only a “well-drilled”

unskilled worker. The use of films in order to utilize the analysis of movements for regrading purposes expresses the desire to eliminate so-called "idle" times, and the preoccupation with maximal speed. The value of the usual methods of time measurement (derived from Taylor), even for the training of ordinary laborers, is well known. Time analysis, as employed in the films used for drilling unskilled workers in repetitive movements, is subject to the same criticism. The idea that in modern industry the worker must often be readapted to technological changes is in itself not unreasonable. But can such a readaptation dispense with a sound, basic training?

MANAGERIAL TRENDS

Other trends, encountered in certain management circles of large-scale industry and which, in this sense of the term, might be called *managerial*, likewise lead to a limitation of apprenticeship.

There is no country in which the State has undertaken the entire task of training workers in schools not connected with business. In fact, private firms are legally required to organize courses in their workshops for apprentices or, as in France, by virtue of the Astier-Cuminal law (1919), to subsidize courses outside.⁸

The decree of May 24, 1938, the most comprehensive in this field in France, up to the present time, provided that all children from fourteen to seventeen years, employed in public or private undertakings, "must receive practical and theoretical vocational training and, in addition, some education in cultural subjects, with the exception of those who have been declared unfit for any vocational training."⁹ Moreover, the French law took account of the degradation of the crafts in large-scale mechanized industry and tried not to lay itself open to critics attacking the increasing numbers of skilled workers who, with their training, had received "useless luggage." Clearly, when determining the number of apprentices to train, one cannot confuse, for example, the tasks of a press-hand with the trade of tool-maker. And so the law provides two "minimum and maximum proportions": the former, in each skilled trade between the number of apprentices and that of the adult workers; the second, in unskilled trades, between the number of children employed (the law does not call them "apprentices") and that of adults from eighteen to twenty-five years of age. Both proportions are revised every five years to conform with technological changes.

But a very serious question arises here. Observation of the training schools organized by large private firms gives ground for fearing that in practice little account is taken of the balance between theory and practice prescribed by the law, and which alone marks a vocational training worthy of the name. Many private firms have seemed to me to find difficulty in reconciling their budgetary needs and their distrust of the theoretical aspects of an occupation, with a "methodical and complete apprenticeship." The economic crisis of 1930, by throwing into unemployment many young people thought to be apprentices—among them numerous wards of the State—showed that actually they were laborers having had only a training limited strictly to the immediate needs of the firm which employed them.¹⁰

This reproach is well known to big industrialists. For instance, after an account of training in the Schneider Works, M. Goineau, representing this powerful firm, tried to convince his listeners that "large-scale industry has not followed an essentially egoistic and utilitarian aim. It has not merely been interested in training workers for its own needs, but has taken care to maintain among tradesmen a high occupational level and a general culture which is indispensable to the progress of industry."¹¹

But the opinion of workers and technicians who have gone through the "special schools" at Le Creusot does not always coincide with the picture which Goineau presents. The programs of these schools, during four years of study, give a mediocre position and rating to general instruction (French, history, geography) and, on the other hand, as early as the second year, show a sharp orientation towards the special needs of the Schneider Works: "Great gaps appear in this frantic instruction: gaps unimportant for the firm but from which the individual will long suffer. The imbalance between scientific ideas and linguistic, philosophical or literary knowledge will tend to increase and make the pupil a worker or technician indisposed to talk, not knowing how to express himself, with a limited vocabulary, no broad, integrated point of view, and no method of work."¹² Let us recall that as early as 1914, Merrheim, the secretary of the French Metal Workers Federation, protested against employers' schools which, sometimes in the guise of philanthropic foundations, exploited children's work, teaching them not a trade but a specialized task, for clearly inadequate wages.¹³

The general attitude of these managerial circles here resembles

that of technicians, though it proceeds in a different spirit. Both tend to restrict training in duration and in thoroughness. I had the opportunity, at the time of the discussion of the decree on apprenticeship,¹⁴ to hear critics in such circles express themselves to this effect. Given the character of most industrial labor, it was useless, people said, to prolong this training for three consecutive years. In the form provided, with its quota of "theoretical" education, it had "elements of no practical usefulness." During this period of time it would be enough to give some idea of general technology and drawing, and not forget the articulation and lubrication of the special machines at which the future unskilled workers were destined to work.

The technicians (who, I repeat, certainly do not have all the engineers on their side) see these problems primarily in the light of the division of labor in rationalization, the multiplication of subdivided tasks and the immediate output from these tasks. The industrialists, opponents of "methodical and complete" apprenticeship, share this view but also introduce other considerations, especially the cost of an apprentice. In addition, there is the desire to train workers who will perform their special tasks promptly, and the fear of paying for the training of skilled workers who might then be "snapped up" by other firms.

This last fear seems to me an important element in the hostility of many employers towards apprentice-training. They cannot even be sure of profiting by the effort to which they have agreed. Here the competition between firms in the same line of production plays a role. An industrialist of the Oise department who made metal coffering for reinforced concrete construction, in order to avoid his regional competitors' "pinching" apprentices trained by him—which had happened only too frequently—split up the training for certain tasks into several parts, so as to adapt them strictly to his own production. For example, in the case of spot-welders, he stopped giving the full training to his workers, and divided the training as the products of his workshops required, in order to prevent his apprentices being immediately useful to his competitors.

TRENDS IN TECHNICAL EDUCATION

Accordingly, the important question is whether the methodical and complete training for the principal industrial occupations, based

on fairly wide theoretical knowledge—which seeks to give a broad occupational culture to the young apprentice—is without *practical* value for the man himself and for a country's national economy, in the existing conditions of modern industry. (Let us disregard for the moment the *human* value of such training, which is obvious.) In order to answer this question we must examine the methodical, complete training where it is given, first of all, in the State technical schools.

These, in France (in 1939), are primarily inspired by the desire to reconcile two trends: the economic tendency aiming at training immediately useful workers who can secure employment; and the “cultural” tendency attempting to win from the years of training a culture which can replace, to the worker's advantage, the “humanism” of high-school studies from which he is practically excluded. These two are mutually conflicting: technical instruction tries to avoid the excess of either and to harmonize them. They appear in programs which combine: (a) a general instruction including very broadly whatever is necessary for workers (courses in French, history, technology and, according to the trades, sciences, decorative composition, architecture, free-hand drawing or draftsmanship, etc.); and (b) a workshop instruction also liberally conceived, which permits the apprentice to pass through the entire trade during his period of study. Generally, the hours of theoretical courses and of shop-work are practically equivalent in number.¹⁵

Should workshop training prepare the young person for the mechanized tasks of large-scale industry? Many apprenticeship masters consider haste in this direction to be wrong and dangerous. And this feeling is widespread, not only among the oldest, who might be suspected of still being tinged with “artisan sentiment,” distorted by their experience of an industrial stage now left behind, but even among the young. They all know and affirm the tremendous cultural value of manual labor, and the qualities of intelligence, reflection, and judgment which it develops. The workshop also aims at developing intelligence. Its problems not merely involve manual skill, as is commonly thought, but also broaden and deepen the intelligence. For instance, psychologists dwell on the importance of attentive perception of an object in the development of mental activity. Thus, few people approved the attempts made—for instance, in the schools of engineering—to reduce the proportion of manual train-

ing and introduce prematurely in its place work on the machines.¹⁶

In the first year of training for turners at the Diderot technical school, the shop hours, about 800 in ten months, are all devoted to manual training, primarily to filing. As a fact of experience confirmed by highly trained specialists, machine work comes easy to young people who have acquired touch, skill, judgment, and quickness of eye from their manual apprenticeship. If, on the other hand, they have been trained too soon for machine work, they balk afterwards at the slowness of execution by hand. How could an adolescent willingly consent to devote twenty hours to work in which he *thinks* that for the future he can get the same result in twenty minutes of lathe-cutting by machine-tools? As a matter of fact (without speaking of hand finishing, required even in much large-scale industrial work), he will never, merely by means of machine-tools, be able to acquire really high-grade skills. If young apprentice-mechanics are disappointed at being placed, not at machines, but at a work bench for long sessions, a beginning may be made by explaining industrial work to them as a whole, having them visit factories, assembly shops and finally despatch departments.

This is the suggestion of Dr. A. Carrard,¹⁷ whose famous training method has incidentally been distorted by certain industrial firms which employ it in a very different "economic" sense from the methodical, complete training which we are now describing. Let us note in passing that even in higher technical education, shopwork retains its importance for developing judgment. David E. Roberts, president of the Institute of Mechanical Engineers, the most important English association of engineers, decries the effects in England of the "cramming system" in the engineering schools and regrets the absence from several years in the workshops of those who would develop there the faculty of observation and the aptitude for making quick decisions and acting in cases of emergency, besides being given the valuable experience of constant contact with the workers.¹⁸

VOCATIONAL GUIDANCE AND ADAPTABILITY

The contrast between a purely technical trend and a more comprehensive one, open to broad scientific and human perspectives, coincides ultimately with several problems bearing on training. The progress itself of vocational guidance has formed part of the effort

to introduce the "human factor" into large-scale industry. It is not my intention in this study to examine it, but merely to consider some of its bearings upon apprenticeship.

The development of the method of tests and the analysis of individual abilities have sometimes, especially in the United States, led to excesses not without their danger. The individual, it seemed, was being considered as an unalterable datum, apart from other individuals and from the realities of the setting in which he is destined to develop and to work and, above all, apart from occupational realities: living and changing crafts, often interconnected, between which the individual is forced to choose not once for all but on several occasions. The analytical research by means of tests, done by American "pedagogues" and psychologists, has a tendency to forget this.¹⁹ Conceived in this way as a rational and rigorous science, vocational guidance has been open to errors and has exposed itself to lively criticism. Clearly, it should not claim to discover in each individual a collection of deep-rooted and unalterable abilities, on the strength of which it would infallibly point to him the only calling to which he is destined, as though by fate.

Vocational guidance can develop and become flexible only by a constant consideration of occupations and of society. A worker's task is not the same from one period of technical, economic and industrial evolution to another; it is different in different types of workshop. Besides, can one isolate an occupation as a self-contained whole, closed and cut off from those about it? Are there not degrees of relationship between craft and craft which vocational guidance and apprenticeship should take into account and which up to now elude a purely analytical definition? Are there not corresponding to them degrees of relationship between abilities which have not yet been revealed, and which the experience of industrial life clearly brings to light? As early as 1930, the International Congress of Applied Psychology at Barcelona had put on its program continuous vocational guidance, taking into account the evolution of tastes and abilities in the individual and demanding that vocational guidance extend over a considerable period.²⁰ A great step forward will have been made, moreover, when systematic consideration is given to the evolution of trades. Here, too, one sees the defects of theoretical research on abilities and tests, which has kept too strictly apart from workshop practice and has thus lost a part of its value.

That industrial life offers a changing reality infinitely more complex than analytic vocational guidance assumes, cannot be doubted from the observations above, brief as they may be, on the evolution of trades. But another element of dynamism is added to this: the transfer of skill, an occurrence which confirms that the question of abilities should be prudently handled, with definite information and discrimination. Vocational guidance can no longer be regarded as the adjustment of an individual to a predetermined trade. We have seen how greatly occupations change owing to the development of technology and of the industrial system, within the framework of which the forces of production operate. I have shown by some precise examples taken from various manufactures (mechanical engineering, textile industries, clothing and food industries), that many trades called by their former names have actually changed their content. Can this surprise any one when he considers as a whole the transformation of the forces of production, the change from craft industry and hand manufacture to mass production in so many fields? The unilateral bond between the individual and his trade, if it has ever existed, has been violently broken. The myth of the individual with a single occupational value cannot be retained as the basis of study or action in this field. The evolution of trades and the regrading of workers show even now the dangers of a vocational guidance and training based on such crumbling foundations.²¹

Indeed, the facts of occupational plasticity mentioned here have attracted the attention of certain psychologists. On the level of manual dexterity itself, phenomena of transfer are observable which must have bearing on occupational life. Thus, as J. W. Cox shows, the effects of training may have repercussions upon other non-exercised activities. When one hand has been trained, the owner becomes more dexterous with the other. The *transfer* of the effects of training is greater if the exercises have been accompanied by verbal explanations teaching the person in question how to work and learn.²²

These still simple, analytical forms of transfer reappear in a much more complex and integrated form at the level of a complete theoretical and practical apprenticeship. Experience in placing pupils, when they leave technical schools in which they have received a complete apprenticeship, shows, first, that thanks to the value of the training, they can often work successfully in trades other than that

which has been specifically taught them. This plasticity sometimes appears even during apprenticeship. In engineering, I have seen many cases in which pupils successfully change their specialty. For instance, they pass from fitting to turning, to machine-tools or pattern-making. In another school specializing in the furnishing industries, young people who have had a three-years' training as cabinet-makers often ask to have a fourth year as wood carvers or upholsterers, intending to learn different trades.

Such passage from shop to shop often encounters resistance from some of the teachers and apprentice-masters who, more or less consciously, are still attached to the single-value concept of the craft, and who fear disorganization of training. But experience shows that whenever it is a question of good students who have assimilated their first basic training, these transfers have given excellent results. I have seen young cabinetmakers become trained very quickly in this way as wood carvers or upholsterers, fitters as turners and vice versa. Manual dexterity, once acquired and reinforced by good theoretical knowledge (design, technology), is easily adapted to other work.

On the other hand, even if this mobility within the schools were resisted, it would reclaim its rights within industrial life itself. There, fortunately, a young man cannot be prevented from benefiting by his diversified training in order successfully to readapt himself to another trade. Among many other examples, I will mention that of a former pupil of the Boulle School who, having been trained as a bronze-founder and goldsmith (trades in which the parallel lathe and machines have a very small part), in a few weeks adapted himself to the trade of setter-up of automatic and semi-automatic lathes in a large automobile works. In the aviation industries, likewise, young cabinetmakers or joiners fresh from their apprenticeship have rapidly been transferred and made excellent fitters.

Such transfers are required by the abnormal condition of the labor market during a period of intensive rearmament, and we do not consider them at all typical. But the results have been so convincing that industrialists have applied directly to trade schools in fields apparently far removed from the trades of aviation in order to obtain the workers they needed.

THE RE-EDUCATION OF
THE UNEMPLOYED

It will cause no surprise to discover, in the occupational education of unemployed workers, facts which show among adults, too, this technical plasticity and these transfer phenomena, which are so important for defining a theory of apprenticeship that is to be both realistic and human.

On this subject, let me begin by some personal observations which I made during repeated visits to a school of occupational re-education organized at Paris by the union of metal workers.

This school, originally created through the initiative of the union and directed by a trained metal worker, Paul Rambert, later benefited from State subsidies and, at the close of 1938, had twenty-odd machines, lathes, milling-machines, grinders, shaping-machines and adjusters. Each day there were in its workshops seventy pupils who were being retrained on machines and at the bench. It trained chiefly aviation fitters and turners, and gave theoretical and practical courses. The unemployed workers came from highly varied crafts.²³ Among them were found former metal workers, fitters or mechanics but also men from trades far removed from engineering—grocers, café waiters, butchers, carpenters, wood pattern-makers, morocco-leather dressers, bronze-workers, engravers, diamond cutters and even an architect's clerk, a stringed-instrument maker and an insurance agent. I will not dwell upon age, though it plays a very perceptible role in re-education, but exclusively upon the level of education.

According to the results observed, the latter does constitute an important element. For the re-education of the fitters and mechanics, ideas of drawing, elementary mathematics and technology were involved. Many unemployed workers found the courses in theory difficult, but indispensable to their training as fitters. The general education which they had hitherto received—and consequently the complete apprenticeship for a trade (whatever it may be)—seemed to be a very favorable preliminary condition, especially for precision work. Moreover, many workers who had obtained their certificate of occupational ability testified that dexterity in the first trade was an advantage in the acquisition of the second, however unrelated that might appear to be. In short, those who had benefited by a good basic education seemed to transfer skill more quickly than the others.

Thus, former electrical workers, joiners, pattern-makers, and cabinet-makers were easily retrained as fitters.

Evidence of the same sort was obtained in other centers, for instance, in the most important of those organized in France under the joint direction of the Ministry of Labor and the Department of Technical Education, the "center of occupational regrading" opened in Paris on April 3, 1939. The first results obtained showed here also that transfers take place with a minimum delay from certain trades to such occupations as workers on a milling-machine, turners or aircraft fitters. In this last case joiners and, even more, cabinetmakers, generally transfer their skill with astonishing speed.

It would undoubtedly be of great practical importance for the reabsorption of the unemployed to make a scientific study of these similarities between trades (without forgetting their steady evolution) on the basis of current experience in retraining in France and abroad. England would supply a rich body of facts.²⁴ In France one might systematically organize the transfer of unemployed workers belonging to trades requiring habits of precision and care, and technical knowledge (such as cabinetmakers, joiners, typographers, jewellers and engravers) to skilled engineering trades in which the lack of skilled labor is felt: turners, millers, boilermakers, draftsmen, and fitters.²⁵ This organization of transfers in a truly rational economy should be the object of permanent action by public authorities, constantly renewed and perfected according to the changes in occupations and the nation's needs.

UNEMPLOYMENT AND APPRENTICESHIP

The study of unemployment statistics by occupational categories (qualitative statistics), in its turn, further confirms the usefulness of a complete apprenticeship, based on sound theoretical and practical knowledge. Actually, in France, these statistics do not cover the whole field.²⁶ Only towards the end of 1937 was the principle of a qualitative census of the unemployed adopted.²⁷ This was first carried out in the department of the Seine which then contained about half the total of unemployed registered in France.

Problems of the skilled labor supply have been considered (especially since the social legislation of 1936) from very different points of view, and in commentaries which were frequently emotional. The interpretations of private industry, of State and semi-public under-

takings, and of trade unions are not in accord. I can make no analysis of them here, though I have sketched one elsewhere.²⁸ There is no doubt that many industrialists have tried to make an anti-union weapon out of the crisis of skilled labor.

From the documents studied, it appears indisputable, in the technical field, that the registered unemployed are (except in industries grievously affected by the depression, such as the building industry) largely unskilled workers, chiefly laborers, or workers thrown out of production and already made superfluous by technological development.²⁹ The case of these last, to which trade-union leaders draw attention, has not been sufficiently publicized.

During 1938 I observed this at the trade-union school for occupational retraining already mentioned. There, in addition to the unemployed workers being retrained, employed workers were to be found, mostly from aircraft factories, who, after finishing their day's work, attended these workshops to improve their knowledge. Several of them had entered industry without having had to pass any serious test, but they might at any moment have to pass it. When questioned, they said that, above all, they wished to gain more precision, lacking which they would prove inadequate and might lose their jobs. If employed workers had to make such an effort, it may be easily imagined how many of their unemployed comrades were made superfluous by technological progress and were incapable of passing trade tests if required. Really skilled workers have to work hard to become and to remain so, unless they want to become useless and be trampled underfoot by technological progress. This fact must be taken into account in interpreting the results of qualitative statistics.

The preliminary findings of the studies in occupational regrading showed that many of the unemployed were not well acquainted with the title of the trade under which they were registered as unemployed. There were very few workers with a high degree of technical ability. These indications were further confirmed by the investigation into unemployment in France undertaken by the *Institut scientifique de recherches économiques et sociales*.³⁰ This investigation, using statistical methods, attempted to determine the skill-levels of the unemployed, and for this purpose compared the workers' wages at the time when they became unemployed with the average wages of the general group of their occupation in the same region. It was found

in this way that the wages of the former were lower than those of the latter, so that it is certain that the unemployed were less skilled workers. A few results are given in the table below, in which the difference from the highest regular wages is marked by D:

<i>Trades studied</i>	<i>D</i>
Fitters and tracers	10%
All metal workers	10
Building workers	7
Woodworkers	11

The investigation also indicates a remarkable fact: the difference, D (except for a deviation in 1933), tended to diminish as the depression continued. That is, as unemployment continued, it gradually affected more highly skilled workers:³²

<i>Year</i>	<i>D for fitters</i>
1931	11%
1932	8.5
1933	11.95
1934	10.4
1935	9.8

This, like the preceding observations, shows that training by a complete and comprehensive apprenticeship frequently provides an effective protection against unemployment, in any case, the best protection the worker has under the economic conditions of the existing system. It allows him to protect himself longer than others in his original trade and, if overtaken by unemployment, to transfer to trades in greater demand with more chance of success.

SCARCITY OF SKILLED WORKERS

With this as a starting point, how is one to explain the scarcity of skilled labor which, contrary to the general opinion, is appreciable in certain branches of economic activity, not only in France but in Germany, the United States, Belgium and most industrial countries? Let us note at this point some of the general conditions of this phenomenon insofar as they are linked with the problems of mechanized industry.

First of all, there are the abrupt variations in industrial activity.

New industries are created, creating a need for new trades. Thus, automatic glass-making reduces the openings in manual glass-making and requires new categories of artisans for the manufacture of windowpanes. Side by side with these changes in manufacturing processes, other fluctuations have assumed a greater and greater importance; such are those depending on the armament programs, the sudden expansion of which involves the creation of new industries, causing sudden hiring when a program is to be filled, and afterwards the equally abrupt discharge of the skilled men who had been attracted. The entire labor market and the problems of trades are, of course, dislocated like the rest of a country's life by so great a diversion of resources and energies towards war industries.

In the national self-sufficiency of the Third Reich, the hunt for manpower assumed the most brutal forms. Under these conditions, vocational guidance loses its human meaning and any other kind of meaning, pure and simple. For instance, authoritarian measures were employed against small shopkeepers and artisans who were accused of having made themselves independent (*verselbständigt*) during the inflation period. They were "shifted" from these employments to industrial trades. In March, 1939, Dr. Muenz showed that since the advent of the new regime, 104,000 artisans had been forced to close their shops, and the *Deutscher Volkswirt* demanded "a new wave of rationalization" by means of which it might be possible to recruit more than 350,000 persons among artisans and small traders, who would be provided with "a more productive occupation."³³

In France, where no comparably radical measures had been taken against the middle classes, it was nevertheless possible to observe, especially after September, 1938, a great confusion in the life of the trades, in which there appeared enormous demands for fitters, millers, turners (and, generally, all skilled engineering crafts) which, thanks to the lure of high wages and immediate gain, absorbed young men sometimes already preparing themselves for other trades. During the "peace economy" it was possible for the majority of the workers of certain industries affected by the depression (for instance, from 1930, the knitted-goods industry of Troyes) to enter other trades. In the far more disquieting case of the enormous armament industries, great difficulties will probably be encountered on the "contraction" of the programs. The above-mentioned remarks make it seem probable that serious obstacles will be raised

against the regrading of young workers who have not had a methodical training and have simply been *drilled* in some specialized operations of one or another war industry.

In addition to these changes, the effects of continuous transformations of industry are felt at the same time. Their importance has been pointed out above in connection with the problem of new skills. In spite of the crisis—and, as we have seen, sometimes because of it—industrial trades adapt themselves to technological changes, to mechanization and to automation. On the other hand, many old trades have declined. Others change their content. These different observations show the dynamic, progressive nature of modern industry, in which the strictly technological fluctuations are complicated by economic ones (depression) and by abrupt changes due to armaments. Only a broad training, in effect, of a multipurpose character, would make it possible to face the complex causes of the scarcity of skilled labor and to reduce them by speedy and successful transfer and regrading. Occupational plasticity must correspond to industry's technical plasticity. The plural values of apprenticeship must correspond to the multiplicity of techniques of the mechanized shop, which is constantly in process of transformation through technological progress.

APPRENTICESHIP AND HUMANISTIC EDUCATION

These realities cannot be neglected by any apprenticeship truly adapted to its purposes and to what is required by young people who expect from it alone their equipment for life. In this sense, a clearer consciousness of the social, economic and technical picture of which it forms a part has been followed in the field of industrial life by a sort of "re-introduction of the human factor" into apprenticeship, which was desiccated by technicist or falsely utilitarian ideas. The beginning of a humanistic development has been perceptible in France between the two wars in the efforts of Technical Education, in spite of the modesty of its financial resources.

Competition between the workshop and general education must lead to an equilibrium between them. The workshop itself is becoming a center of education, for ideas are more accessible and even clearer when they assume concrete, material shape, in the preparation and performance of a piece of work. The workshop's chief

function is recognized to be the development of intelligence. "Almost all the problems presented by the shop are problems of intelligence, so much so that their solution, obviously, leads not merely to the development of a certain manual dexterity but also, indisputably, to a broadening and deepening of intelligence."³⁴

Technical Education must try to reconcile economic and pedagogical requirements. It knows that the trades evolve, that technological and economic transformations are constantly demolishing and reconstructing into new patterns the elements of which they consist. It "rejects the idea of narrow specialization, of a providential, I was on the verge of saying an absurd, alliance between human nature and a trade which tomorrow may not exist."³⁵ It tries, above all, to develop intelligent and instructed youth, with abilities, habits and *general* skills which prepare them for these transfers, the realities of craft existence today and, perhaps even more, of tomorrow. There is nothing more respectful than this technical education as regards man's freedom to work, nothing more hostile to occupational fatalism which lurks beneath certain naively ambitious and pseudo-scientific conceptions of vocational guidance in its early phase. Industrial psychology's genuine research in this field is likewise of incontestable value, and becomes here the servant of pedagogic and humanistic purposes.

In the most serious works of industrial psychology there does indeed appear a very different theory of apprenticeship from that of the technicians. The operations of mechanized industry require a different kind of labor from that of well-drilled laborers. "A fine human organism must correspond to the fine, powerful, complex machine of our day."³⁶ Certainly the new forms of training are not to be confused with those of the artisan period or even of craft work done by journeymen at the beginning of the second industrial revolution. But new forms of instruction are sure to arise, combining in a scientific manner the broad, theoretical views of technology and, on the other hand, practical training, especially education of attention.

For undoubtedly that is the most characteristic feature of the modern forms of industrial work: attention, the effort of which was formerly expressed in free rhythm, is henceforth in many cases more intense, restricted and continuous. This is as true in the semi-automatic as in the automatic machines, in which man's role has

become one of superintendence and control. Attention, prompt decision, with exact reactions and great motor flexibility, distinguish the modern mechanic.³⁷ And, dominating the work of the truly complete worker, these abilities must be supported by theoretical and technical knowledge which enable him to see the machine which he uses as a part of the whole organization of the factory, and to understand the technology of the operation process which he carries out. Furthermore, his transfer to new operations will in this way be easier. Consequently the apprentice deserves to be regarded as a psychological type *sui generis*: no longer a student and not yet a worker.

Such a training implies a new, complete conception of education in which, in addition to the old "humanities," a humanism will be expressed which reconciles culture and work. Gradually, from the close of the nineteenth century, amidst the tumult of the second industrial revolution and the imperious pressure of economic causes, the inadequacies of the old classical education were laid bare, as had been foreseen in France by Rabelais, Pascal, Vauban, Diderot and several others.³⁸ The need was felt for a new kind of education, taking into account both economic and human needs, not sacrificing the body to the brain, not neglecting the fertile elements of the new environment permeated by technology, but trying to control it. To this need, inseparable from the second industrial revolution, corresponds the effort to humanize apprenticeship, some features of which we are examining. What characterizes it is the difficult attempt to respond to the needs of industry and agriculture, to the fluctuating necessities of obtaining employment and earning a living, and to society's needs—and simultaneously to give a real education (not a drill) to produce men. Elsewhere, in lands devoted to the myths of blood and soil, and to the tyranny of the warrior-state, apprenticeship has only molded youth to society's material restraints. The counterweight of free individual culture was lacking.

In an illuminating passage, Georges Sorel remarked that "the modern factory is a field of experiment constantly enlisting the worker in scientific research."³⁹ One must resist routine, always have one's eyes open to technical difficulties and innovations. Invention is the great mainspring of modern industry. The relations between the laboratory and the factory must be intimate. "Our entire civilization is a system of physics, the simplest worker is a physicist," Albert

Thierry remarked. And it was he also who assigned vocational education "the mission . . . of re-establishing in the city-dweller the *fullness of humanity* destroyed by specialization and the machine."⁴⁰

Aspirations towards a labor humanism corresponding to the new material and spiritual needs of the period can be seen in many thinkers of our time. In France they are vigorously expressed in the trade union movement. The American Federation of Labor also, though frequently attached to the privileges of the old crafts, wishes the former, but now inadequate, craft training to be replaced by an educational system which will permit the worker—even when bound to a subdivided task—to understand the separate processes as well as the whole process of production,⁴¹ that is, by a general technical culture which will raise the worker and make "a physicist" of him.

The conflict between economic requirements and individual culture is a constant feature of social life. This conflict, in fact, has constituted a dialectical progression ever since Greco-Roman antiquity, in a society founded on a slave economy, produced a radical difference between those burdened with manual work, those who worked and traded (*negotium*), and those who enjoyed leisure (*otium*) and the comfort necessary for culture. Mechanization has once more deepened the opposition between work and culture, which, in certain of his activities, the medieval artisan had reconciled. The ascendancy of the community over the individual has apparently strengthened these contradictions: the conflict between economic needs and culture is increased in the world of today by that between an education made for society (as it exists) and one made to liberate and dignify the individual. The hopes for a humanistic education look beyond these oppositions to "a state of civilization in which the possibilities provided by technics will become a cultural means for the individual."⁴²

ASPIRATIONS AND REALITIES

Thus, at every point of the horizon, the crisis of skilled labor, commentaries on occupational re-education and regrading, and the polytechnical development of modern industry, show the inadequacies of the old system of secondary education ("the humanities") in a world transformed by technology, and the importance of a broad apprenticeship, both theoretical and practical, which would harmonize economic needs and the hopes of human dignity.

There are men of action, administrators, and writers who understand and wish to assist these trends; we have given significant evidence of that fact. But to what extent are these hopes being realized? What obstacles do they encounter?

In an important report drawn up by the National Economic Council after long preparation and after hearing representatives of all sectors of the national economy, both employers and workers, there is an impartial analysis of the state of vocational education in France on the eve of World War II.⁴³ The Astier-Cuminal law (1919) had provided for training courses which municipalities could be compelled to organize, and attendance at which was compulsory for all young wage earners. As a matter of fact, these courses "are too few. Their equipment is all too often inadequate and they are not regularly enough attended." Technical education has been subject to "apparently greatly exaggerated" attacks. The effort made in France since 1919 to create and develop technical education "has already produced remarkable results, especially considering the paucity of funds at its disposal." The latter were indeed pitifully insufficient for so important a task. In 1938 and 1939, respectively, in France, the appropriation for technical education was 188 and 195 million francs. How, even with the addition of the tax on apprenticeship, could the State by this means adequately assure education in its own establishments, the creation and subsidy of vocational courses, and control of apprentice-training in private industry?

The decree of May 24, 1938, the text of which is strikingly precise and realistic, restates the requirement of "practical and theoretical vocational training, including some general culture" for all young people of fourteen to seventeen years employed in industry or commerce. It very wisely sets out the conditions under which is regulated the minimal proportion of the number of apprentices in each trade involving a methodical and complete apprenticeship, to that of the trained adult workers and employees. This proportion must be revised every five years, as must the maximal and minimal proportion of the number of young people of from fourteen to seventeen years employed by each firm in trades not involving a methodical and complete apprenticeship, to the number of adults from eighteen to sixty-five years. The decree gives the State a hold on recalcitrant businessmen, who have to make an annual contribution of two

thousand francs (1938 equivalent, fifty dollars) for every young person not employed according to the legal requirements.

The timetable of vocational courses must not be less than 150 hours per year. This requires a system of supervision of which the organizational expense would greatly exceed so scanty a budget if attendance were observed and supervised so as to ensure that the courses constituted real education and training. Neither in the State schools—most of them excellent but very inadequate in number—nor in the vocational courses of other schools, can most young people find the complete apprenticeship the need for which is so keenly felt, and which is ever more strongly imposed by technological and social developments. For various reasons touched upon in the course of this study, the State seems to be prevented from meeting one of its chief obligations, the education of youth. The resistance of private interests has often made inoperative arrangements which assume the good-will of the employers and the collaboration of the employees and their unions. The latter, which on the whole sympathize with the attempt at technical education, criticize the “drill” tone given by all too many private firms to vocational courses and workshop-schools. Their distrust—not unfounded, as has been seen—further complicates the problem. The decree of May, 1938, was to have been supplemented by a series of decrees and regulations governing its application which the war made impossible of passage.

Moreover, we cannot emphasize too strongly another, apparently financial, but fundamentally social, aspect of the question of apprenticeship. This aspect is very clearly evinced by the falling off of third-year pupils in many vocational schools and centers. For most working-class families it is a heavy burden, after elementary school, to prolong for four years (including that of pre-apprenticeship) the period during which the young person brings home no money. Now, many apprentices (especially those in training for engineering) can perform work in production as early as the end of their first year of training. Between the wars, moreover, a policy of excessive leveling of wages diminished the incentives, for young workers and their families, of a substantial financial reward which would eventually compensate them for the lack of earnings during the training period. Apprentices saw comrades of their own age, knowing no more or

even less than themselves, already receiving higher wages and enjoying a better standard of living. In these conditions, mass-production shops exert a constant attraction upon them, and thus cause a breaking-up of methodical and complete apprenticeship. In centers where such an atmosphere exists, it is only rarely that more than 25% of the young men finish their whole cycle of training before entering industry.⁴⁴

Thus, in looking at the 1939 results, one should not be surprised to find a disturbing proportion of young men among the registered unemployed. In the first place, the qualitative census of the unemployed of the Paris region (which at that time, it will be remembered, made up about half of all the registered unemployment in France) showed young men of less than eighteen years among the unemployed who received assistance.⁴⁵ A large number of these young men had had no training before registering as unemployed, and the trade which they claimed corresponded to no practical experience, but no doubt simply to an aspiration. These youths were destined to idleness and vagrancy: no employer would engage them while he could find a trained hand among the older workers. If their numbers were as estimated in the labor force statistics, one would be tempted to consider them relatively low. Actually, however, these figures were far lower than the real numbers: "Indeed, it is really a question of youngsters having to register with public employment offices on leaving elementary school, as this was an indispensable condition for their later receiving unemployment assistance."⁴⁶

In fact, the number of young people, whether receiving assistance or not, who had had no apprenticeship was far greater. According to some surveys,⁴⁷ there were in March, 1937: at Alfortville, out of 1,404 registered, 250 unemployed under twenty-one years old; at Argenteuil, 300 out of 2,150; at Vitry, 500 out of 2,500. As for young nonregistered "unemployed" (all whose parents were working and who lived at home), their number, according to the mayors of the communes quoted, was about twice that of the registered young. So there were many young persons considered unemployed, though they had not reached their majority, which in industry is set on the average at eighteen years. These were rejected both by school and by any sort of employment. Yet, clearly it is the school and a broad complete apprenticeship which at this stage should be receiving and preparing them for their adult life.

The employment of young people who have not yet reached their majority must also be considered an undesirable custom. In France, according to the statistics of 1931, there were 2.14% of the youth under fifteen and 13.96% of the adolescents from fifteen to nineteen years among the total of occupied wage earners. How many of this number received any training in the firms in which they were employed?

Yet, even among those who had passed their majority, among the young unemployed of from eighteen to twenty-five years of age, many laborers were to be found who had never had any trade. This age category was well filled and M. Pouillot (1938) estimated it as about 15% of the total number of registered unemployed.⁴⁸ Here, then, was another very important contingent of young men who had slipped through the loose net of apprenticeship and were sadly stranded at the very start of their careers.

This unsatisfactory state of affairs is not peculiar to France, and identical or similar observations have been made in England and the United States.⁴⁹ The French *Investigation of Unemployment* sensibly remarks that these figures are the most impressive because depression first affects the oldest workers. But the young, by themselves, form nearly half the working population. "So the unemployment crisis, while affecting the young proportionally less than the old, has actually affected a considerable number of the former just because workers of less than twenty and of from twenty to twenty-nine years of age make up a large contingent."⁵⁰

In the case of Holland, the problem has been studied closely by Mass Geesteranus, who, on the basis of official figures, estimated the number of young unemployed from fourteen to twenty-four years of age inclusive as 100,000, which corresponds to more than 1.1% of the total number of inhabitants.⁵¹ It is noteworthy that the Dutch government includes all the unemployed of from fourteen to twenty-four years in the category of "young unemployed," whose situation is a matter not for regrading but for vocational training and technical education. A noteworthy fact is that the unemployment of the young (who are at first employed at a low wage) increases at a certain age: "a large number of these young men are dismissed as soon as they reach a certain age, from the industries in which they are employed."⁵²

These facts—which might easily be multiplied—sufficiently show that efforts for a humanization of labor, so thoroughly justified in an

industrial civilization on both economic and educational grounds, meet with complex and profound difficulties of which chronic unemployment is not the least. How are all the young people in a social structure in which hundreds of thousands, nay, millions, of adults are cast out of economic existence through apparently *necessary* and permanent causes, to be given a trade? How can the most liberal efforts here and there make for an apprenticeship worthy of the name? How can an education, both technical and human, be effective in a social structure in which the adolescent and his family must for years display almost heroic disinterestedness and endure great sacrifices and a daily, perceptible lack of earning power? These sacrifices last to the end of his apprenticeship while all about he is enticed, as soon as he has been "licked into shape," by well-paid jobs for common laborers or semiskilled workers, especially during periods of boom production. In these conditions, the pioneering spirits of apprenticeship are building on sand, and their labor is, as it were, undermined daily by the economic exigencies of their environment. The large-scale industries which need unskilled workers for urgent orders, and care as much for "the humanization of labor" as a fish care for an apple, daily entice thousands of youths from their training, by the mechanical action of the laws of self-interest.

Only the State can secure the execution of so vast a plan in the service of both community and individual. But the State could do so only at the cost of a great financial effort and through a vigorous policy which would silence private interest and blind egoism. In spite of the praiseworthy energy which has been displayed here and there, in France the State has not succeeded in this, nor has it done so among the other great Western nations. In this chapter it has been shown that technical education, coming in its turn under the influence of the "human factor," has tried to introduce it into apprenticeship while taking industrial evolution into account. And we have also seen that this attempt at humanization encounters social problems far beyond the scope of pedagogy, psychology and technology, which it would be folly not to recognize.

EVENTS AND TRENDS

SINCE 1945

It is quite true, as we noted in 1950, that the chief elements of the problems dealt with in this chapter, and the direction of their

development, which reflects fundamental necessities, have survived the upheavals of an abnormal period (1939-1945) and, as soon as these subsided, have re-emerged in a very similar form and just as clearly outlined. Nevertheless, it is possible at this time (1954) to get a broad general view of the prolongation of these trends in the postwar period.

Trends among Artisans

Owing to lack of resources, and later to the war and the occupation, the *Chambres de Métiers* were only able to begin their activities under the 1937 Act after 1946.

In practice, since no decrees were issued under Article 2 of the above-mentioned Act, which would have made apprenticeship compulsory in artisan trades, the situation remains confused. Moreover, the Legislature made no special provision for financing the proposals, and the receipts from the apprenticeship tax are very inadequate. The *Chambres de Métiers*, the guardians of the artisan spirit in France, are nevertheless trying to strengthen their position gradually, and in particular, to unify the general rules of apprenticeship which vary from region to region. As the defenders of a liberal and anti-collectivist ideology, convinced that artisans constitute a "factor of social equilibrium" whose independence and basic characteristics it is important to maintain,⁵³ they have to struggle against other tendencies created by the continual progress of industrialization and the spread of modern methods of management and work. Their opponents see in the 1937 Act "a nostalgia for the corporations and guilds of the Ancien Régime." They would not be sorry to see this piece of legislation disappear, and the whole occupational training of French youth codified in a single act. Is it likely that France will remain for very long, in this respect as in so many others, the country of diversity?

Technicist Trends

Technicist trends, of which we mentioned several examples in the interwar period, while they are still active, appear to be declining, at least in their most extreme form. There are several signs of this development, but it is enough to mention here, by way of example, the success of the international congresses devoted to the social problems of Scientific Management held at Royaumont since 1947,⁵⁴ and

the appearance of new attitudes in the training of technicians and engineers.

More and more frequently, conferences of engineers include on their agenda a discussion on the importance of general culture and the need to reconcile this with the requirements of specialization.⁵⁵ Still more significant is the desire shown by the consultative assemblies and public administration to keep future engineers and technicians informed about the psychological and social problems of technology, and to acquaint them with research on the "human factor." In this respect, the opinions expressed by the Economic Council (20th October, 1953) on the training of engineers and junior technicians in France are very illuminating. "The trade of engineer," it says, "while it requires a sound general culture for which the traditional university subjects, brought to life by the spirit of inquiry, are satisfactory, also requires an exact knowledge of technical, economic and human phenomena of the industrial world which present-day education does not adequately satisfy."⁵⁶ The Economic Council also expressed the hope that the institution of probationary periods in industry (private as well as nationalized) for engineering students would become general. In this way, these future engineers, before obtaining their diplomas, would benefit from a training, both vocational and human, in the factory, would learn discipline and would improve their knowledge of working conditions. Neither the system of probation, nor the new educational subjects which we have mentioned, have as yet been generally introduced into the curriculum of the technical colleges, but in the absence of a methodical education, the efforts of trade unions and professional associations in this direction are increasing, and indicate the growth of a new attitude.

It should also be noted that the expression, "worker promotion," as used in certain technicist circles between the wars, has fallen into disuse, and has been taken up in quite a different sense, under the form of "job promotion," by the directors of technical education, as will be seen later.

Trends among Employers

Certain groups of employers, particularly in certain sectors of industry, continue to support the idea of a vocational training reduced to a minimum and directed towards the immediate employment of

young workers in the factory in the normal process of production. In the building industry, for example, such criticisms are often made and are aimed particularly at the low efficiency of young workers who have a certificate of occupational ability when they leave the training centers. Discussions on the industrial diploma (*Brevet Industriel*),⁵⁷ which is considered too theoretical and academic, have been equally characteristic.

But on the whole, it seems that, in comparison with the inter-war period, employers have come closer to the viewpoint of those concerned with technical education who, for their part, have made praiseworthy efforts to adapt vocational training to the actual working methods required of those whom they teach. Thus, both in the training centers and in the technical colleges, it is planned to organize for young workers, at the end of their training, probationary periods of several months which would enable them to get used to the conditions and the rhythms of the workshop.

Moreover, in some branches of industry, such as the chemical industry, oil, and particularly iron-founding, manufacturers actively co-operate with those in charge of technical education, and encourage the training of technicians in the state technical colleges, where the students, thanks to maintenance grants paid to their families, can have the benefit of an extra year of study which enables them to specialize.

Finally, we should note the creation and the development since 1948 of national consultative committees on occupations, which include representatives of public authorities, employers, employees (engineers, managers and workers), teaching personnel, and even the parents of students. These bodies, at present numbering about twenty, constitute, in the industrial sectors which they cover, an obvious place for discussions of vocational training. It should be emphasized that all three union organizations (CGT, FO, and CFTC*) are represented in these bodies—a rare occurrence in France—and that they provide, in particular for the employers, a medium of information, of contact and of communication which has certainly

* [The French labor movement is divided today into these three main groups, the *Confédération Générale du Travail*, the *Force Ouvrière*, and the *Confédération Française du Travail* *Chrétiens*. In terms of political orientation, they are, respectively, under the influence of the Communists, the Socialists, and the Catholic Church.—HLS]

helped to overcome many misunderstandings and prejudices, although there is still much progress to be made.

In the north of France, especially in the Roubaix-Tourcoing area, so-called part-time apprenticeship has acquired some importance. It is also to be found in Alsace in the clothing industry. It comprises vocational training and general education given either in alternate weeks or alternate half-days during working hours, and paid for by the firm. The duration of apprenticeship is at least a year. The trade concerned assumes responsibility for the technical training, which it subsidizes from funds provided by the different industries involved on a sliding scale. General education is given in special centers approved and supervised by the Department of Technical Education. The institutions of this type are administered by an intertrade apprenticeship committee, on which both employers' associations and trade unions are represented, in collaboration with the Department of Technical Education. This system, which meets the needs of employers, especially in the textile industry of the north, might well be extended. So far as the vocational training of adults is concerned, the two most important experiments since the Liberation have undoubtedly been the intensive vocational training scheme, called since 1951 the vocational training of adults, and job promotion. We shall return to these later.

Trends in Technical Education

The Law of May 24, 1938, was never followed by the decrees and regulations which would have given it practical effect, so far as obligatory vocational training is concerned. Only the first section, which established a system of vocational guidance, was applied. The second section fell into neglect. France still does not possess the coherent body of laws which alone would make possible the solution of the economic, technical and human problems of the vocational training of young people. There is here a deplorable legal void. The Department of Technical Education, as well as the trades themselves, hoped for the creation of a Council for Vocational Training, an advisory body in which representatives of industry and of commerce (employers and employees), would take part and which would co-ordinate the organizations concerned with vocational training, which are at present dispersed among several ministries and public or semi-public bodies. An organization of this kind, which would also

study requirements, collect suggestions for the better use of these training centers, and co-ordinate the research and recommendations of the national consultative commissions, working in collaboration with the Higher Council of National Education, certainly seems necessary.⁵⁸

However, despite these delays in legislation and co-ordination, in spite of the damage caused by the war and the Occupation, and in spite of the limited sums of money allowed for the creation of new centers, and the modernization of existing centers, the activities of the Department of Technical Education have grown rapidly. The number of students, which was 68,000 in 1939, had risen to 303,000 in October, 1953, excluding the numbers (approximately 130,000) taking the vocational courses instituted in 1919 by the Astier Law for young people already working in industry or commerce. This increase in the number of students is largely due to the taking over by the Department of Technical Education of 900 apprenticeship centers, which have been added to the existing centers and have had to be integrated into the existing structure, necessitating "a complete revision of aims, timetables and curricula."⁵⁹ I have discussed at some length elsewhere the problems and difficulties of these centers and the efforts they have made at pedagogic reform.⁶⁰ This experiment is still in process of development and it has the greatest importance for an effective and comprehensive provision of vocational training to the youth of France.

Mention should be made here of the important role of the *Écoles Normales Nationales d'Apprentissage* (of which there are five at present), which are at the same time training centers for the future instructors in the apprenticeship centers, and centers of pedagogical research. Equally important for the training of teachers in the intermediate grades of technical education is the *École Normale Supérieure de l'Enseignement Technique* (E.N.S.E.T.), which should be expanded still more to enable it to fill all the vacancies in this field and thus insure the satisfactory functioning of the teaching establishments. A very interesting innovation allows the traditional recruitment by the school, which is by competitive examination, to be supplemented by the nomination (by universities) of graduates who, after some preparation in a specialized center, enter directly on the third year of the E.N.S.E.T. course. This innovation, together with the creation of a technical baccalaureate, which facilitates access to

higher education for the pupils of technical schools, helps to create new bonds between technical education and other types of education. In this way the social and moral prestige of the different types of education, which in France is influenced by so many traditional prejudices and outmoded values, could gradually be altered.

We should not leave the subject of the training of youth without noting an interesting development in the courses of technical colleges, and especially the results obtained by a new method of manual training of fitters by work with the file, which M. Fourgeaud has introduced.⁶¹ Special equipment is used for beginners (shorter files, parallelepipeds already "trued-up"), and enables the young apprentices to become quickly accustomed to this work, which otherwise requires many tedious sessions.

Since apprenticeship is now much shorter, it follows that the objection which was often made twenty years ago to premature machine work is no longer valid. It is quite common to see apprentices begin work on machines as soon as they arrive at the training school, and this has no ill effects on their future skill as fitters. Moreover, the new method has saved a great deal of time. A comparison of the timetables of 1938-39 and 1953-54 at the *École Diderot* (Industrial Section) shows that the time devoted to general education has increased: two hours of French in the second year, five hours of Mathematics in the third year (instead of two), and twice the amount of time devoted to Physics and Chemistry over the three years. On the other hand, the amount of time spent in the workshop has decreased. It averaged nineteen hours a week over the three years of study in 1953-54, as against twenty-two hours a week in 1938-39. This decrease has by no means reduced the quality of the young technicians coming from the *École Diderot*, as is shown by the eagerness of industrialists to obtain their services, and their subsequent rapid promotion.

This replacement of workshop hours by general education, together with the development of general and scientific culture, can be seen also in other secondary technical schools. It reflects the desire to educate a certain number of their students up to the level of the Baccalaureate in technical subjects, and also the general development connected with the progress of modern technology, which leads the institutions responsible for training technical personnel to extend the scientific basis of their education.

In the training of adults, the Department of Technical Education, on the initiative of André Morice, has recently started a new movement, which is called "Job Promotion." This should not be confused with the intensive vocational training (or, as it is now called, the vocational training of adults) which will be discussed later. Job Promotion is directed at workers of all ages and all levels of skill, who are willing to attend, at the end of the working day or during the weekly break, the workshops of technical colleges or of apprenticeship centers in order to improve their skill, with the assistance of instructors from the Department of Technical Education, and thus rise in the hierarchy of skill or widen their occupational outlook. There are various levels of Job Promotion:

(a) An elementary level, attended mainly by unskilled and semi-skilled workers, former pupils of the vocational training of adults program, which leads to a diploma of occupational skill.

(b) An intermediate level, attended mainly by skilled workers, who are preparing for specially skilled jobs and ultimately for courses which would prepare them for posts as foremen and supervisors. This level also comprises the preparatory courses for the higher level.

(c) A higher level, which prepares for specialist diplomas awarded by the *Conservatoire National des Arts et Métiers* in Paris, and its associated centers, of which the first have begun to function successfully at Lyon and at Lille. Others are being established in the large provincial towns, such as Grenoble. It should be added that outside the framework of these "levels," workers who wish to qualify for job promotion are accepted in the centers where courses are held. These centers have deliberately avoided a too rigid system of regulation which might have discouraged men, often in middle age, whose efforts and spontaneous needs for re-education and improvement it is important to respect. It is certainly heartening to see them in the workshops, where they work in their own way, and to observe the devoted assistance given by the instructors. This is a fruitful beginning which deserves support and encouragement by the public authorities.

Problems of Training Adults

Vocational re-education after World War II had to concern itself less with the unemployed, whose numbers were reduced by re-

construction and conversion from war to peace industries, than with various categories of adults, who, as a result of the war and the occupation (Maquis, forced labor, de-industrialization of the country carried out by the Germans), had not had a systematic apprenticeship or, in some cases, any apprenticeship at all. Moreover, the planning authority (*Commissariat du Plan*) which envisaged a large-scale re-equipment of industry, a development of the national economy and of housing, but whose achievements have not yet equalled the original hopes, estimated at 1,300,000 the number of new workers whom it would be necessary to train before 1950, particularly in building, metal trades and textiles. Finally, even in a normal period, and despite the great effort of the Department of Technical Education, its resources do not allow it, as we have already observed, to provide an apprenticeship in its various centers for all the young people who, on leaving their primary schools, begin work in agriculture or industry. In 1947, a report of the Commission on Manpower estimated that of 660,000 young people reaching the age of fourteen each year, 230,000 go into agricultural occupations, where apprenticeship is practically nonexistent, and 260,000 into industrial or commercial firms where an adequate vocational training cannot be provided. Consequently, many of them have a great deal of lost time to make up in adult life.

In these circumstances, the Ministry of Labor has taken steps since the war to establish an intensive vocational training (*Formation Professionnelle Accélérée*), known since 1951 as adult vocational training (*Formation Professionnelle des Adultes*), a change of title which has the advantage of retaining the same initials (in French) F.P.A., which have become well known.⁶² The F.P.A. was intended to provide a supply of new workers to the occupations in which there is a shortage of manpower, and further, to improve the skill of unskilled and semi-skilled workers. This training could only be intensive; in the first place, it was intended for adults who had little desire to spend a long time in the classrooms or workshops of a school, and secondly, since the trainees had to be paid (decree of November 9, 1946), it was necessary to reduce the cost to the state to the minimum consistent with the aims of the project.

Taking these requirements into account, a period of training of six months was adopted as the most satisfactory, though it has been criticized by some experts of the Department of Technical Educa-

tion who consider it too short for turning semi-skilled into skilled workers. Those responsible for the F.P.A. have replied by saying that their trainees, whose ages range from eighteen to thirty-five years, though their general knowledge and manual training are less satisfactory than those of good trainees leaving apprenticeship centers with a certificate of occupational ability, are nevertheless much more suitable than the latter for immediate employment on the building site or in the factory. Be that as it may, there is no doubt that an additional period of training (or nowadays a period in a job-promotion center) is necessary to make an ex-student of F.P.A. into a good skilled worker.

Up to 1951, the financial credits for the F.P.A. were constantly threatened or reduced, and its very existence was uncertain. Its results are limited, as can be seen from the statistics, but they are nevertheless of some interest. They seem to me more important from a qualitative than from a quantitative point of view, thanks to the conditions which the F.P.A. has been able to establish:

(a) A preliminary physiological and psychological selection of subjects carried out by the *Centre d'Etudes et de Recherches Psychotechniques* (C.E.R.P.),⁶³ which was founded in 1937 under the title *Centre Scientifique de la Main d'Oeuvre*.

(b) Taking the maximum advantage of the psychological condition achieved by many adults, in different forms and degrees, i.e., concentration of attention, emotional stability, previous experience with manual work, a sense of reality and a vividly experienced need to get practical results.

(c) The application, carried out by specialized instructors in the workshops, of rational and standardized methods of training. In this case the responsible body, which is also a training center for instructors, is the *Centre National de Formation des Moniteurs* (C.N.F.M.),⁶⁴ which in addition prepares model examinations. Trades are divided into a number of more specialized sections, and in particular the building trade, which is divided into stonemasonry, reinforced concrete, bricklaying, etc. Both in the training of instructors and the elaboration of training methods, the C.N.F.M. has inherited from the organizations which preceded it an outlook largely inspired by the ideas of the famous Swiss psychologist, Carrard.

On February 1, 1951, the Ministry of Labor drew up a balance sheet of the activities of the F.P.A., distinguishing the public cen-

ters (which form the great majority) from a few centers, about ten, which have been created within private firms. This survey showed that there were at that time eighty-five centers for building, and ten for metal working, and in addition, fourteen general centers whose training courses followed the fluctuations in employment. The total number of workers trained between 1945-51, in all the centers, was estimated at 126,000, a figure which I have reasons for considering optimistic.⁶⁵ This is considerably below the requirements drawn up by the *Commissariat du Plan* for the postwar rehabilitation and development of the French economy. But the protests by both employers' and workers' representatives in the building and engineering industries, when the F.P.A. was threatened, and the performance of former trainees in those branches of industry which had priority needs for manpower, showed that the Ministry of Labor was not trying to keep in existence a superfluous department. In 1951, for the first time, the financial credits for the FPA were raised (to 3.5 billion francs) instead of being reduced. The number of trainees increased in 1952 and 1953 (17,000 in 1952). At the present moment (1954) there are still great difficulties in the recruitment of instructors, and in finding accommodation for the centers which are often very poorly housed.

It is clear from the history of the F.P.A. and its problems since 1945, that the direction of its effort has had to be changed, and that this change is responsible for the new beginning which it is called upon to make in the next few years. At the end of the war it was a question of training, or retraining, demobilized servicemen, deportees, former members of the Maquis, etc. In combating unemployment, which is its primary task, the F.P.A. satisfied at the same time the needs of reconstruction. It can, in the same way, combat the effects of technological unemployment, by redirecting unemployed workers to the expanding branches of industry, above all to the "priority" sectors.

This process, when it is a conscious and deliberate policy of vocational guidance of adults, is more in the nature of a "change-over"; this is the second important task of the F.P.A. In this case, it is a question of directing the trainee workers towards those trades for which the apprenticeship of young people does not provide enough manpower. For instance, in France (and I have observed the same thing in other European countries, except Italy) adolescents are

reluctant to train for the heaviest types of building work. It is even noticeable that adults, already skilled, seize any opportunity to leave this work and to enter less dirty and more attractive trades. The FPA, in the building industry, as in engineering, could carry out the important task of obtaining for those sectors of industry which are the most unpleasant and which suffer most from shortage of labor, the skilled manpower which they need. This is, therefore, as E. Rossignol says, "a complementary and not an alternative means of training."

Finally, the F.P.A.'s third group of activities has been to organize the special training of North African trainees, who, because of their inadequate general knowledge (and also differences of language and culture) cannot attend the ordinary centers. Furthermore, the F.P.A. is now responsible for the training of the physically handicapped, and for experiments in the vocational training of prisoners in certain prisons.

Thus the F.P.A., which set out with a specific object in the immediate postwar emergency period, seems obliged to take on, little by little, a variety of tasks of adult training, re-education and reclassification, while continually adapting the subjects of its courses, and its methods, to the manpower needs of industry, needs which are undergoing qualitative and quantitative changes through technological development and fluctuations in the labor market.

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PART THREE

TOWARDS A SOCIAL PSYCHOLOGY
OF THE FACTORY

The Worker and Rationalization

THE EFFORT to introduce consideration for the human factor into the new forms of industrial labor has, therefore, been considerable. We have seen it expressed through a whole range of preoccupations with problems which rightly appear as fundamental: fatigue, rest pauses, accidents, monotony, automation, re-grading and apprenticeship. But even when this effort is supported by the science of the engineer, the physiologist, and the psychologist, it encounters difficulties which are beyond its scope. Hitherto, however, these aspects of mechanization have been examined in and for themselves. It is now essential to point out some characteristic reactions of the workers to the new forms of work and to rationalized industry, and this will lead us to the problem of "industrial relations" through which, to some extent, all the others are reflected.

1. WORKING-CLASS REACTIONS

In Other Countries

In large-scale mechanized industry which was already, in the United States about 1880, on the way towards mass production, Taylorism was the first tremendous movement of rationalization. It offers a typical example (for all the subsequent attempts at Scientific Management derive more or less directly from it) and a starting point from which to recapitulate the major reactions of workers, and to examine their implications.

The Hoxie Investigation, conducted in thirty-five firms designated by Taylor himself, had shown that the first reactions of the American workers were unfavorable and that their opinion of time-study was especially critical.¹ In the words of the American Federation of Labor, "the inhuman and hideous system" called Taylorism after its inventor "reduces human beings to the condition of mere machines."² In time and motion study employers do not clearly explain the way in which the new wages are determined, they "do not open their books." Workers consequently refuse to open theirs, and instead act with suspicious hostility and practice restriction of output.³ In England, following its first application to the J. Hopkinson Works where it was badly received, an attempt was made to introduce the system into the coal mines. The English worker's individualism, very obvious in the old trade unions, at once made itself felt.

In a personal investigation, J. H. Mitchell, a miner who had worked for seven years in the same mine, pointed out the chief stages of this evolution.⁴ Mechanization, he says, has the effect of concentrating technical responsibility for the work in the management and the offices. *Laissez-faire*, hitherto practiced by management, thus becomes impossible. But the worker is badly managed; the independent miner with his pick gives way to hurried and over-worked groups. A narrower form of solidarity then makes its appearance. Mitchell regrets that the engineers and foremen, interested only in technical matters, pay no heed to the human aspects of the evolution towards mechanization. Among the new features of work he notes the increase in the number of accidents caused by the difficulty of using machines in narrow, ill-lighted spaces, the danger of short-circuiting and fire, and the discomfort of noise which is worse in the mines than in most factories. As in the past, the miner needs to be on the alert for the noises which indicate to him the condition of the roof, but this becomes much more of a strain with the advent of mechanization. If necessary, the miner can, of course, stop the conveyor, but he fears his comrades' ridicule and his employers' displeasure. His nervous strain is thus increased far beyond that of a surface worker.*

Hostility to the division of functions introduced by Scientific Man-

* [Cf. the comparison of the work situations of surface and underground workers by Alvin Gouldner, in his *Patterns of Industrial Bureaucracy*, The Free Press: Glencoe, 1954.—HLS.]

agement is perceptible in all the evidence given by English workers as to their new conditions of work. Instead of widening the gulf between management and shop personnel, one of them remarks,⁵ suggestions should be encouraged, and information spread in the factory as to the financial and commercial conduct of the business. Here we recognize the American workers' claim (the employers should "open their books"), reflecting the workers' mistrust and the internal contradictions of the firm. Another worker, Watson, an old mechanic, reproaches Taylorism especially with having taken from the worker the responsibility for *his* tools, and *his* machine. Of course, each machine cannot become the monopoly of a single worker, but he comments that the machine belonging to no one is usually in poor condition. The new organization likewise gravely misjudges worker psychology when it takes from the worker the means of sharpening his tools himself and the right to be the only one to use them.⁶ The demands of Mitchell and his comrades are not revolutionary; they aspire to a co-operation springing rather from a reformist, sentimental brand of socialism. At the same time, they are significant for their denunciation, as a fundamental error, of the workers' non-collaboration in Scientific Management.

Workers' reactions to mechanization have been most thoroughly studied in the mines. On several important points the observations of German miners agree with those of their English comrades.⁷ The mechanization of the German anthracite mines took place very rapidly. In 1913, 95% of production was done by hand or by the use of explosives; in 1926, machine production had reached 67%. The miners, especially the older ones, did not take well to the change, and complained of physical and nervous tension (noise, and sustained attention). But the reactions are complex: when the miners may choose between the pick and the pneumatic drill they do not reject the latter; indeed, they even protest when it is proposed to deprive them of it. The same holds true for the conveyors; the miner is hostile to their introduction, but also to their abandonment. To the psychologists who examine these reactions, they appear rather mysterious. But they become clearer in the light of later observations. The miner, even if he is not personally affected, recognizes that the machine deprives many of his comrades of employment; he cannot regard its appearance with favor, though he primarily suspects its economic effects and not the machine itself. He does not feel that

he derives his full share of the benefits of rationalization. His wages are raised, but not proportionally to his effort. There is a basic suspicion, the echo of which I have personally heard in the Paris region (metallurgy), at Lyon (weaving), at Saint-Etienne (arms and bicycle factories), at Grenoble (glove-making), at Lille, Roubaix and Sedan (spinning and weaving), whenever I could discuss these questions informally with workers who had experienced mechanization and speed-ups.

Thus is explained the fact, reported by the German inquiry, that workers often seek rationalized factories; they are drawn by the increase of wages, in spite of the extra effort demanded of them. Among the advantages of mechanized mining, miners stress the increase in the volume of air and the satisfaction in working in groups in which tasks are divided and distributed. Some value the physical assistance brought them by the machine and also the relatively greater safety. In the mines, for instance, the pneumatic drill has minimized the use of powder and the danger connected with it. It has also diminished the coal dust flying about in the galleries. But such advantages are far from being recognized by all, owing to a latent economic suspicion.⁸ This investigation, to which I refer for details, shows with striking clearness in the example of the coal mines the complexity of the factors influencing the workers' reaction to the machine.

Among French Metal Workers

The same complexity is found throughout the successive reactions of French metal workers at the time of the first experiments with Taylorism in the Paris region. We have already mentioned the methods used in a large factory at Boulogne-Billancourt, in which time fixing was based on the operating times of workers especially chosen for their skill and working under more favorable conditions than those of the workshop. On December 5, 1912, a strike broke out at the Renault Works. On the advice of A. Loyau, secretary of the Engineers' Union, the workers drew up a regulation which approximated the working conditions of the time-study man to those of the worker; the time-study man's operations would be checked by the foreman of the shop where he worked and by the foreman of the shop where the parts were fitted. Two workers would participate in this check. These propositions were accepted by the management,

but in practice, the workers said, nothing was changed.⁹ The "pace-setter" continued to make only one part in the series, and was relieved from going to the different offices and storerooms to get his materials and parts, which allowed him to gain time. Everything was prepared for him and placed within his reach. He was provided with special steel, and new freshly ground tools. This is how an active trade unionist, J. Couergou, then a worker at the Renault Works, reports this strike. I will give extracts from the vivid account which he sent me:

"Towards the close of 1912, the factories, five in number, took up a good deal of space. Two others were under construction, a coach-building shop and a foundry. Nearly 4,000 workers and clerks were employed there. In spite of dismissals and victimization, their morale was rising.

"In the sheet-iron and tin-plate shops more than 50% of the workers were organized, had formed shop committees, and had several times successfully resisted wage reductions. The turners began to organize. Among them were advanced elements, and spying was decreasing, when in December, 1912, the employer, who had sent two engineers to the United States to study in the works of the United States Steel Corporation the principles of 'Scientific Management,' tried to apply these principles to the Billancourt works. The workers rose *en masse*. The strike did not last more than two days, if I remember rightly, and the employer yielded. Committees of delegates like the one in the shop for manufacturing tanks, radiators and sheet iron, were formed in the other departments and recognized by Louis Renault.

"In February, 1913, Renault, in violation of his promise, again tried to apply the Taylor system in his factories and refused to talk with the workers' delegates. At the same time, an article which appeared in the newspaper *l'Auto* told the workers that the use of Taylor's methods in American factories had resulted in overcoming the housing shortage by allowing the worker to occupy in a very short time those places of rest, the cemeteries.¹⁰ The application of a system which was to bring them quickly to a premature death was not to the workers' taste and they abandoned work *en masse*.

"The strike lasted five weeks. It was led by the secretary of the engineers' union and by the present writer, at that time secretary of the tin-plate workers' union and of the inter-union committee of the

Seine metal workers union. Understanding, as Marxists, that the application of such a system in any factory threatened the whole proletariat, we toured the Paris region with the members of the strike committee, holding meetings almost every evening, at the gates of the factories, in the great industrial centers, to prepare our comrades to resist the application of a system, the purpose of which is clearly set forth in F. W. Taylor's works.

"The struggle was violent; strikebreakers came from various parts of France, especially from Le Havre. *Agents provocateurs* got into our gatherings. They were discovered and had to flee. Only lack of funds prevented complete victory. The Taylor system was beaten but the workers were its victims. Some of them, including the militant leaders, were not re-employed."

Reading the commentaries on Taylorism of Alphonse Merrheim, secretary of the Metal Workers Federation, one feels that, in spite of the lack of accurate knowledge of the details of the system, the workers' instinct was not deceived as to the effective use of this method by capitalist rationalization and its long-term implications. "As is seen, the worker's personality, intelligence, even his desires, are effaced, annihilated and driven from the shops and factories. All his thought, all his movements, are molded, and constantly fixed on the tool and the movements of the machine at which he works, or of the muscular labor which he is performing. The worker is intended to become, and has become, an automaton governed by the automatic movements of the machine and supplementing it. His personality and initiative are intended to disappear; they have done so. He is no longer anything but a supplementary wheel, indispensable to the task or to the machine performing the work. What does his day-to-day physical condition matter!"¹¹ Merrheim, analyzing the causes of the Douai and Billancourt strikes, is aware of the argument used in favor of the system by its advocates: that strikes break out when the industrialists fail to take the precautions prescribed by Taylor and are, in fact, called forth by counterfeits of the true method. But, Merrheim asks, "is this not perhaps a simplified statement of capitalist practice? Anyway, the method, as we have seen, is no better than its imitations: it springs from the same barbarous, inhuman spirit, unworthy of men who claim to be civilized." And to one of the chapters of his study Merrheim gives the title: "Labor despised and degraded." These lines were published (*La Vie ouvrière*, March 5,

1913) shortly after the beginning of the second Renault strike, February 10, and while it was still going on.

At that time, unionism was little developed in the metal industry, and Merrheim returned depressed from Douai where he took part in the strike. The industrial system engenders and disseminates among the working class both corruption and poverty. The employers deceive the workers, "playing upon their ignorance and constantly removing from them any one who might enlighten them." Work of the kind done by such laborers and disfigured by experiments like Taylorism, "is not the kind of work that Zola acclaimed, but slavery."¹² This will merely aggravate the struggle between employers and workers and make the collision of their interests even more violent. And since, in the violence of the militant worker, passionately devoted to his comrades' cause, we see reactions typical of working-class mentality, I think it useful to quote this further passage from Merrheim's conclusions:

"How can it have been thought that unionism would ever tolerate the Taylor method?

"What does this method do? What is it intended to do? Is it not clearly the sharpest expression of capitalist disdain for the working class? Instead of restraining the lower instincts of individuals, appeal is made to their appetite for gain. Instead of developing the spirit of co-operation, the attempt is made to destroy every thought of solidarity among the workers. Instead of increasing their scanty initiative they are told: become machines. Instead of using individuals according to their qualities and abilities, every producer of average quality is discarded in order to use only brutes. In short, intelligence is driven from the shops and factories. There are to remain only hands without brains, flesh-and-blood automata adapted to iron-and-steel automata. If that is what is called progress, we must be opposed to this form of it. But it is not progress. The use of the Taylor method can only set the interests of employers and workers against each other and make more embittered and even more violent the fight of the exploited against the exploiters. The workers not only have to defend themselves against the theft of their labor; they have to protect themselves from physical decay and preserve their right to be human beings endowed with intelligence."¹³

Equally indignant and critical opinions may be found in Emile Pouget (an anarchist by origin), the famous pamphleteer of "*Père*

Peinard," who, since grown wiser and more accommodating, was well known even at that time for his level-headedness.¹⁴ Pouget studied the question less closely than Merrheim, but denounced just as vigorously "organized overwork," and the degradation of work and of the worker: "Yes! It is time indeed to encourage initiative, to promise skill and rewards . . . when you have already turned the worker into a brute and moron and reduced him to being only the extension of the machine which he must run blindly and ignorantly!"¹⁵

These opinions of workers, formed in the midst of conflict, stressed the *sweatshop system* and (understandably enough) overlooked the positive aspects of Taylorism in the technical field as an effort for more accurate and rapid production. They did not distinguish clearly between certain progressive suggestions of Taylor and the characteristics of the capitalist system which was exploiting them. They rejected everything at once, the valuable elements as well as the cruelty of their application. The result was controversy within the labor movement.

A militant worker of Roanne, Ravaté, wrote in *La Vie ouvrière* defending Taylorism against certain of Merrheim's accusations.¹⁶ Fundamentally, he said, Taylor has merely applied the general principle, "Go straight to the goal with the least possible trouble," and he made the following remarks which are, in my opinion, very sensible: "Trade unionists cannot be opposed to a better employment of human energy in production. On the contrary. Then why take up arms against certain principles? We might as well give up machinery. The whole argument against the Taylor system could be used, and was used, against machinery at the time of its first appearance, but my trade union ideal is not a return to nature." In short, Ravaté reminded his readers that present-day society abuses mechanization, but that the latter itself is not responsible for this fact and must not be repudiated because of it. It is the abuses, and the circumstances which create them, that must be fought.

From certain points of view, these reflections were rather vague, but they induced Merrheim to modify his opinion in a new study of the Taylor method (April, 1914). At the conclusion of this article he wrote, "We have reached a stage of industrial evolution which makes necessary new methods of production and work."¹⁷ He thus recognized that "Taylor's merit is to have understood that it was necessary at this new industrial stage to adopt some new methods."

He dwelt on the necessity of training a body of competent personnel for the application of Taylorism and noted that "up to the present, engineers, on leaving their technical schools, are, above all, 'theorists' who have no real competence in the profession they are taking up."¹⁸ Merrheim thought that technical education would incline towards the training of specialists, of planning engineers, of time-study engineers, of "pace-setting" workers who would serve as a foundation for the time-study of subdivided movements. He feared that an even stricter and more cruel system of exploitation might ensue than under the system of craft work or small-scale production. But behind this still vigorous hostility, there appeared in his thought a distinction between the substance (which was valid) of certain technical suggestions of Taylorism and the use of the new methods by employers in the present conditions of the firm and of private profit. No doubt he had taken into account such criticism as that of Ravaté, which made him realize that a wholesale rejection, turning its back on technological progress, could not be in the line of advance of the labor movement.

Distinction between the Machine and Its Use

At the end of World War I, organizations of a reformist tendency, fascinated by the prosperity and high wages of the United States, were tempted to give the workers a share in the benefits of rationalization. The ideology of certain leaders of the Second International, entirely won over by rationalization of the American type and convinced that it was a genuine stage of social progress, had an influence on the union leaders.¹⁹ In the United States, after Taylor's death, the evolution of the American Federation of Labor (A.F.L.) was rapid and typical. The results of experiments in worker collaboration undertaken, from 1922, by the Baltimore and Ohio Railroad and then by other railway companies,²⁰ and the clever propaganda of the Taylor Society, both contributed to convince the doubtful. Gompers, president of the A.F.L. and his successor, Green, declared themselves in favor of intensive production. With the Taylor Society presenting "scientific management" basically as a task common to owners and workers, which could not succeed without their collaboration, the A.F.L. defined its official attitude and on December 3, 1925, its president, at a reception given by the Taylor Society, declared: "The A.F.L. recognizes that the worker's

welfare depends on the efficiency of management.”²¹ Reformist trade unionism took up a similar position in Europe and the French C.G.T., under M. Jouhaux’s influence, declared that the workers were willing to collaborate in scientific management with the object of increasing productivity.

But really to understand the spirit in which the skilled workers of the great union organizations interpret the collaboration and rationalization sought by capitalist industry, special inquiries must be made. The worker must also be situated in a psychological environment where he chooses, and is able, to express himself with some degree of frankness and freedom, and this is far from always being the case. Such conditions are most nearly approached in informal meetings with skilled workers. During discussions of this kind on the eve of the second world war, skilled unionized workers, tool-makers, mechanics, and engine drivers, gave the following expression to the psychological assumptions of workers’ collaboration with scientific management.²²

Above all, the worker does not want to be asked in the factory for anything but his occupational value. He demands entire liberty in everything else. In particular, any attack on union freedom is very keenly resented and endangers any chance of co-operation in the progress of the firm. The loyalty of the worker élite to its organizations, and especially to the attempt at occupational protection and training made by the *Bourses du Travail*, is very keen and punctilious, and many technicians (not to mention the employers) still make the mistake of underestimating its importance in the daily life of the firm.

The business head must make his impression not by threats and sanctions, but by his technical and human value, his authority. His action must be exercised without either brutality or weakness towards the worker, but through persuasion. The worker would like, when he desires it, to be able to talk freely to him. Favoritism in the choice of foremen should be excluded, and the wishes of the delegates chosen by the workers should be allowed a considerable influence. As for the worker’s share in the life of the factory and his acceptance of the rationalization of production, this is inconceivable unless the management first shows its confidence in its employees. “Trust begets trust” is a phrase often on the workers’ lips. But, they say, everything again becomes uncertain as soon as the worker perceives that an attempt has been made to exploit or to deceive him. Thus, he

will never consent, during a change in the mechanical process of production, to see his piece-rate cut down or his total pay decreased on the pretext that the machine's yield has become more rapid or that his own new tasks are less skilled. Are steam locomotive drivers to be paid less if the line is electrified, on the pretext that it is easier to run an electric machine? "We are not the ones," a speaker said, "who should bear the cost of technological progress."²³

Though such discussions still show that, on these questions, the minds of certain skilled workers are not completely clear or free from illusions, the difference between the *possible* value of rationalization and its *real* dangers in the social framework of capitalism has been increasingly recognized in Western trade unionism between the two wars. Conversely, fewer and fewer traces are found of the old worker distrust of the machine, considered as an enemy. I still found evidence of this "Luddite" state of mind in February, 1935, among textile workers of the Lille region where the introduction of continuous frames by the owners of spinning mills had caused a sudden increase in unemployment. Then, on several occasions I heard: "The machine is our enemy"; "The machine is killing us!" But the workers who cursed in this fashion were not, as a matter of fact, militant members of the labor movement. On the other hand, at the *Bourse du Travail* at Lille, at the same period, I found that the difference between the machine and its conditions of exploitation was clearly understood.

Leaders of the "united" C.G.T. (General Confederation of Labor) often quote the attitude of the Russian revolution with regard to mechanization and rationalization. The best informed of them refer to Lenin's famous statement on Taylorism in which he demanded that "the Soviet Republic adopt any technical suggestion of a scientific character which promises to be of any value" and pointed out the combination of progressive elements in Taylorism with a subtle exploitation of labor power.²⁴ In 1934 and 1935 I took part in far-ranging discussions of these questions among skilled workers, smelters and fitters of the Citroen automobile works.²⁵ Their attitude towards technical progress was thoroughly alert and positive. They reproached the management of their business for not carrying out an intelligent rationalization of workshops, especially as regards three points:

1. Working methods were not studied thoroughly and in collaboration with the workers.

2. Men belonging to the various teams were not selected in such

a way as to work co-operatively with one another; they were constantly moved about in the shops, from one machine to another.

3. The instructions of the planning department, worked out and imposed from "above," did not make possible the best use of the shop machines as to precision and speed. But on this subject workers did not conceal the fact that they avoided contributing to the management their quota of suggestions and improvements, for these, they declared, might be immediately turned against them through an intensification of work unaccompanied by a corresponding rise in wages.

This last remark is of the greatest importance and is, as it were, a *leitmotiv* of workers' reactions to rationalization by management. It stresses again the essential problem of participation by the worker.

Favorable attitudes towards scientific management increased in the French labor movement after the adoption of the social legislation of June, 1936. In a detailed study of these questions, one would have to show the propaganda conducted by trade unionists in favor of rationalization and mechanization in order to increase hourly output, and to combat the arguments of the adversaries of the forty-hour law who were complaining about the decline in total output. In an interesting inquiry entitled, "Produce more? France can do it, but how?," Chevalme, federal secretary of the Metal Workers Union and member of the National Economic Council, replied in October, 1937, by a series of suggestions concerned with better technical organization in the iron and steel industry, and decrying the inadequate use of existing equipment. As a whole, the investigation tended to show that large firms "can very easily finance a modernization of equipment which would make possible an increased production beneficial to the nation."²⁶

This favorable attitude towards progress in equipment and organization does not prevent strikes from breaking out whenever too brutal an attempt at rationalization is made. This is particularly the case in many firms which have attempted to introduce the Bedaux system. The Bedaux Company (named after its founder, a French-Canadian resident in the United States) claims that its engineers, sent into the workshops themselves, can determine the amount of "normal" work which should be performed by each worker. The unit of measurement to indicate this quantity is the "Bedaux" or "B." A "B" is a fraction of a minute of work plus a fraction of a minute of rest, in

different proportions according to the nature of the task.²⁷ In other words, it is the labor which a "normal" worker can perform per minute under "normal" conditions of installation and equipment. The company maintains the strictest silence as to the procedures by means of which its employees determine the quantities of each kind of work which may be demanded of each worker, in each task, and as to the physiological guarantees against overstrain. A comparison with jobs studied scientifically by psychologists suggests that the calculation of speeds and of the "rest factor" by the Bedaux engineers is not much better than the gross empiricism of the first "laws" enunciated by Taylor.

Anyway, it is a fact that in the companies where the Bedaux experiment was tried, the workers' reaction was on the whole very unfavorable.²⁸ I was able to verify this at Birmingham in 1933, in an important machine shop in which a strike occurred. The workers were made particularly suspicious by the mystery enveloping the procedures which were imposed upon them, without any satisfactory explanation (the management itself claimed not to understand them). The trade unions have published several critical reports on the Bedaux system. They especially state that the distribution of bonuses, as used by Bedaux (25% to the foremen and supervisors) is open to criticism and very dangerous. It is extremely likely to lead to forms of intolerable pressure on the part of the foremen who, stimulated by gain, urge the worker to excessive output. The reaction of the German unions was no less violent. In Italy, the directors of the Fascist trade unions had to show their opposition to a system which, by their own admission, led to the discharge of workers over forty years of age. In France, strikes occurred on several occasions, marking the workers' distrust of the "secrecy" of the Bedaux system (for instance, in December, 1937, at the Goodrich works, where the workers complained of being unable any longer to calculate their pay exactly and of finding their wages reduced without the possibility of appeal).

In the evolution of workers' reactions to technicist methods of rationalization, the basic fact seems to me to be this distinction which is gradually gaining ground (though even today it is far from being clearly accepted by all workers), between the machines, as *instruments* placed in their hands, and the often distressing consequences produced by the *use* of machines under the present industrial sys-

tem. I have dwelt on the example of Taylorism, for it seems to me to have aroused typical feelings. In it one can see the point at which the militant workers overcome the impulse of fear and hate which, ever since the time of the Lyon weavers and the English Luddites, has always been the worker's first reaction to the dangers and hardships brought by machines. A close study of the worker's conscious state of mind in his relation with machines should be made. This would also make it possible to assign proper importance to the factor revealed during this study by so many data: the distrust of rational organization of techniques made by the employer, a distrust which is all the greater because the worker feels that they are imposed upon him by the management and its collaborators. Since he has no share in rationalization, he may the more legitimately suspect that it will increase the effort required of him without compensating him, in return, by a corresponding increase of wages. From this point of view, Taylor, though at first he tried to be a technician devoted to promoting the general welfare and the co-operation of all, himself committed a basic error by deliberately preventing the co-operation of the workers in the planning and preparation of rationalization. His famous reply to the worker Shartle is well known: "You are not supposed to think. There are other people paid for thinking around here."²⁹ But Shartle, who at that time represented tens of thousands, nay, millions of workers throughout the world on whom were soon to be imposed the same grim necessities, would never admit that he had lost the right to think.

2. OBSERVATIONS OF INDUSTRIAL PSYCHOLOGISTS

Several of the chief themes which we have just seen directly expressed by the workers are also found in the psychologists' study of workers' reactions to rationalization.

A complete survey of these scientific works should start with research bearing on exclusively psycho-physiological reactions, but these have already been presented in the chapters on the human factor, and will not be mentioned here except to be given their place in this new context.

Subjective variations

It is generally agreed by industrial psychologists that rationalization applied regardless of the worker's psychological reactions finally

causes events unfavorable to output itself, whatever may be the value on the purely technical level of the methods and arrangements introduced. Thus an excessive division of labor, even if it results in an immediate increase of output, eventually harms what may be called the worker's occupational constitution, making him lose all sight of his work as a whole, and leading him to boredom and to a feeling of having had enough, and, more than that, to pathological phenomena that will be mentioned below.

Nevertheless, concerning the psychological reactions of the worker to mechanized and repetitive work, it is proper to recall the wholly subjective and relative nature of the idea of monotony. A complicated task, if repeated, may eventually seem "monotonous." Conversely, as Munsterberg had already observed, simple tasks do not seem "monotonous" to all workers without distinction.

Monotony is not an objective characteristic of a certain task but a subjective part of the reactions of the workers to rationalization (varying according to individuals or, rather, according to certain psychological types). This is why quite a number of workers react to mechanization by giving up the attempt to find intellectual and moral satisfaction in their occupational activity. Such types prefer uniform tasks which do not require any intellectual effort, but allow them to think of something else. They do not suffer from the uniformity of a task unless it simultaneously (usually to assure their own or their comrades' safety) mobilizes their attention. For them *the environment* of labor, and especially agreeable working companions, are very important.³⁰

The attitude of workers who belong to this psychological type to the prospect of a change in the technical process of work is therefore, *a priori*, negative. They dislike any change which alters their routine and for some time, at least, forces them to think of their work. It is interesting and, at first sight, paradoxical, to note that all measures of rationalization in large-scale mechanized industries encounter an initial hostile reaction on the part of what is often a large proportion of the working personnel. Of course, this psychological reaction is connected with an industrial system in which the worker receives his orders from above and submits to them without sharing in their preparation in any way.³¹

On the other hand, workers who belong to a different psychological type, and who cannot dispense with the use of their intellectual facul-

ties in their work, still show an appetite for change. They seek and find elements of variety in work which, viewed from outside, seems uniform. They even introduce them whenever possible. Such types tend to give a positive reception to every change in their process of work. But here, too, the purely psychological reactions must be seen in the actual context of industry and, in the present case, they are offset by the feeling of distrust which, in the face of a rationalization coming from above, and outside the control of the workers, leads the latter to see behind every new technical process an intensification of work, and therefore an increase of fatigue uncompensated by a proportional rise in wages.³²

Among many workers, even those whom the social and industrial state of affairs makes content with the degradation of their occupational activity, observers note unfavorable effects on the physical and mental constitution, effects which cannot be separated from the workers' reactions to rationalization as they appear in inquiries conducted by the social sciences. In large towns the average worker in rationalized industry feels keenly the diminution of his importance as an individual, and his vital tone (*Lebensbejahung*) suffers from this. A sort of stunned condition appears even in leisure time, and the worker loses his ability to enjoy in sport, play, and reading, compensations for the mechanization of his occupational activity. Among the 1,200 women workers in a biscuit factory, although 75% of them had had a good elementary education, 89% admitted that they read nothing but women's magazines and pornographic literature.³³ Among men, an observer notes in the United States, a decline is apparent in serious interest in public affairs.³⁴ Also, the turning point in the worker's curve of occupational activity in terms of age has shifted: whereas before the war of 1914 it lay, in Germany, for instance, in the neighborhood of forty years, this age limit (at which point the worker in large-scale industry deteriorates, earns less, and is often diverted to less important tasks) has clearly been lowered.

Among workers engaged in repetitive and mechanized tasks, a greater and greater number of those not adapted by their psychological type to this sort of work show signs of psychological disorganization and disequilibrium. It is among them that investigations and statistics show the diffusion of pathological phenomena: psychasthenia, neurasthenia, and "nervous depression." In Germany, the Reich Ministry of Health, in its report of 1928, noted an increase

in the number of cases of neurasthenia and of illnesses designated by this name.³⁵ In a highly mechanized American factory of the Worthington Pump Machine Corporation, the proportion (computed as a percentage of the total annual number of workers absent for sickness) of illnesses designated as "nervous depression" increased between 1926 and 1929 with the intensification of rationalization: 1926-12%; 1927-18%; 1928-29%; 1929-34%.³⁶

It is clear why psychologists and psychiatrists like Vladimir Eliasberg, concerned with these numerous indications of psychological disorganization connected with occupational activity, have been tempted to draw up a complete pathology of work, interpreting industrial phenomena (especially disequilibrium and conflicts) by the notions of inferiority complex and "resentment," the latter borrowed from Nietzsche and, above all, from Max Scheler. Among the grievances which the workers feel against rationalization in the conditions of capitalism are some with objective grounds, and others that are subjective. Thus, when the worker feels tired or exhausted, an element of his feeling is the idea of "exploitation" which involves that of being prematurely worn out. This subjective feeling precedes the objective reality of physiological exhaustion. In other words, considerations of an emotional character (themselves associated with ideas which have a social origin) in practice cause an inhibition of activity. With this feeling of being exploited (itself an expression of resentment) must be associated many industrial conflicts and, on the individual level, neuropathic disorders: "We see," Eliasberg writes, "among the effects of the phenomenon of dependent labor [that is, rationalized labor at an obligatory rhythm—G.F.], a hypersensitivity, a complex of distrust, fear and explosiveness; we see how relations between the members of industrial society harbor poisons and how, in social struggles, the conflict is often much more for prestige than for real gain. We see an infinite anxiety, an excessive need for security; all of which undoubtedly proceeds from a feeling of weakness and resentment."³⁷

If this interpretation of social disequilibrium and conflict in industry in terms of a "resentment" complex, which intervenes as a permanent and latent psychological factor, actually has explanatory value for certain behavior, it should not be overestimated and should not in any case prevent one's taking into account objective elements springing from the real, everyday conditions of industrial life. Among

these the foremost are worker reactions to the rationalization of times and wages, and to certain initiatives of employers in the field of social policy. Here again we are really upon psychological ground, but closer to the everyday reality of the workshops.

Objective factors

Rationalization often appears in the life of a firm as the introduction or improvement of machines, tools, or apparatus, through which human labor obtains a higher degree of efficiency. Often, while the expenditure of labor remains the same, output is increased. In this case, the worker feels no negative reactions; they are even favorable if, through a system of bonuses, his wages are also increased. Agreement ends, and the worker's opposition hardens, when he has the impression that his output has increased, not only because his work is more efficient, but also because the expenditure of effort itself is greater, a forced increase, imposed by the technical measures of rationalization which surround his job activity like a rigid framework. In some cases, workers explicitly state that the rise in wages is absorbed by the increased expenditure on food which becomes necessary.³⁸

Thus, when not inhibited by the distrust just mentioned and also when not threatened with technological unemployment, the worker tends to take a positive attitude with regard to practical measures of rationalization.³⁹ Actually, the two conditions are rarely found together. The worker is inclined to see nothing but his increased output and to declare that the increase in his wages is not in proportion to it. The fact of rationalization often has still another repercussion on these psychological reactions wherever the worker finds that increases of output in mechanized shops do not result in wage bonuses as great as those where manual work still prevails. He tends not to recognize that in the former shops, the new mechanical installations play a larger and larger part in the rise in output and have to be paid for and amortized.

If, on the other hand, one had to describe the employer's psychological reaction, it would be noted that he, conversely, tends to attribute the increased production solely to mechanization, and thus to lower the rate for piecework wages. The management takes its stand on the fact that the worker's *direct* physical effort is often decreased by more scientific and advanced mechanization. It ig-

nores the increased *indirect* involvement of the nerves (for instance, through the noise of the machines) and of the attention made necessary by the speed of the work rhythm, and the increased danger of accidents.⁴⁰

So the worker's distrust often cannot be dispelled, for lack of a wages and times policy practiced clearly and boldly enough by managements. Most of them do not take account of the workers' psychological reactions to these important points. The calculation of operation times—a calculation determining wage rates—constitutes a ground of resistance for the worker when he feels he has been injured. This takes place whenever the management changes the *time* without changing the method of work itself. On the other hand, whenever the management avoids this danger and employs well-defined, unequivocal measures at this essential point, the workers' reactions show the effects of this, and relations between the personnel and management improve perceptibly. This, for instance, is what happens at the Repair Shops of the S. N. C. F., at Tours. The Time-Study Office there determines the methods of work resulting in the minimum prime cost. An average worker (not an exceptional one) is chosen by the Office to perform the succession of operations which make up a new task. Losses of time for tooling are included. By a very careful analysis, each of the most commonly employed machines is given its time graph which is used by the engineers of the Planning Department. So, for a new task involving similar sets of operations, management has at its disposal all the means needed for calculating the time of the new operation by analogy with previous ones. Besides, it is a principle, strictly observed, never to change a time (once it is published in the shops and applied in wage calculations) while the working procedure remains the same; that is, if the Planning Department has made a mistake to the disadvantage of the management, no correction is made. The time can be changed during the course of work only to the advantage of the workers, when the latter show that they have been injured.

This policy has given good results from the psychological point of view. The worker here is not, as is often the case, subject to corrections of time which (made to his disadvantage as rationalization proceeds) arouse in him a continual distrust as to all decisions of the Planning Department. Little by little, his confidence is gained and these arrangements lead him to make suggestions for improving his

place of work or methods of machining. Changes of time in the course of a task can be made in only one direction; the worker feels that the management is not "cheating" and, for his part, is not tempted to go slow when the times are being calculated. Besides this, since the times are recorded by the Planning Department according to machines and sets of operations, it has the necessary elements for preparing other tasks and does not have to keep starting time-study all over again. Thus the worker feels himself less watched, and his attitude towards the whole of his working life is less tense and more favorable.⁴¹

The example we have just given significantly reflects the workers' latent distrust of anything coming from the Planning Department and the means which an intelligent management can use to combat it. But it would be committing another error to suppose that workers' resistance to rationalization can be offset by charitable works, housing, social aid, and sports clubs—an attitude which trade unionism designates by the general term of "paternalism." This, in turn, arouses a new suspicion among the workers. They see in it an indirect means of making them give up their fight for their rights and of undermining the power of their organizations.⁴² In fact, it is true that private assistance and "paternalism" are often invoked in employer circles to show that state social legislation and the workers' trade union struggles are alike unnecessary. Whenever the worker feels that an attempt is being made to interest him in the firm in order to persuade him to accept increased rationalization and to break his bonds with those social and occupational groups (class, union, etc.) of which he feels himself intimately a member, his reaction will usually be distrust and a retreat into himself.

Restriction of Output

It is indeed a sort of retreat into himself, or rather a contraction of his occupational physical and moral resources, a sort of inhibition of his total work-potential, that is revealed in many cases and under different forms by observers of large-scale rationalized industry. It may be recalled here that it was against what he called "soldiering" that Taylor, the great pioneer of technicist rationalization, thought that he had to fight his first battles. He and his followers were led to begin the struggle with the unions, reproaching them for systematically encouraging "soldiering."⁴³ From a certain point of

view, by no means superficial, one may regard rationalization as a collection of more or less flexible, skilful and appropriate measures, changing the relative positions of different economic, moral and repressive stimulants to place the worker in a condition (within the social framework of industrial capitalism) in which he is *forced to* abandon the limitation of his effort and to put forth as much as possible of his physical, technical and psychological potential. This struggle, more or less overt according to cases, between the two opposed currents of limitation and expansion, appears in a variety of events.

In a penetrating essay,⁴⁴ little known by specialists, though on a level with his historical and sociological work, Max Weber, while studying "the psychophysics of industrial labor" shortly before World War I, already noted that the worker's outlook and especially the state of his relations with the management of the business in which he works, have an important effect upon output. Thus, on the basis of studies conducted on large-scale German industry which was then the leader in Europe of the rationalization movement, he was led to emphasize the phenomenon of "slowdown," or the intentional restriction of output. This phenomenon is certainly not one of today only (1908), he noted,⁴⁵ but the employers' complaints on this subject have increased since the beginnings of the century, for two reasons: first, the rationalization of wages carried out parallel to the methodical increase in output; and second, a decline in the practical effect of strikes, resulting from a better organization of the employers.

The employers tend to throw all responsibility for "slowdowns" on the unions. Max Weber observed that this is a highly superficial way of looking at it. In fact, it can be shown that restriction of output (not only what may be called involuntary, temporary or emotional, but also what is fully intended and conscious) is apparent even in the absence of any union, among nonorganized workers. It can be found wherever a feeling of solidarity exists among the whole body or a fraction of a working personnel. It is a sort of conscious, tenacious, silent struggle which the worker carries on to defend the price of his labor.

It may have as its object: (1) to obtain high piecework rates; (2) while the rates remain the same, to prevent intensification of the rhythm of work; (3) to show bad feeling towards the industrial environment, both management and staff, the reasons for which are

more or less clearly felt. Max Weber studied the case of an important linen-weaving mill, where about 400 different articles were being manufactured. The patterns were often changed, and the management had calculations made of operating times in order to fix the piece rates of the new articles. It was then that slowdown increased.

When practiced by a large enough section of the personnel in a firm, "soldiering" acts as a workers' weapon of wage policy, adapted to rationalization. Max Weber justly observes that it is often "the substitute for a strike."⁴⁶ In a conflict over wages between employers and employees, the question is to know who can hold out longest. Compared with a strike, and from the point of view of the worker, a slow-down has the advantage that it does not require any complicated union organization or assistance fund at the place of work. The workers do not have to give up their livelihood (as they do in a strike), but merely to restrict it. Their situation, then, from this point of view, is more favorable than in a strike and is so in the sense that their adversary cannot, in each particular case, prove the degree or even the fact of slowdown. And if an employer attempts to dismiss, on such grounds, a worker who is not obviously inefficient, he releases a violent movement of recrimination among the personnel.

According to the documents studied by Max Weber, it really seems that, at least in Kaiser Wilhelm's Germany of the years about 1910, the slow-down increased at the expense of the strike, a fact also partly to be explained by the generally conformist, bureaucratic nature of the political and trade union movement among the German working class of this period.⁴⁷ Though the importance of slow-downs has certainly been exaggerated by business leaders, it is a reaction to rationalization which must not be underestimated. The study of some individual cases shows how hard it is to isolate the phenomenon, and to measure its effects exactly, because of the variety of factors affecting output.

The phenomenon of intentional restriction of output became more extensive and complicated with the extension of rationalization and the complication of piece-wage systems, in which some technicians of "scientific management" have thought that they could discover incentives capable, in themselves, of leading the worker to put forth his full labor potential. S. B. Mathewson, himself a worker in mech-

anized teams, pursued in the United States an interesting study of the restriction of output among nonunion workers.⁴⁸ He gives the typical example of a mechanical engineering factory in which he was one of a team of three, sharing as a whole a bonus system. His two comrades were confident that if the team increased its output to reach an hourly earning of ninety-five cents, the management would decrease their wage rates. They might easily, the author remarks, have doubled their output, but took good care not to do so.⁴⁹ Here one sees what paradoxical effects may result from systems of financial incentives acting in the psycho-social framework of capitalist industry. These effects are sometimes the exact opposite of what the authors of these "scientific" wage schedules envisage, since they lead to restriction of output and inhibition of the worker's potential.

Moreover, workers slow down whenever an increase in the intensity of labor (machine rhythm, speed of conveyor belt, etc.) seems to them excessive. In a preserve factory studied by Mathewson, the workers threw fragments of tinplate into the machines or placed the tins to be machined incorrectly so as to retard the conveyor belt, the speed of which had been increased by a third by the management.

The worker's reaction to rationalization (and let us recall that this inquiry concerns chiefly nonunion workers, who are by definition more individualistic) is not solely determined by individual financial incentives, but also by factors of a social and economic kind. The worker will restrict output to prevent the discharge of comrades, or to favor the employment of additional hands, to stabilize the wages in his craft, or to satisfy his grievances against the management and foreman, whether justified or not. All these reasons call forth considerations of a collective and social character. Once more, those industrial experts who have confined themselves to an individual psychology, often indeed quite a crude one, are overwhelmed by facts from all sides showing the influence of the network of social bonds in the milieu in which the worker lives and works, in and outside the workshops.

So it is not surprising that in the conclusions of his study Mathewson, after having stressed the importance of "slow-downs" among American workers, remarks⁵⁰ that Scientific Management has not succeeded in creating a spirit of trust between the two parties to a labor contract, a fact which, fifteen years after Taylor's death, means

the defeat of the humanitarian dreams of co-operation between employers and employees which the great engineer had so often declared to be the ideal on the horizon of his system.

Free versus Regulated Work

Unfavorable reactions to changes in the process of manufacture, to increased output and to time-study, and cases of deliberate restriction of work are, we have seen, frequently found in the workshops. These facts, each in its own way, express a negative attitude on the worker's part towards measures coming from "higher up," which are not clear to him because they are imposed without his having in any way collaborated in them, without (as is usually the case) anyone even bothering to inform him of their reasons and importance. Scientific observations of workshop life show that this absence of initiative, autonomy and participation in the shaping of conditions and procedures of work plays a great role in the worker's attitude towards rationalization.

Among its total effects, the latter involves that of transforming work previously regulated by the worker himself (craft work, retaining features of the artisan period) into work regulated from the outside. Yet it would be wrong to suppose that all mechanized tasks are regulated from outside merely because in them man's share in production has decreased. As Preller notes, one must distinguish, among mechanized tasks, between *those dominated by the machine* and *those which dominate it*.⁵¹ In both cases the worker is freed by mechanization from disagreeable labor. But, whereas in the latter an appeal is still made to his intellectual collaboration and his understanding of the supervision and control of mechanical apparatus, in the former nothing is expected of him but precision, as from a living appendix to the machine.

However this may be, the progressive substitution of work regulated from the outside for work freely shaped by the worker himself, is one of the chief characteristics of contemporary industrial evolution. The new economic and technological conditions of industry clearly do not allow most workers to find and select the best working methods for themselves. From now on, in the interest of the quality and quantity of production, everything prevents each worker from being free to form his movements and work procedures according to tradition, mood and imagination. He must abandon an

empirical attitude for a rationally studied behavior, well-adapted to the aims of his particular activity. This shift from a still latent empiricism to a science of work has been one of the characteristics of progressive industrial societies for over half a century.

The methodical study of the movements and procedures of work, and their transformation (from the psychological point of view) into automatic movements wherever that is possible, are stages which psychology would not dream of denying and the importance of which it readily recognizes. Moreover, other things being equal, the worker works better and is mentally more at ease when he uses correct working procedures which for him have become psychomotor automatisms.

But experience shows that much tact and prudence must be used when one tries, as it were, from outside, to impose working methods upon a workshop. Workers are not all of the same psychological type as the famous Schmidt, the Dutch laborer at Bethlehem Steel, who was the subject of one of Taylor's first experiments, and, as the latter stated, was "more like an ox than any other type."⁵² Observation shows that they usually resent having imposed on them every detail of working methods, as required by Taylorian and other systems of "scientific management" which establish, by coercive authority, *the one best way*⁵³ to be employed. The dominant role of work schedules, the too frequent intervention of time-study men, pace-setters, inspectors, and checkers, create a sum of unfavorable dispositions which inhibit and even injure the worker's personal potential. He is irritated; he does his work unwillingly; mental work, requiring a high expenditure of nervous energy, continues to take place where medullary automatisms would be sufficient. "Consequently," Durig writes in this connection, "it should be anticipated that co-ordination, which functions so perfectly in ideally automatized movements, is now partially disturbed. The man who works unwillingly stimulates muscles which the happily working man never calls into play; the basic rhythm, inculcated by automatization, which involves and facilitates the working process, is continually subject to the interferences of the will and disappears."⁵⁴

Work externally controlled in detail, such as is currently required by technicist rationalization, takes from output the possibility of expressing the work capacity of the worker. Whether the worker's disposition is good or bad, he is forced by this sort of technological

iron collar to give the same production. Before these coercive measures were introduced, the lowering of working capacity was normally reflected in the quantitative lowering of output. Nowadays the worker's psychological reaction has to follow other paths and find other outlets: the lowering of quality, defects in the work, accidents, or irregularity of work. This process culminates in certain pathological phenomena, of which mention was made above, sickness, and sometimes premature exhaustion and death.⁵⁵

The worker also shows his negative reactions to what is imposed on him from above by his attitude with regard to roughly made decisions about vocational guidance or selection. If the selection of a task is made for him without his being consulted, as by a decree, his occupational inclinations will be restricted by it and his potential weakened.⁵⁶ In a factory in which he personally is treated with greater consideration, where he has a voice in things, where he sees a tendency to shape tasks according to men rather than to adapt men strictly to tasks, selection excites less resistance and commands greater authority. In contrast, job placement as it functions practically in industry (even with the aid of competent specialists) often has negative and inhibiting effects on the worker. Here again, we realize that industrial psychology may have very different meanings and effects according to the general conditions of the society of which it forms a part.

It makes no difference that directions for vocational selection may have undeniable scientific value. If they are applied from above, they are almost sure to offend the mentality of the worker. Many other cases exist in which carefully studied and technically exact measures are ill-received by the workers because (even if they have been perfected by laboratories) they seem to the workers to be unilaterally imposed on them by the management. Thus it is a common thing for conflicts to arise over rest pauses. Workers prefer pauses few in number but lasting longer, whereas from the purely psychological point of view, a different apportionment which distributes them in larger numbers over work shifts is recommended.⁵⁷ But no matter how well-founded their purpose, as long as measures appear to be imposed on the workers in the management's name without any consent or participation whatsoever by the workers, they are encumbered from the outset by a heavy psychological handicap and cannot bear all their fruit.

Thus, for the psychologist aware of the complexity of industrial facts it is a scientific rule, so far as is possible, in any given case to allow the worker freedom to determine his work and select his own means and methods. He contravenes this rule only in the case of adequately proven economic necessity. Even in such a case, he considers the exhaustion of the worker's capacity, taken over a long period. On the other hand, he then proceeds not by crude application of rational methods, but by instruction: the workers' reluctance already perceptibly dwindles if he is shown the defects of the empirical method hitherto followed and the practical value, from the point of view of fatigue and efficiency, of what is proposed to him. Experimental tests clearly bring out the advantages of such re-education (or education) when it is flexibly and tactfully conducted in the workshops. The worker then reacts to the rationalization of his movements in a far more favorable way, and his output shows the effect of this. In a preserve factory, photographs showed that, when plunging fruit into a sugar solution, workers made movements composed of rectilinear segments variously directed and composing a broken line. Under the direction of industrial psychologists, workers were re-educated for three months to work by moving their hands in curved lines. Output was 88% higher than when produced by empirical movements. Young workers already accustomed to the old movements were re-educated and attained an increase of 27%. In no instance did the psychologists observe any inhibitions or psychological resistance.⁵⁸ But the re-education turned out to be useless among the older women workers. Farmer and Brooke made similar observations in metal-polishing workshops.⁵⁹

More generally speaking, observations show that workers react more favorably to rationalization of their movements in proportion as they share (or have the impression of sharing) psychologically in the criticism of their rule-of-thumb movements and the selection of rational ones. If they are induced to admit that the methods and movements which they have spontaneously chosen are not very efficient, they are able to draw the moral from this instruction and to improve their processes of work by themselves, in accordance with the advice received. In an American factory, photographs of the work of each employee were taken; these were enlarged and cast on the screen in slow motion, and the workers thus learned to avoid

superfluous gestures. Ten days were enough for an average increase of 10% in their output to appear.⁶⁰

Even if the worker cannot thus be persuaded to collaborate practically in the reshaping of his task, the facts show that there is an advantage in allowing him psychological participation in the new measures, in, so to speak, keeping them clearly before him during his work. In this way Sachsenberg, carrying on his noteworthy inquiries into assembly-line work, showed that the worker reacts better when made aware of the passage of time and of the level of his output by a clearly visible clock and an apparatus for registering output.⁶¹ In an American paper mill the weight and moisture of the product, and indices of its quality, were regularly measured, and the changes posted clearly in the shops. The result among the workers was an increase of interest in their work, reflected in a definite rise in the quality (as well as the stability) of output. Besides, the number of their technical suggestions, formerly few, increased perceptibly—a very significant change—and by considering the best of them, output was raised 5%.⁶²

It may thus be claimed that it is always helpful to interest the worker as much as possible in measures of rationalization, and to arouse his spontaneity and thought. His more or less conscious inhibition is combated and his personal potential, if not completely brought into play under the conditions of private enterprise, is nevertheless more engaged. Even in assembly-line work which, by its rigid nature, seems inaccessible to this attempt at flexibility, the psychologist takes this state of mind into account by adopting practical measures of a limited extent, of course, within the limits of the assembly-line rhythm which remains obligatory. The clearly visible clock and apparatus for recording output (also always visible) give the worker the impression that he may to a certain degree apportion his effort and, according to the time and his position ahead of or behind his fellow workers on neighboring lines, distribute it to his own taste. If the introduction of rational methods is a necessity, and the substitution for free work of work regulated externally is an unavoidable phase in the development of industrial labor, there is nevertheless a great difference between the attitude of the technicist rationalizer towards these facts and that of the industrial psychologist aware of the psychological, economic and social realities. While the former works through constraint and the alternate use of financial

incentives and repressive measures (Taylor's "plum" and "whip"),⁶³ the latter tries to retain the worker's freedom and initiative so far as is possible, and to insure at least his psychological share in the necessary changes in his work. The former cares only for the immediate *external* results of rationalization, the increased output which technical measures force on the worker even against the resistance of his body and mind. The latter considers the much longer-range effects of rationalization, from the angle not only of technology but from the far broader one of the sciences of man, and wants to know the worker's *inner* reaction to the increased output to which he is forced to consent.*

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In the numerous studies carried out in the United States and England

* Among the few studies of a scientific character, since 1945, concerned with technicist rationalization is the book of Philippe Laloux, *Le Système Bedaux de Calcul des Salaires* (Paris: 1950), in which the advantages and disadvantages of the system are objectively described, and the reactions of workers explained.

Other parts of the Scientific Management movement have tried to base themselves, at all stages from the first analysis of the work situation, upon a collaboration with the employees, both workers and technical personnel, and, in particular, the movement known as *work simplification* which was initiated in the United States by Mogensen. The spread of these movements is at the present time too limited for any social effects to be apparent.

on incentives and motivations, job attitudes, absenteeism, and turnover, much information can be found concerning certain reactions of workers to rationalization. One can consult, on these topics, the bibliographies in the well-known books of M. L. Blum, *Industrial Psychology and its Social Foundations*, New York: Harper, 1949; N. R. F. Maier, *Psychology in Industry*, New York: Houghton Mifflin, 1947; D. C. Miller and W. H. Form, *Industrial Sociology*, New York: Harper, 1951; W. E. Moore, *Industrial Relations and the Social Order*, new edition; New York: Macmillan, 1951; M. S. Viteles, *Motivation and Morale in Industry*, New York: Norton, 1953.

Human Relations

SCIENTIFICALLY CONDUCTED STUDIES by industrial psychologists of workers' reactions to rationalization show a sort of guiding thread through all the conclusions of partial investigations. The worker is not favorable to measures imposed on him from without, in the elaboration and operation of which he has been unable to participate in any way, through discussion, experiment, or consultation. As his inhibitions and his more or less conscious will to go beyond this stage of industrial organization reveal, he is reluctant to feel himself nothing but an *object* of rationalization. For their part, on the basis of their observations, the recommendations of the psychologists all aim at involving the worker materially and mentally in the life of the firm and the shaping of his work in such a way as to change him from a mere object to a *subject* of rationalization.

This introduction of psychological considerations into the rational organization of work should be regarded quite naturally as essential by the scientific observers of industry, the psychologists who, as we have seen, as early as the first wave of Taylorism, had immediately noted the system's defects in the field of the worker's psycho-physiology.¹ The emphasis placed by them on the glaring faults of technicist rationalization should not, therefore, surprise us. But it must be noted that even in those employers' circles in which it had begun its career, certain signs show that rationalization itself (vaguely enough, to be sure, at first) was becoming conscious of its

own shortcomings and pointing to a new field upon which the efforts of Scientific Management were soon brought to bear.

NEW TRENDS IN SCIENTIFIC MANAGEMENT

At great length and in great detail, Taylor had perfected the technological aspect of his system, but he had contented himself, so far as personnel psychology was concerned, with very simple and inadequate data.² For a long time, he had confined himself to the elementary incentives of "personal ambition" and looked sceptically upon all forms of collective incentives such as co-operation or even profit-sharing, which he considered ineffective because, as he used to say, "no form of co-operation has yet been discovered in which each individual has a free field for his own ambition. The latter has always been and always will be an incomparably more powerful incentive than that of universal happiness."³ Even the satisfaction of this "ambition," in the sense of a wish for greater gain, must be carefully limited. Going by his own impressions, Taylor set the rate of increase at 60%, beyond which the worker, hitherto sober and thrifty in his private life, becomes disorderly and dissipated.

Yet, as his experience as an organizer grew, his contacts with business made him feel more and more strongly that he could not depend solely upon the compelling effect of the methodical compulsion with which his system surrounds every worker, to induce him to do better work and to increase his output. Sincerely, but also very ingenuously, he had hoped to offer a final solution to the inner conflicts of industry. As the years went on, he evidently became increasingly preoccupied with the desire to establish co-operation between employers and employees. Lecturing at Harvard, he defined the principles which should guide the management of workers: the financial incentive, what he called "holding a plum for them to climb after"; the fear of sanctions, in other words "cracking the whip over them, with an occasional touch of the lash"; and finally active, instructive collaboration, consisting in "working shoulder to shoulder with them, pushing hard in the same direction, and all the while teaching, guiding and helping them." Present-day business management is satisfied to combine the plum and the whip, using the latter too often, though its use shows the lack of efficiency. In contrast, the sort of management dreamed of by Taylor, "Scientific Management, the management of the future, consists in the application of all three

elements, the lash, however, being left almost out of sight, while the close, hearty co-operation of the management with the workmen becomes the most prominent feature, and a good big plum is kept always in sight.”⁴

But only during the last years of his life did Taylor recognize, still without seeing clearly all the difficulties which are obstacles to this collaboration, that it demands a kind of mental revolution among both employers and employees and a radical change in the relations which ordinarily exist between them in industry. Such is the meaning, indeed, of one of the statements which, in January, 1912, he made before a special committee of the House of Representatives: “Scientific management,” he said to the American legislators, “involves a complete mental revolution on the part of the workingman engaged in any particular establishment or industry—a complete mental revolution on the part of these men as to their duties towards their work, towards their fellow men, and towards their employers. And it involves the equally complete mental revolution on the part of those on the management’s side—the foreman, the superintendent, the owner of the business, the board of directors—a complete mental revolution on their part as to their duties towards their fellow workers in the management, towards their workmen, and towards all of their daily problems. And without this complete mental revolution on both sides, scientific management does not exist.”⁵

To be sure, when he was defining this mental revolution, indispensable alike for the owners, the supervisory personnel, and the workers, Taylor still considered it as the cult of output, the substitution of industrial science for traditional empiricism, and did not rise far above these generalities.⁶ Nonetheless it is true that he indicated a path which his friends and followers after him were to take. Collaboration between the two camps was admitted to be more and more necessary by the Taylorians and by the “efficiency engineers” trained in the tradition of Taylorism. H. S. Person, deputy director of the Taylor Society, shortly before the depression of 1929, affirmed in his turn: “We can’t have an efficient and lasting organization unless we obey the natural laws of collaboration governing the mingling of the individual’s interests and desires with those of the group, and the necessary adaptation of individual faculties to group needs; laws based on fact must take the place of the individual’s authority, assumptions and whims; the differences, the motives, the desires and

the faculties of human nature must be considered and profited by in approaching the common goal.”⁷

So technicist forms of rationalization, after an industrial experience of several decades, turned to individual psychology and, in proportion as they put this to the service, interests, and desires of the “group,” timidly discovered social factors. This was a first attempt at readjustment, necessitated by the now recognized impotence of Scientific Management to create in the United States (and elsewhere) a spirit of confidence between both parties to a labor contract.⁸

Though the exact dates of the turn in this evolution cannot be assigned, from about 1920 in the United States one observes the appearance, and then the rapid increase, of studies of the mentality of workers, supervisors, management personnel and *leaders*. Influenced by their disappointing experiences and also by the industrial psychologists whose voice was becoming increasingly audible, business leaders and their staffs recognized the importance of the junior executives and their attitude towards the personnel with whom they were in daily contact. The analysis of their functions made by Taylorism was declared to be inadequate and the necessity was admitted of studying them from the psychological point of view if it was desired to promote this collaboration which was talked of so much, and without which Scientific Management could not take root and flourish. Questionnaires were sent out to industrialists, workers, and foremen and supervisors. In 1923 the American Management Association was created, an association which does much to widen the horizon of efficiency engineers.⁹ The “personnel men” in firms began to repeat that “the human element is the most important element in business.”¹⁰ Managements approved, but as yet made no changes in their behavior. Only with the depression years of the 1930’s did the *industrial* (or “*personnel*”) *relations* movement¹¹—already on the agenda of research of technicians and psychologists—spread widely among the great employers’ associations and the businesses of America and Europe. “Human relations” is an extension of this development.

The expression thus marks a stage in the development of Scientific Management. Whereas such formulae as “labor problems” and “labor market problem” stress the one-sided way of looking at these problems, seen solely from the angle of interest of the employers, that of *industrial relations* emphasizes reciprocity of rights and re-

sponsibilities in the relations of employers and workers. It may either be taken in a broad sense (the relations between organizations of employers and those of workers) or in a narrower one (relations between the management and employees of a firm); and the second sense has clearly prevailed.¹²

The signs of this effort to improve Scientific Management by introducing into it psychological considerations appeared between the wars, ever more numerous in America and, spreading from there, in Europe. We shall study some examples more closely. The purpose of Scientific Management remains the same. It is a strictly economic one: through a maximum output to secure a minimum loss of effort or of material. But the means become so complicated, flexible, and refined as to transform little by little the face of Scientific Management. An "International Association of Industrial Relations," with headquarters at the Hague, was created; it holds congresses and distributes publications.¹³ In France I have attended meetings at which, after making studies of workers and inviting some of them for personal interviews, rationalization technicians and engineers ended by stating the necessity for creating "an industrial *esprit de corps*" through better relations between members of a given firm.¹⁴ The International Labor Office in Geneva notes "among those inclined to make experiments in rationalization, a more and more marked tendency to believe that if rationalization must be applied to production it must equally be applied to industrial relations. . . . Not only manufacturing, but the relations between employers and workers, must be rationalized. . . . If there is room for mechanization in industry, there is also room for psychology. Relations between employers and workers must be established on foundations provided by psychology." And we may judge the extent of the ambitions of Scientific Management rejuvenated by these new currents when we read that, according to both the I.L.O. and Dubreuil, it desires nothing less than to discover the law of harmony which "certainly" exists in industry, "a law as simple and universal as that of gravity."¹⁵

F. W. Taylor held out as a distant and marvelous goal for his system, the welfare, reconciliation and happiness of men. Scientific Management reaffirms these generous aims at each of its stages. We shall now see in more detail how the "industrial relations" movement went about trying to introduce the consideration of psychology (and what kind of psychology) into practical business life.

MANAGERS, TECHNICAL STAFF AND FOREMEN

To promote this harmonious collaboration, whose necessity for the success of rationalization was so pressing, it was clearly essential to alter the attitude and the mentality of the staff members—and, for this purpose, first of all, to get to know them. Hence the quantity of questionnaires sent to the personnel, and the burst of inquiries and detailed, methodical interviews carried on among the workers by teams, either of independent researchers or appointed by large firms, inquiries and questionnaires which initiated the industrial relations movement.

The question of foremen became a leading problem between the two wars. Though at the close of his life Taylor recognized that a “mental revolution” was as indispensable among the foremen as among the workers,¹⁶ nevertheless at the beginning of his career as a rationalizer, he accorded little or no interest to the psychology of the supervising personnel. His functional analysis of tasks devolving upon the foreman in a factory organized according to his system is famous. Introducing division into this craft also, he split its powers, assigning them to four “bosses”: the administrative boss, the production or speed boss, the chief inspector, and the maintenance boss.¹⁷ This division corresponded to that of the four departments of the Planning Office, and the commentaries with which Taylor justified it are of great technical interest, but indicate no consideration of the psychological factors arising in the relations of the foreman to the workmen in his shop. Ford gave flexibility to Taylor’s hierarchy of foremen and tried to lower the barriers between them and the workers. The latter must be able to turn to anyone in the shop to ask for an explanation or a suggestion; formality was reduced to a minimum. The management’s collaborators were designated not by titles but by functions. The factory was constantly visited by “flying inspectors.” So Ford innovated and corrected some of the faults of Taylorism. But fundamentally he made no change in the play of functions and did not go deeply into the actual psychology of relations between workers and foremen.¹⁸

Questionnaires sent to industrialists, managing personnel, foremen and workers testify to the importance attached from this time by investigators to the problem of supervision. J. D. Houser,¹⁹

after having distributed among many factories in the United States a detailed questionnaire on industrial relations in business, drew conclusions about the state of mind of American supervisors, which it is interesting to sum up at this point. After analyzing the replies he noted among them: (1) suspicion and fear; (2) self-assertion through power, based on a keen taste for authority and taking the shape of autocratic interferences; (3) a self-centeredness and self-satisfaction rather than a devotion to the general interest of the firm and, on the other hand, usually a slighting of the desires and points of view of subordinates; (4) silence on the part of business leaders as to their policy of internal organization and personal relations—while these are matters appertaining to management, they are left to the intuition and wishes of the lower managers; (5) lack of a sense of social responsibility—management and subordinate staffs see no further than the limits of their own firm. If the leaders of very large firms seem to show increasing confidence, their ideas are still too often vague, more emotional than rational; (6) an inadequate imagination with regard to the human problems of industry and the ways to solve them, especially overestimation of financial incentives, the only ones admitted, which are regarded as a universal panacea for conflicts and the resistance of wage earners.

Besides these direct surveys of the outlook of supervisors, an attempt was made to understand their behavior by studying the results they get in their relations with the personnel whom they are responsible for directing. The extent of foremen's success with workmen is, in fact, for psychologists of "industrial relations" the surest index of their value. In an inquiry among a group of 200-300 workers employed in a repetitive job, the mass-production manufacture of paper products, Kornhauser and Sharp studied two shops, A and B.²⁰ Both were occupied in exactly the same operations: hours of work, wages, and the general conditions of the wage-earner were precisely the same in both. Physical conditions were a little better in A than in B. Yet towards their work as a whole (and even towards the physical conditions), the workers of A had a clearly less favorable attitude than those of B. A more advanced study then showed that the quality of the supervising personnel in A left something to be desired. This inadequacy was then communicated by the workers to all the other aspects of their work and its influence spread. Other

observations made by Houser also show how diverse were the results obtained by different foremen within the same firm in their relations with the workers.²¹

The conclusions of many such inquiries confirm the needs which business leaders have felt in the conduct of their affairs. With the mechanization of industry, the foreman's functions change and demand new qualities and a different kind of training. Previously, when craft work and free rhythm were general, he was required to get from the worker a high and regular output. This role is now filled in a large degree by the machine's obligatory rhythm. In tasks where the skilled worker needs technical data, these are given him in detail by the instruction cards of the planning department. Production and output are recorded by accounting services without the foreman having to intervene. But, on the other hand, the originators of industrial relations observe that the foreman is the regular go-between and buffer between the workers and management. He should certainly have real technical ability in the special work assigned to his shop, be able to recognize faults of quality and difficulties in the working of the machines, and also help carry out the management's new methods and projects. Yet, even the apparently technical parts of his functions now include a very important psychological factor, so that American Scientific Management tends increasingly to consider the foreman, and wants him to be considered, as a *human engineer* or expert on men. He must know and understand his workers personally, instruct and guide them on every occasion, and make them familiar with their factory or workplace.

This is the intention of the training courses for foremen created within and on the initiative of firms.²² Emphasis here lies on the foreman's psychological training, on a new sort of *leadership* consisting not only of command, but of instruction, help, understanding, and the winning over of personnel. This is also the meaning of the action taken among foremen by such professional associations as the powerful National Foremanship Board in the United States which, by means of publications and discussions, develops an interest in industrial relations among its members.²³ Thus, a more flexible, more "psychological" organization of labor recognizes the importance of supervisors for collaboration within the firm and tries to train them with this in mind.

But the "mental revolution" glimpsed by Taylor should affect not

only the subordinate ranks of supervisors; it should permeate the whole works and affect the management, or rather, it should start from the latter. The business leader's ideology should be reformed and the content of his personality changed, together with his attitudes and his professional outlook. Up to now the captain of industry has imposed on his associates through prestige and a spirit of domination and fear. Instead of this, the new leader impresses his collaborators and workers because he has the gift of convincing them and of "speaking for" them. He no longer presents himself to them as a "superior," always perched on a pedestal of authority, carefully restricting contact with his "inferiors" and afraid to compromise himself. He ceases to be a *boss*, a master, and in the true sense of the word, becomes a teacher, a guide, a *leader*. Far from having any trace of "ownership by divine right," the ideal for the new pioneers of Personnel Management would clearly be to produce leaders who were members of the industrial group, invested by it with authority and responsibility, and able to associate all those about them in a common aim.²⁴

Such are the broad lines along which, after their observations and experiments, the partisans of industrial relations have tried to change the attitude of business heads and help in the conscious training of new leaders, able, at least in part, to overcome the obstacles encountered by the first generations of industrialists who tried to apply rationalization. Formerly, the owner monopolized the legislative, executive, and judiciary powers. Thence sprang certain psychological difficulties very apparent in the internal relations of business, where they can be overcome only if a clear separation of powers (such as has taken place in political society) occurs in the industrial group.²⁵ Moreover, stress is laid on the thorough transformation of mental habits by which the leader is to base his authority, not on prestige but on the *expression* and use of the individual capacities, tendencies, ideas and desires of his entire personnel. He shows a greater sense of his responsibility the more he can develop the group he leads by his "constructive, integrating" action.²⁶ Even the industrial psychologists who have adapted the conceptions of American Scientific Management to Europe, pruning and giving them balance, have retained the chief characteristics of the "new leader" whose position is justified only because he is the one best able to help and carry with him his subordinates.²⁷

Whatever the opinions (which will appear later in this study) I hold as to the direction and scope of this movement, it would be quite wrong to think that, so far as concerns the training and practical behavior of business heads, it has amounted only to a wave of pious wishes and well-meaning theories. Aided by events and in part springing from them (since Taylor's Scientific Management had to be reconsidered and transformed), it has certainly had an effect, especially on the management of large firms which had collaborated with "Personnel Relations" offices, and it has improved the psychological atmosphere within many of them. Ford, as will be recalled, had already had to introduce less formality and more flexibility into the internal organization of his factories. Nearer to our time is W. A. Patterson who directed the United Air Lines, one of the most powerful American air transportation companies. Concerning his tours of inspection across the United States, he says that the success of his conversations with his employees wholly depends "on the informality of the meeting."²⁸ Wherever he goes, he wants to know the reactions of the personnel, clerks, mechanics, pilots, and radio-telegraphers, to the rules and to the functioning and innovations of the company. In this way he gathers many suggestions, some of which have radically changed the working of the air lines:

"We do not send an announcement to the field office that the president or vice-president is going to be there at a certain hour on a certain day and will speak on such-and-such a subject. There are no 'brass bands.' We go out, and as we make our rounds and see an evening ahead, perhaps two or three days in advance, we go to the superintendent of that particular place and say, 'How about getting a few of the boys together for dinner?' There are no speeches, no one stands up. You can't tell who is the president and who are the employees. I get as much criticism as anybody—friendly criticism—and suggestions that I might pass on to management officers, as well as things that I can pass on to other employees.

"We talk *with* our employees—not *at* them. I have seen so many meetings, even in our own company, where the employees come in, herded like sheep. They sit down. Finally, the executive stands up, they all open their mouths, and he starts a great oration. That is what I call talked at. I believe employees like to be talked with. They want to feel they are part of the company."²⁹

Arrangements such as these go beyond the mere analysis of tasks and functions to which earlier Taylorism confined itself. One feels that "industrial relations" have taken effect there.

The President of United Air Lines bases his actions on a desire to develop in his employees solidarity and *esprit de corps* with the industrial group which makes up the firm. He correctly sees in many employees this psychological need and considers that the essential task of the management in this field is to satisfy it. This is a characteristic attitude of managements affected by this movement. Industrial relations are taken out of their traditional framework in all sorts of ways; for discipline based on restraint, the substitution of what the English call *morale* is attempted, a collective state of mind based on the feeling of belonging to a working community.³⁰ It is desired to publicize this, make it fully known and develop it among all members of the firm: workers, supervisors, technicians, employees of the planning departments and managers. Until recently, scientific management was not acquainted, and prided itself on not being acquainted, with any but purely *individual* psychological factors. Now it has discovered that these are insufficient and is moving more and more towards a *social* psychology.

But how far does the notion of morale as a substitute for discipline correspond to a scientific social psychology of the firm? What sort of social psychology does it implicitly recognize and appeal to? In what way is it based upon social psychology? A more detailed study of several particularly fruitful experiments in the field of industrial relations will enable us to answer these questions.*

* The developments portrayed in this chapter have become stronger and have spread more widely in Europe since 1945. They represent, in the second half of the twentieth century, one of the principal features of the "free enterprise" system.

In France, the growing numbers of "productivity missions" visiting the United States have spread among business executives, engineers, supervisors and a certain number of civil servants, American ideas concerning relations within the firm. All too often this has happened without paying attention to the problem of adapting these ideas to psychological and social conditions which are very different from those in the United States.

The literature on this subject, in specialized journals or in pamphlet form, is endless. In the Recent Bibliography at the end of this chapter I have included only a few publications of a scientific character or of particular significance.

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Some Experiments in Human Relations

THE HAWTHORNE INVESTIGATION

IN THE UNITED STATES, by far the most important investigation into the problems of industrial relations is the one which was conducted from 1927 to 1939 (a period of twelve years) at the Hawthorne Works of the Western Electric Company. The scope of this study corresponded to the immense plant which was its scene, and it is justly famous in American industrial and scientific circles, for it represents an effort, until then unheard of, at collaboration between psychologists and the management of a powerful company to study certain aspects of the human factor in industry. I shall not go into a detailed description of the complicated progress of this investigation, and of its various repercussions. Besides, many reports whose technical exactness leaves nothing to be desired have been published in the United States. But I shall abstract from these documents the chief facts and conclusions which have special reference to the problems of the social psychology of the firm which we are studying.¹

The Hawthorne Works are situated partly in the suburb of west Chicago, partly in the neighboring town of Cicero (Illinois). They

make up the most important works of the Western Electric Company, which is the supplier of telephone equipment to the Bell Telephone Company. The Hawthorne plant covers a vast area and, at the time when the research in which we are interested began, employed about 29,000 workers, men and women, employed in everything concerning the manufacture of telephones. They included the most diversified occupations from that of the metal-worker to the diamond-cutter, from the toolmaker to the bookkeeper, the assembly-line laborer to the engineer, the wire-drawer to the weaver, the messenger to the departmental head. Some idea of the quality, variety and volume of objects produced at Hawthorne may be obtained by recalling that they have to satisfy the needs of a large proportion of the users of the telephone in the United States, numbering many millions.

Among the 29,000 workers and clerks of the plant, almost sixty nationalities were represented. About 75% of them were native Americans; Poles and Czechoslovaks formed by far the most numerous foreign contingents and after them, Germans and Italians. It is to be noted at the outset that among the large American firms, the company is one of those which have given most attention to the welfare of their wage earners, providing among other things a restaurant of good quality and moderate prices, a fine hospital, and efficient services of vocational guidance. There had been no strikes or open signs of discontent for more than twenty years. The investigators considered it beyond doubt that the company enjoyed a relatively high standing among its workers.

The Hawthorne investigations could only be carried on as a result of close collaboration between the management of Western Electric and members of Harvard University: anthropologists, physiologists, doctors, and above all, psychologists specializing in industrial problems.²

THE TEST-ROOM EXPERIMENTS

In the first stage of this research the investigators studied for more than five years, with their consent and even their co-operation, a group of five young and experienced women workers engaged in the assembly of telephone relays—a subdivided, repetitive job. The workers were located in a special room, the "test room," and allowed to talk with one another. While they worked, one of their

comrades stocked for them the parts required for the assembly and handed them to them. At the outset, it was explained to them that the aim of the observations was to determine the effect on the work of certain conditions such as rest periods, lunch in the middle of the morning, and reduction in the hours of work. They were expressly advised to work at a moderate rhythm and not on any account to race one another. The equipment of the experiment room was identical with that of the corresponding production shop, except for the presence of certain pieces of apparatus for recording and measurement (of output, temperature, humidity, etc.). The output was measured minute by minute and day by day. An observer was constantly present, always ready to step in and advise.

In this group of women organic changes were observed, for the details of which there is no space here.³ Anyway, they proved that the increase in output recorded elsewhere in the test room was not obtained at the cost of the workers' organic equilibrium.⁴

Careful examination of the variations in output showed that it slowly increased over a period of three years and then became stable at a high level. During this period there were waves of irregularity, slumps, some of which lasted only a few minutes and others lengthening into months. None was related to changes in the physical environment, such as changes in temperature, for example; on the contrary, they clearly corresponded to psychological changes: the feelings of the young women towards one another or towards their supervisors on their team as a whole. On the other hand, when the investigators created experimental changes in the physical environment, the increase of output was not affected. It remained stable, whatever the nature of the changes introduced into the conditions of work, including those of financial incentives. A crucial observation was that, on eliminating the advantages given the test-room team (such as rest pauses, snacks, hours of work), and returning to the initial conditions, no perceptible change occurred in the output curves or in the improved psychological dispositions of the workers.⁵ On the other hand, an experiment of the same sort in the ordinary production shop led to a fall in output and to discontent.

The test-room workers themselves showed a certain perplexity as to the increase of their output. Yet in their conversations with the investigators, they suggested that something in themselves was involved, the exact nature of which they could not define, some-

thing like a liberation from restraints or "interferences" which disturbed them in the ordinary shop outside the test room.

Yet, at the same time, a marked improvement was noted in the mental attitude of these girls with regard to their work and to the working environment. We are therefore confronted by two concomitant phenomena: an increase of output not associated with experimental changes of a *physical nature* and, on the other hand, an improvement in psychological attitude. "This simultaneous improvement in attitude and effectiveness," writes one of the industrial directors of the investigation, Putnam, "indicated that there might be a definite relationship between them. In other words, we could more logically attribute the increase in efficiency to betterment of morale than to any of the major alterations made in the course of the experiment. We concluded that the same relationship might exist throughout the entire plant and that the best way to improve morale, which was thought to be at a comparatively high level, was through improved supervision."⁶ And G. A. Pennock, who was one of the originators of the Hawthorne investigations, gave the same interpretation to the parallel improvements in output and morale: "A relationship of confidence and friendliness has been established with these girls to such an extent that practically no supervision is required. In the absence of any drive or urge whatsoever they can be depended upon to do their best. They say that they have no sensation of working faster now than under the previous conditions, and that their greatly increased production has been accomplished without any conscious effort on their part. Comment after comment from the girls indicates that they have been relieved of the nervous tension under which they previously worked. They have ceased to regard the man in charge as a boss. . . . They have a feeling that their increased production is in some way related to the distinctly freer, happier, and more pleasant working environment."⁷

After the first two years of experiments the workers had been gradually brought to understand that the observer was present beside them as a sympathetic listener, not as a *gang-boss* or a "pace-setter" who had received strict instructions from the management, and that he possessed on the subject of production his own clearly defined principles. They had become less timid, said what they thought of the customary supervisory methods at Hawthorne and how they and their comrades reacted to them. The output of one of the test-

room workers had, however, been very irregular; one day it became stabilized. The investigator noted that this improvement coincided with the end of troubles which had disturbed her private life and that it ceased as soon as these troubles recurred.⁸

The periodic reports sent by the team of investigators to the company's management resulted in certain favorable changes in the practice of supervision. They completely upset the management's ideas as to the qualities needed by a good foreman. According to the experiments being made, it appeared that a good foreman was not a talker and a "coach" but, above all, a good listener who knows how to listen and who is interested chiefly in improving working conditions rather than in using "incentives" and "goads."

On the basis of the first results of the investigation, the company then asked itself two questions. What was the real value of the supervisors in the Hawthorne shops? And what was normally, from the worker's point of view, a good working environment? To be able to answer this, and at the same time to check in another experimental shop the chief conclusion of the test room,⁹ the company undertook in September, 1928, a vast program of interviews among all its personnel.

THE INTERVIEW PROGRAM

In one stage of the test-room experiment, one of the investigators had already used interviews with young women, and these had proved to be fruitful sources of information. But this occasional procedure soon became a carefully perfected method which was later considerably developed. After the workshops of the Inspection Branch (where some 1,600 skilled and unskilled workers were employed), the program continued in the Operating Branch, including all the workers of the production shops (more than 15,000) and went on to other Hawthorne departments. In a little more than two years, by the end of 1930, 21,216 persons had been interviewed. At first, each session lasted about thirty minutes, but as the method was perfected and the confidence of the employees increased, this average length rose to about one and one-half hours.¹⁰

The technique of the interviews was uncertain for a long time until it became fixed in a form tested by results, and the story of these attempts shows the scientific spirit, patience, and will to succeed of the leaders of the investigation. But we cannot enter into

details here. Starting with a fairly usual conception of an interview, the investigators used prudence, precautions and psychological adaptation with their subjects in order not to startle them, but to lead each one to communicate what they thought important in their working life. From the start, anonymity was assured in the strictest fashion. All the results given in the reports were anonymously presented. Each worker was assured that he was requested—not ordered—to answer such and such a question. It soon appeared that the interviewees were glad to have an opportunity to express themselves. Some asked to be interviewed, and among them were some foremen. This program seemed to be in high favor with the company's personnel.¹¹ Gradually, however, the investigators were led to abandon the original questionnaires and to let the interviewee talk with perfect freedom, since it was found that he tended voluntarily towards the subjects most important for himself. The special technique of the interviewers, based on the attainments and classic research of psychiatry,¹² was continued to order to get the company's employees to communicate, most easily and completely, their underlying pre-occupations and impressions. In these, working life was closely intermingled with private life, as was to be expected. Without interruption or any sign of impatience, the interviewer listened to the worker who was being questioned, took a real interest in what he said, no matter what it was, and tried to discover:

- (a) what he wanted to say;
- (b) what he did not want to say;
- (c) what he could not say without assistance.¹³

It was observed that the mere fact of thus being able to express what one is deeply interested in and of discovering sometimes, with the interviewer's aid, new interpretations, raises the industrial morale of certain workers. It is not astonishing, moreover, that a program conducted with such prudence and tact was, on the whole, well received and that, by itself and before any practical application, it relaxed and improved human relations within the Hawthorne Plant.

Yet neither the company nor the investigators were satisfied with this result. They wanted to throw light on the psychological problem of the supervisors and on that of the optimum working environment. Now, as we might expect, the material thus assembled after more than twenty-one thousand such nondirective interviews was extremely heterogeneous and, in general, marked by a subjectivity which made

its analysis and practical use too difficult. By selecting the different subjects spontaneously broached by the workers during their interviews, the variety of their concerns may be seen: from wages to transportation, from the club to uncleanness, from fatigue to furniture, from the restaurant to smoking, from savings to tools, etc.¹⁴

Concerning the supervision of work and the way in which the company's supervisors performed it, out of 4,662 comments made in the Operating Branch, 2,770 were unfavorable. So that, basing himself on these results alone, one of the directors of the investigation could affirm that ". . . relationship between first line supervisors and the individual workman is of more importance in determining the attitude, morale, general happiness, and efficiency of that employee than any other single factor."¹⁵ But this was still too general. And, even though they had the feeling that in this mass of personal stories and complaints they had come upon phenomena important for the life of the industry, the investigators remained perplexed and were at a loss to explain this deficiency in industrial relations in a company so attentive to its employees' welfare.

Casting a retrospective glance at this interview program at Hawthorne, two different stages are at once discernible. The first, during which the 1,600 workers of the Inspection Branch were questioned, was still conducted in the manner of ordinary investigations: it set itself a purely industrial objective, to determine whether the feelings of constraint, mentioned by the women of the test room, were caused by defects in the supervisors' attitude. It was soon seen that the method used was inadequate if the purpose was to obtain from the workers a deeper expression of their reactions. So, in a second stage, through the 10,000 interviews of the Operating Branch, a much more flexible and efficient technique was perfected, which yielded a rich harvest of facts. But then, as the interview method was perfected, it naturally tended to become more and more absorbed in the analysis of individual psychological cases. All the more that, since the comments were strictly anonymous, they were classified solely by their psychological content and without any possible relation to the shop selected, the time period, or the concrete (social and industrial) details, in short, to the whole context from which they had been taken. So the reader is faced by a mass of comments in which emotional elements predominate—expressions of personal viewpoints, prejudices and sometimes grudges. This is clear as soon

as they are compared with one another; the comments on material conditions prove far more valid and useful than those concerning persons.¹⁶

The question was therefore, in the third stage, to advance from a purely personal knowledge to a knowledge having an objective and practical value for the purposes of eventual improvements. The information from the test room and the mica room helped to get over this difficulty. Had not the success of these interviews been due to the fact that the women workers had, indeed, been studied individually and methodically for many months, but also due to the fact that, being in one group, it had been possible to follow both the story of their relations outside the factory (as, for instance, in the case of the woman worker No. 5, reported above) and that of their relations among themselves? The investigators who had tried to treat their indulgent interview subjects as independent and isolated atoms found themselves called to order by the facts: "The individuals who make up a working department are not merely individuals; they constitute a group within which individuals have developed routines of relationship to each other, to their superiors, to their work and to the policies of the Company."¹⁷ It was therefore necessary to take account of the *group* and its inter-relations, if they wanted to place the information given by the worker in the context which would throw light on it, and in which it could be interpreted objectively. So, in its final phase, the program had recourse to a combination of interview and direct observation.¹⁸

During this phase, one or two of the investigators were sent to a shop where they studied the workers of a group taken individually, day by day and week by week, at the same time observing without interruption the inter-relations and activity of the group which they formed. In this way, having gained a certain degree of the workers' confidence, they had the impression that they were getting nearer the central point of the questions that had initiated the program. In addition to other tendencies and conflicts, interacting even more profoundly than the personal qualities and behavior of the supervisors, they discovered a source of disorder in the work itself, in the way of performing it and the relation of the worker to it.

More exactly, the worker, it was recognized, is not attached to his work by a relation which integrates him with it or makes him experience a community of interests with it, or a feeling of deep

participation—and this, even at Hawthorne, was manifested in practices of slowdown and restriction of output. Why?

Most often the worker reacts in this way to regulations, methods of payment, and technical innovations which are applied with implacable logic but without bothering to explain them to him. Mayo mentions the case of a work group in which both workers and foremen were ignorant of the normal rate of production set by the company, and the reasons for which it had been chosen, and did not understand the method of payment which was being applied to them.¹⁹ Here, at the conclusion of this broad study conducted without any preconceived ideas, we again encounter one of the chief lessons of European industrial psychology: *the worker's psychological reactions are unfavorable to any behavior forced on him from above without his mental participation in it or understanding of it.* When one rationalizes, when one establishes or changes a system of industrial organization, it is necessary to convince. Lacking this, one, so to speak, merely administers a drug to a recalcitrant patient: "It may be good for him but he is not persuaded. If an individual cannot work with sufficient understanding of his work situation, then, unlike the machine, he can only work against opposition from himself."²⁰

In spite of the diligence and variety of its administrative branches, Western Electric itself had failed to carry understanding "to the very bottom." Upon observation, it became clear that many workers felt internally divided, a prey to more or less conscious conflicts with the company, the supervisors and their co-workers. They felt and expressed hostility to a state of affairs which was forced upon them and which drove them, for what they considered their own protection, to going slow and a "disloyal" mentality. There was no other answer, the investigators stated, than to increase the understanding between workers and company, and make it spread through the shops.²¹

This is a really remarkable practical conclusion, since, setting out from a localized and special industrial objective, the investigators eventually put their finger on certain general and essential problems of rationalization. The Western Electric investigation, in fact, ends by denouncing any application from above of methods of rationalization imposed as logical mechanisms, and especially at a time when regulations, instructions and procedures are bound to change frequently, owing to technical progress. It is thus dangerous

to try to apply forcibly to workers (in a take-it-or-leave-it manner) plans handed down from the offices, however carefully they have been thought out. What is needed is to make them understood, to spread this understanding, and to make the largest possible number of workers share in it.

RECOGNITION OF THE SOCIAL FACTORS

Thus the investigators of Western Electric, in their turn, are led to a criticism of *technicist* rationalization. In the conclusions of their very full account²² they distinguish two chief functions of an industrial enterprise. The first is to create a product: this is the economic function to which, in the design of rationalization, technical organization corresponds. The second is to "distribute satisfactions" among the individual members of the firm, maintaining good relations among employees, and their good-will and co-operation. To this function there should correspond a "human organization." But while the former has been extensively studied by the different systems of rationalization and scientific management, the second has been scarcely touched and the slightest progress achieved has been constantly challenged by the new and powerful developments of mechanization.

But technological and human organization are reciprocally interconnected and interdependent. Any technological innovation, taking place in the workshops, changes the social structure of the firm. So it should be introduced only in the most favorable degree and at the most favorable moment. A preliminary study of technological changes from the point of view of their repercussions upon the human factor is always indispensable. The reactions of the workers affected by this innovation must be considered, or resistance will be encountered in the worker and even troubles which affect output. In short, once a technological innovation is decided upon one must: study the reactions of the workers directly or indirectly affected by it; anticipate and understand the problems of interpersonal relationships raised by the new organization of work or the new techniques; and, finally, as its basis (and before its application) this measure must be given an explanation throughout the workshops which is comprehensible and acceptable to the workers.²³

Clearly the psychologists of industrial relations are turning scientific management far away from and well beyond the oversimplified procedures with which Taylorism had been satisfied. More especially,

their conception of the firm as a "social system," characterized by the interdependence of its elements, is obviously an important advance by comparison with the attitude of the first rationalizers, who completely neglected this essential aspect of the internal problems of the firm. Resting on this sociological basis, the Hawthorne investigators were able to understand and explain why the technological changes, made hastily and without consideration of their social consequences, led to disequilibrium. This is the case whenever the workers have been forced too quickly and "from above" to adjust themselves to new methods and systems of organization which, as it seems to them, rob their work of the social meaning which in their eyes it previously possessed. There is thus aroused within them not only a feeling that they have been robbed and a resistance to this particular change, but, in general, an irrational irritation at any kind of technological innovation.²⁴

So, while not denying the merits of technicist rationalization, the Hawthorne investigators reproached it with never having known how to state the problems of the organization of industrial labor in terms which take account of the human factors within the firm and especially of the social system which it forms. For lack of this, technicist rationalization eventually puts the firm, in the sense of a "social system," off its balance. Simultaneously, it often deprives the worker of what used to make his task meaningful. The traditions of his trade, his established routines of work, his interpersonal relations (at the factory)—everything is at the mercy of a measure abstractly and "logically" decided by the managers. Thus, workers are deprived of long-tested and matured occupational values and, being in a constant state of instability, are made incapable of acquiring new ones.²⁵

Recognition of social factors by the investigators shows itself in different ways: in the consideration they give to the team of workers, to the whole shop and even more to the factory viewed as a "social system." It shows itself also in the notion of the *social meaning of labor*, a meaning so important for the worker that, when he considers that his job is deprived of it, the balance of his working life is broken and his whole morale is affected. This provokes a distinct fall in output, and possibly obsessive ideas.²⁶

Nor is it surprising to find this sociological spirit in the conclusion of an investigation, one of the first findings of which, after the patient observations of the test room and the mica room, was recognition of

the prime importance of a social factor over all the other causes of the change in output. In the famous Period XII, it will be remembered,²⁷ all the material advantages granted the young women workers of the test room were withdrawn. The rest pauses, the morning snacks, and the reduction in working hours were cancelled. Yet the increased output was maintained. So the socio-psychological factor made up of the more agreeable environment, good comradeship, relaxation, flexible and understanding supervision introduced into the test room (that is, a pattern of relations between persons integrated in a group), predominated over the changes in physical environment and, so to speak, gave them its own color.²⁸ As for the rest pauses, if they affected production it was not because they directly reduced fatigue, but because they changed the mental attitude of the test-room workers, and this affected their entire industrial milieu.²⁹

Surprisingly, it was the same with financial incentives.³⁰ Moreover, what is still more important, the efficacy of a financial incentive, according to the Hawthorne investigation, is so closely allied to other factors that it cannot be considered as something in itself, able by itself alone to exert effects on an individual. "Only in connection with the interpersonal relations at work and the personal situations outside of work, to mention two important variables, could its [a wage incentive's] effect on output be determined."³¹ Now, both these variables immediately involve social factors. Generally speaking, no change in the physical or financial conditions of work had a foreseeable and calculable effect, in terms of output, unless it was connected with *the psychological and social attitude of the worker*, a conception which includes: the personal bond of the worker with his work; the amount of meaning it affords him; his integration in the team, department and factory; and his social and family situation outside the factory. The individual facts of a physical or psychological nature must be placed in this social setting in order to assume an objective and determinate meaning, and to become measurable.

THE THEORY UNDERLYING THE INVESTIGATION

In the account of the practical conclusions of the inquiry and especially in the critique of technicist rationalization, we have repeatedly spoken of the contrast between *logical* conduct (such as the

pure technicians desire to impose by their measures of rationalization) and *nonlogical* behavior, in which the traditions, occupational routines, and feelings of the workers are mingled. Now we must bring out in broad outline the doctrine of the Hawthorne inquiry, in order better to comprehend its range and value.

First, let us recognize that, at least in part, this doctrine has arisen from observations made in a careful and prudent scientific manner by the investigators during their long and complex work. In the face of the behavior of the supervisory personnel and works personnel of the Hawthorne factories, they assumed the state of mind in which the anthropologist begins the study of an Australian or Melanesian population: trying to penetrate the secrets of a human group, with no preconceived idea, with the prudence and wariness of the anthropologist who seeks nothing so much as to gain the confidence of the individuals composing this group, especially in order not to disturb their usual behavior and, consequently, the very thing he is anxious to know and explain. This spirit of social anthropology, which inspires the methods of the Hawthorne inquiry, is one of its most valuable and original aspects.³²

Nevertheless, going beyond the experimental findings made at Hawthorne and permeating the inquiry, there is also to be found a basic ideology in which the influences of various contemporary authors mingle and a theory of the evolution of industrial societies is sketched.³³

According to the Hawthorne investigators, there are epochs and societies in which the individual is completely assimilated by a human group, in which every gesture or rite is strongly integrated and has a group meaning. Anthropologists describe in this way the life of communities in so-called "primitive" societies. But, in the same manner, a nonlogical code of behavior predominates in any society in which economic activities are thought of as social functions, analogous in this sense to the rites of a primitive population. Thus, in the artisan and hand manufacturing period, the producers' daily lives are permeated by a nonlogical code, thanks to which artisans and journeymen conform to work routines, traditions of occupational culture, patiently matured and transmitted interpersonal relations, feelings of value and hierarchy; and through the integration into society of their occupational framework (guilds, guild masters,

corporations), they are directly aware of the social significance of their economic activity.³⁴

The industrial revolution brought about the disintegration of this framework. In curious agreement with Cournot, whom they seem not to have read, Dr. Mayo and his collaborators see in the modern world a broad development from the *vital* to the *rational* which they, for their part, call the passage from a "nonlogical code" to a system of "logical" behavior. Of this vast, compulsive drift towards the logical, rationalization seems to them a striking example. It attacks the entire complex of traditions, occupational habits, culture, social meaning and feeling which certain daily tasks still imply and, sometimes almost overnight, seeks to force them into logical molds.³⁵

Three kinds of logic are found within the factory: the logic of *cost*, that of *efficiency*, and that of *sentiment*.³⁶ The first two, though sometimes conflicting in the branches of management, enter into factual alliance in technicist rationalization to impose their decrees, from above, on the workers in the shops. But the B.W.O.R.* experiment shows how the calculations of the logic of efficiency are blocked by the actual behavior of the workers. In the methodical planning of division of labor and financial stimuli, rationalization assumes that the worker will miss no opportunity to increase his earnings (and, for this purpose, his output) to the limit of his physical capacity. But facts, in the shape of restriction of output, show that this is not so. The formal organization of the factory encounters a latent, informal organization practiced by the workers, and the logic of efficiency runs up against the logic of sentiment. Technicians know nothing of the fact that the individual belonging to the social system of the factory does not behave exclusively according to strictly logical or economic considerations. And so their anticipations often turn out to be incorrect.³⁷

In its attack on the whole of nonlogical behavior, rationalization brings the worker nothing to replace it. So the worker resists the process. He does not feel himself part of this new economic organization. What he wants is, first of all, to remain in an organic social relationship with other men and, after that, to have an economic function serving the group, and to be valued by it. Latent psy-

* *Bank Wiring Observation Room*.

cological conflicts, the poor morale common in large-scale industrial shops and diagnosed at Hawthorne, are connected with the process of disorganization caused by the clumsy, unilateral application of rationalization's "logical" systems. The mission of scientific advisers to industry is to bring to light, in the shops, the inadequacy and dangers of an administration which persists in ignoring the nonlogical elements of worker behavior and the spontaneous organization which unites workers underneath the formal, visible, official organization of the firm. These advisers on industrial relations have set themselves the practical task of avoiding, when possible, the compulsions and conflicts caused by the logic of efficiency in trying to force men into its molds, and of preserving the social structure of the firm by a really broad psychological and sociological understanding of the human factor.

In basing this practical research on the idea of a "social structure" of the firm, considered as a separate unit, and in trying to preserve this unit from all causes of disintegration or division, the team of investigators at Hawthorne were falling in with the most deep-seated concerns of the leaders of industry. They were thus aiding all the measures by means of which, for decades, the enterprising employer has sought, by creating *centripetal* countercurrents, to combat and offset the *centrifugal* (political, economic and trade union) currents which divert from the firm the worker's interest, sympathy, and intelligence, and enlist them for other aims outside the factory. In this way, the investigators were effectively helping to study and strengthen the means of integrating the worker with the collective unit of the factory. We shall rapidly set forth some of these means, in order to bring out the social psychology of the firm implicit in the Hawthorne inquiry, and then to subject it to criticism.

Following in this respect a movement which is sweeping other large-scale businesses of America and Europe along similar paths, and obeying similar necessities, Western Electric has tried, by the most appropriate means for the special conditions of its production and its personnel, to develop an "industrial *esprit de corps*." At Hawthorne there is a "club" whose resources and numerous activities are adapted to the extensive dimensions of the firm and the varied range of interests displayed by the members of its personnel. It provides the latter, according to their tastes, with social gatherings, dances, sport events, and dramatic and musical performances. The

"Hawthorne Club," including as many as eight secondary clubs and twelve different sections for athletic sports,³⁸ is run by the personnel, and all the employees of the works share its offices. In this way the officers find opportunities for meeting one another and making one another's acquaintance, no matter what their position in the shops, the offices, or the hierarchy. It is a way of bringing individuals in the factory into contact regardless of differences of technical training, or social origin, or of the grades in the internal hierarchy, of breaking down distinctions of rank, and of reinforcing or creating emotional bonds and interpersonal relationships which are primarily sustained by membership in the same large firm.

The sports competitions are especially valued by the "personnel counselors" of Western Electric and are developed among the various shops, branches, and occupational groups of the company, because they form useful safety valves for the inevitable hostilities of an organization where so many individuals are distributed and assigned their roles.³⁹ So the inspectors' team will be made to play baseball with that of the operators or that of the office employees. Side by side with interbranch competitions, such as those of baseball, are others organized within a shop or a branch. These are usually bowling teams. All, workers and supervisors, are on the same footing here and vie with each other under conditions of strict equality. The industrial relations counselors recommend these procedures, by means of which feelings of jealousy, antagonism, or hostility, either between collectivities (interbranch games) or individuals (intrabrand games), have an opportunity to be diverted and expressed without endangering the human organization of the business. So it is clear that some conflicts between foremen and workers are sidetracked and find substitutes in a bowling match in which the authority of the superior in rank is of no avail to him unless he acts skilfully and faithfully according to the rules of the game. This tends to transpose serious conflicts—or conflicts which may become serious—onto a plane in which they beneficently dissolve. The effort is made to satisfy the desire for equality by satisfying it outside the hours of work (during which it cannot be satisfied); group solidarity is developed by creating occasions for identifying all employees, foremen, workers, etc., with a larger group, *The Company*.

The conscious and adroit bringing into play of *seniority* is another way of contributing to the same purposes. All employees, whether

simple machine-hands or members of management, may at least be compared and associated in terms of seniority, i.e., the date of their entry into the company's service. If in other respects everything separates them socially, technically and psychologically, they may at least have this common denominator, this career in which each advances in turn with an inexorable equality which cannot arouse envy or dispute. Let us listen to the investigators on this subject, as they clearly show the anthropological spirit in which these problems of industrial psychology are treated practically: "That seniority was recognized as an important factor in the social organization of the company is seen by the importance attached to it by the employees and by the number of social rituals and privileges organized around it. Important service anniversaries were celebrated by dinners and parties given by friends, by 'write-ups' and pictures in the *Microphone* [the newspaper of the Hawthorne works], by public congratulations from someone in high authority, and by the conferring of certificates or buttons symbolic of the 'age' attained."⁴⁰

Finally, by taking over the complicated burden of social services, the company strengthens itself as a collective personality and develops its hold on the whole personnel who benefit by these services. The statistical study of the interviews of the Operating Branch had already shown that, among the many subjects spontaneously referred to by those interested in them, social services were at once what most preoccupied them and what received from them the most favorable comments.⁴¹ The company conceives the program of these social services in a very broad sense, including in them, among others: health and accident insurance, life insurance, pensions, retirement allowances, hospitalization, and services of financial and legal advice. In doing this, it assumes responsibilities which should belong to the State. Here, then, a powerful industrial firm is seen taking the place of the social collectivity in order to assume towards the worker a role which that collectivity does not fulfill, or fulfills inadequately. In return, the company receives an important moral benefit from this attitude: it adds to the vigor of its collective personality, and itself becomes a complex and enveloping social institution. In so doing, it further helps to fortify the centripetal, integrating currents, according to the plan whose operation we have studied.

CRITIQUE

The Hawthorne investigators end their extensive study by throwing into sharp relief the factors of integration. They manage to distinguish whatever unites, or may contribute to uniting further, all the individuals who are parts of the firm considered as a "social structure." But though carefully stimulating these unifying centripetal tendencies, in accordance with management, they seem not to analyze or even to perceive the differentiating and centrifugal psychological and sociological currents, whose importance is so great in the mind of the industrial worker. This exclusive stress laid on one aspect of reality is surprising in what is otherwise so conscientious a study. One finds oneself wondering whether, after all, the investigators were not unconsciously inhibited, in the presence of the Western Electric Company, by the duality of their functions as both scientific research workers and industrial advisers for management.

Actually, whenever they detect differentiating currents, these are inside the business and of secondary importance: what they call "the logic of efficiency" opposed to that of "sentiment," the "logical code" of rationalization confronting the "nonlogical code" of traditions, routines, and sentiments developed among the workers during preceding stages of industry's technical evolution. In a workshop they recognize the existence of occupational groups, little cliques opposed to one another; they describe rivalries, jealousies, even antagonisms, in the factory, between crafts, shops, and grades; but they always ascribe to them a cause and purpose bounded strictly by the firm. Even when their observations force them into contact with a far-reaching phenomenon going beyond the boundaries of the company (the restriction of output), they see nothing of its range and connections beyond the limits of the firm and consequently are prevented from recognizing its economic and sociological meaning.

It may be recalled that in their study of the B.W.O.R., the investigators, having discovered in a small experimental shop the existence of two groups or cliques, carefully point out¹² that this differentiation must not be overestimated, that it does not signify lack of solidarity between the two cliques or between the cliques and the other workers in the factory, as is shown more by their attitude toward output than by any other sign. With the restriction of output the investigators put their finger on a phenomenon implying similar

behavior over and above all the internal distinctions which they like to emphasize. Whatever the workers' occupational rank, ethnic origin, or family problems, they avoid producing too much in order not to cause the dismissal of some of their comrades.⁴³ Obscurely, but strongly, they feel that there is a definite amount of work to be distributed among them. Minute study of the internal, spontaneous, "informal" organization of the team of the B.W.O.R. shows it to be wholly controlled by the workers' wish to protect themselves against internal indiscretion and external interference. The very distinction of the two cliques tends to follow the line of "normal conduct" defined by the little group of workers with regard to these profound needs. It is a question of "self-protection" against the management, and the chief means at the workers' disposal is to maintain the levels of output approximately uniform.⁴⁴

Observing methodically a group of workers taken at random,⁴⁵ the investigators are thus led to recognize that the mainspring of their inner, spontaneous, secret organization, of their personal interrelations, and of their behavior inside the factory, is the defense of their collective economic condition. They think they contribute most effectively to this—on the basis of a system of piece wages and bonuses—by restricting output. Such an attitude clearly implies a solidarity among workers which transcends individual psychological distinctions, antipathies, membership in such and such a group or clique and even, very often, their immediate financial interest. The practice of restriction of output, the recognition of a certain duration of work as a "norm of conduct," unites them more or less consciously into a collectivity surpassing the internal differences and limits of a firm, even one as vast as Western Electric. The investigators grasped the intrinsic importance of restriction of output, but did not see that here they confronted a socio-economic fact going beyond the company's horizon and relating the workers' attitude to that of other workers, in other factories, in other industries—in other regions, and even in other countries. Far from being explained by the purely internal factors of the firm, this phenomenon involves the economic and social condition of the industrial wage worker within the total society to which he belongs.

The chief weakness of the social psychology of the firm underlying the Hawthorne inquiry is that it persists in considering the firm as a complete, closed social structure, a kind of collective entity pursuing

its evolution independently of all other social groups and within which other groups—the “clique,” the “team,” the “shop,” the “department,” the “factory workers,” the “foremen,” the “clerks,” the “team leaders,” etc.—interact and conflict, but without interfering with the collective realities external to the firm and of a vaster extent. The social organization of the factory, considered as a structure, is a sociological fact of undeniable importance and the authors, in studying it from this angle, drew interesting observations. But they reduce and sometimes falsify their value by, so to speak, suspending the firm in a void, and by maintaining a sort of *social vacuum* about the Hawthorne Works—hypostatized into an absolute entity: “the Company.”

Let us take a worker working in a relay assembly unit. He certainly belongs, within the company, to a certain number of groups the social pressure of which partly determines his conduct: the clique, the team, the workshop, all the workers, not forgetting the factory as a whole, the company. But the complexity of the sociology of the firm derives chiefly from the fact that at the same time as each worker belongs to various collectivities within the works, he also belongs to larger external collectivities, such as the trade union, social class, and nation, in which individual differences play their part, according to the kind of union, occupational skills, ethnic origin and greater or lesser degree of national assimilation. It is enough to mention here some of the groups which influence the worker's consciousness and which meet and are combined with that of the company, which, after all, is nothing but a group among others. The worker belongs not merely to this collectivity—the firm—but, simultaneously, to other groups defined by their position in production and in society, in short, by socio-economic factors whose influences do not cease at the factory gates. By omitting them, and considering the firm as an isolated and absolute whole, unaffected by the real interference of other groups, other collective representations and social forces which make their presence felt in the actual life of a company, one is forced to conclusions which are superficial, incomplete, and even false.

For example, it is not surprising that on the basis of a social psychology which deliberately discards certain aspects of social reality, one is led to consider and explain as “irrational”⁴⁶ the workers' reactions of distrust, inhibition, hostility and revolt against

the social structure of the company: One does not see the rationality, the logical foundation, the relevance to social conditions of these reactions, because one does not recognize the other groups to which the worker belongs and whose influence determines his attitude.

Nor is it any more surprising to see the scientific leader of the inquiry deny any impact of external social conditions upon the internal human problems of the firm, declaring with imprudent dogmatism that "the several researches I have reported possess significance equally for a factory on the Volga or for another on the banks of the river Charles."⁴⁷ Likewise, when the investigators, in the conclusions of their study, criticize the "logic of efficiency" by which the technicians of rationalization are inspired to reform production, they do not see that these engineers are usually not free to choose the path which they follow, that it is not a matter of free choice of one "logic" as against another which might have been preferred under the same conditions, one more considerate of the workers' sentiments. In fact, the rationalizers of Western Electric, aiming methodically under all circumstances at the maximum output at minimum cost in personnel and material, are obeying the determinism of the industrial capitalism of North American society, a determinism in which the company, whatever the investigators seem to think about it, is closely integrated.

Having thus arrived at the end of the critical study of the extensive and fruitful inquiry, we see that it, too, recognizes that the human factor, considered from the purely physiological and psychological angle, is less important than determinations of a social nature. Observation of the young women workers in the test room showed that all the experimental changes in the hours of work, rest pauses, meals, and the equipment of the room, derived their value from changes of a social order which transformed the girls' relations with one another and with their supervisors—the psychology of the group which they formed. The long and costly interviewing program which was carried out during working hours was only so patiently conducted because the investigators and the company attributed greater influence in improving the worker's attitude to work and his output to the social psychological atmosphere than to changes in the physical environment of work. Certainly, by reducing their perspective to the single firm considered as an entity independent of the other social forces which impinge upon it, the investigators minimize

the social factor and fail to see the whole variety and wealth of its influence on the psychology and conduct of the worker in the factory. However this may be, and confining the question to their conception of industrial relations, their conclusions establish *the primacy of the social over the human factor* as defined by a still short-sighted industrial psychology in its early stages.

BAT'A

Though situated thousands of miles away from Hawthorne and employing men of a totally different ethnic origin in producing goods with no relation to those of the great American firm, another giant enterprise nevertheless founded its organization on the same fundamental ideas, with the same basic purpose of improving the company's economy by playing upon psychological factors. The Bat'a works, at Zlin, in Moravia, at least up to 1939,⁴⁸ afforded a remarkable example of the practical application of "industrial relations," probably the most significant which Europe could show to compare with the American developments.

The Bat'a enterprise, after a rapid development, added to the mass production of the most varied types of footwear, the production of materials or auxiliary products necessary for its major production. A "vertical" development was added to its "horizontal" one. The company erected a tannery which alone occupied an area of 236 acres, and factories manufacturing cardboard for shoe boxes, fabrics for linings, half-hose, rubber for certain models—and, starting from this—tires, balloons and rubber toys. All these workshops were provided with constantly modernized equipment, and the automatization of machines was constantly taking the place of human labor on the assembly line. A machine for filling blacking tins itself arranged the empty tins and filled them with hot blacking to the tune of 50,000 cans daily.

Here, too, we have a methodical effort to strengthen the firm considered as the fundamental social collectivity, so as to integrate the worker in it and develop in him an industrial *esprit de corps*. But what gives the great Czech firm its special character and constitutes the originality of its social effort is that, while using the customary means of integration into the collectivity of the firm, it nevertheless subdivided the collectivity commercially into sections having a certain degree of autonomy. Let us study this paradox more closely.

To integrate the worker into the company, the creation of a favorable social atmosphere is even more important than measures of a physical nature: that was the hypothesis on which the Bat'a organization took its stand and which, by the internal orientation of the firm, related it to the industrial relations movement. This atmosphere is the more surely attained the more the initiative, skill, and personal interest of the individual are relied upon. For such a purpose, in a large firm consisting of a conglomerate of plants engaged in making very different products, the stimulation of personal interest required this tremendous whole to be reduced to the dimensions of the individual, his thought and capacity for feeling, and to be dismembered into relatively autonomous sections. This is where the worker's integration into the whole occurs through subdivision of the whole.

Shops and teams were made up in which the worker's initiative, responsibility, skill and personal interest were cleverly roused. Thus, each team for a well-defined operation or manufacture, such as cutting out leather, perforation, sewing, eyelet-making, etc., was given a certain independence. It behaved like a single person.⁴⁹ It "bought" from the team preceding it in production the materials which it had to work on and then "sold" its semi-finished products to the one following it in the series of operations. The shop chief, for instance, would go himself to the works' storeroom to buy the skins he wanted. The team was responsible for the defects of its manufactures; it could gain, but it could also lose.

Trade between the shops was restricted by the team's responsibility to the other parts of the business with which it had relations. Fines penalized bad workmanship. Bonuses were distributed in different ways: the team chief received twice as much as the most favored worker and stood the losses alone, when there were any; the skilled workers were paid in proportion to their output. As for the unskilled workers, they received a fixed, basic wage.

Thus, by dividing the rationalized business into sections, autonomous and interdependent teams having an interest in the output and the financial results, it was hoped that the worker would again begin to work with a will.⁵⁰

One of the most delicate problems with which such an attempt is confronted is that of the production workers' latent distrust of the planning departments, shown many times in the United States from the inception of rationalization.⁵¹ The technicians of these

departments are always tempted—or, at least, the factory workers fear this and act accordingly—to satisfy their “logic of efficiency,” in the words of the Hawthorne investigators, by cutting down excessively both times and piece rates. At Bat’a this danger was obviated by connecting the interests of both: the planning department shared (2%) in the profits of the shops whose work they prepared.⁵² The attempt was made to counterbalance the technicians’ propensity to over-rationalization and to combat the workers’ antipathy for them. Thenceforth their interests were, to a certain degree, the same.

But while attempting to attract the worker to itself by adroit stimulation of his personal interest and his initiative, the Bat’a firm tried to secure his integration with the enterprise as a whole. For the purposes of this plan, everything was sought which could strengthen, in the individual’s consciousness, the collective personality of the factory to which he belonged. Besides the social services usually offered by large firms to their workers (insurance, pensions, clubs, restaurants, hospital, etc.), Bat’a increased the centripetal attraction by organizing an “experimental school,” a kind of trade school intended to prepare young workers highly endowed with the qualities of initiative,⁵³ by the most modern pedagogical methods; a technological museum associated with this and containing all that had to do with the footwear industry (many machines exhibited there could be run freely by the young visitors); and finally, a training shop, through which the new workers had to pass. There they performed in succession all the operations involved in the manufacture of footwear so that they might obtain a total view of it. Here Bat’a made a notable concession to the “polytechnicism” of modern industry, already recognized by Ford.

Furthermore (and this was not the least effective of the factors of integration), the personality of the Bat’a business was systematically enriched and strengthened by the policy and myth of the “chief.” These latter show, from another angle, the desire to harmonize individual efforts within the patterns of a large capitalist factory.

Thomas Bat’a, the founder of the concern, was descended from a family of shoemakers settled since the seventeenth century in what was until recently an isolated and almost deserted valley of Moravia. After his death in an accident (1932) his half-brother, Jan, took command: the “chief” succeeded the “old chief.” Bat’a and his principal collaborators displayed the greatest simplicity. At Zlin there

was no ceremonial, no *titles*, only (as was the case with Ford) *functions*. On reaching the factory each morning, the chief himself punched his card at the time-clock like the lowest of his workers. The building of the management was not at all different from the others, its offices were fitted up with "an almost Spartan simplicity."⁵⁵ There was no attendant at the chief's door. Here is a picture of him during a weekly meal with his collaborators: "This dinner is meant to accomplish the adjustment of antagonisms which are present in this tremendous system of internal competition. It is the scene of a final confrontation of points of view under the presidency of the chief who, as I saw him, fully plays his role of chief. He lets both sides freely expound the arguments concerning each question under discussion, and then frames his own thoughts as though meditating aloud. He does really think aloud, and you can see it by the way he talks, his eyes are raised and look into space, roaming over those present without clearly fixing on any material object."⁵⁶

Is there any need, in regard to this, to remind the reader of the captains of industry dreamt of by the Saint-Simonians, or of the combination of "profound morality" with "high capacity" which Auguste Comte demanded of aspirants to the "spiritual government of humanity?"⁵⁷ Anyway, to take a more recent reference, in the conduct of the chief of the Bat'a businesses with respect to his personnel and collaborators, the American promoters of the "industrial relations" movement would recognize their psychological conception of *leadership*.

Much more than this, throughout the whole structure of the Bat'a concern, there appeared the will to transform by flexible and original means the internal atmosphere, the "morale" of a giant factory. This was an experiment which certainly differed from those of the same type conducted in the United States. It had original characteristics and, on close analysis, one could observe special social, economic, geographic and ethnic conditions which shaped this remarkable organization of incentives. It was adapted to a large firm, "vertical" as well as "horizontal," employing in a valley of Moravia certain types of workers the majority of whom seemed to have come, directly or almost directly, from the peasantry of the region, with a predominance of the ancestral, social and religious customs, characteristics, and traditions which the managers of Bat'a knew thoroughly, and

which they took into account in order to integrate their workers psychologically into the industrial collectivity.

Some of its traits are related to the new forms assumed, since Ford, by American Scientific Management which the chiefs of Zlin had studied—especially the precautions necessary to prevent the worker having the impression of being fitted into a rigid, hierarchical system; to leave him, as far as possible, the taste for initiative and to allow him direct communication with his superiors; and for the responsible technicians to be designated not by titles but by functions. In other respects, the subdivision of the enterprise into relatively autonomous sections, the definition and role of the team, the commercial “game” which each was allowed to play, the conditions of participation in the profits by workers and planning department, all show that here was a carefully thought out technical organization. But it was also a vast attempt to change the psychological relations among the members of a large factory, to strengthen the collectivity and its power of integrating the individual and, consequently, to transform the worker’s mental attitude toward the work entrusted to him.

In a more complete description of industrial relations at Zlin, special mention should be made of the form which paternalism assumed there. Through his very simplicity, the personality of the “chief” was exalted, and it was sought to make him a legendary figure in the workers’ eyes. On the occasion of ceremonies and festivals, a kind of folklore was created and maintained about the Bat’a firm. Certainly not the least of these was the Festival of Labor, celebrated on May 1st by a communal meal of the workers in the shop and a labor parade in the city, which was decorated with wreaths and garlands. While the Bat’a organization developed the centripetal forces it seems to have succeeded fairly easily, in this setting where the workers were intimately connected with the peasantry, in neutralizing the centrifugal forces and securing the depoliticization of the life of the factory. There were no unions at Zlin. The Bat’a organization tended to make its workers believe that political ideals were only abstract formulae and that the only concrete collective reality for them was the Bat’a footwear industry, the success of which they must work for with all their physical and moral strength.⁵⁸

TWO FRENCH EXPERIMENTS

In all industrial nations since the beginning of the century, and especially between the two wars, one finds this desire to approach labor problems—even the apparently purely technical problems of the quality of production and of manpower—from the angle of the modification of workers' psychology within the firm. France has not been immune from these developments and, before returning to the general problems raised by industrial relations, I should like at least to mention two experiments of this sort, very different but both highly significant, which have taken place in France.

The scene of the first was an automatic machine works in the Paris region before World War II, managed by an enterprising and intelligent industrialist, Gerard Bardet. "I have the pleasure," he writes in a published memorandum on this subject, "of managing a business whose activity consists in creating—that is to say, inventing, planning, making and perfecting—all sorts of automatic machines, from laboratory apparatus to the five or six ton machine, with the purpose either of solving a new problem or of doing mechanically work hitherto performed by manual processes."⁵⁹ Once an order was definitely given, it was necessary to reflect for a long time on the problem raised by the required change from manual labor to mechanical combinations. Underlying every machine is an idea: this is what had to be found. After some time the manager and his assistants would give a designer the chief elements of the plan to be carried out. "The project itself advances irregularly through successive approximations, the ideas developing from the complex to the simple. After an incubation of some months during which the designer will have to be followed constantly, day by day, the plan emerges. It only remains for the workshop to carry it out. Then comes the setting up, the assembling, the preliminary trials, a really fascinating period during which one watches the thing conceived stir and take life. Finally, its installation at the customer's factory."⁶⁰

Here, then, is a common task shared by those who conceive the machine, plan it, construct it, set it up and perfect it. The collective nature of the sort of production in which the Bardet works specialized seems to me to have had good effects on the success of the efforts made there to develop a spirit of solidarity.

The head of the business himself told how, starting in 1925, he began and developed his experiment. Also, during visits to the works and conversations with the technical and worker personnel, I observed some of its results during the winter of 1938-1939.

First of all, Bardet's function as employer, and the conception of his role and of his attitude, were effectively changed by his first years of management. Having spent long hours in the shop, having tried to "see" things from the workers' point of view, having imagined their reactions to their surroundings, and having noted (at first with surprise) their "solidarity" and "pride,"⁶¹ he was talented enough to draw some lessons from his contacts with them. He understood how the worker, earning his living by hard toil, felt about the manager and the engineers who reached the factory half an hour later than himself and then visited the workshop, hands in their pockets, chatting and discussing, and how he felt about the enormous difference in salary and discipline between him and an employee in the Planning Department. Moreover, Bardet observed that, from the point of view of command, the worker admits no other hierarchy than that based on technical superiority. This, however, he can do more than feel: he can accept it freely. The organization of a new psychological atmosphere in the plant must take into account the need for equality in discipline and for justice in the hierarchy. All members of the personnel, whether designers, office employees, skilled or unskilled workers, and engineers, were required, in the same conditions, to be equally punctual. The employer would be at the shop half an hour before the workers and leave half an hour after them. The shop supervision was entirely changed. The posts of command were given to workers, mostly young, whose occupational skills were unanimously recognized by their comrades. The methods of pay were simplified and established in terms of technical value; a system of vacations with pay and bonuses for seniority was started. In October, 1932, a collective contract helped to stimulate and reinforce the change in psychological relations within the company. It supported an organization which, above all, developed the worker's confident co-operation with the management of the business as the chief incentive to integration. But other, secondary factors were likewise involved.

A workers' council was created representing the shop personnel. It included four delegates (two machinists and two fitters) freely

elected by their comrades without any sort of interference from the management. Each council was completely renewed every three months, a delegate being eligible only once a year, in order to bring as many of the men as possible into contact with the administrative difficulties of a business.

Without going into details which are irrelevant here, let me note only that the worker council regularly exercised its function first on corporate committees, one for the machinists, one for the fitters, in which, during short weekly sessions, all the plans for improving the quality of work, increasing output by change or adaptation of equipment, economies in general expenses, etc., were discussed. Moreover, a "managing committee" (named in 1938, "Council of Management and Arbitration") meeting each week under the presidency of the head of the firm would examine questions of a general nature. Its members were: the works manager, the foremen and the workers' council. Here the head of the firm had laid before him all facts concerning the work under way, its quality, the progress of orders, and the practical results achieved by the committees. He took decisions accordingly, made a rapid review of the general situation, talking of anticipated orders, and set forth frankly the commercial and financial situation. "These reports," the head of the firm notes, "are essential for me, for they not only help make it possible for me to keep in constant contact with my personnel, but are a highly valuable form of education for the delegates: the attentiveness with which they listen and the conscientiousness with which they discuss are striking; they are learning and therefore rising in stature; and that alone suffices in my own eyes to justify the path that I have laid out for myself."⁶²

This organization functioned with great regularity from 1932, and the tact with which Bardet called on his workers to collaborate with him, little by little created a collective atmosphere of confidence, enjoyed, to my knowledge, by very few factories elsewhere at that time. It is very unusual indeed, not to say exceptional, for an industrialist, even if he accepts workers' management committees in his factory, to let them know his budgetary situation, his manufacturing costs, and his margin of profit; in short, to open his books to them, and to get them to share loyally in the economic life of the company. The workers were responsive to this procedure which, at the same time, proved to be a very effective way of integrating into the works as a

collective reality all who were thus allowed to penetrate its inner life, hitherto hidden from them.

Moreover, on the whole, the value of this experiment in industrial relations was shown by its results. The personnel never struck, even at the time of the great strike wave of June, 1936. The hiring committee, of which half the members were workers' delegates,⁶³ would make decisions in which it subordinated the candidate's political affiliations to his technical value, which indicated its confidence in the management. In a general way, the new organization constantly raised the quality of the labor supply and of the work done. The personnel was stable (its average seniority, in 1935, was over eight years). The atmosphere of confidence made it possible to bring out the need for technical competence in the daily life of the shop and to assign it first place. According to the statements of engineers who told me this, the skilled workers of this factory, compared with those of other firms, showed a superior degree of conscientiousness, and even pride in their work. This psychological situation explains why the management succeeded in substituting task work for piecework. The workers, who could have increased their wages easily by carrying piecework to the limit, preferred to spend more time and earn less in order to achieve a more careful, "finished" product, from which those who worked after them on the same part would benefit. The idea of price disappeared before that of task, the strictly financial constraint of scientific management yielded to the moral constraint of a homogeneous group and, in the teams responsible for assembling the machines, a solidarity in work well done was apparent. Workers with an aptitude for leadership came spontaneously to the fore, and were recognized quite naturally by their comrades. The ranks of the foremen were thus renewed; a good attitude was established between them and the workers, and between the latter and the designing and planning personnel, thanks to strict equality in the rights and duties provided in the collective contract.

Yet it would be wrong to think that the differentiating forces had been completely neutralized. This may be seen from some characteristic discussions in the managing committee. The head of the firm, anxious to enhance the value of the "craft," proposed to the committee a special statute providing advantages in favor of skilled workers, who were to be called "established journeymen"; in particular, these would have enjoyed additional guarantees of security in their

contracts. The workers' council opposed this project in order to maintain the unity of the union body, but then substituted other measures which extended guarantees of this sort to all, regardless of skill. Clearly, the worker personnel, including politically active men and union members, even if it was attached to the collective reality of its factory, did not for that reason sever its organic ties with other collective realities and other social groups. It maintained all its ideas, its emotional reactions, and its basic claims. Certain workers within the managing council even displayed some hostility to economic co-operation with the owner who, they said, was going too far; they conceded "good understanding" but not "class collaboration." Social contradictions and the division into two camps remained latent but present. Integration into the business, however effective, can only oppose—it cannot suppress—the centrifugal currents in a highly developed worker milieu.

Worker collaboration, such as we have just seen put into practice, tried to substitute a moral for a financial constraint in working-class mentality. The *proportional wages* movement (P.W.), which is now to be discussed, counts upon an effective strengthening of the financial incentive to change the psychological atmosphere of the firm and to reach a more complete integration of the personnel.

Whatever may ultimately be the practical outcome of the P.W. movement, it represents one of the most significant campaigns undertaken by employers since Ford, and the most important from the industrial relations point of view that has been initiated in France. At its head is Eugene Schueller, a founder of industries and a vigorous personality among the "self-made men" of the period between the two wars. He controls numerous and important concerns in varied branches ranging from soap-making to plastic materials and advertising. Led by him, the P.W. team, like that of Jacques Duboin a few years ago, or the Columbia University group of technocrats,⁶⁴ emphasizes the modern mechanical revolution and the age of abundance which should be its fruit. I discuss below some of the slogans by means of which the P.W. movement makes its propaganda effective.⁶⁵

Humanity first lived through the stone and then the metal age. During the first two ages man "equalled" on the average one-twentieth and at the maximum one-tenth of a horsepower. Today every man disposes of a motor of, on the average, ten horsepower: so he is 100

times as strong and can produce 100 times as much as the man of yesterday. Now, in spite of this enormous potential, men have never been so unhappy: "overproduction, unemployment, poverty, the class struggle."

I will not dwell upon the economic and moral aspirations of the P.W. movement. They are vast and their exposition has no place here. Let me merely say that it has more originality than just one more theoretic venture of armchair thinkers or publicists. Enterprising employers, more clear-minded than many of their fellows, want to test the movement by putting it into effect. It is from their action as pioneers, they think, that tomorrow's economic world will be re-adjusted, its products distributed, and welfare (corresponding to the power recently acquired by man) assured to everyone. Salvation can only come from some employers who are able to take the initiative because "only they can do it without asking anything of anyone."⁶⁶ As one of them writes in the title of his appeal: *Mission ou démission patronale*—"Mission or Abdication of the Employers."⁶⁷

Seen as a whole, P.W. is, therefore, a new manifestation of the contemporary ideologies which, relying on the tremendous development of the techniques of production and without attacking the foundations of the capitalist structure, call for "revolution through abundance." The lever of this revolution is the proportional wage. But this in its turn only raises the production curve because it transforms the psychological atmosphere within the firm. The economic result aimed at here, as in other kinds of industrial relations experiments, is obtained by a clash or a combination of psychological variations.

Today, the advocates of P.W. continue, "the wage is to man what oats are to the horse; the means of sufficiently sustaining him so that he is able to resume his work the next day in a good physical and psychological condition." The absurdity and scandal of the existing system is to maintain wages at the lowest standard of living in a world in which, thanks to the machine, production is advancing by unheard-of leaps and bounds. The formula of P.W., on the other hand, would make it possible to keep giving man the benefit of the increased production. In order to do this, in each business the average proportion, N , of the production to wages is determined over a fairly long basic period: each month, using the coefficient N , the increase in wages would be calculated in terms of the growth of production. The P.W. falls into four parts: (1) First, the minimum wage estab-

lished by collective agreements is taken as the base for the P.W. plan. (2) Then, as soon as the P.W., calculated at the rate mentioned, has yielded a figure higher than the original wage, the company pays supplementary grants to workers' families. (3) Third, the excess constitutes labor's share in production, a share distributed among the workers in proportion to their usual wages. (4) Finally, because of the fluctuations in production, it proves indispensable to compensate in part the wages of the bad months with those of good months; and for this purpose there is an equalization fund from which is deducted a part of the remainder after payment of the first and second portions.⁶⁸

The formula of the P.W. is clear and easily understood by factory workers. This simplicity and clarity constitutes one of its trump cards from the psychological point of view. It is explained to the workers that they will receive from now on a wage in direct proportion to the increasing production, and that they are certain to get their fair share of the result of their increased effort, just as much as the salesman who knows that his earnings increase in proportion to the business he does. These features assure the initial impetus of P.W. and, if conditions are favorable, make it possible within the first month to distribute to the workers a supplement to their pay, a substantial advantage which in turn helps to convince the hangers-back and overcome their distrust.

For here, too, after all, mental states are what must be changed in the worker in order to increase his output. Though the P.W. team does not consider itself as forming part of the scientific management movement, this idea constantly appears in its activity. It tries primarily to put an end to the worker's great suspicion: "The worker distrusts, on principle, whatever an employer may promise him, and is not inclined to make an added effort in return for promises. Many," Schueller adds with a touch of bitterness, "are unwilling to believe in anything but a system which would let them get rich by ruining the employer, and what troubles them is that in P.W. both profits and wages increase together."⁶⁹ Thus, in an urgent appeal to "the workers and employees," they are insistently asked to understand that P.W. is not just another method of remuneration in addition to all the systems already invented to make them produce more. They are urged to "see in the employers who apply proportional wages pioneers of the economic revolution, men who really want to change some-

thing in the workingman's condition." They are entreated "to consider the interests of the firm as their own, not to suspect every effort at economy or increase of production and to make the best use of the machines and raw materials."⁷⁰

To dissipate "the almost universal distrust"⁷¹ of the personnel for the employer's introduction of P.W., it is launched in a good month, when production is perceptibly looking up. The increased sum on the paycheck helps to pass this first barrier of suspicion. When the workers are assembled again, the moral is drawn from the facts, they "are shown the foolishness of their distrust and that P.W. is a straightforward system which has nothing to do with trickery."⁷² The next month, another beginning is made. If the supplementary wage has increased, this is explained to the workers. If it has fallen, or if only the basic wage has been paid, the reasons are given. So each month an effort is made to improve the psychological conditions, to substitute confidence for mistrust and to make the worker, hitherto an outsider to the business, "a partner." An industrialist who himself is one of the pioneers of the system explains with discernment why P.W. has such quick and favorable results on output: "The workers, employees, and foremen clearly feel that their direct and immediate interest is that output should increase, and they do what is necessary to achieve this result. At first they unconsciously influence themselves: idle time diminishes; the usual little hitches which slow up work—the driving belt which flies off, the machine that stops—assume importance, and ingenuity is exercised to reduce them to a minimum. Then they affect others; the comrade who is a little slack is urged to speed up; the foreman who does not run malingers to earth quickly enough receives a nasty stare; in short, with everyone feeling himself master of his own and his neighbor's wages, the atmosphere is wholly changed."⁷³

It could not be better expressed: thanks to the skilfully re-created and applied financial incentive, a complete change of "atmosphere," the development of a community spirit, is effected—or, at least, it is hoped will be effected—which means, in our vocabulary, the worker's psychological integration into the collective reality of the firm. Ultimately, P.W. even hopes to recruit from among the wage earners "militant representatives" of P.W. It wants to hasten the day on which the most alert and advanced elements will aid in the development of technology (which is always, as a matter of fact, an

important stage in the worker's loyalty to his work), make the machines yield their maximum, take an interest in every phase of production, and demand conscientious performance of those preceding or coming after them in the process of work. Wastefulness and bad workmanship will then disappear in proportion as "an atmosphere of confident collaboration"⁷⁴ develops.

Let us not consider here the ambition of the P.W. movement, which is considerable since, averse to all State interference, it hopes through its own strength and influence to win the adherence of all forms of business in the national economy.⁷⁵ And let us not judge, either, the criticism it has received and the obstacles it has encountered in the managerial-employer world from which it emerged. As for the effect attempted on the workers' state of mind, it is a great error to think that, by opening to them the limitless perspectives of petty bourgeois mentality and manners,⁷⁶ the countercurrents resisting their integration into the firm will be "neutralized." The proportional wage, as the solitary panacea for the social and political realities of our century, after all, represents a very pallid complex of material and moral advantages compared with the great innovations toward which so many workers are striving and from which they hope for a metamorphosis of their condition by the full achievement of their own dignity as men. But in referring to the P.W. movement here, I intended only to disclose a new attempt to change the mental atmosphere of business and to assure the worker's psychological integration with the group which business constitutes, which is an indispensable condition for a more complete unfolding of his capacities for work and thought.⁷⁷

SOME EXPERIMENTS SINCE 1945

Experiments in industrial relations have continued to grow in number, in scope, and in comprehensiveness during the postwar period. They are connected with the increasing concern to reform the business firm, with the efforts of the capitalist economic system, in the different forms which it takes in different countries, to find a new direction in order to counter the growing pressure by wage earners, and with the need for co-operation between the members of a working group. Within the limits of this note, it is only possible to discuss a few outstanding examples in France and in England, but it is clear

that similar examples are to be found in all the developed industrial countries.

In France the proportional wage experiment has continued and, according to its promoters, covered in 1953 approximately 2,500 firms (most of them small and medium-sized), without having modified in any way the basic principles determining its advantages and limitations, of which an account was given above. The establishment of works committees has increased the desire of many active trade unionists to participate in the application of the system, and in particular, to exercise some control over the variations in the relation between the earnings of the firm and the total wages paid.

One of the most active groups of employers among those seeking to change the atmosphere in modern industry is the *Union des Chefs d'Entreprises pour l'Association Capital Travail* (U.C.E.—A.C.T.) which was founded in 1945, and which later took the title of *Action pour les structures humaines*. This organization, which is concerned both with research and action, aims to “transform the relations between capital and labor by means of a new relationship based on the contract of association.” The intention of this experiment is admirable, though it is still on a modest scale in practice, for there were in May, 1952, only fifty-three active members representing twenty-two firms. Among these firms it is interesting to study more closely the *Forges et Aciéries de Bonpertuis* (Isère) directed by one of the founders of U.C.E.—A.C.T.⁷⁸

The directors of this firm, in order to achieve a real “integration” of their employees and to develop in them a community spirit, have formed them into a *société de travail*. The firm pays to this *société de travail* a collective wage, which guarantees it complete ownership of its contribution of work and of any increase in productivity. The initiators of this experiment have taken a lesson from the failure, on the human side, of all the systems of rationalization which are imposed from above, centralized, and authoritarian, and which separate thinking and planning from the execution of the work. Consequently, they have distributed responsibility as widely as possible, in order to lead the *société de travail* gradually to taking over the direction of the process of production. The employees, using the technical apparatus placed at their disposal, and organized in autonomous workshops, participate fully in the daily life and earn-

ings of the firm, in which they have been accorded a recognized status. The firm has attempted at the same time to integrate those of its customers who agree to participate, and accept responsibilities, in its operation. This attempt may be very valuable in an unplanned economy, since it tends, by establishing agreed programs of production and by price analysis to insure, up to a certain point, regularity of work, security of employment, and a steady development of the firm.

The shareholders, instead of being entrepreneurs who act in their capacity of exclusive owners, become suppliers of capital associated with the firm. Their rights in respect of profits are limited and precisely stated. They are proportionate to the original investment of capital, which is periodically revalued. The remaining surplus thus appears as a gain to the community in which other associates may similarly have a share on a contractual basis. Their share of profits is limited in the same way in accordance with the services rendered and the risks assumed.

The *société de travail*, constituted by the body of workers, clerks, and technicians, sells its output to the firm. Each of its members receives in this way a monthly payment from the firm which represents his share of work in the output sold. This includes a guaranteed minimum wage in case of sales at a loss. The general earnings of the firm comprise all the amounts distributed, and in addition, the community gains represented by undistributed profits (the statutory reserve and the carry-over).

The method of distribution, which cannot be discussed in detail here, and which is, moreover, somewhat complicated, insures the following to all employees: (1) a minimum wage; (2) a contractual share in the general earnings; (3) the shareholders receive a dividend of 2½ % on their capital, which is revalued each year on the same basis as wages; (4) if a surplus remains, additional payments are made to the technicians and managers, in accordance with a steeply graded sliding scale, above the minimum provided under headings (1) and (2). This maintains the incentives to skill and technical competence.

In addition, a special subcommittee of the works committee participates in management, with full knowledge of the total earnings and of the profit or loss of each workshop and department.

The experiment seems to have developed in an atmosphere of

genuine good faith and of real integration of the employees. It should be emphasized that this result has been obtained by going outside the traditional procedures of capitalist enterprise, and it seems clear that in the social and psychological conditions of French industry, this is a necessary condition for success.

Another instance of French enterprise, whose methods and success have aroused considerable interest not only in France but also abroad, is the *Télemécanique électrique* (T.M.E.), a large firm which manufactures contactors for electric motors and which has three factories near Paris, at St. Germain, Reuil and Nanterre, and one at Ménilles (Eure). As a result of its sound and unique organization, its system of collective bonuses, and its understanding of the human and social problems of the firm, as well as the quality of its products, the T.M.E. has obtained exceptional results.⁷⁹

The firm, which was founded on a very small basis in 1925 by four engineers, an accountant, and about ten workers, began, with a technical outlook agreed upon by its founders, the mass production with new patents of a switch gear, without meeting too much competition. In 1928 it was turned into a limited company, and had already perfected the construction of safety relays for the development of the automatization of machinery (in particular, the development of the transfer machines of the Renault works). Today (1954) the T.M.E. employs in its four factories approximately 1,700 people and has an output more than ten times as great as that of 1938. It has expanded considerably abroad, and has established, in several countries, firms manufacturing under license ("Contactor Switchgear" in England, and others in Milan, Brussels, Morocco, and Brazil).

The success of the T.M.E. is largely due to the methods of payment, which are of three kinds; a fixed wage, a share in profits, and a sliding scale.⁸⁰ For the fixed wage, all employees are paid monthly; all hourly wages have been abolished, and this has allowed the firm to eliminate the distinction, which often has harmful effects, between two "classes" of employees. All jobs from that of the laborer up to that of the managing director have been rationally studied and evaluated, taking account of carefully chosen criteria, and grouped in two principal categories: predominantly intellectual tasks and predominantly manual tasks. Every job was studied by two or three

observers. After a long period of analysis and considerable discussion, and also, it should be emphasized, with the agreement of the works committee, a scale of skill for all jobs was established. Each task is given a certain number of points, and wages are calculated by multiplying this number by the value given to each point. The scale of wages at present ranges from one to seven points.

The same principle is applied in determining participation in profits, but in this case the criteria employed are skill and responsibility. Thus, each job has a certain number of points attributed to it on a sliding scale which has a larger range, from one to twenty-six points. The method of distributing profits is extremely simple, and from this point of view more satisfactory than those which are current in other experiments. Half the profits go to the employees, the other half to the firm, which uses its share for capital investment and for the payment of dividends. The share of each employee is determined by dividing the employees' half of the profits by the total number of employees.

The profits are distributed each month, and on these occasions meetings of the managers and technicians, and of a Bonus Committee (comprising representatives of the management and the works committee), provide an opportunity to inform the employees of variations in output. Thus the employees are in a position to check, and, if occasion arises, to dispute, the amount of the bonus.

The distribution of the bonus in these conditions, as well as the periodic revaluation of jobs, acts as an effective means of education, allowing the workers to adjust themselves gradually to the life and the management of the firm. This is far removed from the passive attitude of the workers in many firms towards the works committee, and the reasons for the difference are easily comprehensible.

Finally, a sliding scale based on the cost of living makes possible a periodic revision of the value of the "point" which is the basis of the fixed wage.

Thus the whole system of payment rests on a foundation of good faith, which is apparent to the employees, who have full knowledge of the earnings of the firm.

Moreover, this system is only part of a more general set of arrangements. The T.M.E. prefers to the system of individual bonuses (which are distrusted by the workers because they undermine their unity) the encouragement of individual ability by a promotion

scheme. Training courses are organized at various levels, providing general education as well as specialized instruction.

Working conditions have been studied with remarkable thoroughness, as I was able to confirm by visiting the workshops and offices; studies of temperature, noise, smells, light, and color schemes have been carried out. The new factory at Rueil is air-conditioned and insulated against noise; the workshops and offices are light and tastefully decorated; the restaurant, where workers, technical personnel, and managers eat together, is pleasing in appearance; and the courtyards are full of flowers. This is an achievement which shows that certain defects of the French worker, which many employers too easily regard as innate, incorrigible, and connected with "national character," can be entirely eliminated in a more satisfactory social and psychological environment. This is not to say that all problems have been overcome by the T.M.E., but it is certain that this experiment deserves close examination—and reflection.

With the *communautés de travail* we pass well beyond the frontiers of capitalist free enterprise, for here we have to do with new forms or workers' productive co-operatives. The communities aim at the self-realization of the individual through the solidarity of the group. Although the *Entente Communautaire*, a kind of federation of the communities, denies that there is a dogma or creed underlying these experiments, certain criteria allow it to distinguish the genuine communities among the innumerable projects and experiments which are presented for its approval. These criteria are, in particular, the social ownership of the means of production, common rules unanimously agreed upon, the election of officers on the system of "double confidence," i.e., with the agreement of the grade above and the grade below them, all-round training, and the distribution of the firm's earnings according to human value, i.e., taking into account, in addition to occupational skill, the social value of the member of the community, his cultural contribution, the number of his children, the housework done by his wife, etc. An examination of the statutes of the principal communities shows a great diversity of means employed to achieve the ends which are common to all of them.

The chief experiment is Boimondau (Boitiers et Montres du Dauphiné), a community of about 200 working members, at Valence

(Drôme), which has attracted wide attention, and has had many visitors, both French and foreign.⁸¹ It was started before 1935 by a worker, Marcel Barbu, an exceptionally vigorous personality who wished to set up on his own account. It remained a small business, indistinguishable from many others, until the day when, caught up in the whirl of events, and pursued by the Vichy government and the occupation forces, its outlook was transformed and a spirit of solidarity was created. For Barbu had decided to resist, both for himself and for his employees, the notorious S.T.O. (forced labor in Germany). The community life born in these exceptional circumstances proved satisfying, and a Foundation Act was drawn up on January 1, 1944, by which Marcel Barbu "contributes without any restriction or reservation the productive goods which he wrongfully possesses." However, on his return from Germany, where he had been deported, Barbu developed very grandiose schemes, and in the eyes of his associates lost his sense of reality. He seemed to aim at constructing a new world on the basis of community cells, got himself elected to the National Constituent Assembly, campaigned for a legalization of the *communautés de travail*, and launched a political movement, the *Rassemblement Communautaire*, with which Boimondau refused to affiliate. The members were, in fact, resolutely opposed to any kind of messianism which would separate them from the working class. Moreover, trade union criticisms, to which they were very sensitive, were increasing. Feeling himself isolated, Barbu left the community in July, 1946, which returned to him eight million francs in repayment of his contribution. Marcel Mermoz became the leader of the community, and under his direction it became firmly established and began to grow. In 1951 he took charge of some new communities, grouped in the *Cité Horlogère*, and was succeeded at Boimondau by Georges Matras, who was elected by the members.

All those who have studied Boimondau at all closely, as I have done on a number of visits, recognize the unique atmosphere there. Although the community has accepted, for want of anything better, the legal status of a productive co-operative, its aims are not only, or even primarily, economic. "We do not wish to become a mere collection of buddies who work together in order to make a profit, for in that way the community would lose its lifeblood."⁸² It is concerned, above all, to safeguard and to develop in the work process

that invaluable capital which the human being represents. At Boimondau, the individual is looked after by the community not only at work but also in his leisure, but without interference with differences of philosophical or religious belief, tastes, or personality. The community of work is only an instrument created by men for their own ends, to help them live and develop, and this development is at the same time material, intellectual and moral.

It is worth noting in passing that Boimondau has shown its strength and solidarity by its success in weathering the crisis which affected the watchmaking industry in 1948 (during which period the members worked practically without pay), and that, so far as industrial organization is concerned, it has introduced the most modern techniques, up-to-date machinery, detailed analysis of jobs, and careful study of efficiency and output. The community has even introduced into its workshops Bedaux timekeepers and engineers, which is a bold venture on the part of a workers' co-operative. Output, which was 80,000 cases in 1941, was more than 538,000 in 1952, achieved by 174 workers who thus supplied cases for 30% of the total French output of watches. The concern with efficiency has led Boimondau to have its foremen trained by T.W.I. (Training Within Industry) methods, and to call in Dr. H. Infield, Director of the Group Farming Research Institute (New York), who came personally to supervise the application of his batteries of tests, designed to measure the "co-operative potential" of the members and to record the "moral temperature" of the community.

The sovereign body of the community is the General Assembly of all the members, whose numbers it is desired to keep neither too small nor too large. The figure of 150 members (which makes a total, with wives and children, of 400 people) seems about the optimum number. All important decisions involving the future of the community must be unanimous. The assembly elects a leader of the community (who can be recalled at any time), who is assisted by a General Council of about ten members. The departmental heads and other officials are selected by the system of "double confidence," which was explained earlier. The community statutes, which form the charter of the group's activities, can be changed at any time by the General Assembly, and thus they represent a kind of minimum moral code which is accepted by all. Infractions of the statutes are considered by a tribunal which hears the explanations of the indi-

vidual concerned and only makes its decisions in agreement with him; it is a matter of redressing the situation rather than punishing the guilty party.

Without going into the details of the method of payment, which is based on a system of points and which seems to have been satisfactory despite its complicated nature, it may be noted that after deductions for savings and for unavoidable general expenses, "the wealth produced by labor is divided among all the members in accordance with the quantity and quality of the professional and social work contributed by each" (Article 12 of the Guiding Principles of the community). The wages are based on points for occupational and social activity, calculated in accordance with the technical, human and cultural value of each member, and his contributions to all aspects of the community's life. Since property is held in common, there are no shares, and a member has no claim against the community if he decides to leave it.

The results of this experiment, which celebrated its tenth anniversary in July, 1951, are very clearly positive, both from the economic and the social point of view. It should be emphasized that the level of productivity is very high, and that after provision for insurance, and despite the short working hours, wages are approximately 50% higher than the average in this branch of industry.

The achievements of Boimondau have, since 1945, encouraged the formation of other communities very diverse in their size, type of production, and the social origins of their members. Leaving aside the agricultural communities, of which more than 300 are affiliated with the *Union des Ententes et Communautés rurales*, there are, among the fifty or so industrial communities, several in the building industry, workshops engaged in the manufacture of picture frames and decorative objects (strongly artisan in character), an engine repair shop, a woodworking firm, a grocery business at Boulogne-sur-mer, established as a distributive co-operative, and the *Cité Horlogère*, near Valence, which groups four communities of work. Naturally, there have been some failures, which have often provided useful lessons. Some of these undertakings are very small and lack modern equipment, and it may be questioned whether they are viable in the conditions of industrial concentration of the twentieth century. Nevertheless, it should be remembered that in France, at any rate, the number of firms with less than ten employees is considerable (nearly 800,-

000), while a further 100,000 firms employ between ten and 200 workers. Moreover, the aim of the communities is not to obtain political power or to discover a panacea for social ills, but to give an example of the kind of human relations which can be established in a group based on respect for the human being, and in which the workers are full members with recognized status. In all the communities with which I have become acquainted, it is a major concern of the members not to pursue their own salvation egoistically in these favorable conditions, while their comrades elsewhere have to struggle against great difficulties and against employers who are frequently bitter and lacking in understanding. They do not want to retire into their own world or to cut themselves off from the working class.

In England the most systematic and instructive experiment in industrial relations has been that carried out by the Tavistock Institute of Human Relations, under the direction of Elliot Jaques, at the ball bearing factory of Glacier Metal (Alperton, Middlesex, near London). It lays particular emphasis on the study of a double system of command and consultation, which establishes effective communication between the management and the representatives of the employees, a system which was reorganized several times in the course of the experiment.⁸³

The Glacier Metal factory at Alperton has 1,800 employees, and there are 400 other employees at a factory in Scotland. The management, which is well known for its enterprise, engaged, on the initiative of Mr. W. B. D. Brown, a team of eight experts from the Tavistock Institute (sociologists, psychologists, economists), who had had industrial experience and were familiar with trade union problems. This experience enabled them to establish good relations with the workers in the factory. From the beginning, the research team adopted an independent position, and decided that no inquiries would be carried out without the full agreement of the individuals or groups concerned. Every action and every statement by the team was to be public, or at least brought immediately to the knowledge of those affected by the observations and recommendations. No private contacts between members of the team and employees of the firm were permitted. It was intended that the opinions expressed by the team should be regarded as independent.

The general report drawn up by Jaques, and the supplementary publications,⁸⁴ make considerable use, in their hypotheses and interpretations, of psychoanalysis, though it must be said, of a psychoanalysis far removed from the orthodox doctrine, since it is content to borrow from the latter the concepts of unconscious forces, resistances, and transference, in order to apply them to the study of groups.⁸⁵ Jaques and his collaborators seem to have been largely influenced by the theories of group dynamics of Kurt Lewin and his school. The function of their team, according to them, was above all to assist the group in avoiding psychological impasses, coordinating its powers, defining and distributing its roles, and in releasing its own potential and effectiveness. It should be noted that this conception also allowed a new formulation of the problem of foremen, which Jaques integrated into the experiment as a whole. The problem of the relations between the foreman and his group of workers is, according to him, of the same kind as the problem of the relations between the managing director and his heads of department.

It will be seen that this was a long-term project which would extend over several years; in fact, it is still going on at the present time. The first stage involved a close study of the way in which the firm was organized and run. The problems emerged gradually of their own accord, and only those which were suggested to the team by some department of the factory were studied. Among the first problems considered were the organization of the divisional managers' meeting, a changeover in the wage system of the service department, affecting 100 workers, and subsequently more complicated problems, including the reorganization of the Works Council and of the Works Committee.

The Works Council, at the time the research team's inquiry was entering its active phase (1949), comprised twenty members, including a chairman and a secretary, and met at monthly intervals. Though it seemed to be occupied with many problems, its members did not feel that they were making any progress. They asked the team to help in making the council more effective, and this led to a reorganization of the relations between the Works Council and the Works Committee, and of the weekly management meetings which were attended by the managing director and his eight divisional managers.

Thus the experiment slowly accomplished a profound change in the atmosphere and structure of the factory: a strengthening of the consultative bodies which are assuming a policy-making role, and a complementary strengthening of the executive bodies which have been freed from the task of deciding policy questions, and whose effectiveness has been increased by the authority which they now derive from the Works Council. The composition of the latter body now reflects more satisfactorily the different functional elements of the factory, a concession made by the management to the trade unions. In particular, a sharp distinction has been made between consultative and executive responsibilities, a distinction which has been incorporated in a regulation defining the policy of the company. On the one hand, a system of executive levels has been worked out, from the managing director to the shop supervisors, based on a policy elaborated in the firm and designed for it. On the other hand, the new system of consultation, which discusses and lays down this policy, gives a sanction to the executive decisions. The annual report of the managing director is the main link between these two systems. The management, in presenting this annual report to its employees, submits to criticism and "democratic control," but also benefits from constructive suggestions and, in the last resort, from the employees' agreement, which is extremely valuable for co-operation and output.

The initiators of this experiment may be reproached for passing too easily, in their published reports, from a psychological discussion to a structural theory which they only partially substantiate. Moreover, the interpretations and general conclusions of the reports so far published are only provisional. It would be interesting to know something of the changes which have taken place in the experiment as a result of the changes in the political situation after the 1951 elections, from the situation (the existence of a socialist government) which certainly helped its beginnings. Nevertheless, the study as a whole constitutes, in my view, the most important publication on labor-management relations which has appeared in England for many years. In particular, the establishment of the double executive and consultative system, and the relations between these two parts, is a contribution to solving one of the fundamental problems of twentieth century industry, a problem which has been clearly stated by Alexander Heron,⁸⁶ namely, the need, in

increasingly complex organizations, to separate distinctly the functions of decision-making and discussion, but at the same time to avoid the mistake of sacrificing the latter to the former, which has been the constant and dangerous tendency of so many firms rationalized in accordance with the traditional principles of Scientific Management.

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Three Aspects, a Single Reality

INTEGRATION

THE VARIOUS EXPERIMENTS just presented to the reader, seen from the point of view of the social psychology of the firm, have important common features: they all aim at strengthening the psychological bonds connecting the worker with the firm, at combating, neutralizing, or overcoming the forces which separate him from it, at making the enterprise a collective reality in which the worker is mentally integrated (in a manner he is more or less conscious of, depending on the methods used) and, consequently, in which he will be induced to contribute his physical and technical working capacity more fully. This constant preoccupation in many forms, which has become marked especially during the last ten or twenty years and which characterizes the industrial relations movement, I call the effort at *integrating* the worker with the business. The general means used for this purpose at Hawthorne, at Zlin, or in the Paris region, are not confined to the experiments which I have set forth and emphasized, but are found elsewhere as the practice of industrialists, and are perfected by industrial psychologists, as I shall proceed to show briefly.

The establishment of social services by large industrial firms has been considerably increased since the beginnings of rationalization. I do not propose to describe this in detail, since it has been the sub-

ject of many inquiries and publications.¹ Management, by multiplying the services which it offers the worker and his family, and by trying to arouse in them the impression that it is interested in their present and future welfare by means of effective and selected techniques, knows perfectly well that it is pursuing a policy which may affect the worker's psychological attitude toward the firm as a collective reality, and so toward the daily tasks which it calls on him to perform. It knows that the man who works unwillingly and with no interest in his task performs it less well and with an increase of nervous fatigue. It observes that, on the other hand, if he is satisfied and relaxed, the rhythm of his work naturally rises, through the unconscious influence of a better atmosphere in the plant on the individual.² The effect may even become conscious if the worker is induced to bring into play the reserves of physical and intellectual potential which, hitherto, he had kept secret and withdrawn. But I shall return later to this aspect of the phenomenon of integration.

The fact remains that social services introduced into the firm as a means of integration must be selected, managed and practiced with great tact and discretion. Management must know how to make them seem to the worker a right which is his, not a "charity" which is not entirely disinterested. Otherwise one finds that these services act against the purpose for which they were intended. The worker's distrust is strengthened, the centrifugal forces are not neutralized, and the collective reality of the firm remains an illusion, ready to disintegrate at the first touch of conflicting interests which are always latent. Then, in the eyes of the class-conscious worker, the canteens which the firm has organized are only a means of taking a second toll on his wages which flows back into the employer's cash box. The libraries, business periodicals, insurance and retirement allowances, the home visits of social workers appointed by the management, from now on all form, for him, part of a clever conspiracy to separate him from his own political organizations and his unions, which he and his fellow workers have created to defend their interests.³

When the social services are introduced without offending the worker's class consciousness, either because it is little developed in the working population of the region (which seems indeed to have been the case in the Bat'a Works in Moravia) or because the management has acted discreetly and flexibly, their effect as a means

of integration is generally positive. In a foundry numbering 3,000 workers the labor turnover was only 1%, whereas in other places in American industry it was about 50% on the average.⁴ In this foundry the workers are co-owners, who share in the profits, and have a purchasers' co-operative in which prices are reduced by 8%, and a free hospital for themselves and their families.⁵

The workers' factory committees, such as were seen introduced so successfully in the Paris experiment of the Bardet Works, also form a classic means of integration to which innovating managements have had recourse. The functions of a works committee may be many and important, if the management is enterprising enough to take this course. In an important textile plant in Saxony, the workers' committee was concerned with the progress of mechanization (substitution of machines for manual labor, and of improved machines for old-fashioned ones), the work environment (heating, light, dust), wages paid to the different classes of workers, vocational selection inside the factory, and with social hygiene and preventive measures.⁶ In American railroads, several large companies just after World War I created joint committees in which the management and the railwaymen were represented by freely elected delegates, and whose competence in the field of wages and the organization of work was considerable. Results seem to have been clear and positive, as appears from the increase in suggestions offered by the workers, an almost invariably significant sign of the worker's integration into a company. From 1923 to 1927, in the shops of the Baltimore and Ohio Railroad, nearly 22,000 suggestions were offered, 84.7% of which were considered useful and were successfully applied. Out of 326 of these suggestions, 51.5% were in the management's interest, 15.7% in that of the workers and 32.8% in the common interest of both parties. In another large railroad company, the Canadian National Railway System, reports stress the reduction in loss of time recorded since the introduction of a similar system of co-operation between the management and the railwaymen. A workshop which functions on this system is easily known by the quality of its provisions for safety and hygiene, cleanliness and comfort. Of course, the psychological efficacy of a shop committee depends on the degree to which the management really asks it to function in practice. It helps integrate the worker with the firm when, thanks to the organic co-operation which it initiates, the worker feels that he

is becoming a *subject* and not just an *object* of measures of rationalization.⁷

Among other general conditions which aid the worker's integration, let me also mention those which create an atmosphere of confidence inside the firm.⁸ It is useful, whenever possible, to give relations between the management and the worker a legal character, thus dispelling the worker's impression that charity is being conferred on him instead of his rights being recognized. The supervising personnel should show towards the workers and require from them an ordinary politeness, explain and justify their instructions and assume a fair and impartial attitude. The system of pay is an essential factor of company morale. It should be regarded as fair by the workers, but even that would amount to nothing if it were not also clear and easy to check. In P.W. an industrial relations movement was seen to base its ambitions entirely (and not wholly unreasonably) on a new, advantageous and simple method of paying wages.

Whatever might arouse the suspicion of the worker, who is always on the alert, should be carefully avoided. We have seen what is thought of social services from this point of view. Both the paternalistic spirit—which “protects” and bestows “charity”—and the utilitarian spirit which too evidently betrays its purpose (and social services organized by the management correspond, after all, to a well understood calculation of interest) sooner or later will bring severe disillusionment to the industrialists. The editorship of a factory magazine imposes on those who are in charge of it delicate problems of worker psychology. It will certainly fail if it arouses among the workers the impression of wanting to increase their physical and psychological dependence on the firm. Likewise the training school connected with a factory will not contribute to the worker's integration if the management seeks exclusively to train in it apprentices for its own service and combines certain political views with the vocational training. On the other hand, if the instruction is strictly technical and shows on the management's part a clear unselfishness in training skilled workers not only for the specialized production of its plant but for other tasks, the school will play a positive part in forming a collective consciousness of the company.

The question of the supervision of work is especially important in this field. Experience teaches that it is dangerous to multiply unnecessarily any arrangements restricting the worker's freedom. Otherwise

latent feelings of dissatisfaction, hostility and revolt are cultivated in him.⁹ The evolution of mechanized production widens the gap between thought and the performance of a task. Yet it is best to avoid giving necessary instructions to the workers through a personnel designed especially for this purpose. The instructions should proceed quite naturally from the organization of work itself. "Thus, it would be possible to make the worker feel himself bound to the firm, and a part of the whole, without his dependence on the employers and his superiors being constantly recalled to his mind."¹⁰ As has been seen, the desire to render supervision more flexible is dominant in all the large-scale experiments in industrial relations, still in an elementary form with Ford, but already more advanced at Hawthorne. It became clear that by constantly imposing on the worker from above a control over his work, any chance of getting him to adhere to rationalization measures is lost. Obtaining this adhesion as much as possible will effectively contribute to integration. To this end, industrial psychologists advise certain forms of self-control, control by factory or union comrades and, if necessary, control by automatic apparatus. On the other hand, rigid forms of hierarchic control, which the management openly entrusts to a special personnel, must be prohibited and, even more, secret control, which the workers resent as spying.¹¹

The general means of integration which have just been discussed are related in the sense of being all fundamentally *negative*: they aim at avoiding or combating the worker's distrust, which is justly regarded by experts in industrial life as a basic datum. The worker is in a state of constant sensitivity to every initiative coming from the management and, as an important and clear-headed employer writes, "the worker distrusts on principle anything which an employer promises him."¹² By neutralizing the distrust and, so far as possible, the elements of psychological dissociation, a condition favorable to confidence is created. But industrial relations do not stop at this: they also try to discover positive means for directly strengthening fellowship, industrial *esprit de corps*, the company's collective reality. The planned mixing of the Hawthorne workers with their superiors in their clubs and sport events, in which the "company's" reality is constantly recalled to their consciousness, the mythology and folklore developed about the footwear industry at Zlin, the works committees which end the worker's isolation in his subdivided task and give him the feeling that at last he catches a glimpse of the firm as a

whole and is co-operating in its management, are clearly positive means of integration, representing a more advanced stage of the movement.

RELEASE OF THE INDIVIDUAL'S POTENTIAL

The worker's integration in the firm, pursued with so much perseverance and so much flexibility of methods by managements and their counsellors in worker psychology, would not have been the subject of such patient effort if it had not held out to them the hope of very substantial economic advantages. The far-sighted observers of contemporary large-scale industry have not failed to notice, especially since the dissemination of methods of rationalization, facts which have repeatedly presented themselves to us in the course of analysis of the human problems of mechanization in the factories. They might be called the inhibition, under the usual conditions of production, of a variable proportion of the worker's physical and mental energies.

First, the worker does not call into play his full physical capacity for production. This corresponds to what F. W. Taylor called "soldiering" and what others have called "slowdown."¹³ The study of a phenomenon apparently wholly physiological, such as fatigue, has already shown how closely it is related to the psychological and social conditions of the workshop and the factory in which the worker is employed, depending on his relations with his comrades, supervisors and management. This is so true that the subjective feeling of exhaustion may even precede the objective reality of physiological exhaustion. Like fatigue, the feeling of monotony, of boredom, is relative to the psychological and social milieu of the business. Experiments such as those of the Hawthorne shops, in which output very clearly increased as a result of the improvement of human relations, and the unquestionable rise in output of firms in which proportional wages are discriminatingly introduced, suddenly bring to light the capacities which the worker formerly "hoarded." Such inhibitions often seem unconscious, as is also their gradual removal. The neuro-physiology of work explains these phenomena, which remain on the level of medullary automatism. Moreover, we have noted the importance of the restriction of output, and its economic and social motivations in the worker.¹⁴

To the inhibition of physical capacities is added that of intel-

lectual and occupational capacities. This is the proper occasion for noting that, in practice, technicist rationalization has the same effect (though it says the contrary) as the economic motives which drive the worker to withhold the full measure of the resources of his personality from the company governed by the system of private profit. Industrialists like Ford, and engineers, complain that the workers do not want work which makes them think. They believe that it is a definite characteristic inherent in human nature that the majority are incapable of wanting to progress toward responsible and skilled positions.¹⁵ Even in toolrooms, that is, among workers of an already high technical level, "faking" and the lack of conscientiousness are common when the firm's psychological atmosphere is unsatisfactory.¹⁶ But in the face of such facts the industrial psychologists avoid taking Ford's fatalistic attitude. They understand that the very tendencies of technicist rationalization encourage the inhibition of the worker's mental energies by refusing him the right to think, which is reserved to agencies specialized for this purpose: the planning departments. They know that in the distribution of tasks many rationalizers try to avoid and, as we have said, to "by-pass," occupational skill both for psychological and economic reasons: they want to avoid increasing their dependence on a scarcer type of manpower, which makes greater demands, while on the other hand, they would rather use unskilled workers to whom they pay lower wages. Not the least of the internal contradictions of large-scale rationalized industry is that it complains of reaping—in the lack of intellectual participation, loyalty, and liberation of intellectual and technical energy—what it has sown by sharply separating thought and task performance.

On the other hand, when it has been possible to achieve to some extent the integration of the worker into the company, when the individual has ceased to be an isolated and rebellious atom, inhibition is overcome to the same extent and there is a sudden release of energy which has hitherto been hidden and unused, physical energy which postpones the onset of fatigue and raises output, as in the various experiments described by us. It is at this moment and in this new atmosphere that the incentives of self-respect and emulation may effectively come into play¹⁷—mental energy also, which, intimately allied with physical energy, enables the worker to do his work better, to devote himself more fully to it, even to think of it

and to improve the technical arrangements for it. In Kaiser Wilhelm's Germany, where Social Democracy and the unions were integrated into the State, the most actively militant socialists were also the best metal-workers in their firms, according to Max Weber's report of the testimony of the industrialists of the Ruhr basin.¹⁸ Improvement of industrial relations lowers the curve of lost time and rapidly increases the rise of the curve of employee suggestions. It makes it possible to overcome the suspicious check of piecework and to introduce systems of payment by the job which imply the development of occupational conscientiousness and of reciprocal confidence between employers and employees.¹⁹

Here it must be noted that the factors contributing to the worker's integration are precisely identical with those stimulating him to give more of his potential of physical and mental energy. Thus, when industrial psychologists study the conditions stimulating the worker to bring his capacities into play (*sich selbstbeanspruchen*), they are continually led to stress the influence of the company collectivity and the groups it contains. The quantity and quality of work depend largely on the worker's attitude toward the factory where he is employed,²⁰ on his feelings with regard to his job, and on the social status which this seems to him to command within and outside the factory.²¹

JOY IN WORK

Even the most zealous defenders of experiments in industrial relations do not claim to have obtained from the worker the full utilization of his working capacities, which would require that the worker should give his best to a job whose technical, psychological and social value both the individual and the collectivity had recognized. Yet, corresponding to the objective variations in the quantity and quality of output which show the degree of liberation of working capacity, there are subjective variations in the worker's consciousness of his task. It is here that we come across the emotional complex often called "joy in work."

Whoever says "joy in work" means "work," and consequently, a collection of tasks possessing unity and a degree of plasticity to which the worker's aptitudes and tastes may be applied. Now, examination of the repercussions caused in crafts by technicist rationalization since Taylor showed us that it has tended to decompose

them and replace them by a multitude of subdivided tasks, strictly organized from above by a system of detailed work tickets, or so elementary (like the operations of the assembly line) that they require nothing but a rapid initiation. The worker no longer has any influence on the arrangement and goals of his activity, which is entirely determined by others. And none of the studies made of this subject, or of the testimony which I have personally collected, makes it permissible to speak of joy in work in connection with these subdivided, mechanized and repetitive tasks.

Yet here, too, the facts must be given in their context; the phenomena of work must be considered in the context of the psychological and social collectivity of the factory. It has been seen that subdivided jobs are reacted to differently by the worker according to the atmosphere of the plant, his relations with his comrades, the attitude of the management and supervisors, and the various factors conditioning his integration into the firm. Even if the work is of a strictly heteronomous* nature it may (or may not) be done carefully. In a factory producing tin cans, workers have been seen placing the tins incorrectly on their stamping presses,²² and young women feeding the machines worked more or less well, depending on whether or not they were given the right to talk to each other. In general, the management's attitude, its industrial relations policy, and the improvement of the atmosphere of the firm, if they are successful, can cause the worker (without forcing him) to observe a certain standard of correctness with respect to the firm, if he sees that it in turn shows good faith by fulfilling all its promises and trying to assure him of good working conditions. This "correctness" on the part of semiskilled workers, the whole growing mass of men, women, and young girls (with jobs but no skills) who fill the workshops of large-scale industry today is, actually, about all that is left them that can still be labelled *occupational conscience*. When slovenliness or neglectful and dishonest behavior is observed among the workers of a shop, its origin may almost always be traced back to mistakes and dishonesty on the management's part. The latter can do more to encourage conscientiousness through the example of a correct attitude toward its personnel than by multiplying technical courses or pep talks.²³

* [That is, every detail of the job is determined by other authorities above the worker.—HLS.]

By improving still more the internal atmosphere of the workshops, by making rationalization as flexible as possible, and by developing the integration of the worker, even though he is tied to heteronomous tasks, the firm may succeed in creating *around* these tasks a general atmosphere of contentment which, without really being joy in work, may be called *job satisfaction*. This is possible especially if the worker feels that his expenditure of labor is compensated by a fair wage and if, in other respects, the firm offers advantages for his family and for his leisure. In addition, industrial experience shows that much can be done in this direction if the worker can be interested in his job by being shown, through vocational courses and through job rotation in the shop, the whole process of production of which he performs only a small part, and also by encouraging him through bonuses to make small inventions for his working place, or his tools, and all sorts of suggestions, even if not practical or of immediate use. The worker on an assembly line, putting a bolt in place, who improves the form of the wrench that he uses, will from then on have a different emotional attitude toward his work from that of his neighbor, who submits to the same job passively and without having taken any part in it. Within the same collective conditions, of course, there are individual differences from one worker to another also conditioning the degree of job satisfaction. In a mechanized rusk factory where rationalization was skilfully applied and industrial relations were satisfactory, I have noticed laborers without any training nevertheless deriving an unconcealed satisfaction from their work which consisted in feeding modern, well-maintained machines. They gave the machines women's names and decorated the corner of the factory where they came to work each day.²⁴

Many psychologists, however, while recommending the means which may interest the worker *directly* in the current operations of mechanized industry, do not think that boredom can be banished from it unless the firm manages, *indirectly*, to interest him in these tasks by creating an *esprit de corps* which may arouse in him a warm devotion to the collectivity of production of which he is a part. Thus Wyatt, one of the closest students of these problems, brings us back to integration as an essential condition: "There is no reason why the attitude of operatives toward a firm should be very different from that of the members of public schools, universities, and regiments toward their respective institutions. Loyal and

enthusiastic operatives, surrounded by a sympathetic and friendly atmosphere, will experience a satisfaction which reduces boredom to comparative insignificance.”²⁵

Job satisfaction, which we thus assign to the level of subdivided and repetitive tasks, therefore brings us back by various ways to the fundamental condition of integration. This need not be complete, but it is necessary for it to be seriously begun, first, in order that the feeling of boredom may be effectively resisted and overcome by creating an industrial *esprit de corps* which, so to speak, changes subdivided tasks by giving them a collective coloration and meaning; and then, in order that important groups of workers may be encouraged to give suggestions, make inventions and take an interest in their repetitive operations.

As we progressed from conditions of conscientious work to those of job satisfaction, we imperceptibly left the field of strictly heteronomous tasks, and of this we must now take note; for if the worker is capable of making some technical inventions and suggestions, this is because he enjoys a degree of flexibility in connection with his subdivided task. The boundary between the heteronomous and the autonomous task is, as a matter of fact, neither rigid nor well defined. There is really a certain gradation and interpenetration of the autonomous into the heteronomous, especially if the methods and instructions of rationalization are tactfully applied. In an operation rationalized according to strict Taylorian methods the worker, always imprisoned in the network of organization woven by the offices, and watched over by the foremen, can exercise his conscious will only within very narrow limits. It often even becomes superfluous, and the task is entirely dependent on the automatic nervous centers. But the Taylorian methods have tended to grow flexible through the introduction of the human factor. The managers recognized that it was useful (in the absence of countervailing economic or technological necessities) to leave, within the determined framework of a task, as great a margin as possible of initiative and responsibility, so that while the *plan of work* was fixed from above, the worker was still able to determine the *means* which would bring him to his goal. This is the definition of semi-autonomous tasks.

If, thanks to their surroundings, tasks which are heteronomous in themselves may be accompanied by job satisfaction in the individual performing them, *joy in work*, on the contrary, makes its appearance

only in cases where the worker actually influences the means and ends of his job activity. That is, there is no possibility for masses of workers subject to the strict heteronomy of the methods of rationalization, evolved by Taylorism, to feel joy in work while performing their jobs. By the very nature of their occupations, they are excluded from it, and this fact is clearly important, psychologically and morally, for anyone who wants to judge the industrial civilization of our times.²⁶

Thus, those whose jobs have a technical structure which provides the conditions necessary for the direct development of joy in work are few in number in industry dominated by modern mechanization and rationalization. What is actually involved here? It is just those trades which have kept their old character, the complete tasks whose performance depends on the initiative and will of the journeyman aiming at a distant goal which he feels as a responsibility and a test of his capabilities, a continual confirmation of his skill. But the study of the contemporary state of training and skill, and the development of industrial trades, have shown us how few are the occupational areas in which, in the worker's tasks, crafts can still be discovered which afford the will a plastic material and a sufficiently distant objective. Today, tasks are usually divided, fixed in a strict order, and repeated at rapid intervals; they restrict the horizon of the will to *immediate* or, at best, very close objectives. The trades themselves, therefore, do not often offer the technical and psychological conditions of joy in work, and it is not surprising that the studies devoted to this agree in pointing out its rarity.²⁷

Since the job itself is incompatible with conditions permitting the direct development of the feeling of joy in work, once again at this higher level indirect conditions enter. Thanks to a change in the atmosphere of the firm, integration alone makes it possible to restore incentives to tasks which, taken by themselves, would be incompatible with the development of this feeling. In addition to the minimal conditions which are given by the relative autonomy of these jobs, the worker must be integrated into a collectivity (to which he feels himself bound by a *minimum* of loyalty) which enriches and fulfils the tasks by social elements. These collective sentiments must thus strengthen, color and change the individual sentiments. The small proportion of cases of joy in work reported by students would be still smaller without this effort and this transformation.

Thus, joy in work constitutes an ideal limit, like the integration which conditions it in most actual instances of large-scale industry, and like the liberation of the individual's energies which accompanies it. This means that any systematic optimism should be avoided. Just as it seems impossible to attain the worker's complete integration in the firm under the present conditions of capitalist societies, just as it is an illusion to suppose that industrial relations have produced the full expansion of his physical and mental potential, so it must be clearly recognized that the expansion of joy in work in that phase of human industry in which our evolution is occurring, and its diffusion among large masses of workers, will remain *an ideal limit*. For this to be different, a profound transformation of the economic and psychological conditions of production would be required. And even supposing this to have taken place, even supposing the worker immersed in a fraternal society, radiating solidarity and sympathy in every firm and from them into all workshops and work groups, it would still be true that integration cannot perform miracles, cannot transcend the technological necessities of a transitional period in which human labor is increasingly subdivided among the fragments of the old crafts. It cannot transcend the inescapable disciplines of rationalization and the gaps, filled with assembly-line work, of a still adolescent automation. I shall revert in another connection to the question of the substitutes and new forms of joy in work which leisure and a second trade (hobbies, etc.) may bring the individual.²⁸

However this may be, it is clear now at the close of these remarks, that by successively studying the integration of the worker, the liberation of his physical and mental energies, and joy in work, we have been distinguishing, for analytical convenience, three phenomena so closely overlapping one another that they appear at times like different aspects of a single reality. The integration which attracts the individual into the productive collectivity and obtains his loyalty is simultaneously the condition allowing him to expand further his physical energies of production and his mental energies of technical participation, ingenuity and initiative. Conversely, the development of these energies is one of the surest external signs of integration. It also creates the indispensable milieu in which, in different degrees, stages of development and levels, there may appear among the workers (depending on the technical structure of their occupations which

retain, as we have seen, certain irreducible determinations) occupational conscientiousness, job satisfaction, or even, among those still enjoying relatively autonomous tasks, joy in work. *Integration, liberation of energies, and joy in work*: these are, as it were, different snapshots of one reality taken from various angles. The first is seen particularly from the angle of the sociology of the company, the second from that of the worker's total economic output, the third from that of individual psychology. Thus, once more we discover in a concrete example the profound interrelations existing between phenomena which a narrow positivism wanted to divide into compartments and dissipate into different sciences or "specialties." Man is *one*. To understand him, science must inevitably become *one*.

The Value and Limits Of Human Relations

WE ARE NOW at the end of the third part of this work, and before drawing conclusions from it, we had better glance back and disentangle the broad outlines of the development marked by the facts which we have just analyzed and interpreted.

When the expansion of the means of production through the second industrial revolution necessarily introduced into the factories the scientific management of labor at the end of the nineteenth century, Taylor and his collaborators, and his first imitators, considered the problems of output from the angle of the isolated worker, of the individual. Scientific Management elaborated a methodical group of innovations in the structure and organization of business concerned with the preparation and performance of work, and constantly tried to envelop the worker in an unbreakable network which would compel him to make better use of the machines and to produce more. When all is said and done, it cared very little for the worker's loyalty to its system, as Taylor himself explained to his colleagues of the American Society of Mechanical Engineers: what it required of the worker "is not to produce more by his own *initiative* but to execute punctually the *orders given* extending into the smallest details."¹ More than that, as I have set forth elsewhere² one of the chief psychological aspects of Taylorism is precisely the

attempt, through the medium of strict individualization of tasks, always to consider the workers "as separate individuals."³ Taylor rejected any sort of collective incentive such as co-operation or participation in profits. He affirmed and dogmatically repeated that the basis of human nature is personal interest, and refused to recognize in the worker anything but strictly individualistic motives. The guiding thread of Taylor's attitude was precisely the wish to isolate the worker and separate him from his comrades, and so it need hardly be said that Taylor (and the first generation of those who succeeded him) understood nothing—and wished to understand nothing—of the group forces which have repercussions in the worker's consciousness, especially the trade union influence.

When the social sciences, the physiology of work, and industrial psychology turned to the new field of studies constituted for them by the workshops of large-scale industry (though they very quickly assumed a critical attitude toward the *technicist* methods of Taylorism) they accepted for some time, as an implicit inheritance, the purely individualistic position adopted by the first pioneers of rationalization. This is the period I called that of the "human factor," discussed in the first part of this book. We have seen that it probably represented a necessary stage and that a scientific study from the point of view of the bio-psychological constitution of the individual at work, of the problems of fatigue, accidents, rest periods, and the adaptation of the machine to man, has been useful and profitable in many respects.

But even while conducting their experiments and studies, and while disregarding practical conclusions and advice, physiologists and psychologists were already realizing that the exclusive consideration of the individual was not enough. Or rather, as well as the individual considered as a whole, the man at work, the total man with his varied interwoven interests and bonds with his environment, invaded the bio-psychological problems of the workshops, enlarging them, strengthening them, and casting new light on them. From this point of view the studies of monotony, assembly-line work, automation, and skill formed a crossroads from which it was quite clear that the horizons of research had so far been remarkably limited. It was realized that the study of the human factor could not be successful if one confined oneself to considering only the individual's

bio-psychological elements. There is no important human problem of the worker at grips with the machine whose examination has not increasingly led to the enrichment and surpassing of a narrowly individualistic bio-psychology, through collective influences.

The gradual shift of the psychologists' attention toward the social factor was especially stimulated by their studies of worker reactions to rationalization. At every step they were impressed, in the enterprise, by the importance of the collective psychology of the industrial group and the human interrelationships among workers, supervisors and management which create an "atmosphere." Seen from this angle, the different methods of control, the calculations of wages and times, the distribution of work periods and rest pauses, become so many important elements which condition the collective mentality of a workshop or firm and, through this, output. Their studies constantly face them with this fundamental fact: the degree of the worker's loyalty to the firm. This I have called integration, in order to indicate that it tends to bring into play the *integral* personality—intellectual, as well as emotional and social. To the investigators this appears more and more as the framework containing particular attitudes and concrete problems. Thus, hostility to rationalized work imposed from above immediately suggests the idea of the participation of worker delegates in the economic and technical management of the firm. Similarly, beneath the phenomenon of slowdowns, or restriction of output, appear causes of an economic and social nature. The psychologists, helping Scientific Management to become more flexible and self-critical, discovered the complexity of the human element. The technicist rationalizer supposed that he could still do without the worker's inner compliance and demanded only that he strictly obey given instructions. This attitude is definitely outmoded. The psychologist showed how important is the worker's psychological share in the methodical changes of his tasks for the practical success of Scientific Management. For this reason he interested himself in discovering what was the worker's inner reaction to measures of rationalization. He confirmed the necessity of effective co-operation and harmony among the various categories of the personnel.

So the human factor was no longer the special preserve of the sciences of man as an abstract individual. But there was still no clear understanding of this advance. It took the human relations

movement to make manifest the interpenetration of social and individual factors in the life and organization of the firm.

The human relations movement had developed both on the empirical plane, through the initiative of managers in large corporations, and on the scientific plane, through methodical studies in which teams from the various social sciences collaborated. Both stressed, once and for all the importance of the collective mentality of the personnel, the industrial *esprit de corps*. Both confirmed the fact that the inability of Taylorism to master the difficulties in the application of rationalization was largely due to an underestimation of the psychological problems of the factory. What at first sight seemed to be an obstacle of a technological nature revealed itself, through thorough examination, as an inability to handle men. So from then on a conscious effort was made to introduce psychology into industrial organization; or, more exactly, to influence the worker's behavior by the expedient of carefully studied innovations all aiming at changing the collective state of mind of the firm.

Their common feature was to seek all effective means capable of strengthening the social group constituted by the firm in the face of the other collectivities surrounding it. The protagonists of this movement, less clouded in vision than their predecessors in rationalization, had an inkling (though without clearly recognizing the fact) that the worker belongs not only to the social group formed by the factory, but to other groups also, more or less intimately according to the individual concerned—family, skill group, union, class, political party, nation—and that, in the societies of our time, the different groups (especially the unions and parties) exert a centrifugal and often powerful influence with reference to that of the factory. If it is desired to reinforce the power, cohesion and unity of the firm as a collectivity, it will be a question of opposing and, if possible, neutralizing these centrifugal forces by other, centripetal forces. In each firm the success of human relations will depend on the skilfulness in strengthening the latter by selected means. The same concern is differently expressed by the psychologists when they demand that the worker, who in the original system of Taylorism is never anything but the object of measures of rationalization, should become their subject.

Without straining the point, it is interesting to notice here in passing that in its search for doctrinal foundations the human rela-

tions movement tried to find support in the *Gestalt* theory.⁴ We have seen psychologists and "personnel counsellors" appeal to the organic whole constituted, according to them, by the organized firm. The rationalizers should try to ensure reciprocal relations between different department and workshops, and a mutual adjustment of their activities to one another, so that they will not form a mere conglomerate but a functional whole, in which the collective spirit will by this very fact be disseminated into all the parts. Thus one would ensure the unity of the enterprise, would create for it an *esprit de corps* and obtain the co-operation of its members. Yet a philosophical theory (even so rich and deep a one as that of *Gestalt*), thus imposed from the outside upon industrial problems, can hardly do more than give rise to verbal developments and illusory solutions. This may be estimated by reading this extract from an author with such a viewpoint: "When employers and employees are willing to sit down together to try to solve their problems rather than to bargain on the basis of who possesses the greater economic power of the moment, then we shall be on the road to settling 'the labor question.'"⁵

But other counsellors in industrial relations, without troubling to find ideological foundations for their efforts, aimed only at directly affecting the managerial state of mind through a whole range of practical measures: by spreading a new idea of the functions and attitude of the supervisory personnel; defining and educating a new type of industrial leader; seeking for the integration of the worker but also of the employer, engineer, and foreman; and making experiments with the role played by sport clubs, factory committees, methods of wage payment and profit-sharing, and the division of the firm into semi-autonomous workshops. The repercussion of all these elements of integration upon the liberation of the worker's physical and mental potential and, by this means, upon the quantity and quality of output, conscientiousness, and job satisfaction, has been recognized since then. Having begun with strictly technological methods which were content to bend the worker to their rigorous discipline, Scientific Management, thus renovated, tries to *conquer* him by methods based on social psychology. It tries to reinforce his participation in the firm and for this purpose to develop a "morale" within it, to unify it and reshape it through a spirit of community. Formerly, in Taylor's day, the watchword was *discipline*. Now it is *morale*. The change from one to the other is a measure

of the trend toward social psychology which we have pointed out in the course of these pages. By the very tenacity of their efforts, the champions of the movement admit the setback to the technician tendencies of Taylorism, and the inadequacy of the strictly bio-psychological tendencies of the human factor approach. They recognize that all the practical chances of rationalization are endangered if they do not solve the problems of collective psychology presented by rationalization's practical application.

Their effort has not been without results, as appears from the experiments of Western Electric, Bat'a and many others, both in America and Europe. The contrary would have been surprising. The human relations movement bears witness to a more complete and deeper consciousness of realities and problems on the part of managements and their advisors on organization. Above all, by trying to discover and develop collective counterforces capable of strengthening the worker's loyalty to the firm, it has put its finger on a sensitive point in industrial conflicts within our civilization. It is incontestable that an intelligent and well-advised management, if it directs its attention and resources toward this goal, can succeed in strengthening the bonds of collective mentality within the firm and, by this means, succeed in affecting the workers' behavior. However, as has been said above, if it is to be successful the power of the other social groups to which the worker belongs (primarily class, party, and union) must not be so great under the given historical circumstances that it exceeds that of the business collectivity, even when reinforced, or in other words, so great that the centripetal influences would be incapable of counterbalancing the entire range of centrifugal influences.

Also, even assuming that the economic and social conditions are not too unfavorable, it is possible that the creation of this *esprit de corps* has certain factual limitations which the human relations movement has been unable to discern. This is Geiger's suggestion when he observes with great insight that if the modern firm, as an organizational and technical entity, penetrates positively into the worker's consciousness, it is always felt negatively as a typically capitalist milieu of production.⁶ And though Otto Lipmann recognizes the possibility of a certain degree of integration of the worker with the firm, he seems to agree with this clear-sighted opinion when he writes: "The worker does not believe in a community be-

tween himself, the employer and the supervisory personnel; he considers the idea a booby-trap.”⁷ The practical limits of the effort of the human relations movement seem to emerge from these remarks. It may be admitted to have succeeded, in the best cases, in integrating the worker into the firm considered as a collectivity of organization, technology, and social services, but not as an association of men bound by common ends and sentiments, equal in dignity and rights. But when the movement claims to go further than this, when it undertakes the radical transformation of the structure of the firm through management committees, new methods in regard to wages, profit sharing and participation in management, does it not already represent a retreat on the part of the system of industrial production defined in terms of wages and capital, and its inner penetration by another system and other institutions which are in the process of formation? To say that the worker is becoming the *subject* of measures of rationalization, isn’t this by the same token to say that he is no longer exclusively a *wage earner*?

In all my publications since *La Crise du Progrès* (Chapter II, “On ne nous demande pas de penser”), I have called attention to the doctrine of the separation of planning and execution of work which, since Taylorism, has characterized most of the systems of Scientific Management throughout the world, and I have emphasized its technical, psychological and moral dangers. Recent developments in mechanization have kept the problem alive up to now (1954) in all industrially developed countries. I shall merely quote the statement of Alexander R. Heron in his remarkable book, *Why Men Work*, especially significant since Mr. Heron is Vice-President of an important firm, the Crown Zellerbach Corporation, in which he directs the industrial relations department, which, under his influence, has created an excellent morale in the firm:

We shall do a lasting injury to our business and industrial relations if we fail to distinguish between the right to think and the right to decide. Demagogues are confusing our views of this distinction. They are equally dangerous whether they are the demagogues in union management or in business management. When leaders of some of the large industrial unions laid down their demands of 1945 and 1946, those demands contained the type of program which would have permitted several members of the football team to call the signals on the field. When leaders of management deny in action that they can accept the value of

worker thinking without surrendering the responsibility for decisions, they are equally shortsighted.

If the organization of business and industry is to function effectively, the obligation to make decisions must be centralized within each operating unit, large and small. But if those decisions are to be effectively carried out, the decisions themselves must be made on the basis of all available thinking which is pertinent.

We cannot hope to have a healthy American business body, an effective industrial organism, composed of distinctly separate units distinguished as the *workers* and the *thinkers*. We cannot expect teamwork from 90 per cent of the team members if we insist on telling them that their function is to work, ours to think.^{8*}

* Without confusing situations and environments which are very different in character, it is important to observe here that similar problems arise within the present framework of Soviet industry. In the words of the journal of the Young Communists of the U.S.S.R. (*Komsomolskaia Pravda*, July 17, 1953): "There are in our country many students for whom there is a gulf separating the work of an engineer from that of an ordinary worker, and who have nothing but contempt for those who are engaged in production. In their opinion it is the exclusive task of the engineer to make plans and that of the worker to carry them out."

Among the many articles which have been published in France on the subject of "human relations" may be mentioned that of Michel Crozier, "Human Engineering," in *Les Temps Modernes*, July, 1951, and that of P. Fraisse and Y. Guibourg in *Esprit*, May, 1953.

Conclusions

IN A GENERAL ASSESSMENT of contemporary industrial civilization, we too often consider only the growing ascendancy of mechanization over the human masses and not the effort already initiated to control it. True, its radiating influence fills the horizon, and the changes it has caused in the conditions of life are so broad and deep that one can scarcely see the defensive measures man has begun to take to protect his body and spirit. Yet, other forces have appeared within our social system, employing new techniques, often cleverly applied and circumventing powerful private interests. Aided by the profit system, sometimes resisting it, but backed especially by the new sciences of man, these forces have tried to humanize as much as possible the tremendous apparatus of production which has emerged from the industrial revolutions.

In the first part of this book we examined certain manifestations of this effort which recognizes the importance of the "human factor" and leads to its consideration in the daily routine of the workshops. Its results, frequently remarkable from a theoretical point of view (as scientific knowledge of the industrial milieu, that is, of the complex reality which surrounds man at his work and which is created by and constantly reacts upon him), are already far from negligible on the practical level. If theory and practice have ever been intimately blended in the sciences, it is certainly in those sciences which undertake the study of the industrial milieu and try to secure a better reciprocal adaptation between it and the worker, and espe-

cially between machines and men. Scientific research into fatigue, rest periods, the length of work periods, light, and noise, has not rested content with laboratory experiments and cautious aspirations. More than once it has been able to realize some of its suggestions, impose its way of thinking, and little by little persuade engineers and employers to broaden their vision (originally strictly technicist) of business. In this sense, the effort to introduce the human factor into industry has been an important event, of which neither the practical effects nor the moral value should be underestimated.

But in following the thread of these problems stage by stage, we have also seen that the chief results have been achieved by the sciences of man where their recommendations coincided with the well-calculated self-interest of the industrialists. Reductions of the length of work periods, the fight against fatigue, the methodical introduction of rest periods, are just so many significant indications to this effect. The psychologists trying to improve working conditions in a factory are the first to recognize that it is impossible for them to make a frontal attack on the businessman's private profit and that the human factor has no chance of penetrating except through some channel of common interests. When this is lacking, it encounters obstacles which, on examination, are seen to be outside the physiological, psychological or technological pattern, and which involve the economic system of production and the structure of society. These are some of the characteristic facts of the sociological aspect which brilliantly illuminates a study of the "limits of the human factor."

It thus seems that many apparently inherent and essential characteristics of labor are actually relative and depend on the worker's mental attitude to his task. Fatigue, monotony, output, and quality of work, when methodically observed, show this dependence on personal psychological elements. The fatigue caused by a given task varies according to the interest felt in it by the same worker at different times, or by different workers with different internal dispositions. Monotony is felt unequally, depending on whether or not the worker is interested in his job and on the value he ascribes to it. In other words, the reactions of work upon the worker cannot be abstracted from the tendencies which he brings into play. The effects of mechanization are thus rooted in a psychological, subjective reality, and we cannot be surprised at its complexity when once con-

vinced that so fundamental an activity is capable of engaging the whole of a man. By entering into the conditioning of these reactions, *individual* psychology necessarily merges into *social psychology*.

Personal involvement in work is counteracted by contemporary tendencies in industry. And this is not the least reason for the risk which industry involves for the psychic equilibrium of many individuals. The development of subdivided tasks in the social patterns of large-scale industry, and the technicist orientation of the systems of rationalization, tend to separate the worker more and more from his work. This separation, which is brought about by technological evolution, is further emphasized by the social evolution which makes a semiskilled worker an anonymous element in a firm from which his will, his initiative and his personality are excluded. In Middletown, "an average town" of the United States, the investigators questioned a works manager. He told them of a worker who for fifteen years had been casting steering wheels and had done nothing else. "That man is dead, just dead! And there's a lot of others like him, and I don't know what to do for them. . . . What do you think most of the men in the plant are working for? They're just working. They don't know what for."¹

Since the second industrial revolution, the proportion of workers (and these, for the most part, highly trained and skilful) for whom it is justifiable to speak of pleasurable interest in their work, has decreased still more. Social evolution seems to have conspired with technological development to reduce man's physical and intellectual share in production. If it is true that, in many cases, the machine has lightened human effort, in the form in which it is socially employed in the system of private profits, it has cruelly avenged itself by making many men, when not unemployed, merely living appendages and stopgaps of automation.

TYPES OF RATIONALIZATION

Industrial mechanization, therefore, can only be studied and judged if placed in an historical setting and in a social structure. The same is true of rationalization which aims at methodically developing the mechanization of business with the least loss of human effort or of material. Here, too, one is not confronted by an isolated fact, or by some sort of entity. "Rationalization" is no more an absolute than "fatigue" or "monotony."

It differs according to the economic system of production in which it exists, and it differs within the capitalist system depending on the angle from which it is examined and applied. From the point of view of a country's national economy (A), rationalization is first of all required to distribute the largest possible quantity of work and high wages among the greatest possible number of workers in order to absorb the manufactured products and reduce to a minimum the contingent of unemployed existing at the community's expense. The point of view of the private interest of the entrepreneur (B) (whether an individual or company) is different: it is to achieve an effective use of the machines and the labor force in order to obtain a maximum output and profit. Considered, finally, from the working man's point of view (C), rationalization has still another content: the quest for output is balanced here by concern for the worker's physical and psychic constitution. The solutions chosen correspond to an optimum compromise between two factors: the *maximum* production consistent with a *minimum* of bodily or mental exhaustion. In other words, a high possibility of long-term productivity is sought from the worker, to be maintained without disadvantage to him. This point of view concerning rationalization is that of the social sciences and of the protagonists of the "human factor."

It is clear that in practice one cannot assume simultaneously three different points of view. A measure which is "rational" to one of them will not be rational to the other two, though some measures may be rational to two of them simultaneously. Thus, measures aiming at protecting the worker's working energy may be simultaneously justified from the two points of view of the national economy and of the human factor (A and C).² In contrast, those employers' measures which result in technological unemployment cost the community more dearly than the economy realized by the measures, and are irreconcilable with rationalization seen on the level of national interests (A and B). We have seen, moreover, in the application of measures of rationalization, many instances of conflict between the private interest of managements and the comprehensive, scientific concern for the human factor (B and C). Industrial psychologists succeed in eliminating some of these contradictions by demonstrating to the managements that their interest, properly understood, lies in consideration of the human factor. But other contradictions permit no compromise and can be settled only in the conflict of social forces.

"Agreements," contracts signed between employers and workers, corporative solutions, such as unions including employers and employees, and "charters of labor" only temporarily disguise the fact that the stronger of the two opposing camps is imposing its own interests. Lipmann even makes the observation, and this remark vividly illuminates the whole policy of industrial relations, that to try to arouse job satisfaction in the worker under all circumstances is equivalent to weakening his position in the inevitable conflict.³ These oppositions have their repercussions and are reflected in labor and social legislation.

In showing industrial reality in this light, in declaring that most contradictions between these two points of view (B and C) arise from the social structure and can be solved only within it, industrial psychology openly avows its impotence in this field, and emerges into sociology.⁴

Even though it attempts to maintain an appearance of indifference to these conflicts, industrial psychology, which is a science of man, cannot refuse to interest itself in the fate of the human factor. It cannot remain neutral. It cannot be indifferent to the consequences of the facts upon which it casts light, or it will consent to being constantly *used* for the benefit of private interests (B). Suppose, for example, that a scientific study carried on in a workshop has shown that some measure of rationalization reduces the time of work by 10%. Once known, this fact in the hands of the management becomes a weapon for discharging workers, increasing the production of those who are left, or lowering wage rates. Only the study of the bio-psychological aspects of the new work process can complete the scientific knowledge of it and permit the psychologist to decide and give his opinion, whatever it may be. From his point of view, wage fixing should take into account not only the direct physical expenditure of work energy (often reduced by the introduction of mechanical means), but also the indirect expenditure, the bringing into play of the nerves (noise of the machine), and of attention (quicker rhythm). If industrial psychology were to adopt a strict neutrality between the two conflicting points of view, it would by that fact prohibit itself from pressing its recommendations upon the private interests of business and from introducing into the latter, so far as possible, that respect for the human factor, which it exists to defend.

Let us not deceive ourselves. In a society in which the psycholo-

gist is not invested, in this important task, with the State's authority, but in which, on the contrary, he is often engaged and paid by employers, it is clear that his position is ambiguous and that his recommendations do not always have anything like the weight which they should have. Yet, even though in fact industrial psychology cannot impose its suggestions upon powerful interests (since it seems too far removed from them), it may nevertheless have an effective grasp of reality. As in the example I have just given, it can always remind management, which is not inclined to look at things from this angle, of the long-range exhaustion of the energies of the worker, and point out that it is in its own interest not to encourage this. In a general way, it may force science to consider the common sectors between the points of view B and C, and prove, whenever possible, to the managers of industry that they have an interest in respecting the human factor. It can make them understand that the pleasantness of the workplace has real economic importance, that the worker reacts negatively to the partial, arbitrary, and oppressive use of his occupational capacity, that crude and secret procedures of rationalization (such as the Bedaux system) do not "pay" if one estimates their effects over a sufficiently long period, but that on the contrary, there is an advantage in interesting the worker in the quantity and quality of output. In the face of this process (which he knows to be irreversible) of the despiritualization of the old crafts, the industrial psychologist may often perform a useful service by showing management that it is in its own interest to replace mechanized human work by automatic machines, and to avoid forcing the worker to an incessant use of his attention. The psychologist's action then reinforces the efforts from other quarters to reduce the length of the working day and (having deducted the time necessary for restoring energy and for travelling) to increase the effective length of leisure time.

In addition, the very results of his action certainly depend on the economic and social conditions in which this action takes place. Has he labored for the "human factor" if, after the analysis of a disagreeable task, and after he has in all scientific honesty discovered and recommended a substitute mechanical automatism, he succeeds in discharging a number of workers from a harmful task and turning them over to unemployment? Not only can the psychologist not remain "neutral," but the very nature of his research, constantly skirting the boundaries of other sciences of man, requires him, if he

wants to master his task, to be constantly and clearly aware of technical, physiological, psychological, economic and social interrelations.

Rationalization, then, is not an absolute. There is not *one*, but *several* rationalizations, differing according to the point of view from which they are organized, the concrete conditions in which they are found, and the content assigned to them. Failure to recognize this fact, bringing together under one term such different preoccupations as comprehensive concern for the human factor, the demands of a national economy, and the efforts of managements directed toward maximum output and profit, adds to a latent confusion.

This is how we might explain the widespread misunderstandings which, between the two wars, were caused by the "myth of rationalization,"⁵ which was dealt a severe blow by the crisis of the 1930's but was not entirely exploded. Faithful to their technicist illusions, the engineers protested that the world-wide economic depression was due not to an *excess* but to a *lack of* rationalization. It must be extended "to all the problems raised by the organization and direction of production, distribution and consumption."⁶ Rationalization in itself seemed to them a complete doctrine which it was only a question of developing and thoroughly applying in order to restore industrial civilization to equilibrium and harmony. The champions of this panacea were still ignorant of the variety of rationalizations and the conflicts in which they are opposed to one another in daily practice.

Employers and technicians, accordingly, failed to recognize the dependence of the industrial system upon the total environment which surrounds it. It is somewhat more surprising to find this attitude among scientists, physiologists or psychologists, who, on their part, consider not technicist rationalization (point of view B), but bio-psychological rationalization (point of view C) as the necessary and sufficient condition for good social organization, the final remedy for all the evils with which our mechanical civilization is afflicted. Yet this is what such representative scientists of the human factor school as C. S. Myers, in England, and Elton Mayo, in the United States, suggest in their conclusions.

Myers places all his hopes of solving the human problems of mechanization in industrial psychology. By hastening the progress of automation, by subjecting it to the control of psychologists and physiologists, monotony will be reduced and leisure increased. The

development of mechanization will eliminate all the drudgery which still weighs upon man, and will increase the tasks which arouse the worker's interest and demand intellectual qualities—tasks of “machine-minding.”⁷ Myers did not seem to suspect that other conditions (economic, social and moral) may support or impede this ideal action of the social sciences and must necessarily interfere with it. The English school of industrial psychology, of which he was the founder, followed this general direction and shared in this sort of scientific illusion and particularism.

Mayo believed that mechanization could have no harmful effect in an industrial civilization if the latter carefully and intelligently devoted itself to scientifically controlling the changes in human labor which accompany its progress. “It is urgently necessary,” he writes, “that industry should give as much attention to human as it has to material inquiry. With the institution of adequate researches, physiological, psychological, and social, society has nothing to fear from industrial mechanization.”⁸ Here is a confidence which my study of the facts of rationalization does not allow me to share, a scientific and particularistic illusion, conceived by scientists who do not see the multiplicity and interdependence of the tangled elements in problems which they approach from what is, after all, a special angle. They are thus able to imagine that in the present conditions of industry, it is still possible and effective to have recourse to the social sciences in order to reduce the harmful effects of mechanization. In reality, physiology and psychology, given the actual conditions in which they work, cannot by their recommendations alone and with only the support of their own strength, master the practical problems and remedy the evils of industrial mechanization. To believe that they can is to persist in not seeing the diversity of *rationalizations* which are involved, to ignore the fact that rationalization carried on from the angle of the social sciences constantly faces powerful and redoubtable antagonists, and to misjudge the “limits of the human factor” which the study of industrial facts reveal, and which it is important to bring out once more in these conclusions.

BALANCE SHEET OF THE HUMAN FACTOR

The examination of industrial mechanization has shown us, through the complexity of a reality which it would be foolish to try to simplify, the admirable vigor of an attempt by the new social

sciences, with the aid of methodical observation, to throw light on certain concrete problems and to protect the worker against mechanization while making him profit from its progress. The products of human reason, in the form of the techniques which have been let loose upon the world, threaten man's mind and body. The philosopher may see in the efforts of science a compensatory action of the human spirit, which, suddenly emerging from another point, tries to repair the damage it has caused.

This attempt coincides with the appearance and consideration of the "human factor." Its failure (for, by comparison with its vast ambition, it has failed) is explicable by the latter's limitations. In attacking the human problems of industrial mechanization, physiologists and psychologists assumed that these were amenable only to their research, their instruments of observation and their methods, or at least that they were largely amenable to these. But on coming to close grips with these problems, they saw the principal ones extending far beyond the field of the human factor to which the psychophysiological sciences had hoped to confine them.

Thus the feeling of "monotony of work," as the psychologist tries to define it, is constantly mingled with new psychic, intellectual and social elements and appears as "a thread of the total pattern, but not the total pattern." Bound to the industrial (and therefore social) milieu in which the worker lives, this feeling is something extremely relative. By trying to remedy it, to reduce it, the psychologist runs into obstacles which come from precisely this psychic, intellectual, and social relativity. Examples have been seen in the pages devoted to this question. The feeling of monotony especially depends in great part on the *value* attached to the work being done. Through this channel of value a whole flood of psychic, intellectual and social factors forces its way. One and the same task will be monotonous for one person and not for another, nor for the same person at different times. Without inferring an absolute relativism, or a total dissolution of the fact of monotony, one finds that the champions of the human factor cannot possibly control it without themselves being diverted to problems foreign to those they had decided to deal with exclusively.

Among practical suggestions made by psychologists to combat the feeling of monotony accompanying subdivided and repetitive tasks, changes of work have often been proposed. But when the specialist

is consulted by a factory management he must first prove to it that such job rotation (a measure often difficult of realization technically) "pays." So this is rarely introduced and yet more rarely retained. In fact, the influence of social and moral influences on man at his work is so great that it is hard to find a mechanized form of labor in which they do not make themselves felt. Here industrialists and technicians with little vision, limited by various prejudices and declaring that most workers "are made" for monotonous tasks without responsibility, fail to recognize this relativity of labor to the milieu, broadly considered. Behind the work, the worker immediately appears, and with him arise all the interconnections of the social relations in which he is involved. All who have seriously tried to re-introduce value and interest into the labor of the mechanized worker have found their way obstructed at once by this influence of the social groups and the relations which value and interest imply.

In this sense, there is nothing more instructive than the orientation of English industrial psychologists who, at the end of their studies, in order to imbue subdivided and monotonous tasks with interest, turn to the *esprit de corps* which they find in the regiments, public schools, universities and athletic teams of their country. The question is supposed to be one of creating in the factory a team spirit which would transfigure all tasks.⁹ Led by their particularism and misjudgment of the social reality outside the firm, these psychologists therefore persuade themselves that this sort of interest may be inspired, so to speak, on order, by an appropriate psychological propaganda. But the worker's feeling for his work, as well as the fatigue or resistance which he displays in face of difficult tasks, cannot be localized within a job and restricted to these frontiers. They certainly set in play physiological and psychological factors, but also the relations between the worker and his work, that is, his personal problems and his ties with the various groups to which he belongs, such as family, trade union, and social class, as well as his status in the society or State in which he lives. Here there is a fabric the threads of which cannot easily be separated. Anyone who tries to affect the psychology of the worker at his work will have no success if he ignores this interdependence. Detailed physiological and psychological analysis of assembly-line work (taken as an example)

shows first a *technological* fact, then beyond that, a *psychological* one, and behind the psychological, a *social* fact.

Assembly-line labor is in fact a *technological* stage in the vast contemporary process of mechanization and automation. This process is limited by the progress of mechanical science at any given moment and by economic necessities of income and amortization. Assembly-line labor corresponds exactly to the use of man as a substitute for a still undiscovered or unutilized automatic process. Then, from the *psychological* point of view, it is a subdivided task with obligatory rhythm, with reference to which the champions of the human factor emphasize biological or psychological adjustments (or maladjustments) in the individual, or mental types more or less suitable for work at a free rhythm and at an obligatory one. But the discovery of these abilities in the individual is not enough. Eventually the worker's total personality creates other requirements which bring interest in the work. Hence the different remedies from their field proposed by the psychologists, of which the principal ones are: a total view of operations, the collective stimulus of a rhythm fixed by the whole team performing one kind of work, the workers' share in the organization of their work, or their active participation in its rationalization. Here we pass from the psychological to the *social* plane, since it does not depend on psychology alone to define and obtain the worker's participation in the industrial organization—an important change which upsets the customary framework of industry under the system of private profit.

Furthermore, the worker on the assembly line implies the team, the shop, the business, the union, occupation, social class, and the nation; so many groups to which the individual belongs and which have an influence on the worker's behavior. Assembly-line work, especially, cannot be studied apart from the groups in which it is related to social and economic reality.

There, too, this complexity (behind appearances) of the fact under observation involves the complexity of the remedies proposed as a practical application of scientific research to mitigate difficulties and dangers. Technically, it is clear enough that far-sighted engineers want to hasten the time when these leftovers of human labor will be swallowed up in the great process of automation. But the surmounting by this process of the economic and social obstacles which

stand in its way does not depend on them. Psychologically, it is sufficiently clear that the scientists who are champions of the human factor set their hopes on a blend of broadened and developed vocational training with job rotation: let the worker engaged in motor assembling on the assembly line know what the whole motor is, be able to assemble it and strip it; by changing his place on the line and in the shop, obtain a polytechnical view of the work; let him be put in a position (like the artisan and the master workman of the past) to see the whole of the industrial product and to share in its creation. This attempt to re-introduce an intellectual and social interest in work on the assembly line lies on a path which seems promising indeed. But even here the attitude of the worker confronting his work depends on his relation to the different collectivities to which he belongs. The problem goes beyond the good intentions of the psycho-physiological sciences which meet resistance from social facts.

Such conclusions arise from the study of the problems of automatism, skill, the evolution of trades, apprenticeship, and industrial relations. Each of them displays this barrier to further progress, this sort of *veto* which, at a turn in the road, confronts the physiologist and the psychologist, even the best prepared, who would like to penetrate and find a practical solution for the most disturbing problems of industrial civilization.

The theory of automation gives hope of the total disappearance of unpleasant work, the relocating of workers driven from industry by technical progress in other skilled occupations, and the transformation of the man at work into a sort of demiurge or creator, making and minding machines. But these are technicians' abstractions which the actual evolution of capitalist societies since the beginning of this century has cruelly contradicted. Complete automation is full of wonderful promises: freeing the worker from these subdivided tasks (in which he is half-absorbed by the machine), from assembly-line labor henceforth assigned to mechanical appliances, distributing consumption goods in great quantities, increasing comfort, shortening the working day for all, creating leisure for everybody, and consequently the means for attaining dignity and culture. But here again, technology and the suggestions of the human factor which tend to control its application in industry bring only a magnificent *possibility*; man, alone, through the social and eco-

conomic organization in which techniques are integrated and oriented, can decide the degree to which this possibility may become actual.

This powerlessness of technical progress to deliver, by itself, the benefits it has in store, reappears when it is studied from the angle of the evolution of trades and skills. The most careful attention to the human factor could not make it fruitful, regardless of the soil. We have seen that skill, even in times of rationalization, may be retained in the factories in more or less modified forms. But, on the one hand, even in those shops such as toolrooms, in which skill is concentrated, the workers tend not to deliver all their skill-potential as soon as they see that this expansion of their energy is not compensated by what they consider a just increase in their wages, or that it serves no purpose but the profit of the business which employs them. This kind of inhibition of deep-seated energies—skill, tricks of the trade, the gift of technical invention—is a phenomenon whose importance it would be dangerous to underestimate.

On the other hand, the great problem of skill in capitalist industry is dominated by the direction taken by scientific management, and by the deflection of technicist doctrines as a result of the economic and social structures in which they are set and which they have unsuccessfully ignored¹⁰ The production engineers tend to concentrate within themselves all the planning of labor, to become the Thinking Department, little by little excluding from most of the shops any occupational skill and culture, and multiplying the tasks done by unskilled workers following strictly the instruction cards. Scientific Management discourages initiative and skill (wherever it is not required by mechanization itself). Old trades disappear without any attempt to develop in the men working in the new ones a skill for mechanized labor, which would replace the old artisan skill and permit the worker to master, on the basis of a sound technology, the operations entrusted to him.¹¹ Wherever trained and intelligent workers are not strictly necessary, they are avoided: they might be more demanding with regard to wages, tempted to interfere in the working of the machines (whereas "others are paid" to regulate them), and in other respects less suitable for repetitive and subdivided tasks.

"Strong-minded" persons are everywhere feared. So much so that at many points in this study, we have found that wherever possible, managements tend to *by-pass* occupational skill, in order to

follow the line of less training, less skill, lower wages, and fewer demands from their workers. At every opportunity industrial psychologists, with good reason, demand that the worker be left a certain margin of free action as to the structure of his work, instead of making of him a completely adjusted automaton externally controlled by the Office and its instruction cards. But the actual course of rationalization counteracts these recommendations. Moreover, the wage policy pursued by employers' organizations, and that often practiced by the trade unions, each, in its own way, injures real training and the systematic transmission of skill.

The very considerable efforts to which this skill has given rise aim, by a broadening of the basis of training and a methodical liaison with general and technical culture given to all young people, to create the conditions for a true humanism of labor. All the most authoritative economic and statistical studies show the need of a methodical, complete training given to the great mass of young people and multivalent in its effects. This is at the same time the surest way of dealing with the constant technological changes, of adapting the young worker to them in advance, and of making him surmount the narrow meaning of subdivided jobs, and find beyond them meaning, intellectual value, and unity. But the grave difficulties encountered, in France and in other western countries, by those who have adopted this vast plan, have in fact, up to now, made it impossible to achieve a training considered both as an instrument of culture and as a stage in humanism. Analysis of these difficulties has shown us such crudely technicist and blindly utilitarian doctrines of rationalization as "worker promotion" in the employers' training schools where the occupational and general training of the young worker is too often deflected at the whim of the special interests of the business which shaped him for its own use; workers outstripped by technological progress and rejected by industry; the coexistence, in the same countries, of endemic unemployment, a lack of skilled labor, and unemployment of the young. It has shown us that the desire for a widely disseminated, multivalent training, the springboard for a new culture and humanism, is paralyzed by difficulties which extend beyond pedagogy, psychology, and technology alike, and involve the State and the fundamental structure of society.

Yet, not one of the other great questions which the human factor

has attacked, so clearly shows the limits of industrial psychology and its clash with the social element as that of *human relations*. Under this heading industrial psychologists, American first of all, drew attention to relations between the workers, on the one hand, and the management and supervisory personnels of large-scale business on the other, and dwelt on the influence on output which the state of these relations exerts through the worker's mental attitude. Indeed, everything proves the importance, hitherto unrecognized, of the *inner* relation of the worker to his work. Worker reactions to rationalization carried out unilaterally by firms since Taylor's time clearly show that the workers' distrust is directed less and less against techniques in themselves but rather against their economic use and consequences. The attitude of a man such as Merrheim before World War I, and his increasing flexibility as the result of controversy with his comrades, is characteristic of this progress in working-class outlook. The militant representatives of the *Bourses du Travail* agree with the workers in the shops. Until the worker has a voice in these constant technological changes, and in their control and constant readaptation, he will inevitably tend to believe that rationalization is carried out for his employer's greater profit and only incidentally for his own. In face of any new measures he will display distrust, or rather, indifference, very rarely a wholehearted acceptance. Yet, it is this psychological acceptance by the worker which frees him from all suppression and all inhibition, and expands in him all technical and psychological possibilities in the service of labor, which can transform from top to bottom the conditions and output of production.

This acceptance or conformity, though unnamed, is what is more or less clearly aimed at by those industrial psychologists who have put the problem of industrial relations on their program of practical research. Already the study of the feeling of monotony has extended beyond operating movements and involved the worker's relations with those with whom his life is associated: comrades, foremen, supervisors, etc. The study of output only brings out more clearly these relations which set in motion the whole psycho-social complex surrounding the worker. Instead of "war on soldiering," the ultra-simple formula to which Taylor held fast, large enterprising firms, not too miserly about cost, try to create about their army of wage

earnings a milieu which will reduce, as far as possible, friction between the worker and the managing and supervising personnel, and which will consequently increase output.

But studies like that of Western Electric reveal in the worker a stubborn kernel which no merely psychological improvement can dissipate. "In some indefinable way all was not well with the human situation in the Works,"¹² in spite of all the company's solicitude for the welfare of its workers. It is in the worker's relation to his work that the investigators anticipate this hidden resistance. Certain obstacles have been eliminated. But in spite of the subtle progress of this psychological encirclement, restriction of output has not been overcome, total acceptance has not been won, and the full expansion of energies has not been obtained, even among those who have no political or union bias, as is the case with many working men and women of the United States.

The hope of the *human factor* to solve the redoubtable psychological and technical difficulties in business by this means, to create a team spirit, a spirit of solidarity, and to improve output, therefore, implies on the part of the psychologists (and the companies employing them) a recognition of the link between the technical, the psychological and the social. The sporadic results and limited diffusion of these efforts show their failure in the face of obstacles control the initiative of scientists and the means at the disposal of firms, no matter how powerful. It is certainly an important step to understand that apparently purely technical or bio-psychological problems—output, fatigue, monotony—depend on social facts. Far be it from me to underestimate here the results which have been, and may yet be, achieved in this direction by the pioneers of human relations. But while recognizing the interdependence of the psychological and the social, these pioneers admit within their field of study only the group formed by the team, the shop, or at best, the firm as a whole. And they stop there. The network of social groups to which the worker belongs is far wider and more complex. And if one wishes to disentangle the maze of inhibitions of labor, to liberate in the individual his technical and psychological potential and create full acceptance, the worker's psychological relation must be considered *with all the groups* to which he belongs, including the union, trade, political party, social class, and nation.

FINAL OBSERVATIONS ON MECHANIZATION

The overall observations of psychologists on the general evolution of industry agree with the conclusions as to the particular problems which have just been given. In practice, mechanization has contradictory consequences, whose sharp contrast is inexplicable unless it is related to the conditions in which it is exploited. Machines eliminate many disagreeable tasks from which man then finds himself freed—a positive result. But in the same plant, sometimes in the same shop, alongside cranes and dredger-buckets which replace the handling of materials, semi-automatic machines and conveyors hamper with an implacable rhythm the unskilled workers whom they turn into their living appendages.¹³ Advantages and disadvantages are at times mingled almost inextricably. Opposite processes accompany and overlap one another.

Man's role in production is constantly dwindling in almost all industries; the sector occupied by the machine is being extended. Whenever a new and more productive machine is introduced into a shop, it ought to reduce the length of working time and raise wages immediately. In this way unemployment would be resisted, purchasing power and the number of consumers would be increased, and the workers' interest in measures of rationalization would be more easily obtained. This program, traced by Lipmann, is well conceived.¹⁴ But we know that this pious wish runs up against economic resistance which would first have to be overcome and against social structures which would have to be modified.

Comparison of artisan work and "rationalized" tasks shows other internal conflicts in contemporary industry. The former, in its unity and fullness, its bond with the personality of the master worker and the intellectual meaning which it contained, was a "spiritualized" work.¹⁵ Mechanization leads to a simultaneous and contradictory dual evolution: on the one hand, subdivided tasks increase in number, bereft of initiative, or responsibility, and of overall views. This is the "despiritualization" of work. On the other hand, there appear in certain shops preparatory tasks, tool-making, supervisory work, work in the construction of complex machines, which require training. Much more than this, work (such, for example, as the managing of a travelling crane) in which, as a result of mechanization, the operation on material has become separated from the worker's hand,

no longer requires speed and strength of execution, but precision and attention; that is, not quantitative but qualitative characteristics. The quality of work in this case shows the worker's ability. Thus the processes of despiritualization and of respiritualization of labor accompany one another.

The latter, however, is slight by comparison with the former. On the other hand, there is no rigorous determinism in either of these evolutions. When work which was formerly done by a craftsman becomes subdivided, for instance by the introduction of a number of semi-automatic or automatic machines, several ways are open to management for employment of the labor supply. It may evade and by-pass skill and replace the former skilled workers with unskilled workers. That is what management often does. But it might ask of the operators of the automatic machines a wider, multivalent technical training. Thus, in any case, there is an alternative on the technical level. But the choice itself depends on the socio-economic milieu in which the evolution takes place.

In despiritualized work, the close bond between the worker and the task is loosened, sometimes even broken. The psychologist recommends substituting indirect incentives for the natural incentive of craft work, trying in every way to recreate bonds between the worker and his tasks. Here, also, there is a need for an acceptance by the worker of his work. But we know that this is not producible on demand, since it introduces with and in itself the whole system of the worker's relations with the social groups, and the economic and political structures of which he is a member.

Thus, whatever road we take, we arrive at the same obstacles. For a century-and-a-half, technical progress, widespread in industry, has distributed consumption goods in great quantities. During that time, one may claim that an economic system, *to the degree* to which it is rationally organized, has gradually been introducing the human masses to comfort and hygiene, and increasing their material well-being. Needs for food, clothing, and housing, receive more and more abundant and highly developed responses which, in turn, react upon these needs, progressively refining and transforming them. In short, the individual, *as a consumer*, can enjoy technical progress provided the economic and social system is such that consumption goods are widely distributed to all. But even on such an assumption as this, could the individual who, as a consumer benefits by his

labor, ever enjoy it *as a producer* like the medieval master workman? Even if he does not enjoy it, can he at least avoid suffering from it?¹⁶

The social sciences, combined with an occupational training program of a humanistic nature, provide an answer to these questions, as has been seen. From their investigations they draw practical suggestions, the application of which would undoubtedly help the individual engaged in mechanized industry not to suffer from his work, and even at times to enjoy it in the capacity of producer. It has likewise been seen that the realization of these suggestions encounters obstacles which limit the action of the human factor and involve the organization of society itself.

Thus it is not surprising that industrial mechanization has aroused gloomy thoughts among some of its observers. Can the worker who, in the course of technological evolution, becomes a sacrifice to subdivided tasks bereft of intrinsic interest, hope again to find in the factory a joy in work and an expansion of his own personality? Must he not give up this utopia and try to find compensations outside the factory, in the form of culture and leisure-time activities in which personal tastes may be discovered and expressed? Henri de Man accepted this disillusioned point of view when, on returning from a trip to the United States, he wrote: "If the new methods of work are depriving the worker of much of the happiness which he previously felt in accomplishing his task well, how can he be compensated for this loss by increasing his happiness outside his work?"¹⁷ From this point of view, the sacrifice of man as a producer is accepted. As mechanization becomes intensified, his work is merely considered a thankless task, foreign to his interests, a forced labor of short duration, to be distributed as a social duty among the greatest possible number.

This pessimism, in its turn, must be examined and qualified. Large-scale industry *per se* deserves neither the enthusiastic praise of the technicians nor the moralists' unqualified condemnation. The problems are made up of a constellation of cases and concrete facts which only methodical studies and a broad, many-sided perspective make it possible to explain.

Such is the import of a methodical study of the human problems of industrial mechanization, made with a concern for the collaboration of the sciences of man which have a common interest in this sphere of reality. Universal condemnations are no longer possible;

nor are sentimental and literary attitudes. Mechanization in industry is one of the many aspects of a great change in the conditions of human existence, accompanied by a corresponding upheaval in ways of feeling and thinking. It is useless to try to understand and judge it from the outside, according to intuition or the bent of personal opinions. The problems are so varied, the interpositions of the different aspects of reality are so numerous, that only after extensive search, from changing angles of observation, and after bringing together and comparing the technological, economic, psychological, and social points of view, can one risk general judgments.

One of the points on which many thinkers correctly agree is the service rendered by industrial mechanization in freeing man from difficult, disagreeable and brutalizing tasks. He is ceasing, and will cease more and more, to be used as a physical motor, as a brute force. The worker-slave of matter is increasingly rare. Even under the system of private profit it is usually in the businessman's interest to introduce mechanized processes of handling materials, transportation, etc., even more economical as a result of the very progress of industry. In this sense the famous condition set forth by Aristotle at the beginning of his *Politics* is tending to come true: slaves (and whatever physical slavery used to exist in the proletariat) are becoming useless because "self-acting shuttles" generally produce more and are less expensive. Yet, one must not forget in the present stage of industrial evolution that for *physical* slavery there has been substituted for millions of unskilled workers the *mental* slavery of subdivided tasks and assembly-line work. The demands of private interest also prevent techniques from making good all their beneficent promises in the direction of human freedom and dignity. There is nothing more significant than trade union protests against the introduction of some new technical procedure, whose practical effect is to end the disagreeable work of certain unskilled workers—by reducing them to unemployment.¹⁹

Accusations of psychological and moral degradation cannot be made today, either, with as much ignorant dogmatism as formerly. The problem exists, but not as a certain superficial kind of literature has wanted to pose it. From this point of view, there are considerable differences between different mechanized tasks, which cannot be judged at a glance of the artist's eye from outside. It is untrue that *in itself* the machine suppresses all joy in work. It is the conditions

imposed by a narrowly technicist rationalization, in the service of special interests, which widen the gulf between the worker and his mechanized work. It is the narrow, finicky distinction between the theory and practice of labor, separating the worker from all occupational thought, which maintains this gulf. It is also aggravated by the unsatisfactory social relations between workers and supervisors within the firm. Even in the present conditions of industry, certain factories are found, though rarely, it is true, in which the elements of a "joy in mechanized work" may be felt. I have seen workers personally attached to their machine—like the artisan and his tools—giving it a name, caring for and decorating it. In this sense it is understandable that engineers have tried to clear the ground of a number of commonplaces. There is a good deal of truth in this statement of one of them: "I believe we have begun seriously to question our first assumptions concerning the effect of machine-tending on the individual. These assumptions were derived principally from the reports of observers who were essentially artists and whose judgments appear to have been highly colored by poetic imagination. Their sweeping generalizations have not been verified by the more numerous and sustained observations of those intimately concerned with industry."²⁰

If the individual worker's problem in mechanized industrial civilization demands a careful study and patient and adequate investigations, that of the individual *as consumer* seems much easier to explain. It is undeniable that mechanization without reference to the social means of distribution of its products, mechanization in itself, multiplies goods and can put good quality products at the disposal of ever increasing masses of consumers, thus creating comfort, enriching life and extending its conquests and joys. Think only of the variety and brightness of the low-priced fabrics accessible to working women and girl clerks, thanks to the new techniques of printed fabrics. The appearance of the streets in the large cities in the summer, between the two wars, was agreeably changed as a result. Taken by itself, the machine therefore has the twofold potential of creating leisure and the goods which make it possible to enjoy leisure.

At this point, however, certain critics evoke the specter of a world stripped by mechanization of variety and beauty—standardization, uniformity, advertisement signs, building developments repeating,

as far as the eye can reach, their indistinguishable shanties, scrap-iron dumps, and service stations. In this gloomy picture, mechanization can take credit only for standardization. But this—another point less and less disputed—does not necessarily mean the disappearance of individual differences, or of variety in the creation of objects. It is merely proposed (for the sake of producing them better, more economically, better adapted to their purpose, and more easily replaceable) to reduce the elements of production to a certain number of types: bolts, screws, threads, shafts, girders, handles, frames, etc. But the combination of these elements may still be quite varied, like the games of building-blocks which children play, or again, in chemistry, like the combinations of elements capable of entering into an infinite number of compounds. If only a planned industry adopts for its mass-production factories a range of types which are also elegant, practical and cheap, nothing but advantage can be seen in this. As one of its champions pertinently writes, "it is through standardization that man—the creator of forms—will conquer the excesses of mechanization. For it is mechanization, and not standardization, which mass-produces ugliness. All the objections with which our ears are assailed—uniformity, ugliness, poor quality, suppression of imagination and of luxury, negation of individual freedom, etc.—should not be laid at the door of standardization but at that of the anarchical system of production, within which *anyone*, subject to neither esthetic nor technical control, may manufacture *anything*, by *any means* he chooses (and by mass-production)." ²¹ Certainly standardization is closely connected with industrial mechanization. But here again, the machine is not in itself a danger for civilization, and can become one only if it is deprived by social forces of its potential. To tell the truth, even in the present confusion of production, one cannot say that standardization has involved any very obvious disadvantages in the whole framework of material life, undoubtedly because many industrialists are opposed to it, through routine, ignorance and individualism.

Any "optimism" claiming to draw necessary conclusions from mechanization considered as an independent entity is therefore as false as the opposite "pessimism." The effects of mechanization justify no value judgment abstracted from the concrete circumstances in which the problems are set, and especially of the economic and social conditions of industry. Any general, purely theoretical attitude

has very little meaning here and cannot contribute to our knowledge. This is true of judgments about the human effects of mechanized production and also of those which indict its practical and esthetic value.

How many regrets has one not heard for the industry of days gone by, the quality of objects prepared and shaped by hand with so much patience, such tools—both numerous and simple—when each element is considered separately! And how can one deny that the admiration for objects shaped by the best artisans of the past is justified? Sometimes, looking at a collection of such objects, furniture, ironwork, harness, crockery, masterpieces carved in wood, cast in metal, modelled in clay, fashioned in leather, one feels that artisan production, characterized by this mastery of material through hand-held instruments, manifested in mankind's technological evolution a certain kind of perfection, and marked a pinnacle, a zenith. But should the feeling for this perfection prevent us from recognizing that the modern machine, constantly brought to higher levels of efficiency and precision, used with intelligence and discrimination, makes possible a new stage and a new sort of perfection? The study of the material culture of primitive people is beginning to show other kinds of technical mastery which co-exist among them with habits of thought foreign to our logic.²² In my opinion, the industrial development of the West during the last century must also be considered from the point of view of the social anthropologist if one would judge fairly the products of mechanization. One expression of man's technical genius is disappearing over the horizon, but before our eyes another is being born.

TOWARD A TRIPLE REVALUATION OF WORK

It appears certain, therefore, that the mass introduction of mechanization in the industry of capitalist societies since the beginning of the nineteenth century by no means irremediably threatens the dignity of man as a consumer. If, on the other hand, he is considered as a producer, it presents dangers for his psychic equilibrium and his spiritual future which are more difficult to overcome. Let me, then, at the close of these pages, summarize the conditions which alone would make it possible to give industrial work a value in the eyes of the worker himself.

The first condition, and an important one, is that the psychophysiological control of the work be so assured that the individual does not have to suffer from it, either in body or mind. This implies

the full operation and development of all the guarantees initiated and explored by the physiology of work and by industrial psychology. It means the fullest possible consideration of the human factor, in those sectors of industrial labor where its relevance is not affected by considerations and obstacles outside its scope.

But let us make no mistake; these are complex and difficult problems for any economic system. The physio-psychological protection of the worker is partly conditioned by social factors, but *only partly*; for instance, the adaptation of individuals to the obligatory rhythms of the assembly line and other semi-automatic tasks is not a purely social problem any more than is the fight against cancer or tuberculosis. I do not mean that the data are the same no matter what the society, but only that this problem is not wholly solved by the transformation of the mode of production and of social institutions. The protection of the worker's body and mind against the effects of mechanization is incumbent upon all industrial nations. But it is clear that the difficulties will have a different aspect according to the societies, and the more or less efficient weapons they have to confront them. No doubt, the full solution will remain an ideal for some time to come.

Let us regard it, however, as being in process of realization. Let us assume that the worker's body and mind, threatened by mechanized tasks, are protected against the harmful effects of the new forms of work. The worker's physical and psychic health is safeguarded, but as yet this is only a negative achievement: the elimination of the painful consequences of work. But what are the conditions under which the worker might enjoy his work? The study of the human factor and its limits suggests how this evaluation of work might be brought about in a society from which the basic obstacle of private profit had disappeared: a triple revaluation which should be alike intellectual, moral and social.

One could combat the despiritualization of mechanized labor in its many forms by a generalized and multivalent training, broadly based on theoretical and practical knowledge, by shortening the working day, and by job rotation. Thus, fed by technology, any task, having become the element of a complete job which the worker masters and understands, may be a source of interest for him, an opportunity to conquer a difficulty, a cultural means, and an aspect of the whole production process. If he is not indefinitely tied to it,

any task may be a stimulus to reflection and enrichment for the *worker-physicist*. Thus through technology, the view of the complete job, and his modest participation in the total life of his firm, the worker can overcome the fatal contradiction, increasingly emphasized by rationalization since Taylor's day, between the *performance* of work and the *planning* of it. Only as a result of a broad and generous synthesis of these contradictory aspects can the worker see an *intellectual value* re-emerge in the variety of subdivided tasks, which will necessarily remain his lot until the present phase of technological evolution is ended.

A task thus enriched and renewed would successfully rid itself of the chief defects of subdivided, repetitive, monotonous labor. By retaining or multiplying them, the ruling classes of society are trying to justify the contempt in which they hold the poor and ignorant masses, and the inferior role to which they relegate them. On his part, the unskilled worker has nothing but indifference for the interchangeable tasks which arouse in him no interest, no real knowledge of material, and which touch no deep spring of his personality. In spite of the efforts of clear thinkers who realized (in the face of a bourgeoisie which has exhausted its energies and is increasingly cut off from reality by its own rhetoric) that a place for industrial work must be made within our culture, the raising of this work to a higher value had, on the eve of the recent war, remained nothing but a dead letter in current opinions, mores, and institutions. The edifice of bourgeois humanistic studies, though badly cracked, still dominated the scene. On the one hand, the structure of capitalism does not permit what would amount to a revolution in the ways of thinking, educating and living, though this is foreshadowed. On the other hand, technological progress, daily creating subdivided and degraded tasks in the workshops, deprives many workers, who have become appendages of machines, of all respect for their changing and unstable occupations. If, on the contrary, this work could be methodically varied, illuminated by technology, conscientiousness, and culture, machine work, by recovering an intellectual value, would be raised by this very fact in the eyes of the one who performs it. Dignity and *moral value* are associated with intellectual value.

But this is not all. If these tasks, even thus illuminated and renewed from the inside, had no purpose which interested the worker, if they were performed in the individualist framework of a firm to

which his innermost self was foreign, they would remain, in spite of everything, on the surface of his personality. The worker must understand the *social value* of his work. There must exist between himself and his comrades, and between himself and his firm, a close co-operation. If he feels himself participating and responsible (to any degree) in the life and management of his firm, if he feels that his work has a place in a collectivity, factory, society, or nation, to which he is not a stranger, and if he identifies himself with their inclinations and hopes—then even subdivided operations take on for him a meaning which they could not acquire without these conditions. It is by coupling the tasks of large-scale mechanized industry with deep incentives such as these that the whole personality of the worker may be most effectively involved. In this way, the triple revaluation of work—intellectual, moral and social—would be assured. Thus, even under the specially difficult conditions of the present stage of industrial work, a transition on the way to automation, new forms of “joy in work” might appear.

A GIANT TEST

Such are the chief conclusions to which, in my opinion, the study of industrial mechanization leads. Among the many aspects of the tremendous modern evolution in technology, this aspect is the first which has begun to be studied by the social sciences, probably because the problems of mechanization are presented more clearly in industry, and because they have there a more precise outline than in other fields such as city life, leisure, the arts, or new forms of feeling. The sciences of man (especially psychology, just emerging from the swaddling clothes of metaphysics, intuitionism, and academic positivism) seem to be getting their hands in by attacking the practical problems of the workshops. And let us remember that curiosity has been stimulated also by industrialists far-sighted enough to understand that the broadly conceived interest of their firms would benefit by a deeper knowledge of the problems of labor.

However this may be, industrial mechanization considered as one aspect of mechanization, which has been examined with more efficient means than have other aspects of technology, seems like a great experiment in the new trend of the history of civilization. Thanks to it, one can watch more closely the penetration of machines into a sector of human activity (that concerned with the production of

consumption goods), one can follow their progressive development, the reactions of the men who conceive them, make them, mind them or profit by them, and those of science which studies them. In the interlacing of facts we have seen different aspects of identical human realities, depending on whether they are considered from the technical angle of mechanical science, the individual angle of physiology or applied psychology, or the social angle of the groups which are active and combined in them—at least, such are the chief aspects which have appeared to me. Doubtless there are others. I am convinced that any aspiration to scientific knowledge of these phenomena is illusory if the views taken from these varied angles are not confronted with and enriched by one another. The technological, the physiological, the psychological and the social are inseparable. In this rich field, the coexistence of different perspectives and levels has been recognized; each of them contains an aspect of reality and none of them reveals the whole of it. We have seen the attempt of the sciences of man to introduce a scientific and human control of industrial mechanization, the progress and gains of this attempt, and what civilization in the near future may attain from a deeper penetration by these sciences. The limits of this attempt have also been seen. This rich field shows with singular clarity the dependence of these phenomena (which to so many minds seem still subject only to the sciences of the species and the individual) on collective realities and social structures. In this sense industrial mechanization is a giant test which casts a glaring light on the repercussion of social factors upon contemporary man's mental and moral activity. It also shows in what direction a humanism anxious to change *effectively* the conditions of human life must orient its course and its hopes.

References

LIST OF ABBREVIATIONS USED IN REFERENCES

Aspects	<i>The Social Aspects of Rationalization</i> (Geneva: International Labor Office, 1931).
CNOF	<i>Comité national de l'organisation française</i> .
IFRB	Industrial Fatigue Research Board, British Medical Research Council.
IHRB	Industrial Health Research Board, British Medical Research Council.
JNIIP	<i>Journal of the National Institute of Industrial Psychology</i> .
Lahy	J. M. Lahy, <i>Le Système Taylor et la Physiologie du travail professionnel</i> (Paris: 1921).
Lipmann	Otto Lipmann, <i>Lehrbuch der Arbeitswissenschaft</i> (Jena: 1932).
Mayo (A)	Elton Mayo, "The Human Effect of Mechanization," in <i>Papers and Proceedings of the 42nd Annual Meeting of the American Economic Association</i> , XX, 1 (March, 1930).
Mayo (B)	Elton Mayo, <i>The Human Problems of an Industrial Civilization</i> (New York: 1933).
Myers (A)	C. S. Myers, <i>Industrial Psychology in Great Britain</i> (London: 1925).
Myers (B)	C. S. Myers, <i>Industrial Psychology</i> (London: 1929).
MW	F. J. Roethlisberger and W. G. Dickson, <i>Management and the Worker</i> (Cambridge: Harvard Univ. Press, 1939).
NIIP	National Institute of Industrial Psychology.
PSM	F. W. Taylor, <i>Principles of Scientific Management</i> (New York: 1911).
SM	F. W. Taylor, <i>Shop Management</i> (New York: 1911).
Viteles	Morris S. Viteles, <i>Industrial Psychology</i> (London: 1933).
Wallon	Henri Wallon, <i>Principes de psychologie appliquée</i> (Paris: 1930).

Preface to the First Edition

1. *La Crise du Progrès, esquisse d'histoire des idées* (1895-1935) Paris: 1936. Revised, 1954.

2. *[Ou Va Le Travail Humain?* (Paris: 1950). In this third volume of the series, Prof. Friedmann devotes fully one-third of his observations to

the technology of the United States and brings up to date his long interest in American social science and social affairs generally.—HLS.]

3. *Problèmes du machinisme en U.R.S.S. et dans les pays capitalistes* (Paris: Editions sociales internationales, 1934); *De la Sainte Russie à l'U.R.S.S.* (Paris: Gallimard, 1938), chaps. II, III and IV.

4. *The Fédération des Bourses du*

travail, founded by Fernand Pelloutier (1867-1901), was the first organization in France to represent all the working-class groups. Each *Bourse du travail* was thus a local center which grouped all the trade unions of an area. After Pelloutier's death the *Fédération* was absorbed (1902) into the *Confédération Générale du travail* (CGT) but the term *Bourse du travail* is still used today to designate the building which is the provincial headquarters of the *Union Provinciale des Syndicats*, and which is, therefore, the center of a large part of trade union activities. [For a brief description of contemporary French trade union developments and structure, cf. Adolf Sturmthal's *Unity and Diversity in European Labor* (Glencoe: The Free Press, 1953).—HLS.]

Introduction to the Original Edition

1. M. Berthelot, *Science et Morale* (Paris: Calmann-Lévy, 1897), p. VIII.

2. On the ideology of progress at the turn of the century, cf. my *La Crise du Progrès*, chap. I.

3. On the second industrial revolution, cf. *La Crise du Progrès*, chap. I.

4. On Taylor's political and social attitudes, cf. *La Crise du Progrès*, chap. II, "Les abstractions d'un ingénieur."

Part One

Chapter I

Taylorism and the Human Sciences

1. This is not the place for a new sketch of Taylorism, and moreover, this would duplicate the one I have already given in *La Crise du Progrès*.

I refer the reader to chapter II of that work. The study of Taylorism from the scientific point of view to be found there assumes, on the reader's part, a general knowledge of Taylor's activity and doctrine, and of the economic and social setting in which they developed.

2. Besides his prefaces to the chief French translations of Taylor's works, Le Chatelier wrote a general treatise, *Le Taylorisme* (Paris: Dunod, 1928).

3. *La Crise du Progrès*, chap. II.

4. J. Edwards, "The Fetishism of Scientific Management," *Journal of the American Society of Naval Engineers*, May, 1912.

5. S. Gompers (President of the American Federation of Labor), "The Effect of Industrial Combinations on Labor Conditions," *The Annals of the American Academy of Political and Social Science*, July, 1912.

6. Belgian Ministry of Industry, Labor and Supply, report of the mission of inquiry on *Le Travail industriel aux Etats-Unis* (Brussels: 1920), vol. I, p. 215. This report was partly drawn up by H. de Man.

7. R. F. Hoxie, *Scientific Management and Labor* (New York: D. Appleton, 1916), pp. 16 ff. and 129 ff. By the same author, *Trade Unionism in the United States* (New York: D. Appleton, 1920), pp. 320, 323.

8. J. A. Hobson, in *Sociological Review*, July, 1913.

9. "Ein System zur Auspressung der Menschenkraft," *Frankfurter Zeitung*, February 2, 1913; Emile Pouget, *L'Organisation du Surmenage* (Paris: 1914). Cf. Lahy, pp. 27-28.

10. Lahy, p. 169.

11. A. Merrheim, *La Vie Ouvrière*, February 20, 1913, p. 224 and pp. 214-215.

12. E. Pouget, *op. cit.*, p. 24.

13. Cf. section III, chap. I, pp. 000-000, the study of workers' reactions to rationalization.

14. G. S. Watkins, *Labor Problems*

(New York: Crowell, 1921), p. 324.

15. Cf. the excellent account of Veblen's work by Maurice Halbwachs, in *Revue Philosophique*, I (1921), 228.

16. Such is the case with the works of W. Moede on the selection of apprentices and, in general, on vocational guidance, published in *Praktische Psychologie* in 1919 (pp. 6-18; 65-81) and 1920 (pp. 339-350; 365-387).

17. H. A. Overstreet, in H. C. Metcalf, *Scientific Foundations of Business Administration* (Baltimore: 1926), p. 316.

18. *Cours de philosophie positive*, (5th ed.; Paris: 1892), vol. VI, p. 655.

19. L. Lévy Bruhl, *La philosophie d'Auguste Comte* (Paris: F. Alcan, 1900), p. 92.

20. Such is the case in the United States with Galton and his students. Cf. Viteles, p. 33.

21. W. Stern, "La psychologie de la personnalité et la méthode des tests," *Journal de Psychologie*, 1928, pp. 5 ff.

22. A. W. Kornhauser, "The Study of Work Feelings," *Personnel Journal*, 1930, p. 351.

23. Research done by J. M. Lahy, since 1905. Cf. *Journal de Physiologie et Pathologie générales*, 1913, pp. 824-835.

24. H. Munsterberg, *Psychology and Industrial Efficiency* (Cambridge: Houghton Mifflin, 1913), pp. 308-309.

25. Wallon, p. 7.

26. Bronislas Biegeleisen (Cracow), *Report of the Fourth International Conference of Industrial Psychology*, 1927 (Paris: 1929), p. 293.

27. "This . . . is the most important element of the system advocated by the writer . . . the arch without the keystone would fall to the ground." SM, p. 94—Fr.

28. SM, p. 96—Fr.

29. Cf. the chapter on fatigue, pp. 77-92.

30. Frank B. Gilbreth first became

known for a remarkable work on bricklaying, which had great success and remains a model of its kind: *Bricklaying System* (New York: M. C. Clark, 1909). His principal works on time and motion study are: *Motion Study* (New York: Van Nostrand, 1911); *Fatigue Study*, N.Y., 1916); *Applied Motion Study* (New York: Sturgis and Walton, 1917). These two last works are in collaboration with Lilian Gilbreth.

31. Lahy, pp. 60 ff.

32. *Ibid.*, p. 64.

33. E. Farmer, "Time and Motion Study," IFRB, report no. 14 (1923), p. 6.

34. C. S. Myers, "The Efficiency Engineer and the Industrial Psychologist," JNIP, 1923, p. 170.

35. E. Farmer, *op. cit.*, pp. 18 ff. In a reply to an article by Myers (JNIP, 1924, pp. 40-45), the Gilbreths on the whole maintained their original positions.

36. J. Amar, *Le moteur humain et les bases scientifiques du travail professionnel* (2d ed.; Paris: 1923), p. 644.

37. J. Ioteyko, *La Fatigue* (Paris: Flammarion, 1920), pp. 95, 106, 166.

38. *La Crise du Progrès*, chapter II, "La guerre à la flânerie."

39. Edgar Atzler, "Physiologische Arbeitsrationalisierung," in *Körper und Arbeit, Handbuch der Arbeitswissenschaft* (Leipzig: 1927), pp. 418-419. Cf. Gunther Lehmann, "Physiologie der Arbeit," in Fritz Giese, ed., *Handwörterbuch der Arbeitswissenschaft* (Halle: 1930).

40. Atzler, *op. cit.*

41. Atzler, *ibid.*, pp. 419-420.

42. Arnold Dürig, "Ermüdung im praktischen Betrieb," in *Körper und Arbeit*, pp. 611-612. Cf. also pp. 630-631.

43. Cf. Lipmann, p. 189.

44. Lipmann, p. 187.

45. Friedrich Sander, "Arbeitsbewegungen," in J. Riedel, ed., *Arbeitskunde*, (Leipzig-Berlin: 1925), p. 202.

46. Lipmann, p. 186.
47. Farmer, *op. cit.*, p. 34.
48. Myers (B), p. 89.
49. *Ibid.*, p. 112.
50. C. S. Myers, *Mind and Work* (London: Putnam, 1920), p. 23. Myers summed up the judgment of English industrial psychology regarding Taylor in *Business Rationalization* (London: Pitman, 1932), pp. 36-42.
51. E. J. Marey, "Travail de l'homme dans les professions manuelles," *Revue de la société scientifique d'hygiène alimentaire*, 1904, p. 196.
52. By the same author, *La Méthode Graphique* (Paris: 1885).
53. As to this research, cf. the statements and references given by Lahy, pp. 49, 50, 155.
54. F. and L. Gilbreth, *art. cit.*, JNIP, 1924, pp. 40-45.
55. Taylor, PSM, p. 56.
56. *Ibid.*, p. 57.
57. *Ibid.*, p. 58.
58. *Bulletin of the Taylor Society*, II, 5 (December, 1916). Cf. J. Amar, *op. cit.*, p. 610.
59. A. Chauveau gave an account of his work previous to 1891 in his book *Le travail musculaire et l'énergie qu'il représente* (Paris: 1891). For his later works and those of other physiologists on the expenditure of energy by the human body, cf. G. Weiss, *Physiologie générale du travail musculaire et de la chaleur animale* (Paris: 1909).
60. *Bulletin of the Taylor Society*, December, 1916, *art. cit.*, p. 579.
61. J. Amar, *op. cit.*, p. 611.
62. Lahy, p. 155.
63. He was speaking of a group of shovel workers of "extraordinary" quality trained at the Bethlehem works by a careful selection, and an individual, methodical training.
64. PSM, p. 74.
65. Ms. of lectures at Harvard, cited in Frank Copley, *Frederick Winslow Taylor, Father of Scientific Management* (New York: Harper Bros 1923). vol. I. pp. 321-322.

66. PSM, p. 59.
67. PSM, pp. 75 ff.—Fr.
68. PSM, p. 45.
69. *Ibid.*, p. 85.
70. *Ibid.*, p. 69.
71. SM, p. 63—Fr.
72. Cf. *La Crise du Progrès*, chap. II. Also F. B. Gilbreth, in *The Journal of Political Economy*, July 1913, p. 623: Scientific Management cannot succeed "unless the organization is supported by the hearty co-operation of the men. Without this there is no scientific management."
73. Le Châtelier, *op. cit.*, p. 146.
74. Cf. *La Crise du Progrès*, chap. II, "Apogée de la Rationalisation."

Part One

Chapter II

Some Contributions of the Physiology of Work

1. Preface to J. Amar, *Le moteur humain, op. cit.*, p. X.
2. *Ibid.*, p. IX.
3. Concerning the IFRB, reports no. 29, 41, 44, 50 are especially interesting from the point of view of biological rationalization.
4. G. P. Growther, *Muscular Work, Fatigue and Recovery* (London: 1932).
5. Cf. Atzler, "Die Aufgaben der Physiologie in der Arbeitswissenschaft," *Technik und Wirtschaft*, no. 8 (1924), 173-180. Cf. also the collection edited by the same author: *Arbeit und Ermüdung* (Berlin: 1927), pp. 3 ff.; in *Körper und Arbeit, op. cit.*, cf. "Physiologische Arbeitsrationalisierung," pp. 409 ff.; and A. V. Hill, *Living Machinery* (New York: Harcourt Brace, 1927).
6. Cf. the excellent summary of this work in Wallon, p. 16, "Les conditions physiologiques du travail."
7. Atzler, *Körper und Arbeit, op. cit.*, pp. 425 ff.

8. Studying the "functional modifications in the human organism caused by muscular labor of long duration" (*Le travail humain*, Sept. 1934, pp. 284-294), Marchac also concluded, from his experiments, that in the course of this sort of automatic work, even if of only average intensity, a certain change occurs in the inner structure of the work and new elements are involved in the apparatus of co-ordination. Thus visual control, which with trained persons is not required, again becomes necessary in uninterrupted work of long duration.

9. Atzler, *Körper und Arbeit*, p. 424.

10. Wallon, pp. 18-19.

11. Amar, *op. cit.*, pp. 281-282.

12. To the research mentioned on the nervous system, circulation and breathing, a complete review should add all the research constituting the biochemistry of fatigue; especially on the lactic acid involved, changes in the sensory organs, the blood (leucocytes, chemical composition of the blood, sugar content, water content, etc.), in body temperature, metabolism and alimentation. Cf. Arnold Durig, "Bio-chimie de la fatigue," in Atzler, *op. cit.*, pp. 247 ff.

13. Atzler, *op. cit.*, pp. 431 ff. Cf. the table of experiments, p. 435, and that of optimal speeds, p. 440.

14. *Ibid.*, p. 485.

15. *Ibid.*, pp. 486 ff.

16. This rule, expressing physiological conditions determined by experiment, opposes the exclusion of "idle times" and "useless" movements recommended by Taylorian time-study.

17. Research in physiological rationalization carried on to determine this minimum generally requires experimental apparatus for the measurement of the amount of oxygen consumed in the different conditions of rest and labor. Cf., for example,

the research of Faillie, Liberson and Vial de Sachy in the normalization of ballast forks. *Le Travail Humain*, I (1933), 278-296.

18. Static effort—maintenance of the body in a given attitude—is much more tiring than dynamic labor. Herbert Lehmann, in "Das statischdynamische Arbeitsäquivalent," *Ind. Psychot.*, V, II (November, 1928), pp. 313-333, attempts to discover their mutual relation. He compared the fatigue produced by both kinds of work during experiments in which the subject interrupted and resumed his task at will. According to Lehmann, static work may be considered about four times as fatiguing as dynamic work. These conclusions must be remembered in arranging machine parts to avoid as much as possible static efforts (for instance, in the handling of levers and controls).

19. On the Western Electric research, cf. below, section III, pp. 304 ff., and especially the bibliography, p. 426.

20. This aspect of the research is discussed below, pp. 000.

21. Mayo (A), p. 166.

22. *Neue Psychologische Studien*, no. 2 (1930), 220-251 and 253-315.

23. For several recent studies in this field, and particularly those of the Max Planck Institut (Dortmund) which is the principal European center for studies in the physiology of work and where the work of Atzler is being continued, see Recent Bibliography.

Part One

Chapter III

Fatigue

1. Georges Dumas again takes this point of view in his *Traité de Psychologie* (Paris: F. Alcan, 1924), vol. II, p. 1147: "Whatever is not the

reaction of the organism to stimuli of the milieu must be sociologically explained."

2. Wallon, p. 23.

3. E. Kraepelin summed up the general conclusions of his research in his introduction to the collection edited by him, *Psychologische Arbeiten*.

4. April, 1933, Rockware Glass Works, Greenford, Middlesex. The investigation was conducted under the auspices of the NIIP. The experiments on the checking of bottles were conducted and graphically interpreted by J. W. Seymour.

5. E. Kraepelin, "Die Arbeitskurve," in *Philosophische Studien*, 1902, pp. 459-507; "Über Ermüdungsmessen," *Archiv für gesamte Psychologie*, 1905, pp. 9-30. Among the first works on fatigue and effort should be further mentioned: Ioteyko, in *L'Année psychologique*, V (1899); and Trèves, "Le travail, la fatigue et l'effort," *L'année psychologique*, XII (1906).

6. "We can say that fatigue is not an entity but merely a convenient word to describe a variety of phenomena. The common fallacy of supposing that the word 'fatigue' corresponds to a definite thing has been the source of much confusion." D. B. Dill, American Management Association, May, 1933, quoted by Mayo (B), pp. 25-26.

7. "Critique des tests de la fatigue," a report submitted to the Sixth International Conference of Industrial Psychology, *Revue Scientifique du travail*, I (1930), 59 ff.

8. Myers (A), p. 71.

9. *Ibid.*, p. 44.

10. E. P. Cathcart, *The Human Factor in Industry*, (London: Oxford Univ. Press, 1928), p. 17.

11. Mayo (B), pp. 26-27.

12. Cf. Karl Marx, *Capital*, (ed. Costes), vol. III, pp. 62-63.

13. Cathcart, *op. cit.*, pp. 20-21.

14. Myers (A), pp. 42-43.

15. Myers (A) and (B). In the

review of the NIIP, *Human Factor*, Jan., 1937, are two good summaries of the ideas of English industrial psychology on fatigue: H. M. Vernon, "Fatigue in Industry," pp. 1-8, and G. H. Miles, "Fatigue from the Industrial Point of View," pp. 8-16. Cf. also Wallon, pp. 46-48.

16. The role of the superior nervous centers in the appearance of fatigue immediately permits us to understand why fatigue may be hastened by a multiplicity of decisions or choices in the course of a process of work and, on the contrary, retarded (in persons with aptitude for an obligatory rhythm) by a well-regulated automatism. Cf. Myers (B), p. 89.

17. Myers (A), p. 42.

18. Lahy, seeking objective signs of fatigue, had already (in 1916) observed that in the new mechanized occupations the muscular efforts are diminished, and that fatigue must be sought in the superior functions of the nervous system: rapidity of thought, memory, judgment, and above all, attention (Lahy, pp. 179 ff.).

19. Myers (A), pp. 39 ff.; Myers (B), article by Rex Knight, pp. 61 ff.

20. Wallon, p. 48.

21. Mayo, Paper delivered to the Personnel Research Federation (November 15, 1929); and Mayo (B), p. 26.

22. Cf., below, section III, p. 304. The final report on the Hawthorne Investigation, written by F. J. Roethlisberger and W. G. Dickson, published as *Management and the Worker* (Cambridge, Mass.: Harvard University Press, 1939) and indicated in our references by MW, dwells with greater precision on the relativity of fatigue into which not merely organic elements enter but personal and social ones. It gives examples (pp. 570 ff.) of curves not agreeing with the purely physiological interpretation of fatigue. Except in the case of purely "physical labor," it is thus im-

possible to consider the worker as a physiological machine, conditioned solely by his physical milieu (*ibid.*).

23. Lipmann, pp. 21-25.

24. "Psychologie und Arbeitswissenschaft," *Zeitung für angewandte Psychologie*, March, 1930, pp. 87-103.

25. K. Sottonin, "The Problem of Industrial Fatigue," *Problems of the Psychology, Physiology, Reflexes and Hygiene of Labor*, 3 (Kazan, 1928), pp. 5-14 (in Russian).

26. A. Melian, "La fatiga industrial y su profilaxia," *Rev. de org. científica* (September 1, 1928, pp. 21-28), gives an interesting classification of the causes of industrial fatigue: (A) Causes inherent in the individual (temperament, abilities, psychological state); (B) Causes related to the physical environment of the work (temperature, noise, light, etc.); (C) Causes inherent in the work itself (poor adaptation of machines to the human body, posture in the course of work, rhythm, repetition); (D) Causes related to the organization of work (duration, distribution of work periods, rest pauses).

27. Cf. Hilde Rigaudias-Weiss, *Les enquêtes ouvrières en France entre 1830 et 1848* (Paris: 1936).

28. "Clearly, with the progress of mechanized industry and the experience accumulated by an entire special class of workers, there must be increased speed and so increased intensity of labor. Thus, for half a century in England, the prolongation of the working day and the increasing intensity of factory work were simultaneous. But it is clear that in work not depending on occasional impulses but on regular, daily renewed uniformity, a point must be reached where extension of the working day and intensity of labor are reciprocally exclusive, so that prolongation of the working day is possible only by reducing the intensity of labor and, inversely, increased intensity neces-

sarily involves a reduction in the working day." K. Marx, *Capital* (ed. Costes), vol. III, pp. 62-63). This process Marx calls "the conversion of greatness of extent or duration into intensive greatness or the greatness of degree" (*ibid.*, p. 62).

29. Taylor, SM, par. 200-210, pp. 51-53—Fr; PSM, p. 77—Fr.

30. PSM, p. 80—Fr.

31. Myers (B), pp. 68-69.

32. *Ibid.*, pp. 66-67.

33. *Ibid.*, p. 71.

34. *Ibid.*, p. 73. Cf. also Welch and Miles, *Industrial Psychology in Practice* (London: Pitman, 1932), pp. 9 ff.

35. Myers (B), p. 77.

36. Welch and Miles, *op. cit.*, pp. 12 ff.

37. This concern may be found, however, in the investigation of Sheila Bevington, G. H. Miles and Gladys Roberts, "An Investigation in a Tapestry Factory," *JNIIP*, vol. IV, no. 3, p. 165.

38. Myers (B), pp. 77-79; Welch and Miles, *op. cit.*, pp. 17 ff. Cf. also the important experimental research of George H. Shepard ("Effect of Rest Periods on Production," *Personnel Journal*, Oct. 1928, pp. 186-202) who found that, in the conditions of his experiments, the optimal proportion of rest to work was about 16.6%.

39. Myers (B), p. 82; IFRB, reports nos. 41 (H. M. Vernon and T. Bedford) and 42 (S. Wyatt); Welch and Miles, *op. cit.*, p. 12.

40. IFRB, report no. 10 (J. Loveday and S. H. Munro, "Preliminary Notes on the Boot and Shoe Industry").

41. IFRB, report no. 24 (E. Farmer, R. S. Brooks and E. G. Chambers, "A Comparison of Different Shift Systems in the Glass Trade").

42. MW, p. 571. For the literature concerning the physical and psychological aspects of fatigue, see Recent Bibliography.

Part One

Chapter IV

The Working Environment

1. Leonard Hill, *The Science of Ventilation and Open Air Treatment* (London: 1919), Part I.

2. IFRB, report no. 1 (H. M. Vernon, "The Influence of Hours of Work and of Ventilation on Output in Tinsplate Manufacture"). Cf. also reports nos. 21, 35, 37, 39.

3. IFRB, report no. 19 (Ethel E. Osborne, H. M. Vernon and B. Muscio, "Two Contributions to the Study of Accident Causation").

4. IFRB, report no. 11, p. 7.

5. Myers (B), article by A. Hudson Davies, pp. 51 ff.; IFRB, reports nos. 40, 49, 57 and 81.

6. Myers (B), *ibid.*, pp. 52-53.

7. Joint Report of the IFRB and the Illumination Research Committee, "The Relation between Illumination and Efficiency in Fine Work," by H. C. Weston and A. K. Taylor, 1926.

8. *Ibid.*

9. W. Ruffer, "Die Beleuchtung als Leistungsfaktor," in *Der Mensch im Fabrikbetrieb* (Berlin: 1930), p. 87. Cf. Lipmann, pp. 293-294.

10. Lipmann, p. 294.

11. J. M. Lahy, "L'influence de l'éclairage sur le rendement," *Mon Bureau*, September, 1927.

12. R. E. Simpson, *Mitteilungen des Internat. Rationalisierungsinstitut*, no. 2, p. 113.

13. Michelet, *Le Peuple* (2d ed.; Paris: 1846), p. 73.

14. H. Dubreuil, *Standards* (Paris: B. Grasset, 1929), pp. 263-264.

15. Aspects, p. 337. Cf. also de Man, *La Joie au travail* (Paris: 1930), cases 38 and 39.

16. J. J. B. Morgan, in *Archives of Psychology*, 1916, pp. 24 ff.

17. D. A. Laird, "Experiments on

the Physiological Cost of Noise," JNIP, no. 5 (1929), 251-258.

18. A. W. Kornhauser, "The Effect of Noise on Office Output," *Industrial Psychology*, 1927, p. 622.

19. IFRB, 18th report, pp. 18-21 and 43. Cf. also IHRB, 11th annual report (1931), p. 65.

20. Kenneth S. Clark, *Music in Industry* (New York: National Bureau for the Advancement of Music, 1929).

21. H. C. Weston and S. Adams, "The Performance of Weavers under Varying Conditions of Noise," IHRB, report no. 70 (1935); cf. also IHRB, report no. 65. Note also the interesting experiment undertaken in a garment-making factory where many women, in the same room, were working at sewing machines. Springs were placed under each machine. Pieces of felt were placed under the felt, in order to reduce the vibrations transmitted by the floor. Cf. Welch and Miles, *op. cit.*, p. 50.

22. Works of the Soviet Institute of Labor in Transportation. Cf. G. Friedmann, *Problèmes du Machinisme en U.R.S.S. et dans les pays capitalistes*, pp. 57-58.

23. Myers (B), *art. cit.*, p. 60-61.

24. Cf. the admirable record and human testimony of the worker, Georges Navel, an excellent writer, in *Travaux*, Paris, 1945, p. 69: "Noise intoxicates and stupefies, and man cannot live dispossessed of himself, surrendered wholly a prisoner to real life and without the help of his musings. He is an animal, too. He has to walk, to free himself occasionally from the station where he stands motionless before the vise or the machine, to move his legs, to hear the sound of his own voice or of another's, to speak, even though to say nothing, but to free himself from the clinging spider webs of his own silence."

Part One

Chapter V

Adapting Machines to Men

1. It is well to note here that among primitive tribes it is the tool which originally tends to become adapted to the human body: primitive man so shapes the tool that his gesture tends to obey the law of the least physical and mental effort. Anthropologists have noted in particular that a single tool (the spade, for instance) has different types of handles among different peoples: short, long, smooth, with cross-pieces, etc. (A. Haudricourt, *Revue de Botanique appliquée*, nos. 230-231 (1940), 759-772.) Thus among primitives there is to be observed a direct defense of the body in the course of work, a protection which scientific consideration of the human factor is trying to redevelop in mechanized civilization.

2. Myers (B), *art. cit.*, pp. 114-115.

3. *Revue Scientifique du Travail*, nos. 3-4 (1930), 324 ff.

4. Wallon, p. 142.

5. J. M. Lahy, "Le Facteur Psychologique dans la construction des machines à écrire," *Année Psychologique*, XXVIII, pp. 245-7. Cf. also *Rev. Scientifique du Travail*, June, 1929, p. 291 and no. 2, 1930, p. 184.

6. Cf. above, chap. II, pp. 67 ff.

7. Lipmann, pp. 169 ff. and 301 ff.; Cf. also Angles, in Myers (B), pp. 114 ff.

8. Lahy, p. 192.

9. Weston and Adams, "Observations on the Design of Cotton Machinery in Relation to the Operator," JNIP, April, 1930, pp. 97-107.

10. Legros and Weston, "On the Design of Machinery in Relation to the Operator," IFRB, report no. 36; Miles and Angles, "Psychology and Machine Design," JNIP, vol. III, no.

3, pp. 159-151; S. Wyatt, "Machine Speeds and Output," JNIP, vol. III, pp. 406-414; H. Lossag, "Griffelstudien," *Industrielle Psychotechnik*, September, 1926, pp. 257-274. Cf. also the works of R. C. Garry (under Cathcart's direction) on the installation of levers, IHRB, 18th annual report, 1938, p. 24.

11. In the workshops of the Diderot Technical School, Paris.

12. *Revue Scientifique du Travail*, June, 1929, pp. 265-271.

13. Wyatt and Langdon, IHRB, report no. 82, 1938.

14. *Ibid.*, p. 42.

15. *Ibid.*, pp. 43 ff.

16. Miles and Angles, "Psychology and Machine Design," *art. cit.*

17. Weston and Adams, *art. cit.*

18. Legros and Weston, *op. cit.*, p. 30.

19. In the postwar period a new direction has been given to the study of work positions, and more attention is now paid to the human factor in the planning and installation of technical equipment. Thus new problems have been set for the experimental psychology laboratories. Cf. A. Chapanis, W. R. Gardner, O. T. Morgan, *Applied Experimental Psychology; Human Factors in Engineering Design* (New York and London: 1951). And eminent psychologists, such as F. C. Bartlett, have emphasized the great importance of these factors for increasing productivity. Cf. the latter's vigorous statement of this viewpoint in "Men, Machines, and Productivity" (*Occupational Psychology*, October, 1948), and also the important book by L. Walther, *La Psychologie du Travail* (Geneva: 1947), published at the time of his interesting experiments in the watch-making industry.

Further references will be found in the Recent Bibliography.

Part One

Chapter VI

Accidents

1. Myers (B), p. 122.
2. Aspects, p. 310.
3. *Ibid.*, p. 331.
4. *Ibid.*, pp. 331-332.
5. H. Dussier, "Les accidents du travail et le système de prévention appliqué dans les usines luxembourgeoises des Sociétés Arbed et Terres Rouges," *Rev. Sc. Trav.*, no. 1 (1930), 93 ff.
6. F. Ritzmann, "Le rôle du médecin dans la prévention des accidents du travail," *Chronique de la Sécurité Industrielle* (I. L. O.) March-April, 1933, pp. 30 ff.
7. E. Farmer and E. G. Chambers, "A psychological study of individual differences in the accident rates," IFRB, report no. 38 (1926); by the same authors, "A study of personal qualities in accident proneness and proficiency," IFRB, report no. 55 (1929); Cf. also IFRB, report no. 18, pp. 49-50 (studies of the Portsmouth Arsenal).
8. Ritzmann, *art. cit.*, p. 32.
9. A. Stephenson, in Myers (B), p. 128; Sidney J. Williams, in *Waste in Industry* (Hoover Inquiry) (New York: 1921), chap. XIV, pp. 336 ff.
10. Kafka, "Zur Psychotechnik des Bremsens bei der Elektrischen Strassenbahn," *Supplement of Zeit. f. ang. Psychol.*, 1926, pp. 102-106.
11. Karl Marbe, *Praktische Psychologie der Unfälle und Betriebschaden* (Munich-Berlin: 1926).
12. M. Greenwood and H. M. Woods, "The incidence of industrial accidents with special reference to multiple accidents," IFRB, report no. 4 (1919); E. Farmer and E. G. Chambers, IFRB, report no. 38 (1926); E. Newbold, "A contribution to the study of the human factor in the causation of accidents," IFRB, report no. 34 (1926).
13. A. Stephenson, "Accidents in Industry," JNIP, vol. III, no. 4, pp. 195-196.
14. Myers (B), p. 132.
15. *Journal de Psychologie*, 1937, pp. 290-294.
16. E. Farmer, "The Psychological Study of Accident Proneness," *Industrial Welfare*, 1933, p. 16.
17. Myers (B), p. 137.
18. H. M. Vernon and T. Bedford, assisted by C. G. Warner, "The relation of atmospheric conditions to the working capacity and accident rate of Coal Miners," IFRB, report no. 39 (1927).
19. Myers (B), p. 139.
20. J. M. Lahy, "La sélection dans les transports. Amélioration de l'apprentissage. Diminution des accidents." *VIth International Conf. of Industrial Psychology*, April, 1930. L. Bacqueyrisse, in *Trav. hum.* II, 4 (December, 1934) 442-448, and in *Bulletin du CNOF*, December, 1938, pp. 102-107.
21. Myers (B), p. 135.
22. I put the question, in Moscow, to Soviet industrial psychologists, especially I. N. Spielrein and his collaborators, Hellerstein and V. Kogan.
23. This interpretation of the cause of accidents is confirmed by the fact that only 5 to 10% of them can be prevented by technical safety devices (*Waste in Industry*, pp. 336 ff.).
24. *Ibid.*, pp. 337 and 340.
25. Aspects, p. 317.
26. *Ibid.*, p. 318.
27. *Ibid.*, p. 332.
28. An inquiry which I conducted among workers of the Center of Occupational Reclassification, organized by the Union of Parisian Metal Workers (1938-1939).

Part One

Chapter VII

Conclusions

1. H. P. Weld, *Psychology as Science* (New York: Henry Holt, 1928), p. 17.

2. W. Bingham, "On the Possibility of an Applied Psychology," *Psychological Review*, 1930, pp. 289-305.

3. Myers (B), pp. 8-9.

4. L. Witmer, "Clinical Psychology," in *Psychological Clinic*, 1907, p. 3.

5. J. M. Lahy, "Les Fondements scientifiques de la psychotechnique," *L'Hygiène Mentale*, XXVII (December, 1932), p. 277.

6. Wallon, p. 218. Cf. also, Wallon's "Psychologie et Technique," *Journal de Psychologie*, nos. 3-4 (1935), 161-182.

7. Welch and Miles, *op. cit.*, p. 17.

8. *Ibid.*, p. 53.

9. The discussion of the principles and the practical application of industrial psychology, and of its relations with general psychology, has continued since 1945, and the development of the discussion can be followed in the proceedings of the 9th, 10th, and 11th International Congresses of Industrial Psychology (Congrès Internationaux de Psychotechnique, Berne, 1945, Göteborg, 1951, and Paris, 1953). Cf. Recent Bibliography. It is apparent from these reports that industrial psychology is, on the whole, no longer considered as a mere technique without any theoretical importance, and that the attempt is being made to get a clear view of its aims, its principles and its concepts. The opening address by L. S. Hearnshaw at the 11th Congress shows this development very clearly.

Part Two

Chapter I

Problems of Monotony

1. *Treatise on the Wealth of Nations*, ed. Methuen, 1904, vol. II, p. 267.

2. Buret, *De la misère des classes laborieuses* (Paris: 1840), vol. II, p. 38; Sismondi, *Nouveaux Principes d'Economie Politique* (2d ed.; 1827), vol. I, p. 395.

3. Fourier, *Le Nouveau Monde Industriel* (3rd ed.; 1848), pp. 74-75.

4. Proudhon, *Système des Contradictions économiques*, chap. IV, pars. 1 and 2.

5. Proudhon, *De la Justice dans la Révolution et dans l'Eglise*, sixth study, pars. 37 and 38.

6. *Communist Manifesto*, (London: Labour Party Centenary Edition, 1948), p. 134.

7. Cf. the examples given in Karl Bücher's classic work, *Arbeit und Rhythmus* (4th ed.; Leipzig, 1908).

8. Adam Smith, *op. cit.*, vol. I, p. 6.

9. H. Dubreuil, *op. cit.*, pp. 226-7.

10. H. M. Vernon, T. Bedford and S. Wyatt, "Two Studies on Rest Pauses in Industry," IFRB, report no. 25, p. 34.

11. *Ibid.*, p. 23.

12. May Smith, IFRB, Fourth Annual Report, 1924, pp. 26 ff.

Similar reflections occur on the relativity of the worker's feeling of monotony depending on the milieu, in the largest sense of the word (collective life of the factory, personal hopes and prospects, family and social life), in MW, pp. 90-127 and 573. Based on the experiences of the Relay Assembly Test Room the investigators especially conclude (p. 127) that monotony cannot be defined on the single basis of variation in output and that it is above all a state of mind.

13. Lipmann, "Der Anteil des Menschen am Produktionseffekt," in *IVth Conf. Int. de Psychotechnique*, Report (Paris: 1929), pp. 224 ff.
14. May Smith, *op. cit.*
15. *Ibid.*
16. H. Rupp, "Psychologie der Fliessarbeit," *IVth Conf. Internationale de Psychotechnique*, Report, pp. 235-241.
17. S. Wyatt and J. A. Fraser, "The Comparative Effects of Variety and Uniformity in Work," IFRB, report no. 52, (1928), p. 29; S. Wyatt, "Boredom in Industry," *Personnel Journal*, VIII (1929), 165.
18. H. Rupp, *art. cit.*, p. 241.
19. H. Munsterberg, *Psychology and Industrial Efficiency*, (Cambridge: Houghton Mifflin, 1913), pp. 198 ff.
20. Wallon, p. 42.
21. S. Wyatt (in collaboration with Frost and Stock), "Incentives in Repetitive Work. A Practical Experiment in a Factory," IHRB, report no. 69, 1934.
22. *Ibid.*; cf. Summary, p. 57, no. 11.
23. *Ibid.*, p. 56.
24. H. Wunderlich, "Die Einwirkung einformiger zwangsläufiger Arbeit auf die Persönlichkeitsstruktur," *Zeit. ang. Psychol.*, XXV, pp. 321-373.
25. Among the workers questioned by de Man in his study on *la Joie au Travail* (Joy in Work), several belonged to this type, for instance, number 24 who praised the machine for allowing him time to think of political questions during work.
26. A. Gemelli and A. Galli, "Sur l'adaptation de l'activité humaine à l'activité de la machine," *Rev. Sc. du Travail*, vol. II, nos. 3-4 (1930).
27. Lipmann, "La Part de l'homme dans la production," *art. cit.*, p. 255.
28. S. Wyatt, "Boredom in Industry," *art. cit.*, pp. 166 ff.
29. Work in process on the eve of the last war in the laboratories of the state railways under the direction of D. Weinberg. Cf. the data given by this author in *Encyclopédie Française*, vol. VIII, p. 8.48-2 ff.; P. Lévy, *La Sélection du Personnel dans les Entreprises de Transport — Le Laboratoire du Travail du Réseau de l'Etat* (Paris: 1936).
30. A. Pound, *The Iron Man in Industry* (Boston: Atlantic Monthly Press, 1922), p. 182.
31. *Apprentissage* (Paris: Eyrolles, 1926), p. 52.
32. M. S. Viteles, "Selecting cashiers and predicting length of service," *Journal of Personnel Research*, 1924, pp. 467-473.
33. Wyatt, Fraser and Stock, "The Effects of Monotony in Work," IHRB, report no. 56, 1929, p. 53.
34. Thorstein Veblen, *The Instinct of Workmanship* (New York: Macmillan, 1914).
35. G. H. Miles and A. B. Eyre, in Myers (B), pp. 106-107.
36. *Ibid.*, p. 106.
37. H. Lossagk, "Experimenteller Beitrag zur Frage des Monotonie-Empfindens," *Ind. Psychotechnik*, no. 7 (1930), 101-107.
38. IHRB, report no. 56, *op. cit.*
39. Wyatt, *art. cit.*, p. 162; IHRB, report no. 56, p. 42; Myers (A), p. 71.
40. Lipmann, "Der Anteil des Menschen am Produktionseffekt," *art. cit.*, p. 225.
41. *Ibid.*, p. 224.
42. *Ibid.*, p. 225.
43. *Ibid.*, pp. 225-6.
44. Wyatt (with Frost and Stock), IHRB, report no. 69, *op. cit.*, pp. 56-57.
45. Birmingham, 1933.
46. H. Sachs, "Das Monotonieproblem," *Zeit. f. ang. Psych.*, XVI (1920), 71-80.
47. IHRB, report no. 56, p. 34.
48. IFRB, report no. 52, pp. 29 ff. Cf. also D. W. Harding, "A Note on the Subdivision of Assembly Work,"

JNIIP, V (1931), 261-264.

49. S. Wyatt, *art. cit.*, p. 165.

50. *Ibid.*, pp. 168-169. The effects of daydreaming on the individual will differ according to whether or not he can express himself "socially." In the former case morbid forms may be avoided (cf. MW, pp. 321, 573). In short, the form assumed by daydreaming depends on the concrete conditions of the worker's occupational, family and social environment.

51. Elton Mayo, "Basis of Industrial Psychology," *Bulletin of the Taylor Society*, IX (1924), 249-259.

52. Wyatt, *art. cit.*, p. 168.

53. H. M. Vernon, T. Bedford and S. Wyatt, IFRB, report no. 25; S. Wyatt, IFRB, reports nos. 32 and 42; Vernon and Bedford, "Rest Pauses in Heavy and Moderately Heavy Industrial Work," IFRB, 1927, report no. 41.

54. de Man, *op. cit.*, cases nos. 38 and 39. As to the importance of conversation as an antidote to tedium and monotony, cf. Wyatt and Langdon, IHRB, no. 82, table XIX, p. 38.

55. Wyatt, Fraser and Stock, *op. cit.*, pp. 22 ff.

56. E. Mayo, "Day Dreaming and Output in a Spinning Mill," JNIIP, 1925, pp. 203-209.

57. Wyatt, *art. cit.*

58. One of the three governing passions according to Fourier's analysis of human nature.

59. Fourier, *Traité de l'Association domestique agricole* (1st ed.; Paris and London: 1822), vol. II, p. 77. Cf. F. Armand and R. Maublanc, *Fourier* (Paris: 1937), vol. II, p. 161.

More than a century after Fourier, the large trade union organizations still dwell on the favorable effect of job rotation and include them in their program. Cf. the report of the German unions on the 40-hour week, *Die 40-Stunden-Woche*, ed. Th. Leipart (Berlin: 1931), quoted by Lipmann, p. 409: "Many workers would

probably have a different attitude toward their work if they were not constantly chained to the same task."

60. R. F. Hoxie, *Trade Unionism in the United States* (New York: Appleton, 1920), p. 322.

61. Dubreuil, *op. cit.*, p. 229.

62. H. M. Vernon, S. Wyatt and A. D. Ogden, "On the extent and effects of variety in repetitive work," IFRB, report no. 26, 1924, pp. 1-12; S. Wyatt, "The Effects of Change in Activity," *ibid.*, pp. 13-37; S. Wyatt, "Studies in Repetitive Work," IFRB, report no. 32, 1925; S. Wyatt and J. A. Fraser, "The comparative effects of uniformity and variety in work," IFRB, report no. 52, 1928; H. M. Vernon, "On certain effects of long spells of repetitive work," *British Journal of Psychology*, XVI (1926). Part 3; Wyatt, Fraser and Stock, "The Effects of Monotony in Work," IHRB, report no. 56, *op. cit.*

63. IFRB, report no. 52, p. 36.

64. IHRB, report no. 56, diagram 18, p. 26.

65. A. Weygandt, "Über den Einfluss des Arbeitswechsels auf fortlaufende geistige Arbeit," *Psychol. Arbeit*, vol. II, pp. 118-202. As to Weygandt, cf. Wallon's remarks, pp. 52-53.

66. E. L. Thorndike, *Educational Psychology* (New York: Teachers College, Columbia University, 1914), vol. III, p. 135.

67. IFRB, report no. 52, p. 25.

68. Wyatt, Frost and Stock, IHRB, report no. 69, 1934, p. 57.

69. Viteles, p. 548

70. IFRB, report no. 52, p. 24.

71. Dubreuil, *L'exemple de Ba'ta* (Paris: Grasset, 1936), p. 343.

72. Among the factories I have visited I will mention as an exceptional case a rationalized biscuit factory of the Paris region, where systematic changes had been successfully introduced into the assembly-line labor of women making rusks

(M. F. A. Company, Batignolles).

73. May Smith, cf. above, p. 000.

74. Study among workers of the Citroen Works, who were students at the Workers' University of Paris, 1934.

75. Mayo (B), p. 35.

76. *Ibid.*, p. 47. Cf. below a fuller description of Mayo's ideas about the Hawthorne Study, pp. 304 ff.

77. Wyatt, *art. cit.*, p. 169.

78. *Ibid.*, p. 170.

79. H. Ford, *My Life and Work* (Garden City, New York: Doubleday, Page and Co., 1922), p. 103.

80. H. B. Drury, *Scientific Management, A History and Criticism* (New York: Columbia Univ. Press, 1918), p. 21.

81. de Fréminville, *Apprentissage*, *op. cit.*, p. 52.

82. H. Ford, *op. cit.*, p. 105.

83. IFRB, report no. 52, *op. cit.*, p. 25.

84. Lipmann, p. 189.

85. Wyatt and Langdon, "The Machine and the Worker: a study of machine-feeding-processes," IHRB, report no. 82, 1938, p. 43.

86. Léon Walther, *Etude Techno-psychologique d'une industrie de produits alimentaires* (Geneva: 1928), p. 192.

Part Two

Chapter II

Rhythm

1. Arnold Durig, in Atzler, *Körper und Arbeit*, *op. cit.*, pp. 527 ff.

2. K. Bücher, *Arbeit und Rhythmus*, *op. cit.*

3. Gustave Glotz, *Le Travail dans la Grèce ancienne* (Paris: 1920, pp. 333-4).

4. Michelet, *Le Peuple* (2d ed.; Paris: 1846), pp. 84-85.

5. G. H. Miles and A. B. B. Eyre, in Myers (B), pp. 102 ff.

6. *Ibid.*

Notes to Pages 151 to 163

7. Cf. above the study of the maximum rhythm and the *one best way*, pp. 157 ff.

8. Miles and Eyre, *op. cit.*, p. 105.

9. C. S. Myers, "The National Institute of Industrial Psychology at London," *Scientific Review of Labor*, June, 1929, p. 272.

10. Miles and Eyre, *op. cit.*, pp. 100-102.

11. Wyatt and Langdon, IHRB, report no. 82, *op. cit.*

12. *Ibid.*, p. 5, diagram 1.

13. *Ibid.*, p. 6.

14. *Ibid.*, p. III.

15. Lipmann, pp. 59 ff.

16. *Ibid.*, pp. 197-198.

17. Durig, *op. cit.*, pp. 502-503.

18. D. W. Harding, "Rhythm in Typewriting," JNIP, V (1931), 434-442.

19. R. S. Brooks, A. B. B. Eyre, E. Farmer and B. Muscio, "An Investigation into the Packing of Cigarettes," JNIP, I (1922), 12-14 and 68-75. Cf. also the favorable results of the rhythmical movement of the rake guided by miners: Farmer, Adams and Stephenson, "An Investigation in a Coal Mine," *ibid.*

20. The recent publications of Léon Walther on natural rhythm and physiologically homogeneous groups, together with the practical applications in a watch-making factory at Soleure (Switzerland), are important forays into a new field. Cf. *Où va le travail humain?*, pp. 218-222, and, in the present book, the Recent Bibliography.

Part Two

Chapter III

Assembly-Line Work

1. Yet it must be noted that, in the new procedure of assembly-line production perfected in the United States, it is often the worker who goes

to the work, passing from one to another part of the shop.

2. Cf. the description of these devices in J. Ermanski, *Theorie und Praxis der Rationalisierung*, transl. from the Russian (Berlin: 1930), and in S. Giedion, *Mechanization takes Command* (London: Oxford University Press, 1948).

3. A. Gemelli and A. Galli, *Rev. Sc. du Travail*, II, 3-4 (1930), *art. cit.*, pp. 324-325.

4. *Ibid.*, p. 327. As to the comparison of work to a compulsory rhythm with work to a free rhythm, cf. also O. Graf, "Untersuchungen über die Wirkung zwanglaufzeitlicher Regelung von Arbeitsvorgängen," *Arbeitsphysiol.*, VII (1933), 358-397.

5. *Ibid.*, p. 335.

6. *Ibid.*, pp. 345-346.

7. *Ibid.*, diagram 8, p. 350.

8. *Ibid.*, p. 351.

9. Wyatt and Langdon, IHRB, report no. 82, *op. cit.*, p. 43.

10. *Ibid.*, p. 40.

11. Hans Rupp, IVth International Conference on Industrial Psychology, *art. cit.*, p. 236.

12. The educational and stimulating role of the whole, if set before the worker's eyes by conveyor-belt work, is likewise stressed by Lipmann, p. 196, and E. Sachsenberg, "Psychologie der Arbeit am Laufenden Band," *Maschinenbau*, IV, 11 (1925).

13. Rupp, *op. cit.*, p. 237.

14. Sachsenberg, *art. cit.*

15. Wyatt and Langdon, *op. cit.*, p. 40.

16. H. Duecker, "Psychologische Untersuchungen über die Arbeit am laufenden Band," *Ind. Psychot.* V, 7 (1929), 214-224.

O. Graf, *art. cit.*

C. Kottgen, "Die allgemeinen Grundlagen der Fließarbeit," *Zentralblatt für Gewerbehygien und unfallverhütung*, Supplement 12 (1928), 1-17.

17. Rupp, *art. cit.*, p. 238.

Notes to Pages 164 to 178

18. Cf. above.

19. Wyatt and Langdon, *op. cit.*, p. 43.

20. Aspects, p. 347.

21. Dubreuil, *Standards*, *op. cit.*, p. 221.

22. Aspects, p. 348 and reference of note 5.

23. *Ibid.*, and reference of note 6.

24. Lahy, pp. 144 ff.

25. Quoted by Lahy, pp. 146-147.

26. Cf. the remarks of the "Reichskuratorium für Wirtschaftlichkeit," in Aspects, p. 347, note: "The magic power of the conveyor attracts workers. The worker's personality disappears. Yet the workers get used to it. This adaptation is not always voluntary, it is often obligatory, because they will lose their livelihood when they can no longer follow the rhythm of the endless iron belt."

27. O. Streine, "Fließarbeit und Arbeiterschutz," *Zentralb. für Gewerbehygien und Unfallverh.*, Supplement 12 (1928), 18-27.

28. Hans Mayer-Daxlanden, "Der Einfluss der Fließarbeit auf die Gesundheit des Arbeiters," *Deutsche Krankenkasse*, XVII (1930), 551-557.

29. Wyatt and Langdon, *op. cit.*, p. 40.

Part Two

Chapter IV

Automation

1. Cf. A. P. Usher, *A History of Mechanical Inventions* (New York: 1929).

2. P. Maurer, *Machines automatiques, mécaniques et électriques* (Paris: 1934), p. 39 [designated below by: Maurer (A)].

3. Androuin, *Le travail des métaux aux machines-outils* (Paris: 1929), p. 356.

4. *Ibid.*, p. 357.

5. On automatic machines, cf. chap. III of Maurer (A).

6. H. Marot, *The Creative Impulse in Industry* (New York: Dutton, 1918), pp. 4-5.

7. Wyatt and Langdon, *op. cit.*

8. M. d'Ocagne, *Le calcul simplifié par les procédés mécaniques et graphiques* (Paris: 1893).

9. Atzler, *Körper und Arbeit*, p. 428.

10. K. Marx, *Capital*, I, chap. XII, Vol. 2, pp. 229-230 (Costes edition).

11. P. Maurer, *Machinisme et automatisme* (Paris: 1927) [designated below by: Maurer (B)].

12. *Ibid.*, pp. 17 ff.

13. *Ibid.*, p. 35.

14. *Ibid.*, p. 36.

15. Let me at least mention here the works of L. Couffignal, *Sur l'analyse mécanique: Application aux machines à calculer et aux calculs de la mécanique céleste* (Paris: 1938), and the statement of this which he made in *L'Homme, la Technique et la Nature* (Paris: 1938), pp. 279-291.

From these influential and original works let us take, for our purposes, the concept of what Couffignal calls "Abstract mechanical analysis," by which is meant the study of the various activities in which man has been or *will be able* to be replaced by the machine, and the search for the laws of this substitution. Ultimately one would thus make possible a preliminary logical determination of the industrial operations capable of being automatized: conditions necessary but not sufficient, since this theoretical determination must be supplemented by a practical judgment on the technical possibilities and economic cost.

16. Hydraulic automation was equally developed in the Orient. *The Treatise on Automata* by Al Tazari (School of Mussulman Painting at Bagdad), now at the Library of Saint Sophia at Constantinople and copied in the middle of the fourteenth century, contains many illustrated examples of this.

Notes to Pages 178 to 195

Cf. Descartes, *Traité de l'Homme*, ed. Adam-Tannery, vol. XI, pp. 120, 130-131. Cf. P. M. Schuhl, *Machinisme et Philosophie* (Paris: 1938), p. 38.

17. Maurer (A), pp. 154 ff.

18. F. Simiand, *Le Salaire, l'Évolution sociale et la monnaie*, *op. cit.*, vol. II, pp. 52, 254, 381, *et passim*.

19. Maurer (A), pp. 51 ff., "Principes d'Automatisation."

20. *Cybernetics, or Control and Communication in the Animal and in the Machine* (New York and Paris: 1948).

21. H. Dalziel Duncan, in *American Journal of Sociology*, May, 1951, pp. 599-601.

22. *L'Année Psychologique*, Vol. II, Section I (1952), 307.

23. New edition of *La Crise du Progrès*.

Part Two Chapter V

Occupational Skill

1. *Philosophy of Manufactures*, 1835.

2. *Op. cit.*, vol. I, bk. I, chap. I.

3. Ure, *op. cit.*, vol. I, chap. I, pp. 19-21. Cf. Marx, *The Poverty of Philosophy*, ed. Giard (Paris: 1922), p. 172.

4. R. F. Hoxie, *Scientific Management and Labor* (New York: Appleton, 1916), p. 16.

5. Brussels, printed by A. Lesigne, 1920, *op. cit.*

6. John P. Frey, *International Molders Journal*, quoted in *Le travail industriel aux États-Unis*, *op. cit.*, p. 230.

7. *Scientific Management and Labor*, *op. cit.*, p. 231.

8. André Philip, *Le problème ouvrier aux États-Unis* (Paris: 1927), p. 224.

9. Discussion by Samuel Gompers,

in "The Effects of Industrial Combinations on Labor Conditions," *The Annals of the American Academy of Political and Social Science*, July, 1912, p. 59.

10. Aspects, p. 357.

11. Dubreuil, *Standards*, pp. 210 ff.

12. H. Ford, *Moving Forward* (Garden City: Doubleday, Doran, 1930), p. 42.

13. *Apprentissage*, p. 51.

14. Setzermann, *Maschinenmarkt*, August 2, 1927; cf. Aspects, p. 344.

15. C. G. Renold, *The Economic Journal*, December, 1928, pp. 599-602; cf. Aspects, p. 344.

16. Cf. Ford, *My Life and Work*, p. 87; also, *Moving Forward*, pp. 179, 184, 192.—Fr.

17. *Apprentissage*, p. 32.

18. R. and H. Lynd, *Middletown*, p. 74.

19. *Ibid.*

20. Julius Hirsch, *Das Amerikanische Wirtschaftswunder* (Berlin: 1926); cf. Aspects, p. 344. These figures are confirmed by Arnold Durig, *op. cit.*, p. 612.

21. Ford, *My Life and Work*, p. 79.

22. F. B. Gilbreth, *Motion Study* (New York: Van Nostrand, 1911).

23. *Le salaire, l'évolution sociale et la monnaie* (Paris: 1932), vol. II, pp. 42, 254, 381, et *passim*.

24. This "unsupported" lathe is fundamentally only a device for grasping and moving conveniently the object on which the worker is engaged; its role may be compared with that of the vise for the fitter.

25. Report published by the Belgian industrial committee for occupational and technical instruction, *Bulletin du Comité central industriel*, Brussels, Nov. 18, 1936.

26. *Ibid.*

27. As for the work of ditch-diggers, cf. the testimony of G. Navel, in his fine book, *Travaux* (Paris: 1945), pp. 163-174: "I admired the

men working with me, their skill in timbering deep trenches. They can reinforce them with planks and shafts so that they do not crumble. The walls were perfectly vertical. . . . In many of their movements a thoughtful skill was evident. . . .

"There is fatigue but the work is neither stupid nor brutalizing. One must work carefully and watch one's movements. The pickaxe can be well manipulated only if one pays attention. Diggers use it with a minimum of effort. Their movements are intelligent and well-regulated. To handle the shovel without excess fatigue or to do an equal amount each day requires skill. When he has to throw earth from a very deep trench every worker prides himself on his shovel cast. By repetition of the same effort is born a rhythm, a bodily cadence which is beneficent. It is no easier to swing your shovel well than to throw a discus."

28. Cf. the statements of C. H. Harrah, reported in *Le travail industriel aux Etats-Unis*, p. 251, and quoted below, p. 000.

29. F. Simiand, *Cours d'Economie politique*, 1928-9 (Paris: 1929), p. 23.

30. *Middletown*, p. 75.

31. *Human Factor*, May, 1932, pp. 183-186.

32. M. Fairchild, "Skill and specialization," *Personnel Journal*, IX (1930), 142.

33. A. Gemelli, "Recherches sur la nature de l'habileté manuelle," *Journal de Psychologie*, 1929, pp. 164-165; and, by the same author, "Diagnostic de l'habileté motrice," *Revue Scientifique du travail*, June, 1929, p. 185.

34. Unpublished paper of M. Grignon, Director of the *Institut de Soudure autogène* (Paris).

35. Pierre Lévy, *La sélection du personnel dans les entreprises de transport*, *Le laboratoire du travail*

du réseau de l'Etat (Paris: 1936), diagram I, p. 20.

36. *Ibid.*, p. 22.

37. Lipmann, p. 189-190.

38. Copley, *F. W. Taylor*, vol. I, p. 189.

39. *F. W. Taylor*, SM, p. 105.

40. *Le travail industriel aux Etats-Unis*, p. 261.

41. N. Wallichs, "Moderne Amerikanische Fabriksorganisation" (Taylor system), *Technik und Wissenschaft*, V, Heft I (1912).

42. H. B. Drury, *Scientific Management: A History and Criticism* (New York: Columbia University Press, 1921), p. 221.

43. Ford, *My Life and Work*, p. 103.

44. Scott and Clothiers, *Personnel Management*, p. 463; cf. Philip, *op. cit.*, p. 225.

45. *Ibid.*

46. A. Durig, "Ermüdung im praktischen Betrieb," in *Körper und Arbeit*, *op. cit.*

Part Two

Chapter VI

Industrial Training and

Occupational Culture

1. Cf. *La Crise du Progrès*, chap. III, "Les utopies artisanales."

2. F. B. Gilbreth, *Motion Study*, *op. cit.*

3. E. Hijmans, "Promotion ouvrière des manoeuvres," lecture given December 13, 1937, to the *Centre polytechnicien d'Etudes économiques* (C. P. E. E.), *Bulletin of the C. P. E. E.*, no. 44 (January, 1938); cf. also the author's paper to the *Centre d'organisation scientifique du travail* (C. O. S. T., Ministry of National Economy, Oct. 1, 1937), published in the *Bulletin of the C. P. E. E.*, no. 41 (October, 1937).

4. Hijmans, *ibid.*

5. *Ibid.*

6. *Ibid.*

7. *Ibid.*

8. Cf. the report on "Le Problème de l'apprentissage dans les professions industrielles et commerciales," presented by Ingrand and Celier to the National Economic Council, *Journal officiel*, April 15, 1938.

9. Legal decree of May 24, 1938, section II.

10. Ingrand and Celier, in the report already mentioned, make the following appropriate remarks as to training courses organized by private industry (*op. cit.*, p. 641): "The fact that production shops are organized primarily for production results in their being frequently poorly adapted to the training of young people, and the pedagogical value of the training given there is often mediocre."

Apprentices run the risk of being employed at tasks immediately useful but with no educational bearing. In small shops the apprentice often runs errands and renders small services to the trained men without learning his trade. Even if he works at his trade, "it is to be feared that he does not have the opportunity to practice all the techniques of his trade."

To sum up, the report concludes, "apprenticeship within the firm may be a necessity in certain trades (for instance, mining) where nothing can be a substitute for direct experience. But this is unsuitable for very young children: it should complete a training already begun elsewhere and, in many firms having neither qualified instructors nor sufficiently complete equipment, such a training can constitute only a clearly inadequate apprenticeship."

11. Paper by M. Goineau, general secretary of the Schneider Works, to the *Semaine de l'apprentissage*, *op. cit.*, pp. 82-83.

12. "Les Ecoles patronales du

Creusot," *L'Université syndicaliste*, October and December, 1933.

13. *La Vie ouvrière*, April 5-29, 1914, p. 398.

14. Discussion of the paper by M. H. Luc at the *Comité National de l'Organisation Française* (CNOF), session of June 15, 1938.

15. Cf. the use of time in the Diderot technical school (Paris), in 1938-39:

DIDEROT SCHOOL—
ENGINEERING SECTION

1938-39 Subjects Taught	Number of hours per week		
	1st year	2nd year	3rd year
Gymnastics	2	1	
French	3	2	2
Ethics	½		
Civics		1	
History- geography	1		
Legislation			1
Arithmetic	1		
Algebra	2	2	1
Geometry	2	2	1
Physics	1½		
Chemistry	1		
Technology		2	3
Mechanics		2	2
Electricity		2	2
Ornamental designing	1		
Descriptive geometry	4	4	6
Industrial designing			
Shop technique		1	1
Shop work	21	23½	21½
Individual study	5½	3	5
Homework	1	1	1
Total	46½	46½	46½

16. This is why the concepts of apprenticeship, in general very interest-

ing, developed by Androuin (cf., for instance, his account of *La formation des apprentis mécaniciens pour l'industrie moderne*, Paris: 1933) have aroused lively criticism among shop instructors in the French schools of technical education.

17. *L'Enseignement technique*, no. 2 (May, 1938), p. 17.

18. *Ibid.*, no. 7 (December, 1938), pp. 61-62.

19. Cf. Viteles, chap. VI, "The nature and distribution of individual differences."

20. Cf. *Report of the VIIth International Congress on Industrial Psychology*, (Barcelona: 1930).

21. Cf. H. Wallon, in *L'Enseignement technique*, no. 9 (February, 1939), pp. 34-35.

22. J. W. Cox, *Manual skill, its organization and development* (Cambridge: 1934); *op. cit.* by D. Weinberg, *Encyclopédie Française*, Vol. VIII, p. 8.48-8.

23. The Principal of the school, who understood the theoretical and practical importance of these problems, at my request circulated among the workers being re-educated in his shops (1938) a questionnaire which I had drawn up as follows: "Name.—Age.—Length of unemployment.—What was your level of general education at the time you entered the school?—Have you a school certificate?—What was your training in your former trade?—Length and place of training.—Was it in a school?—Have elements of your former trade helped you to learn the new one?—What elements?—Have you any elementary knowledge of mathematics?"

The answers given to this questionnaire have supplied me with valuable material for studying the transfer of skill.

24. Cf. National Economic Council, *La main-d'œuvre et le chômage*, I, "La sélection et la rééducation professionnelle des chômeurs," report

presented by Mr. Brissaud (Melun: 1937), pp. 20-21.

25. *Archives du conseil municipal, Conseil général de la Seine*, "Notes sur une visite des Centres de rééducation professionnelle pour les chômeurs à Chateaudun, Beaugency, Châteauroux et Clermont-Ferrand," presented by M. Georges Marrane, general counsellor, January 19, 1937.

26. Quantin, in his report to the *Conseil Supérieur du Travail (Commission permanente)*, justly and regretfully observed in 1936 (p. 73): "the number of skilled workers among the unemployed is not shown in any of the official statistics."

27. Decree of Sept. 26, 1937, made on the initiative of Philippe Serre, Under-Secretary of State for Labor.

28. G. Friedmann, "Apprentissage et main-d'œuvre qualifiée en France: Faits et Problèmes de 1938," *Annales d'Histoire sociale*, January, 1939, pp. 17-27.

29. See the interesting report of Pierre Pouillot, Inspector General of Labor, published by the *Bulletin de l'Association des Maires du Nord et de l'Est*, no. 21 (May, 1938), "La lutte contre le chômage par le reclassement professionnel des chômeurs," pp. 14-25. Cf. p. 22: "Consider that in the department of the Seine alone more than 40,000 laborers are unemployed and registered as such. It is also proper to add to this number very many unemployed who, though registered in a skilled or semi-skilled category, are nevertheless only unskilled. Experience indeed shows that all the qualitative tests of the unemployed to which recourse has been had up to now have merely put back into the category of laborers unemployed men who had neither qualifications nor skill value which would justify their retention in the group in which they had registered."

30. Institut scientifique de recherches économiques et sociales, *En-*

quête sur le chômage, vol. I, *Le chômage en France* (Paris: 1938).

31. *Ibid.*

32. *Ibid.*

33. *Deutscher Volkswirt*, 1st issue of March, 1939; and C. I. E. F., no. 4, March 10, 1939. Cf. also the facts of "struggle against the artisans" in "*Lutte contre l'artisanat*," reported by the *Bulletin de l'Agence internationale d'information* (Paris) in its issue of June 29, 1938, and the speech of Robert Ley, leader of the *Arbeitsfront* (labor front), delivered Nov. 1, 1938, before the Committee for organizing Trade Examinations (summarized in *Le Temps*, Nov. 3, 1938).

34. H. Luc, *Les Problèmes actuels de l'Enseignement technique* (Presses de l'Ecole Estienne, 1939), p. 26.

35. *Ibid.*, p. 27.

36. J. M. Lahy, "L'Apprenti," *Revue Scientifique du Travail*, March, 1929, p. 16.

37. J. M. Lahy, *Ibid.*

38. Emile Durkheim, *L'évolution pédagogique en France* (Paris: 1933).

39. G. Sorel, *Les illusions du progrès* (Paris: 1921), p. 282.

40. Albert Thierry, *Réflexions sur l'Education* (Paris: 1923), pp. 99-100.

41. William Green (President of the A.F.L.), "The Effect on Labor of the New Standardization Programs of American industry," *Annals of the American Academy of Political and Social Science*, May, 1928, pp. 45-46.

42. H. Wallon, *L'Enseignement technique*, no. 9, p. 35.

43. *Journal Officiel*, Supplement, April 15, 1938.

44. Observations made in training centers of the Toulouse region in 1944-45, confirming notes gathered in 1939 during the period of intensive re-armament. At Toulouse the aircraft industries especially prove attractive and sometimes have propaganda ef-

fects on young men undergoing training.

45. P. Pouillot, *op. cit.*, p. 18.

46. *Ibid.*, p. 19.

47. L. Granjon, *Sauver la jeunesse sans métier et sans travail* (Paris: Editions de la Jeunesse, 1937), p. 8.

48. P. Pouillot, *op. cit.*, p. 19.

49. *Enquête sur le chômage*, *op. cit.*, vol. I, pp. 74-75.

50. *Ibid.*, p. 77.

51. "L'enseignement technique et le chômage des jeunes," report presented to the International Congress on Technical Education, Rome, Dec. 28-30, 1936.

52. This phenomenon was evident in Holland in building, in the graphic arts, among male clerical workers, the hotels and cafés, wood and furniture trades, metallurgy and transportation, and all unskilled work.

53. Cf. the article by M. J. Jeudon, President de l'Assemblée des Chambres de Métiers de France, in *L'Enseignement Technique*, Nouvelle Série, No. 1 (1954), 87.

54. Annual reports published, in special issues, by the *Bulletin du Comité National de l'Organisation Française*.

55. Cf. in the review, *Ingénieurs Arts et Métiers* (July, 1950) the report of the engineers' conference at Lyons, and (September, 1950) the editorial, "Humanism for the Engineer." The establishment of a fourth year of study in the *Ecoles d'Ingénieurs d'Arts et Métiers* was partly the result of such considerations, which are also to be found in the educational movement conducted by the *Fédération Nationale des Syndicats d'Ingénieurs et de Cadres Supérieurs* in its *Centre Economique et Social*.

56. *L'Enseignement Technique*, *op. cit.*, p. 25.

57. A diploma awarded at the end of four years of study in a technical college.

58. A preliminary project of this

kind was nevertheless rejected by the standing committee of the Higher Council of Technical Education.

59. A. Buisson, *L'Enseignement Technique*, *op. cit.*, p. 15.

60. *Où va le travail humain?*, Part III, Chap. 4.

61. Cf. *La Lime, Méthode de Formation Professionnelle* (Paris: Ed. Foucher).

62. Since 1949, the F.P.A. has become the responsibility of the *Association Nationale Inter-professionnelle pour la Formation Rationnelle de la Main d'Oeuvre*. The change in title was decided upon by the F.P.A., as F. Simon explains, "because of the fears which had been aroused by the former title. It was hoped to show in this way that the F.P.A. does not aim, as has been wrongly suggested, at a rapid and mass-production training of semi-skilled workers who would never become fully skilled." (*Notre Formation* [review of the F.P.A.], no. 1, 1951, p. 4.)

63. 13, rue Paul Chautard, Paris.

64. 14, rue Dareau, Paris.

65. This estimate is taken from an article by Paul Bacon, then Minister of Labor, *Revue Française du Travail*, May-June 1951, p. 280. Cf. also the estimate by E. Rossignol, Technical Director of the F.P.A., in his articles in *Formation*, June and December, 1953.

Part Three

Chapter I

The Worker and Rationalization

1. On workers' reactions to Taylorism, cf. Part I, chap. I, pp. 41-43.

2. Quoted by Jules Moch, *Socialisme et rationalisation* (Brussels: 1927), p. 67.

3. Belgian report, *op. cit.*, vol. I, pp. 237 ff. and esp. p. 241.

4. *Human Factor*, IV (April, 1933), 139-150, "The mechanization of the Miner," by J. H. Mitchell.

5. *Human Factor*, October, 1932, "Working conditions and Morale," by T. H. Hargrave.

6. *Human Factor*, July, 1932, pp. 253-260, observations of W. F. Watson.

7. Cf. O. Lipmann, "The German industrial inquiry: Some findings with reference to the psychology of labor" (Paper at the IXth Psychological Congress, New Haven, 1929), *Personnel Journal*, IX, pp. 86-91.

8. *Ibid.*

9. Cf. Merrheim's account, *La Vie ouvrière*, April 5-20, 1914, pp. 391 ff.

10. This refers to an article appearing in *l'Auto* of February 1st and 2d, 1913, which caused a sensation in working-class circles. Charles Faroux made use in this article of a newspaper account of Taylorism by the American author, John Foster Fraser. In it Taylorism was accused of causing speedy and complete physical and moral exhaustion of the worker.

11. *La Vie ouvrière*, Feb. 20, 1913, p. 224.

12. *Ibid.*, March 5, 1913, p. 308.

13. *Ibid.*, pp. 308-309.

14. Cf. Ed. Dolléans, *Histoire du mouvement ouvrier* (Paris: 1939), vol. II, pp. 119 ff.

15. E. Pouget, *L'organisation du surmenage, le système Taylor* (Paris: 1914), p. 60.

16. *La Vie ouvrière*, April 5, 1913, pp. 407-409.

17. *Ibid.*, April 5-20, 1914, p. 306.

18. *Ibid.*

19. This ideology is evident, for example, in the little book already quoted by J. Moch, *Socialisme et rationalisation*, Preface by Léon Blum, on which this paragraph is based.

According to Moch, American prosperity was to be a long-lived phenomenon, the period of the saturation of the market being "infinitely distant"

(p. 111), and crises of overproduction and slump were not to be feared for a very long time. At no point in this study does Moch distinguish clearly between the use of machinery in the framework of capitalism and of socialism.

20. Lipmann, p. 272.

21. J. Moch, *op. cit.*, pp. 80 ff.

22. CNOF, Commission on the relations of man to his work, discussions of Feb. 25 and March 28, 1938.

23. *Ibid.*, session of March 28, 1938.

24. Lenin, *Pravda*, April, 1918; cf. G. Friedmann, *Problèmes du machinisme en U. R. S. S. et dans les pays capitalistes*, *op. cit.*, pp. 53-54.

25. At the Workers' University of Paris where, after our discussions about rationalization, members of the audience, mostly metal workers, discussed among themselves problems raised during the preceding course.

26. *L'Humanité*, Oct. 2, 1937 and Nov. 14, 1937.

27. Cf. *Bulletin du Comité national belge pour l'organisation scientifique*, Brussels, 6th year (April 15, 1932): Edmond Landauer, "Les principes de la méthode Bedaux." Cf. also *Unity, The Journal of the National Industrial Alliance*, Bedaux Number, May, 1932: "The Bedaux System" by C. H. Northcote, and a defense of the Bedaux System in *Welfare*, May, 1931: "The Bedaux System of Human Labor Measurement."

28. As to these reactions, cf. the references given in *La Crise du Progrès*, chap. II, "Apogée de la rationalisation," note 7. Cf. also, G. Haupt, *Das Rätsel der Bedaux-Wissenschaft* (Verband der Fabrikarbeiter Deutschlands, 1931), and, as to the Goodrich strike, *La Vie ouvrière*, Dec. 23, 1937.

29. Copley, *op. cit.*, vol. I, p. 189.

30. On the importance of the human environment of repetitive work,

cf. the study already quoted of Wyatt and Langdon, IHRB, report no. 82. They analyzed the tastes and complaints of workers occupied in the uniform labor of feeding machines. The most desired condition of work is to have agreeable companions (cf. the tables on pp. 33 and 34, especially table XVII).

31. Preller, quoted by Lipmann, p. 194, mentions as an example of this psychological type of worker, and of this resistance, the workers in a lighting accessories factory, who were hostile to all change and preferred the uniform work which they had been doing up to that time to training in new tasks.

32. Cf. the article by H. Wunderlich, already quoted, on uniform tasks.

33. H. Mayer-Daxlanden, *art. cit.*

34. Stuart Chase, *Man and machine*, quoted by Lipmann, p. 203.

35. Reichsgesundheitsamt, *Denkschrift über die gesundheitsverhältnisse im Jahre 1927*.

36. H. Mayer-Daxlanden, *art. cit.* An important inquiry by Russell Fraser conducted on a sample of 3,000 men and women workers of thirteen construction engineering factories, concluded that characteristic neuroses existed in 10% of the workers (9.1% of men, 13% of women) and less serious disorders in 20% of them (*The Incidence of Neurosis among Factory Workers*, IHRB, report no. 90, London: 1947).

37. V. Eliasberg, "Der Arzt und das Wirtschaftsleben," *Psychologie und Medizin*, III (1928), pp. 198-220.

38. Cf. the documents and observations used by Lipmann, p. 167.

39. Cf. Miles and Eyre, JNIP, II, 8, pp. 352-358, notes on the personnel of a works manufacturing and repairing gas cookers.

40. This was, for instance, F. W. Taylor's reaction as soon as he was made foreman in the mechanical con-

struction shop of the Midvale Steel Co.; the beginning of the struggle which he undertook against his former working comrades who had become his subordinates and in which, after three years, he triumphed. (Cf. Taylor, PSM, and *La Crise du Progrès*, chap. II, "La meilleure et la seule.")

41. Notes I made at Tours in June, 1933, at the Repair Shops (Material and Traction) of the S. N. C. F. The measures used by the management of these shops are not at all peculiar to the kinds of work performed there, but, once adapted, would be valid for the time-study offices and shops of a mass-production firm.

42. Cf. Geiger and Leipart, *op. cit.*

43. Cf. Taylor, PSM, and Copley, vol. II, pp. 407-410, 420, 421.

44. Max Weber, *Gesammelte Aufsätze zur Soziologie und Sozialpolitik* (Tübingen: J. C. B. Mohr, 1924), "Zur Psychophysik der Industriellen Arbeit," pp. 61-255. The same volume (pp. 1-60) contains another study devoted to the problems of large-scale industry: "Über Auslese und Anpassung (Berufswahlen und Berufsschicksal) der Arbeiterschaft der geschlossenen Grossindustrie."

45. *Ibid.*, p. 155.

46. *Ibid.*, p. 157.

47. Cf. Max Weber's remarks (*ibid.*, p. 160) on occupational conscience and output of socialist and militant union members: in the opinion even of the employers in Rhenish and Westphalian metal industries, well known for their hostility to the unions, the militant workers are among those who have the highest productivity.

48, 49. S. B. Mathewson, *Restriction of Output Among Unorganized Workers* (New York: Viking Press, 1931).

50. *Ibid.*, p. 146.

51. Preller, "Rationalisierung und Arbeitslosigkeit," in *Die 40-Stunden-Woche*, ed. by Th. Leipart for the German Confederation of Labor

Berlin: 1931), pp. 82-115 and esp. p. 85.

52. Taylor, PSM, p. 59.

53. Cf. Copley, vol. I, p. 327, and Taylor, SM, p. 137: "What [Taylor] demands of the worker is not to produce any longer *by his own initiative*, but to execute punctually *orders given him*, in their smallest details."

54. Arnold Durig, in *Körper und Arbeit*, ed. by Edgar Atzler, *op. cit.*, p. 520.

55. Lipmann, p. 398.

56. *Ibid.*, p. 405.

57. *Ibid.*, pp. 232 ff. and 407.

58. S. Wyatt, "Industrielle Psychologie in England," in Fritz Giese, ed., *Handbuch der Arbeitswissenschaft*, vol. I, p. 1603.

59. E. Farmer and R. S. Brooks, "Motion study and metal polishing," IFRB, report no. 15, 1921.

60. Reports of the International Institute for Rationalization, December, 1929, quoted by Lipmann, p. 277.

61. E. Sachsenberg, "Bestgestaltung der Fabrikarbeit," *VDI periodical*, no. 35 (1929).

62. Robert B. Wolf, "Making men like their job," in *System: Magazine of Business*, January-February, 1919; Cf. Lipmann, p. 278.

63. Ms. of lectures delivered by Taylor at Harvard; cf. Copley, vol. I, pp. 321-322.

Part Three

Chapter II

Human Relations

1. Cf. above, part I, chap. I, the criticism of Taylorism by the social sciences.

2. Cf. *La Crise du Progrès*, chap. II., "Aspect psychologique."

3. PSM, p. 81.

4. Copley, *op. cit.*, vol. I, pp. 321-322.

5. *Bulletin of the Taylor Society*,

June 1926, pp. 102 ff.

6. *Ibid.*

7. Cf. Aspects, p. 381.

8. Cf. the conclusions of Mathewson, *op. cit.*, p. 146: "Scientific management has failed to develop that spirit of confidence between the parties to labor contracts which has been so potent in developing good will between the parties to a sales contract."

9. In the publications of this Association, especially in the *Personnel Series*, many indications are to be found of this evolution of Scientific Management in the United States. Cf., especially, *Personnel Series*, no. 43 ("Values of psychology in Industrial Management") and No. 45 ("New responsibilities of the personnel executive").

10. In the American Management Association's *Personnel Series*, no. 45, p. 4, cf. the lively article of J. Walter Dietz (chief of the personnel department of the powerful Western Electric Co.), who sketches in broad outline the development of "industrial relations" in the United States from 1910 to 1940.

11. The expression *personnel relations* which emphasizes the psychological and individual side of the problem tends in the United States to gain on that of *industrial relations*, which on the contrary predominates in Europe.

12. Aspects, pp. 375-376.

13. Of these publications I mention especially: International Industrial Relations Association, Hague, *Report of first triennial congress held at Cambridge (England), July, 1928, on the subject of fundamental relationships between all sections of the industrial community*.

Concerning the Congress of this Association (I. I. R. A.), held from June 26 to July 3, 1929, in Upper Bavaria and devoted to "Human relations in a rationally organized in-

dustry," cf. *Informations sociales* (I. L. O.), July 15, 1929, pp. 84-85.

14. Works of the Human factor Commission of the CNOF, session of March 28, 1938.

15. Aspects, pp. 393-394. The I. L. O. document is here based on a contribution of H. Dubreuil at the Congress of the I. I. R. A. of 1929.

In 1940 J. W. Dietz, for his part, defined the aim and ambitions of "human relations" as follows: "the *Challenge of the '40's* is this new human emphasis. Science and technology are interested in *things*. Management—American Management—must be concerned first, about *men—people!* When that conviction is translated into action and deeds, the American capitalistic system will have gained the *confidence* of the worker, the customer, the investor, the public—individually and collectively—and reformers will not shake that confidence." *Art. cit.*, p. 8.

17. PSM, p. 104—Fr.; SM, p. 59-61—Fr.

18. Cf. *My Life and Work*.

19. J. D. Houser, *What the Employer Thinks* (Cambridge: Harvard Univ. Press, 1927), p. 107.

20. A. W. Kornhauser and A. A. Sharp, "Employees' Attitudes," *Personnel Journal*, 1932, pp. 393-394.

21. Houser, *op. cit.*, p. 178.

22. Cf., e.g., the creation, program and functioning of courses of this sort in a Pennsylvania plant, *Personnel Series*, no. 43, article by B. V. Moore; in France and Switzerland the supervisor courses organized by the Swiss psychologist A. Cariard (cf. his brochure, *Le chef, sa formation et sa tâche*, 2d ed.; Neufchâtel-Paris: 1938). The School for Scientific Management (*Ecole d'organisation scientifique du travail*, Paris) has long included lectures in its syllabus on "the social and psychological training of supervisors and foremen" and "the foreman's psychology."

23. Aspects, p. 385.

24. Among the many works published in the United States which deal with this transformation of the business chief and the nature of the new leader, cf. *The Psychological Foundations of Management*, ed. by H. Metcalf (Chicago: 1927), especially Bingham's article and that by Follett in which stress is laid on the power of *integrating* persons and conflicts which is to be possessed by the "new leader"; D. Craig and R. Charters, *Personnel Leadership in Industry* (New York: McGraw-Hill, 1925); *Scientific Foundations of Business Administration*, ed. by H. Metcalf (Baltimore: Williams & Wilkins Co., 1926); C. I. Barnard, *The Functions of the Executive* (Cambridge: Harvard Univ. Press, 1938); *Business and Modern Society*, ed. by M. P. McNair and H. J. Lewis (Cambridge: Harvard Univ. Press, 1938).

25. J. D. Mooney and A. C. Beily, *Onward industry* (New York: Harper, 1931).

26. W. V. Bingham, "Leadership," in *Psychological Foundations of Management*, *op. cit.*, p. 26.

27. Carrard, *op. cit.*, pp. 57-67.

28. *Personnel Series*, no. 45, p. 13.

29. *Ibid.*, p. 14.

30. In a more general sense Americans often understand by "morale" the network of psychological relations within the firm.

Par: Three

Chapter III

Some Experiments in Human Relations

1. I have especially consulted: Elton Mayo, "The human effect of mechanization," in *Papers and Proceedings of the 42d Annual Meeting of the American Economic Association*.

tion, Vol. XX, no. 1 (March, 1930), 156-176 (indicated, among the notes on this chapter, by A); by the same author, *Human Problems of an Industrial Civilization* (New York: 1933), Chaps. II, IV, V (indicated by B); G. A. Pennock, "Industrial Research at Hawthorne," *Personnel Journal*, 8 (1930), 296-313; M. L. Putnam, "Improving Employee Relations," *ibid.*, pp. 314-325.

T. N. Whitehead in his two-volume work, *The Industrial Worker*, has made a detailed statistical analysis of the experiments made in the "test room." For the more recent publications, see the Recent Bibliography at the end of this chapter.

The complete report of the investigation, prepared by two of those who participated in it, F. J. Roethlisberger (of Harvard) and W. G. Dickson (of Western Electric), was published by the Harvard University Press in 1939 under the title of *Management and the Worker* (designated by MW).

Elton Mayo, of Harvard, who directed the scientific part of the work, gave an account of it at conferences organized at Royaumont (France), in June, 1939, by the CNOF. I thus had the opportunity to speak with him and on certain points have profited by the information which he furnished in the course of the discussion.

Certain aspects of the inquiry were reconsidered by Mayo in his *The Social Problems of an Industrial Civilization* (Cambridge: Harvard Univ. Press, 1945).

In 1948 I visited the Hawthorne Plant several times and was able to study the counselling program in the factory. (Cf. *Où va le travail humain?*, new edition, 1954, p. 142 ff., and Appendix III).

2. The chief members of the team representing the Western Electric Company were G. A. Pennock, M. L. Putnam, H. A. Wright and W. G. Dickson.

On the scientific side, the Industrial Research Department of Harvard University (directed by E. Mayo and his collaborator F. T. Roethlisberger) supplied the chief contingent of leaders in the investigation. W. L. Warner, professor of social anthropology at Harvard at the time, and now at the University of Chicago, also took an active part in the work.

3. This has been mentioned above. Cf. "Some results of the physiology of labor," pp. 000 ff.

4. A, pp. 166 ff., and MW, pp. 118 ff.

5. "Period XII," which lasted twelve weeks and was one of the chief turning points of the investigation. Cf. B, pp. 64 ff.

6. Putnam, *art. cit.*, p. 315.

7. Pennock, *art. cit.*, p. 309.

8. Worker no. 5. Cf. A, diagram 10, p. 171 and B, pp. 102-107. Other cases showing the connection between production, morale at the works and private life were discovered and followed up. Cf. MW, chap. VII.

9. Such was the "Mica-room" experiment, so called because it has to do with a group of five women workers employed in splitting mica plates and then gauging the thin plates in automatic machines. The experiment lasted from August, 1927, to August, 1930, and on the whole confirmed the results of the test room. Cf. B, pp. 79-82 and MW, pp. 134-160.

It should be noted here that a series of experiments with another group of five women workers employed at the same work as those in the test room, was conducted from August, 1928 to March, 1939, to study the share of financial stimuli in the improvement of output: these experiments showed (similar to that of the mica room) that they played no exclusive or even preponderant role in the totality of causes which had increased production. Cf. "The Second Relay Assembly Group," MW, pp.

129-134 and 158-160.

10. B., p. 87. For details, see MW, chap. IX.

11. Cf., e.g., the texts of interviews cited in MW, pp. 194-199.

12. The scientific directors of the investigation were trying to abstract from the works of Pierre Janet and of the psychoanalytic school, ideas which might be transferred to the field of practical problems set by the development of their program of interviews. Cf. B, pp. 109 ff. and 131.

13. B., p. 91.

14. Cf. B., p. 93, MW, p. 247 and Putnam, *art. cit.*

15. Putnam, *art. cit.*, p. 325.

16. B., p. 101.

17. *Ibid.*, p. 116.

18. MW, chap. XVII, pp. 379-408.

19. B., p. 119.

20. *Ibid.*

21. B, p. 120.

22. MW, p. 552.

23. *Ibid.*, p. 580.

24. *Ibid.*, pp. 567-568.

25. MW, p. 577. In his contributions at the Royaumont meetings, Dr. Mayo dwelt on the role of "Personnel Counsellors." These employees of Western Electric, specialists in industrial relations, have definite functions depending on the recommendations of the psychologists. They are not part of the personnel hierarchy of the company. Distributed among the shops and constantly moving about them, they form a sort of psychological buffer between management and the personnel, charged with spreading understanding down to the lowest level. Their constant action makes it possible to protect the unitary "social structure" of the firm against the "disorganization" which a crudely conducted rationalization would provoke. But undoubtedly it helps also to protect it against the penetration of "outside unionism" and contributes to maintain a "tame" union. Cf. J. L. and H. L. Wilensky, "Personnel Coun-

seling: the Hawthorne Case," *American Journal of Sociology*, November, 1951, pp. 274-277.

26. MW, pp. 574-575.

27. Cf. above, p. 306 f.; and B, pp. 64 ff., MW, pp. 69-73.

28. Similar findings had been made by Kornhauser and Sharp in an investigation previously quoted.

29. Pennock, *art. cit.*, p. 304.

30. MW, chap. VI.

31. MW, p. 160.

32. This refers especially to the study of the worker group assembled in the "Bank Wiring Observation Room," which I shall indicate by BWOR; cf. MW, part IV, pp. 379-548.

The anthropological aspect of the Hawthorne industrial inquiry should, it seems, in part be laid to the credit of W. Lloyd Warner, then professor of social anthropology at Harvard (Cf. MW, p. 389, n. 1). Warner has elsewhere applied the methods of social anthropology to contemporary American society in his studies of the small town of Newburyport, Massachusetts, to which Mayo refers (B, pp. 138-142), and since known as the "Yankee City Series" (Yale University Press).

33. The investigators themselves in a bibliographical note (MW, p. 272), indicated the chief works to which they were indebted: in the field of the social sciences the names are to be noted of Durkheim, Lévy-Bruhl, Malinowski, Radcliffe-Brown, Pitt-Rivers, and Pareto. Elton Mayo, moreover, gives great prominence to the work of Halbwachs and less importance to that of R. H. Tawney (B, chap. VI and VII).

34. B. pp. 120-121, 164-167, 180-181.

35. MW, pp. 547-548.

36. MW, pp. 562-565.

37. MW, pp. 557, 564.

38. MW, p. 540.

39. MW, pp. 540-541.

40. *Ibid.*
41. MW, chap. XI and especially diagram 24, p. 247.
42. MW, p. 510, note.
43. MW, p. 419 and the conclusions, pp. 445-447.
44. MW, p. 522.
45. Bank wiring observation room.
46. B, p. 106.
47. B, p. 145.
48. That is to say, before the German occupation of Czechoslovakia. As to the organization of the Bat'a firms, cf. *Bulletin de l'I. I. O. S. T.*, February and March, 1930, and Dubreuil, *L'exemple de Bat'a* (Paris: Grasset, 1936). This latter work is not, properly speaking, an objective inquiry, for the author shows towards the Bat'a organization (as recently in his books on American rationalization) an optimism and sometimes a lyricism which events have later proved mistaken. But it has good documentary data.
49. Dubreuil, *op. cit.*, pp. 100 ff.
50. Cf. the joint work by Lt. Col. Rimailho and H. Dubreuil, *Deux hommes parlent du travail* (Paris: 1939), in which the solutions of Scientific Management adopted by the Bat'a firms are commented upon and generalized.
51. Belgian report, *Le travail industriel aux Etats-Unis*, *op. cit.*, vol. I, pp. 230 ff.
52. Dubreuil, *op. cit.*, p. 175.
53. For more details, cf. *ibid.*, pp. 318 ff.
54. *Ibid.*, p. 202.
55. *Ibid.*
56. *Ibid.*, pp. 242-243.
57. *Cours de philosophie positive*, 58th lesson. Cf. *ibid.*, p. 212.
58. Dubreuil remarks (*op. cit.*, pp. 311-312), apropos of the Zlin Labor Festival: "A highly significant spectacle. Political ideals are abstract formulae with no direct connection with the life of industry, and the Social Democrat who preserves his

theoretical faith in the ideas of his groups sees no contradiction between the badge he wears and his place in the labor parade. One thing has priority for him: the success of the footwear industry from which he derives his daily bread. This success assured and fortified, he has no hesitation in paying his ritual salute to the idea for which he feels a measure of devotion."

59. "Une expérience de collaboration ouvrière à la Direction d'une usine," by Gérard Bardet, in J. Coutrot, *L'Humanisme économique*, publications of the Centre Polytechnique d'études économiques, document no. 4, 1936, p. 33.

60. *Ibid.*, pp. 33-34.

61. *Ibid.*, p. 35.

62. *Ibid.*, p. 38.

63. The hiring committee, in respect of a particular trade—for instance, for hiring a turner—includes: the works manager, a charge hand, a delegate of the turners, and a skilled turner chosen for his occupational value.

64. Howard Scott and others, *Introduction to Technocracy* (New York: John Day Co., 1933).

65. On the P.W. movement consult: E. Schueller, *La Révolution de l'Economie* (Paris: 1941); the same abridged and illustrated. Cf. also the monthly review *La Nouvelle France économique*; Mr. Schueller's paper at the session of Nov. 6, 1942, CNOF, and the many publications of the autonomous professional federation *Bureau d'études pour l'application du salaire proportionnel*; especially, *L'Application du salaire proportionnel ou salaire proportionnel SP*, Practical guide by André Boyer.

66. Abridged ed., p. 17.

67. R. Algon, *Mission ou démission patronale* (Bureau of Studies of the P. W.)

68. Cf. paper to CNOF, pp. 6 ff.

69. *La Nouvelle France économi-*

que, no. 21, p. 2.

70. Statement to the workers and employees (Bureau d'études pour l'application du S.P., p. 16).

71. Practical guide, *op. cit.*, p. 50.

72. *Ibid.*, p. 51.

73. R. Algon, *op. cit.*, pp. 30-31.

74. Practical guide, *op. cit.*, p. 51.

75. On Sept. 1, 1943, the P.W. movement announced the following results: 353 businesses, employing nearly 32,000 workers and representing a turnover of 4,75 billion francs, were applying the system and declaring themselves satisfied with it.

76. "We must produce and distribute more. A little more food must be created, twice or three times as much clothing, some millions of houses built and some millions of automobiles. Then we shall be in a world in which there will be no more poor, where everyone will feel himself a petty bourgeois of today and will value his life and his property and work to preserve and increase them." (Paper of M. Schueller at CNOF, Nov. 6, 1942, p. 16).

77. Since the liberation of France and in an atmosphere made more favorable by the new legislation of the Factory Committees, efforts to *integrate* the worker in the firm have multiplied. Beginnings made before 1939 have been confirmed and developed. These experiments have been conducted both by the "Young Employers" (Jeunes Patrons) movement and the nationalized firms, confiscated plants or specifically worker communities.

They have excited such interest that the national press has given space to them, as is shown, for example, by Hamelet's inquiry, under the significant heading: "Towards the end of the wage system?" (*Figaro*, April 23 to 26, 1946). It makes no secret of the difficulties which some experiments by industrialists, bold in conception, have encountered (for ex-

ample, the Ruinet Works, at Dijon): "Yet something is lacking in these very intelligent experiments of the young employers: the total loyalty of the workers whom they are trying to associate with their own efforts."

On the other hand, *integration* is achieved in those experiments in which the worker shares fully in the management and in which he is sure to know why and for whom he is increasing his output (Iron and Steel Works of Lyon, The Boimondau Community of Work at Valence). Hamelet for his part notes this: "The working-class outlook which still retards the machine even in such advanced firms as those in the 'Young Employers' Group here becomes a force. The worker at his machine is still class-conscious."

78. For the present brief account of this experiment I have used the information assembled in the excellent pamphlet published by the "Action Populaire," *La Réforme de l'Entreprise* (Paris: Ed. Spes, 1953).

79. H. Migeon, "Une Communauté de travail, la Télémécanique électrique," in *Travail et Méthodes*, June, 1949, and *L'Economie*, supplement to no. 345 (April 10, 1952).

[Frederick Harbison and Eugene Burgess have a brief discussion of the importance of this company in setting a new pattern of progressive management for western Europe. Cf. their "Management in Western Europe," *American Journal of Sociology* July, 1954.—HLS.]

80. H. Migeon "L'Expérience de la Télémécanique électrique," *Cahiers du C. I. E. P. I.* (Tourcoing: 1952), p. 11.

81. On Boimondau, see: *Boimondau, 10 années d'expérience communautaire* (Valence: 1951), and the excellent study by Pierre Drouin, *Cellules d'un monde nouveau*, published in *Le Monde* and reprinted as a pamphlet by the publishers of Com-

munauté (Paris: 1952). On the "communautés de travail" and their problems, see the review *Communauté*, journal of the *Entente Communautaire*, 4 rue Cochin, Paris, and especially the issues nos. 1-2 of 1954, and also the book by G. Riby and R. Roquette, *Les Communautés de travail* (Paris: 1949).

82. Farewell speech of Marcel Mermoz, June 28, 1951, *Communauté*, nos. 6-7-8, 1951.

83. I have made use, for the present account, of the review written under my supervision by J. D. Reynaud, in *Année Sociologique*, 3ème série (Paris: Presses Universitaires, 1953), 453-462.

84. Elliot Jaques, *The Changing Culture of a Factory* (London: Tavistock Publications, 1951). In addition, a whole series of studies concerning this experiment has appeared in the review *Human Relations* (London and Ann Arbor: vols. III, IV, V, and VI, 1950-53) under the names of E. Jaques, J. M. Jackson, J. M. M. Hill, A. K. Rice, E. L. Trist.

85. E. Jaques, "Interpretative Group Discussion as a Method of Facilitating Social Change," *Human Relations*, I, 4 (1948).

86. A. Heron, *Why Men Work* (Stanford, California: Stanford University Press, 1948), p. 85.

Part Three

Chapter IV

Three Aspects, a Single Reality

1. Cf. the collection of *Informations sociales*, published by the I. L. O. and, in France, the documents collected by H. Dubreuil in *Employeurs et salariés en France* (Paris: 1934).

2. The physiology of labor (Cf. Durig, *Körper und Arbeit*, op. cit., p. 520) explains this phenomenon: the worker who does his work un-

willingly has to perform by cerebration and with a nervous expenditure of will what he would do by medullary and automatic action if he were not withdrawn and rebellious.

3. Theodore Geiger, "Zur Soziologie der Industriearbeit und des Betriebes," in *Arbeit*, 6th year (December, 1929), 778.

4. The labor turnover is measured in this case by the number (in percent) of workers remaining in the same firm less than a year.

5. W. Muller, *Soziale und technische Wirtschaftsführung in Amerika* (Berlin: 1926), p. 60, quoted by Lipmann, p. 267.

6. *Aus dem Tagebuch eines Betriebes* (Berlin: 1925), quoted in *Arbeit*, 3rd year (1926), 538.

7. Cf. the documents and reports on American railways quoted by Lipmann, p. 272.

8. Heinz Landmann, "Bestgestaltung der Fabrikarbeit," in *Arbeitgeber*, April, 1931, pp. 160-161.

9. E. D. Smith, *Psychologie für Vorgesetzte* (Stuttgart-Berlin-Leipzig: 1931).

10. Lipmann, pp. 270-271.

11. F. Giese, "Methoden der Wirtschaftspsychologie," in *Handbuch der biologischen Arbeitsmethoden*, ed. by Abderhalden, section VI, 1927, pp. 265 ff.

12. E. Schueller, *La Nouvelle France Economique*, no. 21, art. cit., p. 2.

13. On Taylor and soldiering, cf. *La Crise du Progrès*, chap. II, "La guerre à la flânerie"; on Max Weber and "slowdown," cf. above, pp. 281 ff.

14. Cf. above, pp. 278-84.

15. Ford, *My Life and Work*.

16. Cf. above, p. 196.

17. W. D. Scott, *Increasing Human Efficiency in Business* (New York: Macmillan, 1914), and E. Lysinski, *Psychologie des Betriebes* (Berlin: 1923) have dwelt on the usefulness

of example and self-respect in raising output. Moreover, the important part played by "socialist emulation" in the U. S. S. R. in the period of the five-year plans is well known.

18. Max Weber, *op. cit.*, p. 160.

19. Cf. the Bardet experiment, mentioned above, p. 330.

20. Among the elements conditioning this attitude, Lipmann mentions (pp. 379 ff.): the worker's social security within the firm; his chances for promotion; notice before dismissal; a system of retirement and other pensions; housing conditions; amusement; education for himself and his children; relations with supervisors; the possibility of sharing in determining working conditions, etc.

21. The factors here involved are, among others (Lipmann, pp. 380-383); the worker's opinion of the risk of unemployment in his particular trade; his attitude towards the union veto as to exceeding, in the interest of comrades doing piecework, a certain ceiling of output; and the consideration (in terms of collective representations) which society on the one hand, and the firm on the other, grant to his job.

22. Viteles, p. 563.

23. Lipmann, p. 274.

24. Observations made in the M. F. A. rusk works, Paris-Batignolles.

25. Wyatt, "Boredom in industry," *art. cit.*, pp. 170-171.

26. Studies such as those of Regnet show that many workers, especially if young, are resigned to not finding in their work the satisfactions of their deepest tendencies afforded by autonomous labor. Cf. Rudolf Regnet, "Das Arbeiterlebnis des jugendlichen Werk-tätigen in der industriellen Grosstadt," *Zeitschrift für angewandte Psychologie*, vol. 29, no. 4 (1931), 326-393. Cf. also de Man's study, *Joy in Work*, which comes to the conclusion that feelings of joy in work are rare except

among highly skilled workers performing responsible tasks.

27. Levenstein's study of 5,000 miners, metal-workers and textile workers in Germany, shows only from 7 to 17% of cases of joy in work (Cf. D. Weinberg, *Encyclopédie française*, vol. VIII, p. 8.48-12).

28. Cf. *Où va le travail humain?*, pp. 348-356, on the role of hobbies in our industrial civilization.

Part Three

Chapter V

The Value and the Limits of Human Relations

1. Taylor, SM, p. 137—Fr. The italics are Taylor's.

2. *La Crise du Progrès*, chap. II, "La guerre à la flânerie."

3. Taylor, PSM, p. 72.

4. Cf. M. P. Follett, "Psychology of Control," in *The Psychological Foundations of Management*, ed. by H. C. Metcalf (Chicago: A. W. Shaw & Co., 1927). As for the Gestalt point of view in human relations and the reasons for its practical setback, cf. Viteles, pp. 621-626. The Research Center for Group Dynamics (University of Michigan, Ann Arbor) and the Tavistock Institute of Human Relations more recently have attempted, in a much more subtle and valid conceptual framework, to utilize a Gestalt approach, through Kurt Lewin's influence.

5. M. P. Follett, *op. cit.*, pp. 177.

6. Geiger, *op. cit.*, p. 776.

7. Lipmann, p. 271.

8. Heron, *Why Men Work* (Stanford, California: Stanford University Press, 1948), p. 85.

Conclusions

1. R. and H. Lynd, *Middletown*, p. 75.

2. Among these coincidences between the points of view B and C, let me here recall measures tending to improve the working environment (light, smoke, air, noise, etc.), the adaptation of machines to the operator, and which results in a higher quantity or quality of work, sometimes both. Here technology offers a "stretch of road in common" to the management's interest and that of the human factor. Cf. Lipmann, pp. 403-404.

3. Lipmann, p. 395.

4. *Ibid.*

5. *La Crise du Progrès*, chap. II, "Le mythe de l'après-guerre."

6. Cf. "Nécessité de la rationalisation," *Bulletin de l'Institut International de l'organisation scientifique du travail*, October, 1933. Albert Thomas, though originally a Socialist, declares to the same effect: "In spite of the hard times I think I may say that all, owners and workers, who are collaborating in the international organization of work, are still convinced that if rationalization seems inadequate and defective, it must be corrected by more rationalization." (*Ibid.*, p. 148, note 1).

7. C. S. Myers' introduction to the compilation, *Industrial psychology* (London: 1929). Myers (B), pp. 7-15, well illustrates this state of mind of the English industrial psychologists.

8. "The human effect of mechanization," Mayo (A), p. 176. It is proper to note here that by "social studies" Mayo understands such attempts as that of the Western Electric Co., in

the Hawthorne Works, and not the really sociological study of industrial problems.

9. Wyatt, "Boredom in industry," *art. cit.*, p. 170.

10. *La Crise du Progrès*, chap. II; cf. the comments on Taylor, Ford, and their disciples.

11. Cf. above, "Notes on the evolution of some industrial trades," pp. 202 ff.

12. Mayo (B), p. 95.

13. Aspects, pp. 353 ff.

14. Lipmann, "La part de l'homme dans la production," Paper delivered to the IVth International conference of industrial psychology, 1927, *op. cit.*

15. Cf. Lipmann, pp. 400, 406, 409; and G. Friedmann, in *Encyclopédie française*, vol. VIII, pp. 8.50-1 ff.

16. Cf. Henri Wallon, in *L'Enseignement technique*, no. 9, p. 35.

17. Report of the Belgian mission of investigation on *Le Travail industriel aux Etats-Unis*, p. 236.

18. Aristotle, *Politics*, I, 4.

19. *La Crise du Progrès*, chap. III.

20. H. S. Person, "Man and the Machine: the Engineer's Point of View," *Annals of the American Academy of Political and Social Science*, no. 149 (1930), p. 88.

21. Maurice Barret, in *L'Homme, la Technique et la Nature*, pp. 166-167.

22. As shown by Lucien Lévy-Bruhl's work. On this subject, cf. the reflections of Charles Blondel, "Intelligence et technique," *Journal de Psychologie*, 1938, pp. 338 ff.

Index of Names

- Adams, 104, 106, 409
 Algon, 428, 429
 Al Tazari, 416
 Amar, 54, 60, 71, 403, 404
 Androuin, 176, 228-29, 415, 419
 Angles, 106, 409
 Archibald, 120
 Argyle, M., 350
 Atzler, 55, 56, 69, 70, 71-72, 179, 403,
 404, 405, 416
 Bacon, P., 421
 Bacquerisse, 410
 Bardet, 330-31, 428, 431
 Barnard, 425
 Barret, 432
 Bartlett, 106, 107, 219, 409
 Bartley, 91
 B'ata, 325-29
 Bedford, 114-15, 133, 146, 410, 411,
 413
 Bell, D., 350
 Bendix, 350
 Berthelot, 25
 Biegeleisen, 51, 403
 Bills, H. G., 219
 Bingham, 122, 299, 411, 425
 Blondel, 399, 432
 Bonnardel, 66, 92, 120, 256
 Bourdon, 120
 Brooks, R. S., 162, 287, 414, 424
 Brozek, 91
 Bücher, 131, 158, 411, 414
 Buisson, 251, 421
 Buret, 130, 411
 Carrard, 425
 Cathcart, 81, 82, 406
 Chambers, E. G., 110-11, 410
 Chapanis, 107
 Charpy, 170
 Chase, S., 276, 423
 Chauveau, 60, 404
 Clark, K. S., 99, 408
 Coakley, 190
 Colebrook, 101
 Comte, 47, 328, 403, 428
 Cook, P. H., 302
 Copley, 61, 213, 274, 285, 293, 404,
 418, 422, 424
 Couffignal, 190, 416
 Cox, D., 156
 Cox, J. W., 231, 419
 Davies, 95, 408
 de Freminville, 140, 154, 199, 412,
 414, 417
 de Man, 41, 139, 147, 402, 408, 412,
 413, 431
 Descartes, 416
 Dickson, 85, 406
 Dietz, J. W., 424, 425
 Dill, 406
 d'Ocagne, 179, 416
 Dolléans, 422
 Drury, 153-54, 215, 414, 418
 Dubreuil, 97-98, 125, 132, 148, 150,
 170, 198, 408, 411, 413, 415,
 417, 425, 428, 430
 Duecker, 168, 415
 Dumas, 78, 405

- Duncan, H. D., 189, 416
 Durig, 56, 157, 161, 218, 285, 403,
 405, 414, 418, 424
 Durkheim, 420
 Dussier, 110, 410

 Edwards, 41, 402
 Eliasberg, V., 277, 423
 Ermanski, 164, 415
 Eyre, 141, 159, 160, 278, 412, 414,
 423

 Faillie, 73, 405
 Fairchild, M., 210-11, 417
 Farmer, E., 53, 54, 57, 91, 110-11,
 113, 162, 287, 403, 404, 407, 410,
 414, 424
 Follett, 431
 Ford, 153-54, 198, 201, 203, 215, 296,
 357, 414, 417, 418, 425, 430
 Fourier, 130, 147, 411, 413
 Fraser, 135, 140, 412, 413
 Frey, 193, 416
 Friedmann, 99, 189, 235, 251, 271,
 292, 408, 414, 416, 418, 420,
 421, 422, 424, 431, 432
 Frisby, 107

 Galli, 139, 164, 165-66, 412, 415
 Geiger, T., 370, 430, 431
 Gemelli, 139, 164, 165-66, 210, 412,
 415, 417
 Giedion, 415
 Giese, F., 430
 Gilbreth, F. B., 52, 59, 64, 203, 403,
 404, 417
 Gilbreth, L., 52, 59, 223, 403, 404,
 418
 Glotz, 158, 414
 Goineau, 226, 418
 Gomberg, 66
 Gompers, 41, 194-95, 402, 416
 Graf, 76, 101, 415
 Granjon, 244, 421
 Green, 241, 420
 Greenwood, 113, 410
 Guest, R. H., 172
 Gugenheim, 91

 Halbwachs, 45, 403
 Hamelet, 429
 Harbison, F., 429

 Harding, 162, 412, 414
 Harrah, 208, 417
 Haudricourt, 409
 Hearnshaw, 411
 Heron, 349, 371-72, 430, 431
 Hijmans, 223-24, 418
 Hill, A. V., 68, 404
 Hill, L., 94, 408
 Hirsch, 202-03, 417
 Hobson, 42, 402
 Hoslett, 302
 Houser, J. D., 296-98, 425
 Hoxie, 41-42, 148, 193, 402, 413, 416

 Ioteyko, 54, 403, 406

 Janet, 427
 Jaques, 347-50, 430
 Jephcott, 257
 Jeudon, 247, 421

 Kafka, 112, 410
 Kerr, W. A., 156
 Knight, 84, 406
 Kornhauser, 49, 98, 297, 403, 408,
 425
 Kottgen, 415
 Kraepelin, 78-79, 406
 Kraut, 76

 Lahy, 42, 49, 60, 84, 96, 103-04, 115,
 122, 170, 239-40, 401, 404, 406,
 408, 409, 410, 411, 415, 420
 Laird, 98, 408
 Landauer, 422
 Landmann, 430
 Langdon, 105, 155, 160-61, 166, 168,
 169, 171, 178, 409, 414, 415, 416
 Lauru, 107
 Le Chatelier, 39, 64, 67-68, 402, 404
 Legros, 104, 106, 409
 Lehmann, 55, 73, 76, 92, 107, 403,
 405
 Leipart, 413
 Lenin, 271, 422
 Levenstein, 431
 Lévy, P., 417
 Lévy-Bruhl, 47, 403
 Lewin, 431
 Ley, 420
 Lipmann, 56, 85, 96, 103, 133, 139,
 144, 155, 161, 212, 263, 264,

- 269, 278, 286, 355, 401, 403,
 404, 407, 408, 409, 412, 414,
 415, 418, 422, 423, 430, 431
 Lossagk, 142, 409, 412
 Luc, 239, 420
 Lynd, 201, 210, 375, 417, 431

 Maier, 92, 219
 Marbe, 113, 410
 Marchac, 70, 405
 Marey, 58-59, 404
 Mariott, 302
 Marot, 178, 416
 Marx, 82, 87, 130, 406, 407, 411, 416
 Mathewson, 282-84, 294, 423, 424
 Maurer, 175, 177-78, 180-82, 415, 416
 Mayer-Daxlanden, 171, 276, 277, 415,
 423
 Mayo, 74, 81, 84, 146, 147, 151, 304-
 25, 379-80, 388, 401, 405, 406,
 413, 414, 425, 426, 432
 McKelvey, 66
 Melian, 86, 407
 Merrheim, 43, 264, 266, 267, 402, 422
 Michelet, 97, 158-59, 408, 414
 Migcon, 429
 Miles, 83, 88-89, 106, 123-24, 141,
 159, 160, 278, 406, 407, 409, 411,
 412, 414, 423
 Mills, C. W., 350
 Moch, 262, 269-70, 422
 Moede, 45, 403
 Moore, B. V., 425
 Morgan, J. J. B., 98, 408
 Muller, W., 430
 Munsterberg, 50, 137, 403, 412
 Myers, C. S., 54, 57-58, 80-81, 83-84,
 87-90, 95, 100, 102, 108, 114,
 115, 122, 143, 160, 379-80, 403,
 404, 406, 407, 408, 409, 410,
 411, 412, 414, 432

 Navel, 100, 207, 408, 417
 Newbold, 410

 Oakley, 120
 Overstreet, H. A., 46, 403

 Pennock, 426, 427
 Person, H. S., 432
 Philip, 194, 416
 Pouget, 43, 267-68, 402, 422

 Pouillot, 235, 244-45, 420, 421
 Preller, 284, 423
 Proudhon, 130, 411
 Putnam, 426, 427
 Pound, A., 140, 412

 Quantin, 420

 Raube, 156
 Regnet, 431
 Renold, 200, 417
 Reynaud, M., 344, 430
 Rigaudias-Weiss, 86, 407
 Ritzmann, 110-11, 410
 Roethlisberger, 84-85, 304-25, 406,
 411
 Ruffer, 96, 408
 Rupp, 134-36, 167-68, 412, 415
 Ryan, 92

 Sachs, 145, 412
 Sachs, 42, 402
 Sachsensberg, 167, 288, 415, 424
 Sakine, 101
 Sander, 56, 403
 Scheler, 275
 Schueller, 430
 Schuhl, 416
 Scott, H., 324, 428
 Scott, J. F., 302
 Scott, W. D., 215, 430
 Selekman, 350
 Setzermann, 200, 417
 Shartle, 302
 Shepard, G. H., 407
 Sheppard, H. L., 350
 Simiand, 183-84, 203, 209, 416, 417
 Simpson, 96, 408
 Sismondi, 411
 Smith, Adam, 129, 131, 411
 Smith, E. D., 430
 Smith, May, 135, 134, 150-51, 411,
 412, 414
 Sorel, 240, 420
 Sottonin, 86, 407
 Stephenson, 112, 113-14, 410, 414
 Stern, W., 49
 Streine, 171, 415
 Sturmthal, 402

 Taylor, A. K., 95, 408
 Taylor, F. W., 52, 59, 87, 213-14,

- 285, 288, 292-93, 296, 365-66,
 401, 403, 404, 407, 418, 424,
 425, 431
 Thierry, 241, 420
 Thorndike, 149, 413
 Ure, 191-92, 416
 Usher, 175, 415
 Veblen, 45, 141, 403, 412
 Vernon, 83, 90, 94, 114-15, 133, 146,
 148, 406, 407, 408, 410, 411,
 413
 Viteles, 49, 140, 150, 230, 401, 403,
 412, 413, 419, 431
 Walker, C. R., 156, 172
 Walker, J., 156
 Wallich's, 215, 418
 Wallon, 51, 69, 70, 78, 84, 103, 122-
 23, 137, 231, 241, 401, 403, 404,
 406, 409, 411, 412, 419, 420, 432
 Walther, 92, 106, 107, 155, 162, 409,
 414
 Warner, W. L., 426, 427
 Watkins, 44, 402
 Weber, Max, 281-82, 358, 423, 430,
 431
 Weinberg, 139, 412, 419
 Weiss, 60, 404
 Welch, 88-90, 123-24, 407, 411
 Weld, 121, 411
 Wennewald, 107
 Weston, 95, 99, 104, 106, 408, 409
 Weygandt, 149, 413
 Whitehead, T. N., 426
 Wiener, 188-90, 416
 Wilensky, H. L., 427
 Williams, S. J., 112, 410
 Witmer, 122, 411
 Wolf, R. B., 424
 Woods, 113, 410
 Worthy, 302
 Wray, 302
 Wyatt, 104, 105, 132-33, 135, 137-38,
 139, 140, 143, 144, 146, 147, 148,
 152-53, 155, 160-61, 168, 169,
 171, 178, 287, 361, 409, 411,
 412, 413, 414, 415, 416, 424,
 431, 432

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