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ENGINEERING REPORTS

ENGINEERING REPORTS

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Engineering Reports

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PREFACE

This book is for the engineering student and the engineer on the job. It treats a set of problems that concerns every technical man—problems of conveying facts and judgments to fellow engineers, industrialists, businessmen, and laymen. In dealing with these problems the book stresses the doctrine that effective reports are at once products of sound craftsmanship and contributions to practical action.

Because reports have this dual nature, their making demands wide knowledge and many skills. Nobody can gain this knowledge or master the skills quickly. The good report-maker develops and grows. He is always finding better methods of gathering facts, thinking his way through them, using the potentialities and avoiding so far as possible the limitations of the curve, the map, the table, the spoken word, the written word. In short, he is always becoming more and more adept in putting his facts and evaluations into other men's minds.

The book tries to stimulate him in this endeavor. It does not stop with explaining the basic principles, many of them known for centuries, to which practical communication should conform. In addition it guides the engineer in adapting his application to the many situations he will meet and to the needs of many different readers and hearers.

One reason why we hope to prove helpful guides is that we can thus partly repay those who have guided us. We have for more than twenty years received information and stimulation from technical editors, printers, engravers, psychologists, newspaper men, Army and Navy officers, experts in the study of public opinion, our teaching and administrative colleagues, and clients with whom we have worked on a variety of report problems.

We are under immediate obligation to individuals and organizations who have allowed us to quote from their reports, talks, letters, and articles. Some wished us to make no public acknowledgment; passages that they have let us use appear without quotation marks. The sources of other quoted material are shown in footnotes. These citations must be supplemented here by an expression of our thanks to the following: The American Council on Education, publishers of *Reading in General Education*; Bell Telephone Laboratories; Federal Works Agency; The National Archives; Historical Properties Branch, Army Headquarters Commandant, Military District of Washington, D.C.; United States Bureau of

Reclamation; Princeton University Press, publishers of *The Public Opinion Quarterly*; The Americana Corporation; Appleton-Century-Crofts, Inc., publishers of *Darwiniana*; Doubleday and Co., Inc.; Harper & Brothers; Henry Holt and Company, Inc., publishers of *Principles of Economics*; McGraw-Hill Book Company, Inc., publishers of *Building an Engineering Career* and of *Human Relations Manual for Executives*; Charles Scribner's Sons, publishers of *The Antietam and Fredericksburg*; Military Service Publishing Company; *Harper's Magazine*; *Industrial Marketing: The Magazine of Selling and Advertising to Business and Industry*; *Infantry Journal*, and other magazines cited in footnotes; The Communications Research Institute of the University of Illinois; Mrs. C. H. Baxter; and Messrs. Kemp Malone, R. C. Matson, Douglas R. Mills, Henry L. Coles, H. H. Punke, H. S. Rogers, G. P. Schubert, Russell Thomas, and J. K. Tuthill.

For valuable suggestions as the book was being written we thank A. I. Andrews, George R. Foster, L. R. Malm, N. A. Parker, Frank A. Randall, H. S. Stillwell, H. L. Walker, Charles R. Walters, officials of the University of Illinois Press, our secretaries, and especially our wives. If errors occur in spite of their aid, the fault is ours.

We trust that readers will find the treatment of reports useful and that the book will contribute to improving communication within engineering, industry, and business and between technical men and laymen.

L. A. R.

B. B. B.

E. F. H.

February, 1950

I. Introduction

As an engineer you want to do sound technical work, to serve your employer well, and to be paid commensurately in money and prestige.

The first goal lies beyond the bounds of this book, which presupposes that you have the engineering skill now expected of you. Whether you are an undergraduate, an apprentice, or an established engineer, the assumption is that you can whip the purely technological problems which you encounter.

The second and third goals this book does propose to help you reach. As you advance in responsibility you find that to give good service means to give increasingly broader service. More and more you are called upon for abilities beyond the technological. More and more you are expected to move men to profitable action by communicating to them what you know, believe, advise, and decide. Skill of this kind not only is sought, it is rewarded. You will gain in both income and reputation if you are able to “put across” to engineers, industrialists, semitechnical men, and laymen a variety of facts, conclusions, recommendations.

To say this is not to forget the present needs of undergraduate engineers. Their current problems are discussed. But primary attention is focused on engineering practice.

Engineering practice is extremely diversified. It is, in fact, three-dimensional. One dimension includes such technical categories as civil, mechanical, electrical, and aeronautical engineers. In the second are found functional categories such as production and design engineers. The third is based on responsibility—technicians, supervisors, and administrators.

A man's place in this “matrix” will influence his communications problems. One man's job is to plan electronics demonstrations. Another's business value depends mainly on his ability to write sales letters. The work done by your own acquaintances will give further examples of specialized skills.

Since to discuss them all is impossible in this book, the only feasible approach is to search for the greatest common denominator in technical

communication. This is the engineering report, a form used by engineers in all branches, engineers doing all sorts of functional jobs, engineers on all levels of authority. Upon this our discussion is focused.

For practical reasons other forms of discourse must also be discussed. One, the outline, helps you in planning a report. The simple news story and the précis drill you in attaining virtues which are essential in writing reports. The letter of inquiry, the questionnaire, and the interview are valuable means of gathering data. Still other forms of discourse are themselves embodied in reports; among these are the letter of transmittal, the abstract, the definition, and the outline. Finally, some forms of discourse often supplement or follow a report and on occasion even replace it—answers to letters of inquiry, news stories on engineering and industrial subjects, and articles for professional magazines.

Consequently, in addition to the report proper, this book covers many other kinds of communications which, although allied, are not actually reports.

Part I: Increasing Your Active Resources

2. Your Present Resources

In making effective reports, your first step is to inventory your present resources. You ask: What information do I have about the purposes and nature and kinds of reports and the factors that make a report effective? What report-making skill do I now possess?

Your answer to these questions will probably be too modest. If you are like thousands of technical men, you will say: "I know that government and industry can't get along without reports. I know there are a good many kinds—inspection and oral and restricted and interim and progress and recommendation. But it's clear that these names mean different systems of classification, and they hinder me more than help me in getting an overall picture." In fact, you may decide that you are not certain exactly what a report is.

On the other hand, you may be too confident. On the basis of a few narrow specifications which have been given you, you may feel that you have surveyed the whole field of report-making. You may even feel you have conquered it.

GENERAL KNOWLEDGE ABOUT REPORT-MAKING

Both of these attitudes neglect what everybody knows about reports. Each one of us has made simple reports from the time he was a youngster and has utilized many skills and techniques in making them. So we all know more about them than we think we know. Before summarizing what your technical education has taught you, let's find out what even the layman has discovered merely by living from day to day.

1. All of us have learned that *reports are communications*. They are not ways of expressing ourselves. When we make an effective report we should, it is true, gain a craftsman's satisfaction. But this satisfaction is a by-product, not the main motive. The motive is to share facts and judgments with other people.

Or rather, the motive is partly that. For reports are communications of a special kind—highly practical communications. Unlike general conver-

sation, many informal letters, and most short stories or novels, they are intended to help busy people make practical decisions. Standing between an inquiry on the one hand and an order on the other, *reports contribute to action*.

2. We all know that *every effective report has a bedrock of facts*. Fancies and emotionalism are out of place. Even a child's report has a factual basis. The boy giving his father an account of a fight knows he must offer a truthful reply to "Who started it? Did you stand up and slug? Who quit first?"

We know too that we seldom have on hand all the facts we need for a report; we must work to get many of them. On occasion, *fact-gathering takes more time, skill, and initiative than any other part of the job*.

3. We realize that *facts alone are seldom enough*. "The facts speak for themselves" sounds good but is often untrue. In many reports we have to offer estimates, interpretations, hypotheses, theories, predictions, conclusions, recommendations. That is, we may have to discuss not only what is actually taking place or has taken place, but what might, should, or must be done. Instead of confining ourselves to the actual we have to treat also the possible, the probable, the desirable. We may even find it wise to stress the probable so strongly that we approach the function of the seer. We may have to stress the desirable so strongly that we approach the function of the teacher, the editorial writer, the advertiser, the preacher.

But we cannot take over these jobs and still remain report-makers. In any report that deserves to be called a report, the statements are firmly grounded on facts, the extrapolations are justified logically and scientifically and practically, and the tone is generally dispassionate, as is suitable to factual discourse.¹

4. All of us have learned still more. We know, for example, that a collection of notes or graphs is not yet a report. What it lacks is structure. *Even the briefest report has a discernible organization*.

This structure, we have found, does not depend solely on the facts and our derivations or extrapolations of them. Nor does it depend solely on the kind of action to which our report will contribute. It depends also on the recipient. We seldom give an accounting in just the same way to our equals as to our superiors or our subordinates. We arrange our material differently according as we present it to men or to women. We can't even assume that a given recipient will remain unchanged—a report that suits Jones today may not suit him next week or next year.

¹ "Generally" implies some latitude. In controversial passages a good report may use some emotional language; a few completion reports have a jubilant tone; and a good many oral reports, as well as numerous written ones in the form of memorandums or business letters, would lose effectiveness unless they conveyed a friendly spirit.

5. *The content and organization of a report will vary depending on whether the report is demanded or volunteered.* When we give unsolicited information and judgments, adjusting ourselves to the reader or hearer is commonly rather hard. Why? For the obvious reason that we have more inertia to overcome. The man who receives our volunteered report isn't moving along with us. He may resent doing so. He has other ways in which he'd rather spend his time. So at the start he will be in a state of rest or opposition, and it will be up to us to move him properly. This disadvantage of the volunteered report is shared by "accounts of stewardship" such as are put out by government agencies, welfare groups, and many professional organizations. All of us know that we ought to read them, but usually we have to be coaxed into doing so.

By digging further into our memory we realize that such coaxing takes many forms. One of them involves using several of what are called "communication media." The report-maker who must take special pains to get and hold our attention doesn't restrict himself to the printed word. He may employ tables. Almost certainly he uses photographs and interest-challenging maps or charts. Perhaps he has part of his report broadcast.

We know that *many reports that are demanded also utilize these same devices*—the spoken word, the written word, photographs, tables, maps, charts, graphs. Analyzing more fully, we see that still other media play a part in report-making—equations and formulas; motion pictures, slides, cartoons; demonstrations; bodily posture and bearing; and on some occasions, in oral reports, the deliberate use of silence.

6. We also know that *the physical form of a report affects what the report can say.* As a youngster we wished that grade-cards provided a means of blazoning forth our virtues and explaining away our D's. (When you fill out income tax forms you feel the limitations of the printed blank more strongly still.) Looking at the brighter side of the picture, all of us have at times been surprised to find how much we could say in a map or snapshot or by gestures and demonstration.

A summary of what everybody knows about reports falls into two related parts: a definition of reports, and an enumeration of the factors—the determinants—which interact to produce an effective report.

A report is an organized, relatively cool, and objective communication which may follow a prescribed pattern and which presents facts or deductions from facts, or both, for the purpose of guiding its recipient toward practical action.

The determinants of the content, organization, and details of presentation in a report are these:

1. The situation which makes a report essential or desirable.
2. The action to which the report should or may lead.
3. The facts on which the report is based.

4. Interpretation and evaluation of those facts.
5. The recipient.
6. The potentialities and limitations of the various communication media—what we can and can't say by means of them.
7. Prescribed, prevalent, and feasible patterns and formats.²

THE ENGINEER'S KNOWLEDGE OF REPORT-MAKING

We have seen that even the layman doesn't start from scratch. You can set your starting-blocks still farther forward, for as an engineer you have many attitudes, work habits, items of knowledge, and skills that the average man lacks.

1. You have a greater than average willingness to analyze situations. You neither accept them uncritically nor run away from the task of factoring them.

2. Not only are you willing to analyze situations; you are also fairly capable of doing so. You know that most engineering and industrial situations are complex. You know that the circumstances which comprise them are not all technological—some are economic, some are psychological, some indeed are legal or political. You know that each circumstance can be analyzed further—for example, that mechanical efficiency is the resultant of several factors, that there are various kinds of upkeep costs, that not all workers take the same attitude toward a new machine. And, more vividly than most people, you are aware that the components of a situation are seldom of equal importance but must be "weighted." You try to weight them mathematically. For all these reasons you can factor the situations that may demand a report from you, and you can make at least a start toward deciding what kinds of action your report will contribute to.

3. You have used many kinds of sources of information:

- a. Your own past experience and observation as preserved in your memory and your files.
- b. Special observations and inspections to increase your knowledge of specific problems, situations, and procedures.
- c. Tests in laboratory, shop, and field.
- d. Interviews—at least, informal ones.
- e. Lectures, talks, and panel discussions (oral sources of information over which you have less control than in an interview).
- f. Demonstrations, most of them accompanied by some oral explanation.
- g. Motion pictures and slides.

² *Format* refers to the physical appearance of a document (including the placing of tables and illustrations) and to the kinds and sizes of type used, regardless of whether it is typed, printed, multilithed, or "set up" in some other way.

h. Several kinds of documents comprising the "literature" of many technical fields.

In gathering data from your sources you see what many laymen never see—that inference has to enter into some fact-finding jobs. For instance, you know that subatomic phenomena cannot be observed directly, but that many facts concerning alpha and gamma rays, neutrons, and positrons are accepted as valid.

4. You have a system for recording and filing technical data.

5. You have developed a measure of skill in interpreting and evaluating facts. For one thing, you are accustomed to classifying them. Your college courses have given you check lists, outlines, diagrams, and graphic representations of relationships among material things and processes—and, for that matter, among hypotheses and theories. A few examples are the Periodic Table, charts showing geological strata, a list of the steps necessary in a work-simplification program, and scores of equations.

You not only can classify, you can reason well. Your training in scientific logic should keep you from serious errors when you reason inductively, from specific facts to general conclusions. That is, you should weigh the assumption that random sampling yields valid generalizations; you have learned some techniques for making your samples representative; you know that a time sequence or a simple two-way correlation does not imply a cause-and-effect relationship; you have been warned against the false analogy—the assumption that A and B must have many traits in common because they have one or two in common.

Whether your deductive reasoning is as free from error may be doubtful. But your training will protect you if you will only use it. You shouldn't evade a problem or go off on a tangent; you have been trained to phrase problems accurately, impersonally, and if possible mathematically. You ordinarily don't try to reach a decision by calling names, appealing to prejudices, or attacking the adherents of a belief and the supporters of a plan when logic demands that you decide whether the belief is true and the plan practicable.

Your scientific and engineering education has put you on guard against another kind of loose thinking, the false dilemma—the assumption that there is nothing between black and white, hero and villain, staying in a rut and jumping at the first chance for change. You should be saved from the trap of the false dilemma by your habit of thinking in terms of spectra, scalar quantities, and differentials.

6. In addition to the layman's knowledge that a report should suit its recipient, you have some specific acquaintance with engineering and industrial men. You have associated with engineering teachers and with engineers and businessmen. You have heard them talk informally. You have listened to them lecture. You have read some of the same technical

material that they read regularly. You have made many simple oral reports, and some written ones, to engineering teachers and perhaps to engineers in the field. So you have some idea of what they like and dislike, what moves them to action. You have begun to realize how far it is justifiable to speak of "the engineer," "the mining man," or "the researcher" and wherein you must allow for differences among engineers, mining men, researchers.

7. Unless you differ from most engineering students, you have had both good and bad luck in using several of the communication media. Perhaps you tried to get a good photograph of a mine hoist, couldn't, and had to be content with a word description and a sketch. Or you got the photograph but found it was far from self-explanatory and therefore still had to use words and sketches. You may have written a long analysis of complicated statistics, only to be told, "Do this over and tabulate the material." On the other hand, you have doubtless gained confidence from the favorable reception of tables, equations, maps, curves, or photomicrographs that made your reports clear and concise.

As for writing, don't undervalue your present knowledge. You already employ with much precision the vocabulary of your branch of engineering. You use a good many of the sentence patterns that are common in that branch. You set up some of your statements in accepted enumerative or semitabular form.

In short, you have on hand quite a stock of answers to the question, "What can I say and what can't I say by means of the major media of communication?"

8. You have developed some skill in using prescribed formats. For example, you have submitted unbound reports and reports bound in two or three different ways. Within the report you have used headings and subheadings—Equipment, Procedure, Data, Conclusions; perhaps Purpose, History, Theory, Recommendations. You have included tables of contents, lists of illustrations, and perhaps appendixes. And unless your superiors have been unduly dogmatic, they have told you that the patterns and formats they prescribe are only a few of the many which are common in practice.

3. Applying What You Know

A PREVIEW OF WHAT YOU NEED

Because many engineers let report-making confuse them, the preceding chapter has pointed out what you already know about it and what you can already accomplish. Now let's look at the other side of the ledger—a task that will occupy us throughout the balance of this book.

And not merely throughout the balance of this book, but throughout all your professional life. Learning to communicate effectively is a continuing process. For many years to come you will be improving your ability to size up situations, lines of action, individuals; to gather facts; to see what they mean; and to tell other people by word, map, graph, and picture. Even without formal guidance you would gradually gain skill in doing all these jobs. What a textbook and a teacher can accomplish is to help you speed up the process. They can make you more sharply aware of its parts and stages, more systematic in your approach.

In thus increasing your awareness and your efficiency you need not depart from your engineering habits. In fact, they are very pertinent. You proceed essentially as you do in mastering a new fabricating or testing or maintenance job. That is, when you are learning any new set of skills and have listed what you already know about them and are already capable of doing, you perform these tasks:

1. You check to see that you are fully applying your present resources.
2. You survey the nature of further resources that you must know about.
3. On the basis of both the resources you have and those you need to acquire, you survey the basic practices that you must master.
4. You combine and apply all the resources by doing specific jobs.

This book tries to help you proceed in this way as you learn how to communicate effectively. You will have to coöperate to the fullest. And this coöperation will take energy and thought.

Teaching yourself any of the arts of practical communication is hard. Teaching yourself to make effective reports is especially hard, for two reasons.

One reason is that in many of the situations where a report is necessary or advisable you cannot apply a ready-made formula. The best you can do in analyzing the situation is to ask a set of questions and "map out" the situation as best you can from the answers.

The second difficulty is somewhat like the first. It arises from the fact that most reports are aimed at one individual or a small group. The differences in knowledge, needs, and interests among individuals are so great that no book could discuss them all. What can be done is to give you a sort of check list of traits that you should investigate, point out the commonest psychological problems you will meet, and offer solutions that ordinarily work. But in the last analysis it is you yourself who will have to learn the art of adjusting your communications to men of widely differing interests and temperaments.

A CHECK LIST OF POSSIBLE ERRORS

Check your performance against your abilities by means of the following list. It is based on long experience with student writers and speakers and also with engineers who have been on the job only a short time. The list shows the commonest errors in their reports.

1. Factual errors due to:
 - a. Incomplete observations and inspections.
 - b. Inaccurate transcription of laboratory and inspection-trip notes.
 - c. Faulty laboratory technique.
 - d. Failure to copyread manuscripts before submitting them.
2. Errors in reasoning.¹
3. No analysis of the recipient of the report.
4. Slovenly tables and drawings.
5. Failure to "package" the report as ordered or expected.
6. Late submittal.
7. Unclear phrasing.
8. Wordiness.

Before you go any further in this book, post the foregoing list above your desk. Study it whenever you are to make a report.

By avoiding the errors in this list you will improve your reports greatly. But of course there are many more things that you need to do. You need to gain much knowledge you now lack concerning all stages

¹ M. D. Hassialis, "What Constitutes an Acceptable Technical Paper," *Min. and Met.*, 29:495 ff., September, 1948, gives a long list of errors in reasoning that have caused the rejection of many technical reports.

of the report-making process—analysis of the situation, the prospective action, the recipient; assembly and evaluation of facts; the actual writing and drawing; and “packaging” and submittal. Because language is linear we have to discuss these one at a time, though actually they overlap and interlock.

4. Analyzing the Situation and the Probable Action

Whenever you face a situation that will or may lead to a report, analyze the situation by asking at least these questions:

1. How much have I to say about whether a report will be made?
2. If the choice is not up to me,
 - a. What do the following sources of information tell me about the situation that I face:
 - Standing orders.
 - Special directives and orders.
 - Letters of instruction.
 - Letters of authorization.
 - Conferences with my superiors and colleagues.
 - Previous reports on my subject or an allied one.
 - Sample standard reports on my subject or an allied one.
 - b. What kind of action will my report contribute to?
 - c. Which of the following am I expected to contribute to the action that will be taken:
 - Facts only—preserved as a matter of record or new to my recipient.
 - Facts plus conclusions.
 - Conclusions only.
 - Conclusions plus recommendations.
 - Recommendations only.
3. If I do have a voice in determining whether a report will be made,
 - a. Is the report essential? (To help cut down the amount of needless paperwork and talk in the world is advisable.)
 - b. If the report is not essential, is it still desirable?
 - c. Why?
 - d. Are the kinds of action to which it might lead feasible in view of the time, facilities, and money they will require?
 - e. If action is not feasible now, who would still benefit from my making a report at this time? (Your answer will sometimes be “I myself, by calling my initiative and knowledge to other men’s attention.” This answer is legitimate whenever you are sure your attempt won’t backfire.)
 - f. How would this person benefit?
 - g. What should the report contribute to eventual action?
 - h. Should anyone collaborate with me in making the report?

- i. Who?
- j. What disadvantages will result from collaboration?
- k. If I submit this report, will my organization or I myself be committed to submitting further reports on the same subject or related subjects?
- l. Will time, facilities, and money be available for preparing these sequels?

The check list looks naïvely obvious. Certainly it doesn't differ very much from the set of questions we ask before we undertake any sizable project—buying a car, making a long trip, accepting a job. But its inclusion here is justified by two opposite human habits, that of going off half-cocked and that of postponing big tasks.

Timing, in fact, may be one of your largest problems whenever you know or think that you should make a report. On occasion there will be need of much haste, either so that you can stake out a claim to

A topic,

A method of procedure,

A set of findings,

A hypothesis,

A recommendation or set of recommendations,

or so that you can stimulate other investigators by an early publication of your discoveries and theories. Under either circumstance it may be more important to get out *a* report than to get out a perfect report.

Normally, though, your reports should be just as good as you can make them. Here again the problem of timing enters. Only experience can show you how many hours, days, or weeks you will need for a particular kind of reporting job. But two suggestions will help. One is general: Assume that the task will take double the time you think it should. The second suggestion is more specific: Allow for delay at four stages—

1. Arranging for interviews or inspection trips.
2. Getting replies to letters of inquiry.
3. Translating data from one medium of communication to another.¹
4. Putting the report into good physical shape for presentation.

When you analyze the report-making situation you may help yourself by classifying the kinds of action sought into six groups:

1. Exploratory action.
2. Continuation of present routines.
3. Remedial or corrective action.
4. Expansion of present procedures.
5. Completion of a project.
6. Innovations.

But remember that such a classification is the first step only. Your goal is to describe to yourself the exact behavior to which your report will

¹ For instance, from a table to a curve or from a picture to the written word.

contribute, such as “tripling the floor space in Plant No. 2 and installing approximately \$100,000 worth of new machines.”

It is obvious that many reports must contain plans. These plans should seldom be limited to those for physical improvement or enlargement. What the recipient ordinarily needs in addition is a clear, fairly detailed statement of administrative changes that will follow from the physical development. Moreover, he usually wants to be told how the financial obligations that will be incurred can be met. Finally, he may want to know how the plans will affect related projects. For instance, proposals for an irrigation system must ordinarily take into account its effect on parks, game, navigation, power, sanitation, and domestic water supply.

5. Getting and Preserving Facts

Analyzing the situation and the action in view is your first step when you make a report. What is your next step?

The answer will vary with your age and experience. An engineer who occupies a position of authority and who has come to know a variety of people should follow up his study of the situation and the prospective action by analyzing the person or group to whom his report will go. The novice, however, had better postpone this task until he has gathered the factual data which he thinks are demanded by the situation and by the probable action.

Gathering data is not a single operation. In fact, it usually comprises four operations:

1. Finding where each presumably necessary source of information is.
2. Going to that source or bringing it to you.
3. Interpreting and evaluating what the source says.
4. Recording such of its contents as promise to prove useful.

The next chapter points out that the interpreting and evaluating which you do while you are gathering data must be followed by reinterpretation and reevaluation. The present chapter deals with your immediate decisions—"I'd better outline what this man is saying," "Here's a passage I ought to put down word for word," "I'll copy off this whole equation," or "I'll only look and listen now, and I can make a record later of the stuff that sticks in my mind."

GETTING FACTS

The Basic Principles. For two thousand years, analysts of practical communication have stressed three essential traits of a good report-maker:

1. Resourcefulness in seeking information.
2. Methodical procedures in seeking and getting information.
3. Diligence and persistence.

Naturally, in deciding what kinds of facts to seek and where to seek them you will be guided by the report-making situation, the action to which you will presumably contribute, the time at your disposal, and (as you gain experience) the needs and interests of your recipient. Do not be ruled by your own preferences. Above all, don't waste time gathering data which interest you but are irrelevant to your immediate problem. Record briefly the general nature and location of such data, but don't try to gather them now, or you may never finish your report.

The reciprocal of this advice is just as important: Stay alert for all facts that could change the nature or scope of your prospective report. Suppose you have been asked to check on the technological efficiency of some machine. As you make your inquiries and observations you may come to feel that the machine is dangerous or, on the other hand, that it is unusually safe. The facts that lead you to this conclusion may deserve a place in your report.

Most young engineers find that resourcefulness and alertness are impaired by the habit of looking too soon at what other men have written. As has been said, you do ordinarily need to study certain kinds of documents to make sure you know what the situation and problems are that face you. But in gathering content data for a report, you should usually start with your own memory.¹ Scout through your conscious mind both for pertinent facts and also for clues to the sources of additional facts. Then let your subconscious memory go to work. After that, read in detail reports on subjects that are similar to your own, and talk with people who have made such reports.

As you thus dig into documents, ask yourself three questions:

1. Why didn't the authors get further data on this and that point?
2. Where could they have gone to get such data?
3. Could they go now to sources that were not available then?

By now, you are ready to draw up an organized list of facts you want to gather and of places where you want to get them. Whether the main divisions of your check list comprise topics or locations of data will differ from job to job. So will the advisability of distinguishing sharply between office work and other investigative methods. What matters most is that the list must contain all the major kinds of data you are to seek,

¹ Start with "the literature," however, when you are to do original scientific research; otherwise you may duplicate work that has already been well done. Again, whenever you are trying to produce a patentable commodity, make sure you have not been anticipated. The publications you should use are the weekly *Official Gazette of the United States Patent Office* and the *Index of Patents Issued from the United States Patent Office*. To gain a background you may study such reference works as H. A. Tomlinson, Jr., *Patent Law for the Investor and Executive* (New York, 1928), and A. K. Berle and L. S. De Camp, *Inventions and Their Management* (Scranton, 1933). Observe the form used in these books for references to patents applied for and issued.

must tell where and how you plan to get them, and must set a time deadline for each phase of the work.

In a long investigation you may lose your taste for fact-gathering when you are halfway through that job. While you wait for your second wind, do one of these chores:

1. Perform some such routine task as looking up titles in a magazine index or gathering data from technical handbooks.
2. Inspect some plant or operation that you will find new and fresh.
3. Start to analyze the recipient of the report.

Using the Various Sources of Information. Concerning such ways of getting data as laboratory testing nothing is said here; your purely technical training will teach you almost all that you should know. Only those recommendations that you are unlikely to get elsewhere are given.

Files. Use your company's files as soon as you can. Don't neglect the files of affiliated and subsidiary companies. Bear in mind, however, that some files you would like to use will be closed to you; trade secrets are among your organization's assets.

Interviews. Whenever you seek facts and views by means of a formally scheduled conference with one or more other men, do eight things:

1. Make a list of the data you wish to get.
2. Be sure to omit material that you have no right to ask for.
3. Memorize the list if you have reason to think that the man you interview will react unfavorably to your use of a written or typed list.
4. Draw him out on phases of the subject that are particularly significant. This may mean enlarging your list of questions, or changing its focus, as the interview develops.
5. Without being inquisitive, try to find the factual bases for opinions expressed by the men you interview.
6. End the interview as soon as you have the needed information.
7. Afterward, check the accuracy of facts and figures as far as you can by referring to other sources, including printed sources.
8. Submit the product of the interview to the information-giver for his approval or correction.

Professional interviewers have learned that it is wise to ask some questions whose only purpose is to afford a check on the stability and consistency of interviewees' responses. The novice had better not do so. Consult R. C. Oldfield, *The Psychology of the Interview* (1941).

Letters of Inquiry and Questionnaires. The content of a good letter of inquiry cannot be sharply separated from its form. Hence this type of letter is treated in Chapter 12 along with other kinds of business correspondence. The same chapter deals with the questionnaire, which has to be used occasionally. Both the inquiry letter and the questionnaire

are frail reeds to lean on, because a clear, brief set of questions is hard to formulate and because many people are slow in answering.

Talks and Lectures. The value of lectures and talks is also limited. They seldom yield just what you want just when you want it. You can overcome some of their disadvantages by four practices:

1. Make a calendar of scheduled talks which you, a friend, or (later) a subordinate or agent can hear.
2. Make a practice of keeping a file of notes based on talks or lectures that you attend because their subject matter interests you, even though you have no specific application of them in mind.
3. If possible, visit a site or plant that a lecture has shown to be worth your personal inspection.
4. Get reprints or preprints of significant talks or lectures which are thus made available to a wider group than the original audience.

Visual Aids. You may be able to borrow a few of the motion pictures, photographs, and slides that you need for a report-making project. Unfortunately, no comprehensive catalogues of these are yet available outside the pedagogical field.² The loan of any that you can find out about had best be arranged through your company until your professional reputation justifies a request in your own name.

Statistical Services. Your prestige also influences your ability to get certain kinds of statistical data. But most statistical bureaus and agencies will serve any honest investigator, either at a price or as a public duty. Some profit-making bureaus are more trustworthy than the corresponding noncommercial ones. Of the latter, the federal agencies are on the whole preferable to the state (though a dozen states set a high standard), and the state to the municipal. College, university, and independent research groups likewise differ. Some prefer not to give data on problems which they are still investigating. On the other hand, a few academic, industrial, trade, and labor organizations are unduly eager to broadcast their findings and particularly their opinions.

Statistical abstracts and related collections include a dozen that are indispensable: *World Almanac* (1868-); *Statistical Abstract of the United States* (1878-); *Statistical Atlas of the United States* (1925-) and *Commerce Yearbook* (1922-), both issued by the Department of Commerce; the decennial censuses and the *Biennial Census of Manufactures*; *Statesman's Year-Book* (1864- ; British); *American Year Book* (1910-19, and 1925-); *Municipal Year Book* (1934-); *Yearbook of Agriculture* (1895-), issued by the Department of Agriculture; *Ameri-*

² For progress in listing and evaluating films, see H. R. Nissley and The Cleveland Chapter, Society for the Advancement of Management, "Recommended Visual Aids in Industrial Arts," *J. Eng. Educ.*, 38:205-208, November, 1947.

can Labor Yearbook (1916-); and *International Labor Office Year-Book* (1930). A still greater number are of value on occasion.³

Sources of Bibliographical Information. More information has been published upon even the narrowest of topics than the novice realizes. Learning how to find such of this information as you need is one part of your training. The essentials of the job are skill in the use of abstracts and library card catalogues, knowledge of guides to reference works, and acquaintance with several bibliographical indexes.

Published abstracts, including digest sections of technical magazines, have been or will be explained in your technical courses. Basic facts about library catalogues are presumably familiar to you. If they are not, get the handbook issued by your college or university library.

The *Guide to Reference Books* prepared by Isadore Mudge (1936; supplements in 1939 and, by C. M. Winchell, in 1941) is the most useful general guide. H. S. Hirshberg has compiled a valuable *Subject Guide to Reference Books* (1942). You can also profit from C. B. Williams and A. H. Stevenson's *A Research Manual* (rev. ed., 1950) and Jennie M. Flexner's *Making Books Work* (1943). More specialized are *International Catalog of Scientific Literature* (1902-19); A. D. Roberts, *Guide to Technical Literature* (1939); B. A. Soule, *Library Guide for the Chemist* (1938); Richard Rimbach, *How to Find Metallurgical Information* (1936-); J. E. Holstrom, *Records and Research in Engineering and Industrial Sciences* (1940); R. R. Hawkins, *Scientific, Medical, and Technical Books Published in the United States of America, 1930-1944* (1946); and N. G. Parke, III, *Guide to the Literature of Mathematics and Physics, Including Related Works in Engineering Science* (1947). Because government publications have become increasingly important to engineers, you should know of the following guides: A. H. Boyd, *United States Government Publications* (1931; new ed., 1941); L. F. Schmeckebier, *Government Publications and Their Use* (2nd ed., 1939); Hirshberg and C. H. Melinat, *Subject Index of Government Publications* (1947); J. K. Wilcox, *United States Reference Publications* (1931); Wilcox, *Manual on the Use of State Publications* (1941); *Bibliography of Scientific and*

³ *Poor's Securities* (1868-); *Poor's Directory of Corporations*; *Moody's Security Rating Services*; *Moody's Analyses of Investments*; H. R. Kempe's *The Engineer's Yearbook* (1897-); *Mineral Industry Yearbook* (1892-); L. J. Hughlett's *International Industry Yearbook*; *New York Tribune Almanac* (1838-1914); *Appleton's Annual Cyclopaedia* (1861-1902); *Graphic Analysis of the Census of Manufactures of the United States, 1849-1919* (1923); *Recent Economic Changes* (1929); *Recent Social Trends* (1933); *Facts on File* (1941- ; weekly, with a yearly cumulation); *What's Happening in Taxation and Government Regulation* (1941- ; semimonthly); and *Information Please Almanac* (1947-). Of wider usefulness than its title might indicate is *World Chemical Development*, issued by the Bureau of Foreign and Domestic Commerce as part of its Trade Promotion Series.

Industrial Reports (U. S. Department of Commerce, 1946- ; monthly; weekly before July 1, 1948); and *Checklist of United States Public Documents, 1789-1909*.

Guided by several of the books named above, you should be able to make fruitful use of such indispensable "tools" as the *Engineering Index* (1884-); *Industrial Arts Index* (1913-); *Cumulative Book Index*, issued monthly, quarterly, semiannually, and annually as a supplement to *The United States Catalog of Books* (1900-); the monthly *Catalogue of United States Public Documents* (1895-); *Selected United States Government Publications*, published semimonthly and available without charge from the office of the Superintendent of Documents, Government Printing Office, Washington, D. C.; *Monthly Checklist of State Publications* (1910-); *International Index to Periodicals* (1907-); *Subject Index to Periodicals* (1919-22, 1926- ; British); *Reader's Guide to Periodical Literature* (1900-); and even a considerable number of indexes to fields of activity which the engineer must now and again investigate.⁴ Related to these last are certain aids in studying the technology of the fairly recent past.⁵

In special fields the standard bibliographies that must be mentioned include *Select Bibliography of Chemistry* (edited by H. C. Bolton, 1899-1904); *Geologic Literature of North America, 1785-* (United States Geological Survey); *Bibliography and Index of Geology Exclusive of North America, 1933-* (Geological Society of America); *Annotated Bibliography of Economic Geology, 1928-* ; *Electronic Engineering Master Index* (edited by F. A. Petraglia, 1946); *International Catalogue of Scientific Literature* (1900-14); Davenport and Scott's *An Index to Business Indices* (1937). Special bibliographies are often prepared by government agencies, universities, professional societies, industrial firms, and trade groups. You can get a lead to many of these by consulting the *Handbook of Scientific and Technical Societies and Institutions of the United States and Canada* (4th ed., 1942; National Research Council).

⁴ *Agricultural Index* (1916-); *Occupational Index* (1936-); *Vocational Guide* (1938-46), continued as *Guidance Index*; *Quarterly Cumulative Index Medicus* (1927-); its predecessor the *Index Medicus* (1879-99 and 1903-26); *Art Index* (1929-); *Education Index* (1929-); *Public Affairs Information Service* (1915-); *Service Monographs of the United States Government* (1918-34); *Pamphleteer* (1940-); *Vertical File Service Catalog [of Pamphlets]* (1935-); and "The Weekly Record" of new books in *Publishers' Weekly* (1872-).

⁵ *American Catalogue of Books* (1861-71 and 1876-1910); *Poole's Index to Periodical Literature* (1882-1906); *Annual Magazine Subject Index* (1908-); *New York Tribune Index* (1875-1906); and *New York Times Index* (1914-). Poole's has the disadvantage of being a subject index only. However, it contains entries dating back to 1802, it lists 600,000 articles from 470 magazines, and it paid considerable attention to scientific and engineering journals.

Some of the organizations listed in the above book will compile bibliographies when requested. So will the Engineering Societies Library of New York City (for a small charge).

Three further counsels:

1. Make it a habit to examine the bibliographies in every printed source from which you draw content data.
2. Use a magazine's own self-index when you are seeking short items—including news items—that you can't find in the broad indexes.
3. Don't forget doctoral dissertations. There is an annual listing of these, beginning with 1933.

At times you must resort to bibliographies of bibliographies. The National Research Council has put out several; they cover chemistry, physics, geology, and psychology. Other good ones are *The Bibliographic Index* (1938- ; quarterly, with an annual cumulation); *Bibliography of Bibliographies in Electrical Engineering, 1918-29* (1931); Theodore Besterman, *A World Bibliography of Bibliographies* (1939-40; 2 vols.); and R. R. Palfrey and H. E. Coleman, *Guide to Bibliographies of Theses* (1936).

Encyclopedias. You should use the International, Britannica, and Americana, and their supplements and yearbooks. Among the special encyclopedias, you should know at least Tweney and Shirshov's *Technical and Scientific Encyclopedia* (1935; 4 vols.); Van Nostrand's *Scientific Encyclopedia* (1938); Franklin D. Jones's *Engineering Encyclopedia* (1943; 2 vols.); and Thorpe's *Dictionary of Applied Chemistry* (1921-37; 10 vols.). You should also acquaint yourself with works of still narrower scope that you may nevertheless need to use, such as Schoengold's *Encyclopedia of Substitutes and Synthetics*, Burge's *Encyclopædia of Aviation*, Munn's *Encyclopædia of Banking and Finance*, Searle's *An Encyclopædia of the Ceramic Industries*, Dyke's *Automobile and Gas Engine Encyclopedia*, Wall's *Dictionary of Photography and Reference Book*, Drake's *Cyclopedia of Radio and Electronics*, Leven's *Petroleum Encyclopedia*, and many more, including one that you might miss if it were not called to your attention—Seligman and Johnson's *Encyclopædia of the Social Sciences*.

Other Printed Helps. Thomas' *Register of American Manufactures* is valuable in many ways. So are the engineering handbooks in your own and allied fields. Extend your use of these, of such catalogues as the *Chemical Engineering Catalog* (1915-) and *Sweet's Engineering Catalogues* (1933- ; the title varies), and of governmental and industrial instruction manuals.

In borrowing printed matter that is unavailable locally you can get aid from your company or city library, the Engineering Societies Library,

and the John Crerar Library of Chicago. You can ease their task by knowing how to use the *Union List of Serials*, which lists the periodicals owned by many hundred American and Canadian libraries, and also the Union Catalog.

INTERPRETING AND EVALUATING YOUR SOURCES

Interpretation means that you must understand what your source of information says.

You should have little trouble when you are observing current operations or mechanisms and when you gather information about them from other men's spoken or written words.⁶ But as soon as you go outside your own generation you may err by failing to realize that languages change with time. This is obviously true of word meanings. When Charles II called the then new St. Paul's Cathedral "amusing, awful, and artificial" he was offering high praise. It is true of sentence patterns. Few professional writers today would indulge in the relatively shambling sentences of a Defoe, and fewer in the involuted syntax of Johnson's essays. It is also true of patterns for a whole report. A glance at the early *Proceedings of the Royal Scientific Society* will show that methods of organizing data differed from those we now follow. And it is true even of maps and graphs and flowsheets.

Moreover, languages vary not only from age to age but from profession to profession and from one economic or social group to another. Leaving for a later section (pages 34-36) the details on this matter, suffice it to say here that when you read or listen outside your own field you may find yourself confused, or—what causes even more difficulty—you may believe that you are grasping what really eludes you.

Interpreting cannot be separated from evaluating. We want to know not merely "What does this mean?" but "What does this mean to and for me?"

Evaluating involves determining the *authenticity* of our source of information, determining its *credibility*, and determining its *applicability*.

These are big words for everyday processes—processes that we use when we look at a building or machine no less than when we hear a lecture or read a book. For instance, we say to ourselves, "Is this what it claims to be—an accurate restoration of Colonial Williamsburg? Is this replica of Newcomen's engine authentic? Is this magazine article a hidden ad, and for what? They can call this a candid-camera shot, but it looks faked to me." In short, we keep our eyes and ears open for the wolf in sheep's clothing—for the unauthentic.

⁶ To help you if you do have trouble in reading or listening, this chapter ends with what you may regard as two handbook sections on how to increase your power of grasping the written and spoken word.

But of course a statement (if not a picture or a replica or a model) can be authentic and still not deserve our belief. So we ask such further questions as these:

How close in time, space, and responsibility was the man who gathered or reported these data to the facts he is reporting?

Could he have got the information in the way he says he did?

Does he realize the difference between fact and opinion?

Does he realize the differences among such levels of opinion as guesses, hypotheses, theories, etc.?

Has he any ax to grind? If so, does he realize it?

Does he try to conceal his bias by frequently asserting his impartiality?

If he admits he's biased, is his admission an intentional "blind"?

Has he, or the agency through which he reports, proved in the past to be sincere and trustworthy?

Some of the questions you should raise about authenticity and credibility you can answer by *internal evidence*. If you are well acquainted with the subject of a talk or document you can "spot" statements that rest on inaccurate observation, poor memory, bias, and fraud. You can perhaps discern when a man is holding back part of the truth. You can often tell from the date when the material was gathered or presented whether it is to be viewed with doubt.

In measuring credibility you can often support internal evidence by *external evidence*. You may, for example, properly feel confidence in a book issued by a long-established firm and in an article published by a leading technical magazine. Moreover, you can look into biographical directories to learn something about a writer's or speaker's training, experience, and repute. Some untrustworthy people get their names in these volumes, some good men don't; but the directories give useful clues.⁷ For other circumstantial evidence you can use book reviews and evaluative abstracts. Make it a practice to read such of these as pertain to your own branch of engineering.

One further suggestion. Guard against what is called historical provincialism. In studying an obsolete process or mechanism or theory, be sure not only that you *understand* what it was but that you *appreciate* it properly. Why was it devised? What need was there for it? What

⁷ For men no longer living, use the *Dictionary of National Biography* (British), the *Dictionary of American Biography*, and *Who Was Who*. For living persons, use *Who's Who in America*, *Who's Who* (British), *International Who's-Who*, *Who's Who in Canada*, *America's Young Men*, *Who's Who in Commerce and Industry*, *Who's Who in Engineering*, *American Men of Science*, *Who Knows—and What*, *Directory of American Scholars*, *Leaders in Education*, *American Women*, *Current Biography*, *Current Biographical Reference Service*, the monthly supplements to *Who's Who in America*, and regional *Who's Who* volumes.

advance did it make over previous processes, mechanisms, or theories? Your tendency may be to laugh at *The Rocket* or Hancock's steam carriage or the phlogiston theory. Conquer the tendency, remembering that a century from now some of our own devices and methods and beliefs may easily seem just as quaint.

PRESERVING INFORMATION

Sometimes you must interpret, evaluate, and record almost simultaneously. This is necessary during most interviews, on most inspection trips, and whenever you listen to lectures that will not be repeated or reprinted. But usually you have time and facilities for at least a preliminary weighing of sources before you save part or all of them.

What you decide to keep you can sometimes preserve in the form in which you received it—a set of minerals or fossils or drill-cores; working models; questionnaires; letters; reprints of short articles; photostatic copies; maps, charts, diagrams. But for two reasons you should generally “reduce” most of this material. First, a lender may call back originals before you are through with them. Second, the originals usually differ so much in form and size that you cannot arrange them systematically.

Once you have decided to reduce, you must decide how to transcribe information of two kinds:

1. Data concerning the nature and—whenever it seems desirable—the trustworthiness of the sources themselves.
2. Data drawn from the sources.

Data of the first sort are typified by library cards, by entries in indexes, and also by the overview section of a descriptive report. What they do is to describe the location and nature of a source fully enough so that your readers can get some notion of its worth and obtain it if it is still available.

You could, of course, describe each source of information at the head of each subject note that is drawn from it. But a separate set of descriptive notes is better. It speeds up the making of your subject notes, your acknowledgments, and your final bibliography.

Descriptive Notes. Descriptive notes answer such questions as these: What is this source? Who originated or compiled it? Where? When?

For the average interview, a descriptive note runs like this:

30-min. interview, Dec. 12, 1949, by C. J. Smith with Pres. K. B. Brown of the Intermountain R. R. Subject: Diesels in company's passenger service, 1936-46.

A lecture can be thus identified:

Radio lecture, “Wigwagging Mother Nature” (= geophysical prospecting), by Alfred Miller, editor *The Western Prospector* (Tulsa); Station WPQD, 8:00-8:15 P.M., 10-10-49. Reprints available.

Comparable records of printed sources (bibliographical notes) take several forms. The following will usually serve:

Joseph Black, *Diesel Engines*. New York: Harper. 2d ed., rev. and enl., 1946. Pp. xi, 652. 48 diags., 12 charts, 3 photos.

American Welding Society, *Welding Handbook*, 1938 ed. New York. Pp. 1211.

John Jones (prof. marine engineering, Eastern Polytech), "New Applications of Marine Diesels," *Mech. Eng.*, 56:1201-05, Oct., 1946.

Anon., I Was a "Gold Bug." *Family Mag.*, Jan. 2, 1947, pp. 6 ff. (vol. 34).⁸

Further descriptive data that you sometimes need to include are the date of the first edition of a book, titles of main divisions or chapters, and captions of illustrations and/or tables.

A descriptive note may also carry evaluations of the source—your own or somebody else's. If they are not your own, you will of course have to tell whose, and where you got them.

Give each descriptive note a number.

Subject Notes. A subject note consists of data, not *about* a source, but *from* it.

Some people make subject notes on small slips. But to facilitate filing, it is better to use 8½ by 11 sheets. Even so, some "originals" such as maps or legal documents may be still larger. In this case you may have to set up two files and insert cross-reference sheets that will guide you from one file to another.

A rather complex subject note follows.

Mich. Upper Peninsula

Lumbering

Source: 19; pp. 372-73. Note taken 12-23-49

A leading industry, mid-80's to World War I. Some pickup during World War II. Even now, *little cutting on sustained yield basis*.

J.T.S. [But write U. J. Noblet for latest dope.]

"Accurate data on output are unavailable for the years before about 1905. Examination/ of company records that have survived . . . may yield more information than we now have."

Exploitation and "butchery" not as great as usually said. But several companies in eastern part of U. P. guilty of waste. Forestry schools and Service much concerned during and after T. R. period.

You observe that the note bears a title—"Mich. Upper Peninsula"—and a subtitle. In addition it does these jobs:

1. It identifies its source by referring to a descriptive note to which the

⁸ The last two notes differ somewhat in form because *Mechanical Engineering* numbers its pages consecutively throughout a volume, whereas the other journal starts each issue with page 1.

- note-taker has given the number 19 and also by enumerating the specific pages of that source from which this subject note was drawn.
2. It puts within quotation marks all words left in the language of the source.
 3. It inserts ellipsis dots (. . .) to show that the note-taker omitted some words within the material he quoted.
 4. It uses a diagonal bar to show where the quoted material breaks over from one page of the source to the other.
 5. It paraphrases most of the source.
 6. It identifies the note-taker's own comment by putting it within brackets and by placing his initials in the margin.

Subject notes may also contain an outline of the source or parts of it. The combined topic-and-sentence form (see pages 159-160) is usually the best. If it gives you a note occupying several sheets, you should identify each sheet and staple the whole group together.

Filing Systems. A filing system that suits one person seldom suits another. Develop your own. You can get useful suggestions from Holmstrom, pp. 209-224; S. J. Wanous's *Modern Secretarial Training* (1938); and occasional articles in engineering magazines. A selected list of about forty references is *Filing Systems for Engineering Offices*, issued by the Engineering Societies Library, 29 West 39th Street, New York.

SKILL IN READING

Most of us read inefficiently. The reason is plain. Reading is not one skill, it is many skills; and both to master these singly and to dovetail them effectively takes much energy.

You need to learn six operations:

1. Handling books and other documents as physical instruments.
2. Taking an overview of a document.
3. Using a document merely for reference.
4. Skimming.
5. Fast consecutive reading.
6. Thorough consecutive reading.

Handling Documents. You handle specimens, microscopes, and transits adeptly. You can become just as fast and accurate in handling a book or magazine or pamphlet. Your speed will increase as your own experience in writing reports and articles teaches you how these kinds of communication are most commonly arranged, but even now you can benefit from several drill sessions.

Practice turning quickly to some numbered page in a large document. Then flip as quickly, first to specific entries within a volume arranged on an alphabetical basis, and then to entries within volumes that are arranged chronologically. Learn to "spot" various parts of a complex

report—letter of transmittal, preface, glossary, bibliography, index. Your next drill can be to locate some entry that you are sure the index must contain and then to turn at once to the cited passage in the body. Last, see how quickly you can open at a specific chapter in a document that is arranged on a familiar topical basis.

Surveying a Book or Magazine. Many printed and typed documents, however, will follow an arrangement of topics that is not familiar to you. For this reason you should learn how to survey quickly *any* printed or typed source of a kind that you will use often.

Do at least these things:

1. Read the title page with care. If the title is metaphorical or is based on a historical, Biblical, or literary allusion, you may have to use Bartlett's *Dictionary of Quotations* or an encyclopedia.
2. Note the length of the document. Does its title promise more than you think can be given in the number of pages the author used? If so, look for indications that either he is trying to give much sound information in a small compass or, on the other hand, that he doesn't realize how big his subject is.
3. Observe:
 - The date of publication.
 - The date of copyright.
 - The number of the edition or impression you are using.
 - The names of the author, sponsor, contributors, and other "originators."
4. Observe how probably useful the table of contents will be.
5. Sample-check the index for fullness and accuracy.
6. See what other aids the book offers you—bibliography, glossary, appendix, etc.
7. Read the preface and the introduction. These "preliminaries" are especially important if the book has no index. The average dictionary and many biographical directories use the preface to state clearly the bases on which their entries are arranged. If you disregard the preface, you may never use the book well.
8. Sample the text. Observe the system of headings, the list of illustrations, and such accessories as footnotes and the use of italics and bold-face (blackface) type.

At times you will have to take the further step of looking up, in biographical dictionaries and professional directories, the author and the sponsor.

To begin getting acquainted with a magazine, examine the cover; the title page; the "masthead," which sets forth the publisher, place of publication, and staff; the list of advertisers; a few advertisements; and (by sample-check) the text and illustrations. Notice to what extent the mate-

rial is departmentalized. See whether the entries comprising the table of contents are similarly departmentalized, as in *Life* and the *Mining Congress Journal*, or whether they follow the order of the material in the body. And note whether the table of contents lists the illustrations.

Using Documents for Purposes of Reference. When you are using a document merely as an occasional reference source—when you are drawing from it a few single facts and opinions or small bundles of fact and opinion—the manipulative and inspecting skills that have been named may be all you need. Generally, though, you should keep three cautions in mind:

1. Use with care a propagandist or promotional document.
2. Note when the document was published—it may be out of date.
3. Remember that even a good reference work may contain some printers' errors and some slips of the pen.

Skimming a Document. Many documents contain more than just a few useful data and yet need not be read in detail. The skills that have been mentioned remain valuable but must be supplemented. In particular, you must train yourself to "spot" key chapters and sections, and basic generalizations. And you must learn to do this when the document lacks aids that you have a right to expect—table of contents, index, tabulations, etc.—and even when it is arranged on a plan much different from that which the ordinary technical report or article follows.

By recollecting what you know about the subject matter you should be able to infer what the key chapters and sections will be, and even where you will find them. Then go a step further. Infer where certain basic generalizations will be placed. You can guide yourself by remembering that most able writers follow some one of the standard methods of organizing their material. This means that if the document begins with a specific example or a challenging question, its basic "message" may come just after the attention-arousing passage or else at the very end. Again, many argumentative books or articles summarize their main contentions or recommendations on the last page or so.

You can make other useful assumptions:

1. That the writer has observed the principle of proportion, so that the topics and propositions that get the most space are the major ones.
2. That words and phrases which he defines fully, and those which he defines at the beginning of his write-up or any main part, are basic.
3. That reiterated facts, beliefs, sentences, phrases, and single words are almost sure to be important.

Rapid Consecutive Reading. Ability to skim overlaps with ability to do rapid consecutive reading, the sort that is desirable when you must draw upon the details of a document as well as its generalizations but

think that it deserves little time. To the skills already explained you should add two others.

Anticipating the Writer. One is to infer how a writer will probably develop a topic or a topic statement. He may do so in a number of ways: by definition, classification, repetition, specific instances, enumeration of properties or of advantages or disadvantages, or comparison and contrast. He may employ these methods now singly and now in combination. Thus, he sometimes follows his positive definition with a negative one which in turn leads to a formal contrast by means of a specific example, perhaps anecdotal in form. The fast reader identifies these and other ways of expanding upon a major statement, and jumps across such passages—for instance, repetition due to emphasis only, and many anecdotes or other examples—as he feels he need not read in full.

Stepping Up Your Reading Pace. You should be able to read simple general passages at a gait of at least 400 words a minute. If you can't, expect to put in some long, hard practice.⁹

Much of the secret lies in rapid eye movement. But you may have to precede the attempt to gain this by learning not to make needless body movements. Get some friend to observe whether your lips, tongue, jaws, or forehead moves as you read "silently." You may find that you can suppress needless motions as soon as you learn you have been making them. More likely, for three or four weeks you will have to clench your jaws, keep your tongue between your teeth, or hold your hand tightly over your Adam's apple or your forehead.

Then find how many jumps your eye makes as you read a line about four inches long. The eye does not make a smooth sweep, but fixes briefly on one point in a line and then jumps to another. Get some observer to face you across a table containing the document. Have him watch closely as you read, at your usual pace, a number of lines—preferably those toward the top of a page, so that your eyelids won't obscure his view of your eyes. Thus the observer can see how many fixations you make per line.

If your eye span is less than an inch, increase it. You can use a cardboard templet with a rectangular aperture an inch long and deep enough to permit you to see the white space above and below the printed words

⁹ It is assumed that you have no serious uncorrected visual defects and no other handicaps that might affect your eyesight adversely. If you do have such defects, go to a clinic where you can get the services of neurologists and psychologists as well as of ophthalmologists (see E. A. Betts and Violet Dorris, "Visual Problems of Reading Clinic Cases," *Optometric Weekly*, 33:1777 ff., August 26, 1948).

Several guides to effective reading have been published, among them C. T. Gray, *Deficiencies in Reading Ability* (Boston, 1922); James A. Hamilton, *Toward Proficient Reading* (Claremont, Calif., 1939); and Heiss, Obourn, and Hoffman, *Modern Methods and Materials for Teaching Science* (New York, 1940), pp. 80-87.

of the line. Mark off the line into one-inch intervals. Move the templet quickly from one to another. Thus you will learn to take in an inch of type with every glance. Move the templet faster and faster as you improve. This drill will be of special help if your eye regresses—goes back to a word or phrase on which it has already rested.¹⁰

Now move your eyes smoothly and quickly from the end of one line to the beginning of the next. Don't let your eyes dwell on the last fixation point in a line. Also, practice a one-point landing—move from the end of one line to the very beginning of the next line and to no other point.

Once you have mastered this movement, read only about 85 percent of each line: withdraw your eye from the type at about the fifth space in from the right of a four-inch line and fix it again on the fourth or fifth space from the left of the next line. From what your eye does see, you can infer with sufficient accuracy what it does not see.

Intensive Consecutive Reading. When the subject matter is technical, you must proceed somewhat differently.

Wanting to Read. The physical, physiological, and psychological skills already discussed will not help you much unless you honestly wish to learn by reading. You yourself may prefer to learn by doing, inspecting, listening. Don't let the fact that some people overestimate the value of reading cause you to go to the other extreme and neglect it. Ability to read well is essential in engineering work.

Reading Pace. Reading in specialized subject fields must nearly always be slower than general reading. For complex technical documents, 150 words a minute is good. If you aren't reaching that speed, take a few engineering publications that are of medium difficulty for you. Start with those which have no equations or complex tables. Read them at a gait that permits you to get the meaning thoroughly. A few days later, quiz yourself to see how well you have retained. Read the document again. When your retention reaches what you think is par, measure your reading speed. Then get someone who is better grounded in the subject matter of the document to do as you have just done. See how much faster than you he has read for successful retention. Work to reach his pace.

Devise similar ways of measuring your best speed for material that contains maps, curves, tables. Then tackle material that contains a good many formulas and equations, realizing that "the mere perception in-

¹⁰ The templet may cut a word at a queer place, e.g., *tu/rbulence*. You may therefore prefer to adopt the methods described in Norman Lewis's *How to Read Better and Faster* (New York, 1944), pp. 47-82.

volved in reading formulas makes a greater demand on the eye than reading either scientific prose or mathematical narrative.”¹¹

Of course, pay full attention to headings, subheadings, italics, black-face type, index fingers, and marginal instructions like “Action” or “Annexes Attached.”

The Basic Operations. In thorough consecutive reading, make your first job the same as you did in skimming or in rapid consecutive reading—ascertain just what the document is. Next, compare and contrast it with similar documents and with other sources of information. Third, fuse its “values” with your own experience. Finally, apply what it teaches you.

Just as an experienced engineer compares and evaluates a machine or a product as the same time that he describes it, so an experienced reader performs several of the operations simultaneously. But if you are still an apprentice you had better separate them. Make sure you know the “what” and “how” of a document before you compare it with other sources of information, before you decide how well it does its job, and before you determine how much it can do for you.

Obviously, in thorough consecutive reading you answer the same over-view questions that you do when you use a book merely for reference or when you skim it. Now, though, you should base your answers not only on a knowledge of the framework of the document, but on an intensive study of it. Pay special attention to all statements and clues concerning the intended user of the document, its form, and its functions. Be specific. Don’t stop with saying, “This is a report.” What kind of report? For whom? Aimed toward what action? How sketchy or how full?

Note the purpose of all tables and illustrations. Read the body of the text in close conjunction with them and with footnotes, glossary, and appendixes. If necessary, go to the works cited in the bibliography. Find the author’s word plan. That is, note whether his phrasing is technological, commercial, academic, colloquial, humorously illiterate, unintentionally illiterate. Watch for ironical passages.

To follow these suggestions will assure a competent descriptive reading of many documents. But not of all. In case you are one of the many people who can see the framework better than they can grasp the details, you will have to solve problems of vocabulary and sentence structure, to which we now turn.

1. When you master a document, you know among other things the

¹¹ Bernice E. Leary and W. S. Gray, “Reading Problems in Content Fields,” in W. S. Gray (ed.), *Reading in General Education* (Washington, 1940), p. 148, based on M. A. Tinker in *Genet. Psychol. Monog.*, 3, No. 2, February, 1928, pp. 69-182. *Reading in General Education* was sponsored and published by the American Council on Education.

bare factual or logical meaning—the *denotation*—of every word, phrase, sentence, paragraph, table, and illustration.

To get the denotation isn't always easy. For one thing, most languages contain homonyms. These are words with different meanings that are spelled and pronounced alike—*sound* and *bear*. You can also get tangled in like-sounding words that are spelled differently—*taut* and *taught*; *cite*, *site*, *sight*. Some people even stumble over words which when correctly heard offer no problem—*mainly* and *namely*, *taut* and *taunt*.

A greater source of difficulty is the word which, from one root meaning, has developed a number of meanings. Examples are legion: *dry*, *head*, *check*, *bridge*, *make*, *bar*, *mind*, *compose*, *delivery*, *get*, *bore*, *value*, *idea*, *democracy*, *flux*, *refractory*, *obtain*, *profession*, *engineer*. Some of these, and many more, possess both active-voice and passive-voice meanings. *Collection*, for example, means “the act or process of collecting,” but also “a heap—or a systematized group—of things collected.” *Institution* can mean “the act of establishing,” though it more commonly has a passive-voice significance. Compare “The institution of this program will require much effort” with “The First National Bank was from the beginning a sound institution.” Finally, observe the difference between “The criminal spoke of his first arrest” and “The detective spoke of his first arrest.”¹²

You must know the difference among synonyms—*comprise*, *consist*, *compose*; *occur*, *happen*, *take place*; *consider*, *consider as*, *regard as*, *look on as*. You must know what distinguishes *imply* from *infer*, *factor* from *characteristic*, *phase* from *aspect*, *continuous* from *continual*.

You should also be aware of regionalisms in your vocabulary. Miners of the Tri-State area use *dirt* for *ore mined*, and *concentrate* for *ore*. In Newfoundland a shafthouse is a *deckhead*. You yourself may prefer these terms, but you should realize that most formal documents use the standard nomenclature.

Collocations and idioms may also trip you. A collocation is a group of words that must be learned as a unit (*go home*, *battered side up*) but whose meaning you can infer from its components. An idiom is a group of words whose meaning you cannot infer—*to put up with*, *how do you do*, *look out*.¹³ To interpret collocations and idioms you must take into account

¹² Strictly, all words have more than one meaning. Otherwise, since everything we can symbolize in words is changing, we'd have to discard a word once we used it. Whenever in ordinary speech we must emphasize flux and transformation we say something like “The Stonewall Jackson of Gaines's Mill was not the Jackson of Port Republic” or “He isn't the Bill I knew” or “He isn't the man he was.”

¹³ The distinction here made between a collocation and an idiom comes from an article by Michael West in *The English Literary and Educational Review for Continental Readers*, Summer, 1936. Some of West's examples have also been borrowed. His definition is somewhat too narrow, since it does not cover such idioms as “I was good friends with Smith,” but it will do for most purposes.

the author's background, the context in which he uses the expression, and particularly his audience. *Make-up* means something different to a woman from what it means to a printer. *To make up* adds still other senses. *Powder compact* conveys dissimilar pictures to a metallurgist and a young girl. Generalizing, we can say that meanings differ somewhat as between the sexes, more from generation to generation, and often greatly from region to region, trade to trade, profession to profession, class to class. In grasping the details of a document, be alert to these differences.

Standard but rather uncommon word orders may bother you. You may miff the meaning of a sentence that begins in any but five or six ways. You may likewise have trouble with "We have submitted to the council a plan which . . ." and with "This cost once determined, . . ." The only cure is wider, more attentive reading.

2. Denotations, we have seen, can prove puzzling. A still greater cause of inaccurate reading is ignorance or misunderstanding of connotations. *Connotation* is what a word, phrase, or other verbal element suggests, rather than its bare factual or logical meaning. Denotatively a *kid* means a child to most of us. But we can't use it that way when we write or speak formally. It connotes an attitude that jibes poorly with the occasions which demand formal diction. Or consider *childlike* and *childish*, *manly* and *mannish*. The first word of each pair implies praise; the other, censure.¹⁴ Another example: as later chapters point out, the ordinary "letter of transmittal" is really a letter of submittal. Why don't we call it that? Because to most Americans the unfavorable connotation of *submit* carries over to the noun. True; we are aware that it is *submission* rather than *submittal* which keeps the worse denotation of *to submit*; all the same, we shun *submittal*.

Rather, most of us do. But men who are used to *submit* in its neutral meaning don't balk at *submittal*. Their daily work influences their reaction. Lawyers seldom use *liable* except for an undesired contingency, and most psychologists interchange *likely* and *apt* only when referring to personal abilities. *Exploit* is distasteful to many laymen because they take it to mean waste, greed, or brutality. Some military terms that denotatively are unobjectionable have unhappy connotations (*holding attack*).

Nor is it only our jobs that affect us. Our attitude toward various

¹⁴ Eventually, most changes in connotation cause changes in denotation. *Soon* once meant *immediately*. The latter word is now often used to mean "when I get around to it." Hence, *right away* and *directly* tend to move into the vacant space. But they in turn will probably come to mean *sometime*. Such is human laziness. We might also mention the shift in the connotation of *knave* and *villain* some centuries ago—a shift followed by a change in their denotation.

connotations as well as toward denotations varies somewhat from region to region and group to group. Obvious examples are *lad*, *lass*, *lady*.

Reactions also vary from person to person. Some people are very strongly affected by certain words.¹⁵ Each of us should therefore beware of the peculiar connotations he gives to certain words and "chisel out his own irrelevant reactions"¹⁶ whenever he is reading or listening. For example, you may prefer *recommend* to *suggest*. Don't let your preference keep you from grasping what a writer or speaker intends to say.

Not only single words but collocations, idioms, grammatical constructions, and some word orders have their connotations. "Up to" in "it's up to you" was long considered slang and still is informal. On the other hand, "were he not," "had he gone," and similar inversions are formal. "Would of" and "if he would have gone" have a tinge of illiteracy. "This needs doing" is old-fashioned.

A whole paragraph or section or document may have its connotations. One of the factors that give a specific tone to these units is the vocabulary. A vocabulary that is thin and meager does not imply businesslikeness; it implies lack of opportunities or a slovenly failure to take advantage of them. A second factor is cadence. To many people a rolling swing connotes insincerity, and a stubby, jolty style connotes narrowness and egotism.

The extreme of connotation is found in what are called figures of speech—those words, phrases, passages, and sometimes entire compositions that are intended to mean something much different from what their denotation conveys.

What attitude should you take toward a passage that seems to offer excuses, to be servile, to brag, or to be insincere? Prudence tells you, "Analyze the offending words to find their psychological source." They may of course come from the writer's character weaknesses. On the other hand, they may come merely from his thin vocabulary, his blindness to connotation problems, his professional greenness. And perhaps they come from your own thin-skinnedness.

In what parts of a report must you scrutinize connotations most rigor-

¹⁵ "So common is this tendency to evaluate names as names, that psychologists have been able to demonstrate that practically anyone, *in our culture*, reacts more or less profoundly to isolated words. Psychologists have developed an instrument which they call a psychogalvanometer, and they use it to record changes in electrical skin potential. Records taken by means of this instrument show that it is very common, even for so-called educated people, to undergo changes in electrical skin potential in response to hearing or reading isolated words such as *mother*, *blood*, *love*, *blue*, etc. A considerable change in electrical skin potential in response to such a word represents, after all, a rather profound organismic evaluation of the word."—Wendell Johnson, *People in Quandaries* (New York, 1946), p. 261.

¹⁶ L. C. Zahner in W. S. Gray (ed.), *Reading in General Education* (Washington, 1940), p. 110.

ously? In general, in the statement of conclusions and the discussion of recommendations. These parts often contain emotionally charged words which, for purposes of evaluation, you must "step down" to neutral and factual words.

In grasping the meaning of a document you can go further than you may believe, by applying your general and professional knowledge and letting one part of the document cast light on another. However, you will doubtless still have to employ special reference books.

A good dictionary is an invaluable aid. Properly used, it will give you most of the usual denotations of a word, will offer clues to the connotations, and may even help you interpret figurative uses. It is not, though, a wonderworker. You must know how to choose a dictionary and how to use it.

First, distinguish between general and special dictionaries.

Among the general ones there are unabridged volumes, such as *Webster's New International*, the *New Standard*, and the *New Century*. Get the latest edition or revision. Of abridged dictionaries the best are *The American College Dictionary*, *The Shorter Oxford*, *New College Standard Dictionary*, *Webster's New Collegiate*, and *Barnhart's College English Dictionary*.¹⁷

Special dictionaries are of four kinds—prescriptive, historical, geographical, and professional. Some prescriptive dictionaries—manuals of "good usage"—are untrustworthy. You can, however, usually get good guidance from *Fowler's Dictionary of Modern English Usage* and *Perrin's Writer's Guide and Index to English*. Use also *Crabb's English Synonyms*, *Fernald's English Synonyms, Antonyms, and Prepositions*, *F. S. Allen's Synonyms and Antonyms*, and *Webster's Dictionary of Synonyms*. Among the historical dictionaries, the *New English Dictionary* (the Oxford) and the *Dictionary of American English* are standard. You will have little need for dictionaries of regional terms and pronunciations. More useful to you will be some of the professional dictionaries, such as *Grant's Chemical Dictionary* (2nd ed., 1937), *Dickinson's Plastics Dictionary* (1948), *Chambers' Mineralogical Dictionary* (1948; 47 pages), *Rice's Dictionary of Geological Terms* (1940), *Cooke and Markus' Electronics Dictionary* (1945), *Alsager's Dictionary of Business Terms* (1932), and many more, including *Dictionary of Applied Physics* (1922-23; 5 vols.).

Keep up also with the periodic reports made by the committees on nomenclature and definitions appointed by national engineering societies. You will find indispensable the recommendations of the ASTM.

To choose wisely is not enough. You must use wisely. Read the dictionary's instructions and explanations. Observe the order in which it

¹⁷ In *College English*, 10:214-221, January, 1949, James B. McMillan compares the five leading "college dictionaries."

gives meanings. Some dictionaries present first the earlier senses of a word. Other dictionaries lead off with the contemporary senses. In addition, read the table of contents; many dictionaries give an amazing amount of information.

Part of the job of using a dictionary wisely is to know at what point in your reading of a document you should look up unclear words. Guide yourself in large part by your own temperament. Some people can follow the common advice, "Read along steadily, inferring the general meaning as best you can, and resort to the dictionary or other reference book only after you have finished reading some large thought unit." But many engineers feel insecure when they try this method. They prefer to look up each doubtful word as they come to it, and then to reread.

SPECIAL READING PROBLEMS¹⁸

Writers' Weaknesses. Many of the technical documents you read will be poorly written.

Verbal unclearness is commonest in definitions, static description, and orders (including directives, notifications, and instructions).

To clarify obscure definitions, do three things. Use technical dictionaries, glossaries, and encyclopedias. Study books and articles that may give a better definition than the document you are reading. As a last resort, turn the definition into a sketch.

Use this last method also whenever a description of something at rest is poorly organized or poorly phrased. Try to clarify the meaning by drawing an overview diagram or map, preferably three-dimensional, on which you can sketch the details that the author failed to convey clearly. When some facts are still doubtful—for example, when you can't see just how one part of a machine or area is physically connected to another—you will have to go beyond the document and get external evidence.

When orders are unclear, find out all you can about the situation in which the order was issued, the kinds of action that seem most logical, and the status and temperament of the writer. These facts, and inferences from them, will often point sharply to one interpretation. In an emergency you should act on that interpretation, with willingness to take the consequences. When you cannot formulate one interpretation, act on what seems to you the least improbable.

Incompleteness is commonest in orders, definitions, statements of a problem, predictions, and recommendations. Your remedies include the procedures named above, because you can often remedy unclearness

¹⁸ For a fuller discussion than space permits here, see C. M. McCullough and others, *Problems in the Improvement of Reading* (New York, 1946), pp. 276-278, 285-293, and 363-392.

and incompleteness in the same way. But skimpy predictions and recommendations call for more work. Reread the body of the document; then you can ordinarily infer what the writer meant his forecasts and counsels to be.

Check all definitions for exceptions. Remember that a definition may be too large, as when *cap* is made to include helmets. Or it may be too narrow, as when the definition of a triangle includes "all whose sides are equal." Next, reduce definitions of abstract terms to the concrete. Think of specific persons or things to which the definition would apply if it were wholly accurate. When thus tested, does it stand up? Last, ask whether a definition that was true once is true now.

Against honest *ignorance* the experienced engineer generally has ample protection; he can tally doubtful data against his own stock of facts, his awareness of probabilities, his knack of interpreting character. But novices should resort to external evidence by checking the document against other sources of information.

Misrepresentation may be harder to discern than ignorance. It is commonest in statements of problems, evaluations of personnel, conclusions and recommendations. To safeguard yourself, do four things:

1. Retrace all mathematical steps taken by a writer in leading up to his valuations and predictions.
2. Ask whether the formulator of a problem, conclusion, or recommendation could benefit by getting you to accept his phraseology.
3. Check denotations and connotations. Be skeptical of passages that are highly rhythmic or that contain abstract words which have several meanings. Watch words whose meaning changes from one occurrence to another.
4. Test for such logical flaws as basing an induction on samples which are too few or are unrepresentative, evading the question, "begging" the question, the false dilemma, and false analogies.

Readers' Weaknesses. A young reader is as likely as a writer to be responsible for misconceptions, faulty judgments, and misapplications. Besides, everyone finds certain kinds of technical writing hard to grasp. Troubles due to readers rise mainly from six sources: ignorance of technical terms, impatience, too much rereading, rote memorizing, failure to correlate text and illustrations, and a natural tendency to see the universe in terms of one's own language. Let's treat these briefly.

When you go to a new job, learn the special meanings of all key terms—*section* and *region* in geology or *interval* in military practice. Get straight regarding terms with several meanings, such as *group* in mathematics. Guard against confusing such words as *convex* and *concave* or *photomicrograph* and *microphotograph*.

Realize that impatient reading generally comes from a subconscious

fear of delay or failure. Remembering that most superiors expect you to take ample time for the study of any technical documents, you can master the fear.

Fear is also to blame for much needless rereading. Read only once any simple order, problem, or set of instructions; act on your immediate interpretation. In this way you will soon overcome your fear.

Much rote memorizing is related to haste and to stalling, in that it, too, may come from anxiety neuroses or from resentment. Unwilling to admit that these exist, your subconscious prompts you to seem very meticulous. If this is your disease, proceed as above with the cure. Some people, however, become parrots for a different reason—because they are slaves to words. They can answer questions couched in the exact phraseology of an order, notification, definition, or problem; but if the wording is changed they are lost. Their cure requires the help of friends who will vary the phrasing and sentence pattern of test questions. For instance, to check on your grasp of a positive order a friend may put it negatively—“What road is the battalion *not* allowed to take?” “Which process must we avoid?” The largest group of parrots are people who cannot distinguish between main points and details. Their remedy lies in making frequent oral and written abstracts for friends or instructors to check, and in skimming simple documents of many kinds until they can unhesitatingly “spot” the statements of purpose and scope, the main factual findings, the main conclusions, and the recommendations or commands.

People who don't correlate text and illustrations well usually have a subconscious preference for one medium of communication over the other. Bringing this preference out into the open and overcoming it will commonly enable them to tie their reading closely together.

Last of your major weaknesses as a reader is one you share with every other human being. This is the likelihood of getting entrapped in the grammar of your own language. This does not mean such relatively superficial things as not knowing whether to say *broadcast* or *broadcasted*, *seen* or *saw*. Something much more fundamental is involved—the unconscious assumption that the outside world is perfectly mirrored not only by our vocabulary but by the grammatical structure of our own family of languages. English and related tongues use abstract nouns freely. We easily slip into thinking that an external, tangible substance corresponds to each of these abstractions. (You can readily trace the process by which we make this mistake.) So we often look for a material thing when we ought to be looking for a process. It has been said that the science of thermodynamics was held back for a century by the fact that in English and its cousin languages *heat* is a substantive. Scientists therefore went looking for a substance. We all do the same sort of thing every day unless we stay on our guard. Take another example. People who speak languages

that sharply separate the present, the past, and the future tense of the verb have often gone astray in their scientific thinking because they conceived of time as three things or even persons instead of as a continuum abstracted from experience.

Much more could be said about how to read effectively. But if you put to use the advice given above, you will find that you will gather many kinds of data more readily and accurately than before. You will also find that you will write more efficiently. By and large, the way to learn to write is to use your own eyes and ears, and then to write and write some more. However, it's no secret that a wide and attentive reader is usually a careful and precise writer as well.

EFFECTIVE LISTENING

Few scientific data concerning the characteristics of the listening process have been gathered. Empirical knowledge, however, is sufficient to help you considerably. Much of what is known about effective listening you can apply now. The rest you can put to use after you have done a good deal of public speaking, for listening and speaking are reciprocals.

Wanting to Listen. As with inspecting, reading, or making tests and carrying on experiments, so with listening: You must want to do the job. You must believe that the other man has things to say which it will pay you to hear. You must be willing to let others talk.

Preparing to Listen. Besides, you must get ready in advance whenever you can. It is assumed that you have no correctible hearing defects, and also that you try to obtain good conditions for listening—you sit or stand fairly near the speaker, you try to avoid poor lighting and poor ventilation, you stay at ease but alert, you face the speaker and keep eye-and-ear contact with him.

This is only the beginning. In fact, it's a step beyond the beginning. For, as soon as you know you are to hear a talk or a lecture, you should take stock of your present information. What have you already in mind that may complement, supplement, or correct what the speaker is likely to tell you? Decide—but not too rigidly—in what way you will preserve the speaker's remarks: in your memory alone; by sketch, map, chart, or table; by word-for-word record; by outline; by such digests as are discussed in a later chapter. Bear in mind two other things. One is that we must visualize much of what we hear. The second is that superiors may test our understanding by having us do a job that has been orally explained to us. You must prepare for these contingencies.

Whenever you are to hear a formal talk or hold a scheduled interview, find out ahead of time all that you can about:

The situation or occasion.

The speaker's position, personality, motives.

The kind of action to which the talk may lead.

Its general subject matter.

Then decide what physical aids you should bring—cards, notebook, pen, pencils, protractor, ruler, compass, templet, maps.

If you have to preserve the talk in your memory alone, fix in mind the who, what, when, where, and why. If you use cards or a notebook, record these data in advance—the who, what, when, where, and why of the talk.

Below these, leave a space for the speaker's subject sentence. As we shall see (Part V), many descriptive talks and some other sorts have no subject sentence; neither you nor the speaker can condense his material into a few words. Moreover, a speaker may not give his audience a subject sentence even when he could do so. But most talks contain—at or near the beginning, at or near the end—a summary that either is a short sentence or can be readily phrased as one. Be sure to get this down in your notes.

Giving the Speaker a Fair Deal. As you listen, deal honestly with the speaker. Begin with the assumption that he is sincere and informed.

Overcome the universal tendency to hear only what you would like to hear. Record what goes against your grain as well as with it.

Don't bury yourself in note-taking. Attend to the whole man, not merely to his spoken words. A related recommendation: Disregard small flaws in his diction, grammar, and delivery. A sincere speaker is bigger than his necktie, his shoes, his stance, his gestures, his pronunciation, or any trivial errors of fact in his illustrative remarks.

Attend not only to the speaker but to your previous knowledge of his subject matter. As you listen, recall actively what you know and have thought about his topic.

Improving on the Speaker. Some speakers are vague, others are inaccurate, a few—fortunately a very few among those whom you are likely to hear—are dishonest. If you do encounter a speaker who tries to mislead you, paraphrase his words. While you are listening, attempt to translate his illegitimately emotional expressions into neutral ones. Blank out any prejudiced adjectives he uses, and any name-calling appeals to passion. If he is unusually persuasive, you may have to shut your eyes and withdraw yourself as much as you can from the influence of his bodily and facial gestures and of any stage-setting tricks he may employ. You will nearly always have to reword his subject sentence; you may have to reword his whole talk.

Taking Notes. As has already been said, "Don't take too many notes." To discern the organization and proportioning of a talk, watch the speaker's face and gestures. Note his pauses and intonations. You can't do these things if you keep scribbling all the time.

Decide in what physical form you will take your notes. Loose-leaf note-

books have some advantages, particularly when you are to file lecture notes with those based on other sources (see page 27) and when you outline a talk or lecture in some detail and at some length. Nevertheless, some engineers prefer 5 by 3 or 6 by 4 cards. Cards allow you to separate main points readily from minor examples, quotations, or statistics. They allow you to overcome flaws in the organization of the talk, for if the speaker has given some material out of its logical order you can quickly shift to their proper places the cards containing this material. A notebook is not so flexible. Finally, you can arrange the cards in different ways at different times to meet your changing needs.

Whether you use cards or a notebook, master the topic outline.

If you don't know shorthand, devise your own system of abbreviations.

Whenever possible, make out in advance a check list that you can fill in as the speaker talks. To do this, you will have to judge pretty accurately ahead of time what sort of talk you are to hear—the description of a machine, an area, a process; a report of tests; a definition and application of some principle or theory; and the like. Fortunately, you can often anticipate the broad outlines of a talk and therefore can make out a check list.

Curbing Your Impatience. Because language is one-dimensional, a speaker cannot give you at once all the parts of a description, an explanation, or an order. He is trying to present the details in the manner and sequence that will best suit the majority of his hearers. So you should merely jot down on cards or slips any questions you have and any additions you think the speaker should make to his data. Ordinarily you can destroy these cards or slips by the time the talk ends; the speaker will have answered your questions and filled in what you felt were gaps.

Using Your Mind's Eye. In listening to most talks you will have to make an effort to construct accurate pictures from the spoken word. Developing this ability requires drill.

1. At some time when your mind is fresh and you are alone in quiet surroundings, study a simple map or chart and then reproduce it from memory. Check to see what you left out, what you added, what you misinterpreted. Try it again. Keep on until your reproduction is exact.

2. Borrow a projector and slides. Let each slide stay on the screen for about thirty seconds. Reproduce it from memory.

3. Listen to a transcript of a talk by someone whom you have heard and seen in person. Learn to visualize him in the act of delivering the words to which you are listening. A variation of this drill is to close your eyes during the first part of a newsreel talk given by someone whose appearance and gestures are familiar to you, and then, opening your eyes, to check how fully and precisely you have visualized his delivery.

4. Recall the appearance of a simple machine or structure that you know thoroughly. Have someone read you a description of a different

form of it. Visualize what you have heard. Then check your accuracy by studying the sketches or photographs that accompany the verbal description.

5. Now you are ready to visualize *while* you are listening to a talk or lecture. You will often have to make a split-second decision whether to visualize in three dimensions, or in only two, any important "physical subject" that the speaker names. You may have to decide just as quickly whether you should visualize it to scale and whether you should put it within some physical "frame of reference." That is, when you visualize a machine, should you mentally place it within a shop or mine? In visualizing a building, should you try to see the streets, sidewalks, lawns, railroad spurs, and the like which surround it?

Of course, you are not left without help. An able speaker will tell you about scales, frameworks, surroundings. If he does as he should—gives an overview first, and then presents details in the order best suited to his subject—he will ease your job a good deal. But not all able speakers proceed in just the same way. One gives you the size of a machine before he names its working principle; another, just as experienced, does the opposite. You will, then, have to hold certain details in suspension in your mind until the speaker has finished his description.

Your hardest task is to visualize scientific and engineering principles, such as entropy. Any mental pictures of the operation of principles must be largely metaphorical. You cannot help translating impersonal forces, tensions, and motions into human behavior. When we try to visualize the force of gravity we can scarcely avoid recalling how our own bodies feel as we strain to lift or pull down a heavy weight. When we think of Newton's "sweep over equal arcs," many of us cannot wholly disregard the emotions of mixed strain and exhilaration implied by "sweep." A further obstacle is our knowledge that many abstract principles have been set forth provisionally; in fifty years, perhaps in ten, they may be revised. We should, then, realize that our mental pictures may be tentative and are beyond doubt limited.

Few people can visualize abstractions successfully while they are listening to a talk. Do the visualizing later, in quiet surroundings.

When you attempt the job, adjust the frame of your "photograph" to the principle you are visualizing. That is, decide whether for your purposes you should see the principle as operative in boundless space or, at the other extreme, as operative only in some one kind of machine.

Decide next whether you will better understand and apply the principle if you see it as operating in two dimensions, or in three.

Then face questions like these:

a. In what directions should you see the principle manifesting itself—upward, downward, inward, outward? Centrally, tangentially?

b. Should you see it as functioning continuously, intermittently, or spasmodically; that is, should you symbolize it as a straight line, a dash line, or an irregular line?

c. Is the process that you are visualizing a cyclical one?

d. Should you focus your attention equally on all stages of the process or only on certain stages?

e. If only on certain stages, which ones—the origin of the process, the end point, or the point at which the direction changes?

The last two steps in visualizing are not quite consistent with each other, and cannot be. The first is to find some familiar analogy—the endless belt, the wave, the growing tree, the skyrocket, the piston—that you can think of as similar to the intangible process you are visualizing. Then take away from this image all such properties as color, weight, and materials of construction. Whenever your image ought to be two-dimensional, your mind should finally retain a sort of symbolic line drawing or profile. Whenever it ought to be three-dimensional, you will find it hard to avoid turning a process into a substance. Some engineers can nevertheless do the job pretty successfully by thinking of the lightest, most transparent substance they know. Thus they can make a mental picture of something that is very nearly intangible.

(There is an excellent article that gives valuable counsel on the importance of listening, limitations of organization charts, and many other still more significant matters. You are urged to read it. It is F. J. Roethlisberger's "Efficiency and Coöperative Behavior," *J. Eng. Ed.*, 40:233-241, December, 1949.)

6. Reinterpreting and Reëvaluating Your Data

Your first interpretation and evaluation of data must often be rough and ready. In reviewing your notes, therefore, you will find some which are not reliable. Obviously, apply the standard tests for authenticity and credibility.

A still bigger job consists of seeing what all your data add up to when you put them together. Assemble them after you complete each unit of your data-gathering task, and again when you think the task is finished. On all these occasions, answer four questions:

1. Where do my data show:
 - Gaps?
 - Discrepancies?
 - Downright contradictions?
 - A conflict with the findings from comparable investigations?
2. Do the gaps, discrepancies, and contradictions call for changing:
 - The purpose of my investigation?
 - Its extent (scope)?
 - The order in which I do the remaining investigative jobs?
3. Can I consolidate some of my data by tabulating them, graphing them, or preparing verbal digests?
4. Does any one source of data say or imply all that is said in other sources? If so, can I safely disregard these other sources?

In answering these questions you must guard against four errors:

1. Denouncing opinions which themselves are irreducible facts that you should treat as "things given."¹
2. Showing prejudice against an organization because you dislike some of its executives.
3. Describing labor policies and conditions sketchily or partially.

¹ You may feel that the views of foremen or workers regarding a certain policy are mistaken and even dangerous. But if those views constitute part of the basis on which your company must act, report the views; do not denounce them.

4. Failing to examine an organization's own estimate of the extent, origins, and value of its good will and other intangible assets.

At this stage, too, scrutinize your notes from both a legal and an ethical standpoint. Lay aside all statements that are legally actionable or that seem unfair as you reread them.

Make a preliminary division of your material into three classes—that which you reject, that which should go into personal or organizational files only, and that which you think belongs in the report.

The average novice puts into his reports too much material of four sorts—pseudohistorical data, weak predictions, imprudent praise of some persons and firms, imprudent condemnation of other persons and firms. Material of this kind should be rejected.

Material that seldom belongs in a report but should usually be kept on file consists of confidential data, such subsidiary data as preliminary computations, accounts of facts found during an investigation which are important but do not bear on the immediate purpose, and suggestions for further study.

No matter how honest you are, you will be tempted at times to throw in with the foregoing material all facts that contradict your tentative conclusions. You must overcome this temptation. Your report must include an account of (1) everything which threatens the efficiency, safety, or profitableness of an operation that you favor; (2) all developmental plans which are alternative to one that you yourself believe in; and (3) serious objections to a scientific hypothesis that you are trying to establish or confirm. The time to guard against your prejudices and temptations is at this stage—the stage of reinterpretation and reevaluation.

Be sure you know the distinction among facts, conclusions, and recommendations. Even though you are called upon for facts alone, phrase a conclusion or set of conclusions, and even a set of recommendations, which you can submit if asked to do so. Obviously, you will make sure that the conclusion must follow from the facts. (Reread the article by Hassialis, cited on page 12.) In engineering and industry your superiors must often act not on certainties, but on probabilities. Therefore some of your conclusions can properly take the form of "It appears" or "Under present circumstances" or "So far as can be predicted." Be completely honest in indicating the degree of certainty or uncertainty.

Then check your conclusions—and afterward your recommendations—against your analysis of the report-making situation and the action in prospect. Do they fit the situation? Will they contribute to the intended action or to a feasible line of action? If not, are there good reasons for the discrepancy? For example, did the superior who assigned the report to you misapprehend the real problem? Has the situation changed since you started work on the report? Has policy shifted during that time?

7. Adjusting to Your Readers and Hearers

Sometimes you can analyze a situation without also analyzing the people who want your report or who will take action on it. But usually the personal traits of your reader or hearer comprise a large part of the situation that faces you. To gather facts tirelessly, to draw logical conclusions from them, to prepare neat drawings and tables and text, to spell every word in the report as it is usually spelled nowadays, to write sentences that are varied and “correct”—all these accomplishments may be a waste of time if you don’t focus on your market.

This chapter offers general suggestions on focusing. Later chapters make more specific recommendations. Applying the suggestions and recommendations to each of your reports is your own responsibility.

The basic principle is efficiency, in the sense of demanding from your reader or hearer no more effort than you must demand. Make your report as easy to comprehend and act upon as you can.

This means that at one time or another you must familiarize yourself with a recipient’s knowledge, need for the report, interest in it, general interests, business and professional status as it is and as he thinks it is, motives, attitudes, degree of willingness to grasp the content and intent of your communication, and preferences for one or another kind of communication medium. Practically never do you need to know all these things in order to make one short report. But in the course of a year’s report-making you will almost certainly have to apply the whole list in your analysis.

ADJUSTING TO A SINGLE RECIPIENT

Remember that your recipient is something besides an engineer or a taxpayer or a sports fan. He may be all these; he is sure to be much more. This is why you frequently need to know more about his interests than you might suppose. A comparison drawn from his hobbies, perhaps even a figure of speech based on his interest in football or fishing, may appeal

to him more than a monotonously scientific or technological set of statements.

Just as obvious, and just as often neglected, is the fact that a man's interests and knowledge are two separate things. In fact, you cannot safely assume that a man's interest in a subject on which he has told you to report means that he is a master of that subject. He may know relatively little about it. Moreover, in many report-making projects you will find that the recipient needs to know more than he thinks he needs.

In gathering, organizing, and presenting your material, keep in mind the recipient's motives. Three powerful motives are "skin, kin, and cash." An appeal to these is legitimate. But don't neglect more highly socialized motives, such as pride in craftsmanship, concern for civic betterment, state and national patriotism.

Equally important, remember that the strength of motives may change. Here is a passage that influenced a company in 1946 but would not influence it today, with its sales dropping off sharply and its profits gone:

This expansion of the research program would be justified by one factor alone—the prestige it will give us in the industry. Our trade association, and the research firms which the association employs, are all anxious for us to undertake these investigations. It would be \$100,000 well spent.

Not a single executive of this firm would be moved, except to amusement, by such an argument today.

Temperament is more important than most young engineers realize. Some people are No-sayers. Their first reaction to any proposal is, "It won't work." When you report to most men of this kind you should postpone until the middle or end of your communication any open statement of the proposal. Start instead with facts and views that you know such a man will approve of. However, note that there are some No-sayers who should be handled differently—men who, after first saying No, lean over backward to be fair and to see the good points of the proposal. Give men like that the proposal at the start. Then wait—a minute or an hour or a month—for them to "come around."

Related to a man's temperament is his time sense. You will run up against some recipients who are too impatient, who expect a report too soon. You will have to give these people a preliminary or progress or stop-gap account that a less impatient person doesn't need or want.

Even these adjustments aren't enough. In addition you will often have to discover, and accommodate yourself to, the recipient's communication deficiencies. Ask these questions:

1. To what media of communication does he react unthinkingly? For example, does he automatically like (or dislike) bar charts, slang, slides?

2. Does he oververbalize, that is, does he write or talk too much and use maps, curves, gestures, and silence too little?
3. Does he make the opposite mistake of being too afraid of words?
4. Does he lay too much or too little stress on tangible costs and profits? (A weakness here may not seem like a communication deficiency, but it actually is one—and a serious one.)

“All this advice sounds O.K.,” you may say, “but how are we going to learn every one of these things about a man?” Unless you know him well personally, you can’t. You can, though, find out more than you may at first think possible; and you can make some pretty sharp inferences.

Here are four things to do:

1. Analyze the directives, orders, instructions, and letters of authorization governing your project, particularly those that your recipient has prepared or carefully revised. Such documents will tell you much about his needs, knowledge, interests, status, temperament, and preferences.
2. Examine reports similar to your own which the recipient has accepted previously. Use recent documents, to guard against the possibility that his knowledge, interests, and attitudes have changed.
3. Talk to his associates and subordinates, being careful not to appear to pry.
4. If you can, analyze business letters written or countersigned by your recipient. His personal letters will tell you still more about him, but you can seldom get hold of them.

Whenever the foregoing methods won’t work, you’ll have to employ indirect methods such as looking up your man in biographical directories. Employ those, such as *Who’s Who in Engineering*, that carry detailed accounts. They will yield clues concerning a man’s background, his general breadth or narrowness of interest and viewpoint, his hobbies, and what he regards as his big achievements.

You may have to lean still more strongly on inference. At times all you can do—but it often helps greatly—is to put your recipient into some category of which certain things are generally true. For example, executives as a group possess nearly a dozen traits, including:

The pleasure of accomplishment.

Acceptance of authority and of superiors’ directives.

Strong drives toward achievement, material rewards, and prestige—in that order.

Organizational ability.

Decisiveness.

Firmness of conviction and ability to resist outside pressures.

A constant drive to be moving and doing.

A pervasive fear of failure and a consequent need to overcome a sense of frustration.

Realism—interest in the practical, the immediate, and the direct.

Tendency to identify themselves with superiors and to look at subordinates impersonally.

Freedom from emotional bondage to parents.¹

Not all executives possess all these traits. But by knowing that most do, you can play a percentage game whenever you are unable to scout.

ADJUSTING TO MORE THAN ONE RECIPIENT

If your report will go to a group, such as a committee or a board of directors, see whether you can take as representative some one person whose interests, needs, and traits you can discover. A mixed group presents a harder problem; therefore do one of four things:

1. Aim primarily at those members who know the most about your subject.
2. Aim at those members who have the most authority.
3. Try to find a common denominator for the whole group.
4. By writing individual letters of transmittal to the various recipients and by using footnotes and appendixes, focus one recipient's attention on one aspect of your report, another's attention on a different aspect.

Whenever your report will go successively to a number of men, find out which is the key man or group and aim primarily at him or them. But do not antagonize a less important recipient by any phrasing that seems to scorn his status; try to adjust the report to him as well as to men of higher position.

MINIMUM REQUIREMENTS

Not even an experienced engineer adjusts his reports perfectly to all his recipients. Nor did he do as good a job when he was young as he does now. Expect, therefore, that you will make mistakes at the start and for some years to come. But you can at least begin now to put these principles to work:

Treat your recipient (whether singular or plural) as a highly complex fact. Recognize that your definition of him must result from a mixture of observation and inference. Realize that your emotions can warp your observation and your inferences. Try hard, then, to separate your description and analysis of a man's character from your opinion of that character;

¹ B. B. Gardner, "What Makes Successful and Unsuccessful Executives?" *Advanced Management*, September, 1948, pp. 3-6. With Dr. Gardner's permission, his phrasing has been slightly changed. The study that he reports was made by Social Research, Inc., Chicago, of which he is the Executive Director.

and in adjusting your communication to him, set aside your likes and dislikes, your admirations and antipathies. Size him up as dispassionately as you would size up an ingot or a batch of concrete or a lens. Then, within the bounds of fair dealing, treat him as his properties—not your feelings about his properties—tell you he can most effectively be treated.

Guide yourself by your answers to these questions:

1. Why does my recipient want this report?
2. What does he know about its general and specific subjects?
3. What more does he wish to know?
4. How much of what he already knows must I still give him in order to make the report unified and cohesive?
5. What should I tell him that he is not aware of needing to know?
6. What patterns and forms does he specify, or at least prefer?

Part II: Applying Your Resources: Basic Procedures

8. Using Language Efficiently

As was said on page 12, by putting together and applying what you already know you can make a pretty good report. Since then you've had systematic though rather general suggestions about the stages of work that you should always go through before you start to write a report or to give it orally. If you act on those suggestions, your reports should be accurate, logically thought out, and adjusted in general to your reader or hearer.

However, you still lack much useful knowledge and many necessary skills. Specifically, you still need more information about:

The media of communication—their limitations and advantages.

Components of many reports such as abstracts, outlines, etc.

The physical forms that reports take.

You also need recommendations on the effective use of your own language and of nonverbal media for several kinds of recipients.

Experience shows that you can gain these items of information and these skills most quickly if you start by surveying the principles that apply to every kind of technical presentation. The three broadest of these principles are:

1. Make contact with your recipient at once.
2. Keep contact throughout.
3. Leave him feeling, when you are done, that you and he have finished one job, not a fragment of a job or yet several unrelated jobs.

From these you can derive a number of more specific principles. Phrased as recommendations and put into simple figurative language, they are as follows:

Go to your hearer or reader. Begin your talk or article or report at a point where his needs, interests, attitudes, motives, and knowledge predispose him to heed what you say. Follow this advice even though he has requested your communication, for your minds may nevertheless fail to meet. He may have had only a general awareness that a problem faced

him. It is you who will have to tie the description, the analysis, and the solution of that problem in with his relatively meager knowledge and his needs. In doing so, you may have to guard against stepping on his preferences for or against certain ways of stating and solving the problem.

Next, let him see why and how he will benefit by marshaling his energies to go along with you. You should, it is true, seldom say openly, "Read this (or listen to this) because . . ." But you should so word the statement of the purpose which your communication fulfills that each sentence indirectly tells the recipient, "Here is something it will pay you to know."

Then show him in what direction you and he are headed. Indeed, do more than this. Tell him the destination. Only on rare occasions should you try to hide it. In general you should let him know just what you are driving at.

After you have named the goal, move toward it steadily. Take no avoidable steps. Don't go off on a tangent. Don't backtrack unless your reader or hearer will see the reason and approve of it; arrange your material in such a sequence that you never have to say, "Oh, I ought to have mentioned" or "Chapter 4 should have described . . ." Don't do any chasm-jumping either. That is, don't let him feel that you have left a gap in the development of your thought and that you are making him leap from fact to fact, idea to idea.

Leave him in no doubt as to which are the major landmarks on the journey toward the goal, which are the less important landmarks, which the least important.

Try to plan the march in such a way that he feels no extra strain as you move along, even though you may be calling on him for extra effort. Literally, this means that if the parts of your communication differ in "graspability," you should put them in such an order that each prepares him to understand readily whatever comes next.

Above all, make your own share of the trip as unobtrusive as possible. The reader or hearer is not interested in you. He is not interested in your communication problems. He is not interested in your style. He is interested only in reaching a definite spot. Get him there as quickly as you can, and let him know when he is there.

The above suggestions are more commonly expressed in textbooks by five precepts:

1. Make your communication organic—that is, unified.
2. Make it clear.
3. Make it coherent—that is, cohesive.
4. Make it concise.
5. Give each of its parts its due emphasis.

Now let's see in some detail how to follow that advice. For convenience cohesiveness is treated as one of the qualities contributing to clearness.

For convenience also the problem of obeying the five counsels when you prepare curves, maps, photographs, or slides is postponed to Chapter 10. The precepts themselves stay the same. For example, not only a verbal unit but an illustration or exhibit should have organic form. It should strike the recipient as being "all of a piece." So should a period of silence when used as a communication device. To keep quiet either too long or too briefly may give hearers the impression that your views are unshaped or that your attitude is wavering. But the present chapter is confined to verbal communication.

Several of the suggestions that are given apply to English only. Others apply to any language that resembles English in structure. Most apply universally, because they take into account general habits of thought. They conform to the ways in which nearly everyone's mind works.

UNITY

Unity has already been defined as meaning this: Give your communication, and each part of it down to the briefest clause, a form such that the recipient will see it as doing one job.

We most often violate the canon of unity by bringing in something which interests us but does not concern our recipient. Note *concern*. Everything we put into a communication should be significant to the reader, hearer, or observer. So we should avoid "It is interesting to note . . ." and all equivalent expressions. Not the mere interest of our statements, but their bearing on our main message, is what counts. Nor is it enough to apply this axiom only to the core of a communication. It should govern equally your choice of material to go into any preface, introduction, footnotes, or appendixes that you include. Ride no hobbies anywhere, from first page to last.

In engineering and industrial practice a second common violation of unity results from disregard of distribution and filing systems. Sometimes an inquiry and a complaint could logically be covered in one letter, but practically had better be put into two letters because of the recipient's channeling procedures and records setup. For another example see page 214, on which is discussed the problem of adding recommendations to a record of routine performance. These examples indicate the basic principle: In planning any communication, consider how it will be circulated and preserved.

Remember both of these two precepts whenever your investigation discloses hitherto unknown "relics," such as old roads, trails, sewer mains, test pits, machinery, or intangibles like forgotten data and hypotheses. Let neither interest nor any lack of interest in such discoveries keep you from asking: "For practical reasons should a record be preserved? If so, what form of record?"

Your answer to the first question should often be Yes. Military as well as civilian experience has proved that expense—indeed danger—can frequently be avoided, and benefits obtained, by describing the relics. Your verbal and graphic record should not, it is true, always be incorporated in your report—not even as footnotes or as appendix material. But keep the record somewhere, and see that it doesn't get lost again. A separate report or the files of your organization may serve.

You will sometimes be tempted to include details merely because you worked hard to get them. The energy you exerted has nothing directly to do with the case. Give the reader only what he should have.

So much at present for what unity of content means. The next question is, "How do you attain it?" In three ways:

1. By advance outlining. This usually discloses topics that don't belong in your report.
2. By putting yourself inside the recipient's mind so that you can decide just why he wants your communication, how he will and won't use it, to whom he may transmit it, and in what manner it will be preserved. Knowing these things, you can drop material which other recipients might need but which this one doesn't, and include material which the immediate recipient may not require but which the ultimate one expects.
3. By so planning a report that you keep together in it a figure and the table relating to it, or, if oral, the verbal discussion of the figure or table.

These three steps are usually all you can take when you give a talk. If you are writing, you should perform one further task. You should check back to make sure you have kept the desired oneness of content and tone. Perhaps you can do this checking after you have finished each paragraph. More likely you are one of the many people who should not interrupt the writing process but should wait until they have completed the first draft before looking for weaknesses. In any event, *check*.

As you inspect and revise, take into account the fact that long paragraphs tend to become un-unified. Indeed, some long paragraphs which are logically homogeneous may strike a reader as lacking unity. Few people today wish to go through a paragraph that is longer than 300 words; most prefer a maximum of 200 words for wide-column text and 125 for narrow-column text. Justified or not, their preference must be heeded.

Extremely short paragraphs as well as long ones can be, or at least can seem, un-unified. If you write such paragraphs, your mistake may consist of unnecessarily "atomizing" your accounts of processes and procedures or your descriptions of physical objects. This doesn't mean that your process narrative or description should leave out essential stages of an operation

or essential details regarding a site, plant, machine, or material. It does mean that you should often combine three or four short paragraphs into one. The following passage, for example, should be a single paragraph.

The airport has three concrete runways, each 5300 ft long and 150 ft wide; one turf runway 4000 by 150 ft; and 12,000 ft of concrete taxi-way 50 ft wide.

It thus provides one of the most modern university laboratories of its type in the country and will be still more effective when contemplated construction is complete.

This construction will include buildings for education, for research, and for airport administration, and hangars for storage and maintenance of private, commercial and military flight equipment.

Or your mistake may be that you are neglecting to develop your statements sufficiently. If this is so, perhaps you need to insert a greater number of specific examples, as should be done in the following paragraph.

Industries must differ in methods of recruiting candidates. ^ So must companies within an industry. ^ Procedures that will be satisfactory in one situation will fail in another.

Perhaps, instead, you have taken it for granted that the recipient can supply factual connections of which in reality he is ignorant. A paragraph which asks the reader to see what isn't there follows.

This account of the company was prepared from such written records as had been preserved. Much of the story was obtained from personal interviews with older employees and from contemporary trade journals. The compiler shows the skill of the company's first president in writing effective advertising copy for such journals and in building up a high reputation for his firm.

The revised version plugs up the holes.

This account of the company was prepared *mainly* from such written records as had been preserved. *Because there were few of these for the early decades*, much of the story was obtained from personal interviews with older employees and from contemporary trade journals. *By wise use of the last-named source*, the compiler shows the skill of the company's first president in writing effective advertising copy for such journals and in building up a high reputation for his firm.

Notice how the insertion of the italicized expressions gives the paragraph firmness and unity.

The length of your paragraphs, and the scale on which you develop the main thought of each, are not the only considerations worth keeping in mind. In addition you must guard against wedging one paragraph inside another, a mistake made in the passage that follows.

In obtaining the surface temperature of the round duct the average surface temperatures at each of Stations 0 and 20 were determined separately. Starting at the top, the prong-type thermocouple was placed successively at eight points

spaced at equal distances on the circumference of the duct at the given station. Measurements of the surface temperatures of the round duct were made by means of the prong-type thermocouple shown in Fig. 4. The lead wires from the points of contact, or thermocouple junction, passed through a region which was cooler than the surface of the duct. Hence conduction of heat along the leads and away from the junction tended to reduce the temperature at the points of contact, and the readings of the thermocouple corresponded to a temperature that was lower than the true surface temperature of the duct. The prong-type thermocouple used was of No. 22 B. and S. gage wire. It was calibrated under service conditions by placing it in contact with the surface of the duct adjacent to the embedded thermocouple shown in Fig. 4, and comparing the readings of the two thermocouples. The readings were made as rapidly as the potentiometer could be balanced. At each station the eight readings were averaged, and the true duct-surface temperature was obtained from the calibration curve. The arithmetical mean of the surface temperatures thus obtained at Stations 0 and 20 was then regarded as the average surface temperature for the 20-ft length of the duct.

Sentences 3-7 should be lifted out and made into an immediately preceding paragraph.

A further recommendation: Do not end a paragraph one sentence too late. That is, don't put as the conclusion of Paragraph 1 what is logically the first sentence of Paragraph 2. This error is committed in the following passage.

In the early postwar period we made a study to develop long-range plans for a shoe manufacturing company. Results indicated that a good solution to their expansion problems would be secured by constructing a 300,000 sq ft, one-story manufacturing building. The old multi-story manufacturing buildings could be converted to warehouses. All of the fundamental materials handling problems with which today's conference deals were a part of the considerations involved in this study.

These problems included: placement of receiving facilities, nature of such facilities, placement and nature of storage facilities, methods of transportation within the plant, and extent to which assembly line methods had been practiced and should be practiced. None of these could be neglected. All were of nearly equal importance.

Move the last sentence of the first paragraph to the beginning of the second paragraph. Each paragraph will then be a unit.

As for unity within sentences, most flaws result from two things:

1. Overusing *and*, *but*, *so*, *then*.
2. Hitching long phrases which begin with "thereby causing" or "thus showing" to a sentence that logically has ended. To guard against these tendencies is difficult, especially for a speaker. The chief counsel that can be given is to be aware that you, like the rest of us, should pause and think before yoking main clause to main clause by the above words and before pinning a needless tail onto what is already a complete sentence.

Keep a weather eye out for the common tendency to join coordinate clauses one of which names a material, machine, or process and the other of which tells the function or importance of the material, machine, or process. To be specific, avoid a sentence of this kind:

The tightening of the interlocks is called interlock tension, and much of the design of steel sheet pile walls and cofferdams is controlled by this phenomenon.

Reinforce this counsel by bearing in mind that long sentences, like long paragraphs, tend to become un-unified. It is prudent to keep all sentences below 30 words.¹ Go even further. Make many of your sentences less than 20 words, and some as short as eight or ten.

Less tangible than the preceding recommendations is this: Avoid awkward shifts in tone.

This precept must be interpreted sensibly. It does not mean that a talk or report must be portentously sober all the way through. It does not mean that if you start with a *you* attitude every sentence must begin with *you*. It does not mean that the author of a theoretical analysis must turn his back on practical applications. It doesn't mean that your use of such formal words as *simulate* and *conducible* keeps you from saying "What's up?" or "We got caught off base."

What the principle does mean is that any change in your mental or emotional approach must be justified by the situation and by your recipient's needs, knowledge, interests, and temperament. In the typical lunch-hour conference you can shuttle between the serious and the humorous faster and more often than you would ever think of doing in a written report. A memorandum addressed to a friend and scheduled for his wastebasket after being read can hop from formal to breezy diction in a way that scarcely any other written professional communication can do. A talk or even a write-up whose purpose resembles that of a classroom lecture may be able to move freely from *I* to *we* to *this machine* to *you should to always check*, whereas a scientific report on the same subject would probably adhere to the third-person style (*this machine, the tests, all facts, several conclusions*) and would refer to you, your colleagues, and your recipients by indirection only (*the author, the testing committee, the reader, and even it is necessary to observe*).

Most of the specific suggestions for maintaining unity of tone are given in later chapters, but two recommendations belong here.

1. Remember that "cold type" destroys half the effect of informalities which are successful when spoken, and may make a rapid change of tone seem unjustified. Remarks that "get across big" in class or in a conference,

¹ The following sentence, however, is not too long: "The apparatus comprised the following—a still or kettle consisting of a horizontal boiler, a 4-plate rectifying column, a total condenser, a sight-box, reflux and product rotameters, a reflux heater, and sample cooler."

in a question-and-answer session or an after-dinner speech, in a handwritten letter or even in a brief interoffice memorandum—these may fall flat in a formal typed report. In print, they may not only fall flat but die on the spot.

2. Only a master of speech and writing can shift tone abruptly. A gradual change is better—such a gradual change as was shown in the first paragraph dealing with unity of tone. The phrasing, “This precept must be interpreted sensibly,” is rather formal and the approach is impersonal. After *you* makes its appearance, the syntax and the vocabulary become lighter.

You will find it hard to keep unity of tone or to shift tone gradually unless you develop a feeling for the differences between:

The written and the spoken word.

Social levels of phrasing.

Functional levels of phrasing.

An excellent short survey is a six-page article by J. S. Kenyon.² Read it. Notice too the implications of the following discussion:

“Now and then . . . one sees sentences like this: ‘Whom are you writing to?’ One must condemn such a sentence . . . as a stylistic monstrosity. Its ‘whom’ marks it as done in studied style, whereas its word order marks it as done in unstudied style! No good stylist should be guilty of such gross inconsistency. . . .”³

Now figure out which word breaks the emotional unity of this passage:

Saratoga, Monterey, Antietam, San Juan, and other stimuli adjure us to give thanks for the men who died to save our freedom.

CLEARNESS

Make contact with your recipient right away; keep contact at all times. This is the golden rule of clearness. But it isn’t self-applying. Like unity, clearness is in part subjective; what’s clear to one person won’t necessarily be clear to someone else. This in turn means that the qualities making for clearness can’t be sharply separated from one another. It is only for your convenience that an attempt is made to separate them in the following subsections.

Preciseness. Be as precise as is consistent with giving your recipient what he can and must comprehend. Decide how far he is able and willing to stretch his energies in order to grasp highly specific facts and detailed theories.

First, consider how many statistics to use and how accurate to make

² “Cultural Levels and Functional Varieties of English,” *Coll. Eng.*, 10:31-36, October, 1948.

³ Kemp Malone, “Current English Forum,” *ibid.*, p. 37.

them. Sometimes you should carry to the tenth decimal. At other times you should round 268,791 to "a quarter of a million." Commonly you should hit the mean between these extremes of preciseness and generality.

Decide what should be the ratio of your generalizations, whether expressed or implied, to the details that exemplify or support them. Some readers, and more hearers, cannot absorb more than one basic generalization in each 500 words of copy or each eight or ten minutes of a talk. Other people, on the contrary, resent the open statement of any detail that they can readily infer.

When different recipients need different degrees of preciseness, you have several ways of satisfying their demands. For instance, you may be able to follow up a rather general talk with a question-and-answer session in which hearers who want exact statistics and detailed instructions can get them from you. If your communication is written, you may be able to put certain highly specific facts into footnotes or appendixes that the expert can study and the neophyte disregard. And there are still other methods, as shown in Parts IV and V.

Not merely the number and kinds of details you employ but your phraseology also must be as precise as the situation requires.

For one thing, whenever preciseness is at a premium you should separate space expressions from time expressions. "Employees sometimes (often, usually) misunderstand" should in strict logic be "Some (many, most) employees misunderstand."

A related suggestion is that in careful technical discourse you should change such an expression as "ranges in weight from 0 to 10 lb." Though it will pass in an informal talk or write-up, it is really nonsense. Say instead: "ranges in weight from less than an ounce to 10 lb." Similarly with *squarer*, *rounder*, *more unique*. You will become a bore if you constantly say "more nearly square," etc. But in many scientific documents "more nearly square" is advisable.

Be sure that your receiver knows at once what every pronoun refers to. Use no vague *which*, *this*, *that*, *we*, *he*, *they*. These words may be clear in a speaker-audience situation but unclear when you are cut off from your recipient by time, distance, and the alphabet. Watch *it* with special care. *It* may be a true pronoun, or a so-called impersonal pronoun ("It is raining"), or a dummy subject ("It was hard for us to leave New York," "It's true that we lost money on the deal"). Hence *it* is often momentarily unclear. The only remedy may be to recast a passage completely.

Be aware of the ambiguities that lurk in *while*, *since*, *as*, *with*, *such*. There's no law against *while* for *whereas* or *though*; indeed, many writers prefer "while the" to the awkward-sounding "although the." But be sure your reader won't take *while* to mean *during the time that*. "With this appliance tested" may signify "After this appliance has been tested" or

"Because it has been tested"; and the two meanings are not always practically identical. "Such a big job" is usually clear enough; if, however, there will be doubt whether you wish to say "A big job of this kind" or "So big a job," use whichever expression you really intend. Above all, say "The values were such that . . ." Do not say "The values were high such that . . ."

Weigh with care your use of *practical(ly)*, *material(ly)*, *substantial(ly)*, *apparent(ly)*, *over*, and *field*. On occasion we all use *practically* to mean *virtually* or *almost* rather than to mean *in practice*; *materially* and *substantially* for *noticeably*, *measurably*, *appreciably*, or *significantly*; *over* for *more than*; and *field* for *related studies* or *related practices*. Ordinarily no harm results. But when the context makes our recipient wonder whether *over* means *more than* or *above in space*, then we had better use the 100 percent exact word or phrase. Similarly, to say that such an intangible as loyalty is "materially or substantially enhanced" is to leave some readers or hearers questioning our physics, logic, and ethics. Again, *apparent* should be replaced either by *seeming* or by *manifest* if the recipient cannot well decide which meaning *apparent* is intended to convey.

Notice that many verb-plus-adverb phrases, though usefully versatile, are potential troublemakers because they can be taken in three or four senses. An instance is furnished by *stand for*. It may mean *represent* or *advocate* or *tolerate*. Whenever you employ it, be sure it can be taken only in the sense you intend.

The nature of the context and the preferences of your reader or hearer will determine when you can effectively use such trade phraseology as *paint job*. In a formal report or talk you would ordinarily say *painting* or *coat of paint*. So too with *values* for *valuable parts* or *products*.

Place modifiers where they cannot be misunderstood. "All the men were not there" means literally that all were absent. In documents that have a legal bearing, say "Not all . . ." In any sort of communication, recast "The board is the standard size used by students with a fine quality surface." Guard too against what is called a squinting modifier, exemplified in the sentence below.

Men who make such tests often fail to relate the results to changes in scientific theory.

Often is placed where it might modify either *make* or *fail*. The sentence should be so recast that *often* unmistakably modifies one word.

The recommendations thus far given will doubtless win your assent, for all of them are plainly reasonable. Two other suggestions may appeal less to you.

The first is that you should look far enough ahead to make verbs and

their subjects, and nouns and their pronouns, "agree in number" in such expressions as these:

There *are* big jobs ahead.

There *is* ahead of us a set of tough jobs.

We must take what *amounts* to a loss.

We must take what *amount* to two separate losses.

If the average draftsman will take pains in *his* initial planning, *he* will find . . .

The cost of these programs *is* . . .

The costs of this program *are* . . .

The equipment adaptable to such tasks *is* bulldozers, posthole augers, and trenching machines. [Or, better]: The equipment . . . *consists* of bulldozers, posthole augers, and trenching machines.

The second suggestion that you may find unpalatable is this: Follow the traditional usage of prepositions. We are expected to say *fond of*; *different from*; *adapted to*; *suited to* but *suitable for*; *adhere to* a statement but *stand* or *abide by* it; *allot* something *to* someone *for* some purpose; *allocate to* or *among*, but *divide with* as well as *divide among*; *compare with* when we do not stress resemblances, as against *compare to* when we do stress them, and *liken to* under either circumstance; *prohibit from* but *forbid to*; *recover from* a disease but *be cured of* it. From your point of view there is logic behind some of the expressions and only convention behind others. You should look at the mere conventions just as you look at most traffic rules. What the rule is matters less than that there shall be rules which everyone conforms to.

But in seeking frequent precision, don't become a pedant or a logic-chopper. "The reason is because" for "The reason is that" has become an accepted locution, at least in speech and informal writing.⁴ Use it and use other similar idiomatic expressions.

Concreteness. As has been said, in making your communications as precise as they ought to be, you commonly use a considerable number of details. Because most people are not at home with abstractions, you should appeal frequently to the senses—to eye, ear, taste, touch.

When we say "efficiency has been impaired" we are speaking abstractly. When we say that breakage has increased from four pieces per man per day to seven pieces we have moved toward concrete phrasing. When we say that last month John K. Worker accidentally smashed one piece on the floor every day and now smashes three, we have appealed still more to the eye and the ear and the muscles. Finally, when by means of words we take our reader to Tony Antonelli's drill press and picture Tony's actions in detail, we are being very concrete.

Where to put ourselves and the reader along the arc from the wholly

⁴ See Russell Thomas in "Current English Forum," *ibid.*, 10:168-169, December, 1948.

abstract to the wholly concrete is a problem that must be settled anew each time it comes up. We must take account of more than concreteness. For example, a concrete statement may be longer than an abstract one, and is not always more impressive. "Pride goeth before destruction" loses savor when you turn it into "If you are proud you will be destroyed." Again, throughout a complex report the names of unit operations or processes can, if placed at the beginnings of paragraphs, announce a new subject or a new aspect of your subject more quickly than can concrete phrasing. But don't carry this use of abstract nouns so far as to say, "Daily manual cleaning of the floor is a function allocated to the janitorial personnel." All you mean is that the janitor sweeps and washes the room every day.

While we cannot, then, dogmatically assert that concreteness is always and invariably a primary virtue, we can call attention to three things:

1. Most of us are like the kindergartner who has to learn about two apples and three oranges before he can grasp the concept of number. We need concrete particulars so that abstract generalizations will come alive, hit home.

2. We should make our details not merely concrete but, as well, familiar to our recipient. When we explain a mechanical principle by showing how it works in a Rolls Royce engine we are being concrete; but how many men know much about a Rolls Royce? Usually we should speak in terms of a Ford or a Chevrolet.

3. We can use analogies. The analogy denotes a partial likeness, a similarity or set of similarities that will help us to visualize relationships. To call war, death, famine, and pestilence the Four Horsemen is to use analogy. To call the famous Notre Dame backfield by the same name is to raise the analogy to the second power.

Many analogies are detailed, like the passage on page 55 that begins "Go to the reader or hearer." A sustained analogy may extend for one or more paragraphs.

Simplicity. Many precise and concrete statements are simple as well. But not all. When you are presenting technical facts and theories you can't always make your words at once concrete, precise, and simple; you may have to sacrifice one or even two of the desirable qualities. Ordinarily, though, every one of us could use "plain talk" oftener than we do.

How to reach this goal is an art about which many things have been known for thousands of years. But other techniques have been discovered just recently. For a full account of them you should read the books by Rudolf Flesch, especially *The Art of Plain Talk* and *The Art of Readable Writing*. A few of his recommendations are:

Use all the personal pronouns you can—*you, your, I, me, he*, etc.

Use everyday words that deal with human beings and their relationships—*man, woman, father, son, husband, wife, folks, people, friend*.

Use words that lack prefixes (such as *ab-, con-, il-, ob-, sub-, un-*, and over a hundred more).

Use words that lack suffixes (such as *-able, -ability, -en, -ise, and -ize, -ism, -meter, -oid, -ry*, and over a hundred more, including even *-ly, -th, and -d*).

Use active-voice verbs, especially those that make pictures.

Use analogies.

Keep most of your sentences below 18 words. But count as separate sentences two or more main clauses marked off by semicolons or colons.

It's clear that not all readers want so plain a style as this, even though the subject matter may allow it. Engineers are used to the passive voice and to impersonal wording; they like "the tests were conducted" and not "I made the tests." Engineers are also used to hundreds of technological words that are built up by prefixes and suffixes, and to sentences of some length and complexity. Such men may resent too much simplifying; many of them feel that even when it preserves accuracy it throws dignity overboard. You are not a crusader; you'll have to heed those dislikes.

All the same, Flesch advocates much that you can put to use. His findings are especially worth your study whenever you are aiming at semitechnical and nontechnical people. Here is the beginning of a leaflet for railroad fans of all conditions and ages:

"The main job of a railway dynamometer test car is to measure the pull that a locomotive exerts against the resistance offered by a train. Other things are measured also, and recorded, by a modern test car and its equipment, but these are secondary to measuring the pull.

"You can get an idea of the car's chief function by hooking a rubber band onto a toy wagon full of blocks, and watching the rubber stretch as you pull the wagon along. The load will influence the stretch. On a smooth floor the stretch will be less than over a rug or up an incline. The length of the stretched rubber will give some indication or measure of the amount of effort you exert in pulling the wagon.

"A dynamometer car, like the rubber band, is coupled between the motive power and the load to measure the effort being made by the engine to pull the train. The force involved is tremendously greater than for the toy wagon, but this test car measures it much more accurately than the rubber band can, and at the same time it records the measurements on a paper tape."⁵

It will pay you to analyze these paragraphs. They don't carry Flesch's advice to extremes—he didn't mean anyone to do that. They keep words like *locomotive, exert, motive* (power), and *influence*—words that any railroad fan will find as simple as *job* or *main* or *band*. And one sentence runs to about 30 words. But the writer is talking pretty simply neverthe-

⁵ Courtesy of Arthur Wildhagen, Assistant Director of Public Information, University of Illinois.

less. He puts *main* and *chief* in the place of *primary*. He has *things* pinch-hit for *variables*, and *hooking* for *attaching*. He centers his explanation around an analogy. Finally, he makes two sentences very short, and his last sentence is three sentences so far as ease of reading goes.

When you try to talk simply you will find that the structure of the English language often gets in your way. Hundreds of examples could be cited, but a few will do:

1. While the English verb has become a very flexible instrument—while we can say more things by means of verb forms than speakers of most other languages can—we cannot make a pure, colorless statement about the future.

2. The many ways in which we form past tenses (as exemplified by *mailed, tested, schemed, put, sent, kept, thought, bought, sought, taught; was and were; rode, froze, chose, rang, flung, stole, ate, swore, fell; made and had*) are a nuisance.

3. When we use *must, ought, may, can, shall, or will*—words that lack participial forms and that cannot be preceded by *to* and *will*—we are driven to such roundabout expressions as “he will be unable to do it” or to expressions stigmatized as illiterate even though they may be logical, such as “had ought to be.”⁶

4. The overlap among participles, gerunds, and infinitives can cause confusion. In *grinding machines* it doesn’t matter whether we take *grinding* as a participle or a gerund. But when we see such a title as “Depleting Resources, and the Remedy,” we can’t tell whether the writer thinks of the depletion as caused wholly by human beings or also by natural agencies.

5. We form the plural of nouns in too many ways: by zero change (*sheep*); by the addition of hissing sounds, often with a change in the last consonant of the singular-number form (*nails, tests, boxes, houses, knives*); by changing the vowel (*men, feet, mice*); very irregularly, as in *children*; and by using foreign plurals (*alumni, alumnae, data, criteria, vortices*).⁷

6. Finally—and this ties in with one of Flesch’s main points—even most of our simple prefixes and suffixes have many meanings. Compare *forget* and *forgo*; *beside, besmirch, bedevil, behave, behead*; *revisit, recover, reassure*; *thicken, earthen, brazen, linen, maiden, sunken*; *man-nish, coolish, Finnish, finish, perish, cherish*; *senate, consulate, distillate, arsenate, stellate, populate, evacuate, illustrate, and desolate*. Even the

⁶ If English were wholly consistent, we would not say, “He had decided to become a physician, but ought to have been a lawyer.” We would say, “He had decided to become a physician, but had ought to be a lawyer.”

⁷ More and more foreign words are being given English plurals, such as *memorandums, formulas, vortexes, and appendixes*. The process has been going on for a long time; you probably never saw such forms as *beaux, bureaux, Esquimaux, and banditti*, but they were once prevalent.

ending *-able* and its variant *-ible* lack a single fixed meaning; consider the difference between *perceptible* and *deplorable*.

The other side of the picture is brighter. The English vocabulary is so large and contains so many finely discriminated synonyms that it aids your search for simplicity, preciseness, concreteness. English grammar is relatively simple. English makes effective use of both word order and changes in word form; to a great extent it combines the virtues of a tongue with many case endings and verb endings (such as Latin and German) and those of a positional language such as Chinese. Finally, English is progressive. Its speakers add steadily to its stock of words and to its grammatical devices ("get done," "is being built," "up to you"—all of which are fairly new expressions).

Most of us use these resources too sparingly. One reason is that school grammars give a sketchy and not very accurate account of our language. You should examine instead the works of Curme, Poutsma, Kruisinga, and Jespersen (including his *Analytic Syntax*, a semialgebraic symbolizing of English grammar). You will probably be impressed by the variety, versatility, and flexibility of English.

Directness. Another quality that usually makes for clear writing or speaking is directness. Seek this quality when you organize your reports, articles, letters, and talks. Seek it likewise in framing your sentences and in choosing your words.

But do not measure directness mathematically. In human communication the longest way around may be the shortest way home. Let's look at a few instances.

For three hundred years most formal English questions and negative statements have been roundabout. We don't say "went he?" or "he went not"; we say "did he go?" or "he didn't go." Today indeed most of us factor "have you?" into "do you have?" or "have you got?" We say "I don't have" or "I haven't got" rather than "I haven't."

Americans more and more use the longer forms of several time- and number-phrases. The first member of each pair or set below is commoner than the other member or members.

I haven't seen very many . . .

I have seen few . . .

There aren't any.

There are none.

There aren't any more left.

There are no more.

None are left.

They don't win very often.

They seldom win.

The shorter versions are available whenever you are pressed for space or time. Even when you are not, they are preferable in most highly formal communications.

A further tendency is to speak of having a smoke, having or eating dinner, taking a bath or a look, and giving a glance, rather than of smoking, dining, bathing, looking, glancing. "Smoke?" is ordinarily taken as short for "Will you have a smoke?" instead of for "Will you smoke?"

"Be direct" sometimes conflicts with "Be emphatic" and with "Vary your style." For example, the most direct English word order in most statements is subject-verb-rest of predicate. This sequence, however, often fails to put the stress where it should be placed and, if continued too long, tires the eye or the ear. Accordingly many of our sentences should start with *for* or *in* or *to*; a few, with the object of the verb ("This plan the committee accepts").

Some executives find that directness and tact often conflict likewise. Many business and engineering leaders therefore prefer such indirection as "My thought is" to the straightforward "I think."

Directness may also conflict with exactness. Sometimes you have to choose between a rigorously precise word or phrase and one that the recipient can grasp without effort. You should ordinarily resolve this conflict in favor of his economy of energy. Use few if any words that will send him to the movies; use fairly few that will send him to the dictionary. When you aim at people in that third of our population whose members never fall ill or are injured, say "get sick" or "get hurt." If the differences between an honorarium and other kinds of fees are too slight to risk making your recipient call you a snob, say *fee*. So with *extra pay* instead of *supplementary compensation*. On the other hand, when complete preciseness is requisite, as it is in many communications addressed to technical men, you may have to use unfamiliar words. But define them. Similarly, define unfamiliar mathematical and chemical and engineering symbols. And once you have given a definition, stick to it; do not, in the same talk or document, slip back into an older or more general use of the term.

Other suggestions needed by many engineers relate to sentence structure.

The first concerns compound adjectives. Technical men readily comprehend "the direct-acting, low-limit immersion type control." Laymen usually find such directness puzzling. They need a longer expression containing *of's* and *with's* and *that's*.

The second suggestion deals with adverbial elements that modify a verb. Don't make roadblocks of them. "The furnace after it had been shut down a week was cleaned" isn't as direct in word order as "After the furnace had been shut down a week it was cleaned." At once direct

and brief is a third version: "After a week's shutdown the furnace was cleaned." You will note, however, that when an adverbial element modifies the whole sentence—as *however* does in the passage you are now reading—such an element should often come between subject and verb or between verb and object. Except for transitional expressions of that kind, follow the principle of no adverbial blocks.

Apply a like principle to *of*-phrases and *which*-clauses. The following sentence should be recast: "April 15 was set as the deadline for submittal to the Development Department of all reports of plans approved in principle by the Board on March 1." You can say, "By April 15 the Development Department must (is to) receive . . ." If for some reason *deadline* has to be retained, you can at least put it this way: ". . . deadline for submitting to the Development Department all reports of plans approved in principle by the Board on March 1." The word order is bookish but as direct as the limitations of written English allow. An easier change and a smoother product are exemplified by a recast of "The training in mathematics and physics, in mechanical and electrical engineering, and in the rudiments of business administration which you have had enables you . . ." Simply put "which you have had" after *training*. Then why not go a step further and drop *which*?

Beware of building up roadblocks in complicated sentences that refer to the effect of X on Y. One difficulty arises when you must say "The effect of the load on the floors on . . ." A bigger source of trouble is expressions such as this: "The effect on the design of a machine of this kind of the space it must occupy." A common remedy is "The effect exerted by . . ." or "The effect that the design . . . has upon . . ."

Many rhetoricians object to "A is as great as, if not greater than, B." They prefer "A is as great as B, if not greater." No dogmatic judgment seems possible; the choice should be determined by the emphasis you desire. If you want to stress *B*, end with *B*; if you want to stress *greater*, end with that. Analogously, "We went over but not into the major problem" may or may not be preferable to ". . . over the major problem but not into it." The point is: should you stress "major problem" or "into"? If the latter, the second version is what you want.

Intentional Repetition. Since directness is a psychological and not a mathematical quality, it sometimes is compatible with the intentional repetition of words and phrases and even whole sentences. For instance, if you have one prepositional phrase inside another and then use *but* or *and* plus a noun, repeat the proper preposition for clarity's sake. Thus you need two *for*s in this sentence: "We are concerned for the safety of the investment and for the company's good name."

Repetition is often most effective if varied. Your first statement of a fact might be phrased positively, your second negatively, and vice versa (see

paragraph 1, page 48). Or the first statement might be figurative and the second literal, and vice versa.

Don't overdo repetition, for two main reasons. The more important is that it soon becomes a mannerism which distracts your recipient's attention from the content to the style of your communication. He shouldn't notice the style as such. The second reason is that repetitions may cause typist and compositor to miss one of the occurrences of a word or phrase and therefore to drop material from your copy. In an Illinois Experiment Station manuscript "be below low water" came from the typewriter as "be blow water." On galley proof, "In the area near the well the shape of the free surface cannot be far different for different ratios of b/r " appeared as "... cannot be far different ratios of b/r ."

Explicitness. Giving the recipient just the degree of preciseness, concreteness, simplicity, and directness he needs cannot be separated from the problem, "How explicit should my statements be?" This broad question can be broken down into several smaller ones, two of which demand attention.

The first concerns the choice of words. It can be asked in this form: "When shall I call a spade a spade?" The situations which pose that question are so diverse that they are best treated at various places in our discussion of letters, reports, articles, and talks. However, four general recommendations may help.

1. Before you call a spade a spade, be sure you know other names. Many people get a reputation for being too outspoken merely because they have a meager vocabulary. If you are one of these, study dictionaries, volumes of synonyms, books such as Perrin's *Writer's Guide*; then read widely in many fields.

2. Find out whether the people you deal with think you are too forthright, properly forthright, or timid.

3. If they consider you too forthright, and above all if they regard you as a blunter, do three things. First, analyze the manner in which men who are at once respected and successful deal with other men by means of words. Second, note with care the circumstances in which such men speak their minds and the circumstances in which, on the other hand, they use understatement or a softened form of expression. Third, discipline yourself to follow their example as far as your self-respect allows. You will find that usually "You're mistaken" gets better results than "You're a liar," and that "We haven't checked on the facts in enough detail" gets better results than "We don't even know what the score is."

4. Conversely, if you are too timid you should learn and use expressions which, without being extreme, show that you can recognize and dis-

approve of attempts to push you into the background, coerce you into assent, or stam pede you into action.

The foregoing suggestions are not cure-alls. Nor can you expect any big results from them in a few days or weeks or even months. They are, however, worth following if you find that people think you either a blusterer or a pussyfooter.

Explicitness requires more than the effective choice of single words or short phrases. Another major aspect is this: "Which of my generalizations should I set forth expressly and which should I imply by adroit use of details?"

You sometimes meet the problem on what we might call the all-report front. For example, you must sometimes decide whether your recommendations ought to be set forth openly or whether you should leave them to be inferred from your conclusions. More commonly you face the problem in the smaller parts of a communication, such as the paragraph. Shall you give each paragraph what is called a topic statement—a sentence, or more or less than a sentence, which either sums up the content of the paragraph or at least shows its aim or scope? Shall you, instead, let the details add up in the recipient's mind to your intended, unspoken or unwritten generalization?⁸

If you are in any doubt, it is generally best to set forth generalizations plainly. However, the problem involves so many factors that no satisfactory solution can be offhand or dogmatic. We had better look at the whole big job of arranging material effectively in your communications.

Arrangement. The primary question to ask when you plan your organization of a letter, report, article, or talk is this: How shall I arrange my communication and each of its parts so that it will be clear?

This is not, true enough, the only question you must ask about arrangement. Clarity alone cannot determine the pattern of the talk or write-up. Other considerations enter. One is proportioning; a communication that is clearly organized can nevertheless be out of balance. A second is emphasis; a communication that is clearly organized may still make no impression at all or an adverse impression. A third consideration, just implied, is tact; there's no point in struggling for clearness if you so antagonize the recipient that he closes his mind against you.

All the same, clarity is a prime virtue that must in large part determine the patterning—and then the phrasing, and also the physical setup—of your communication.

To find this principle worth following is easier than to follow it. Clarity

⁸ Most textbooks speak of "topic sentences." The term is too narrow. Only the last part of the following sentence gives the topic for the paragraph that it introduces: "These facts having been established, we can see that the government has no alternatives." On occasion the statement occupies two sentences: "There is just one rule. Think safety." Another example: "That isn't all they want. They want conciseness."

is hard for all of us to attain. One reason is that we often must bow to our recipient's notions about the proper arrangement of certain data. Jones may think there is some "natural order" that a short story must follow, a different but still fixed order that a recommendation report must follow, etc. Smith may believe that every report should have an introductory summary. Roe may feel that all speeches should open with a funny story. Jones and Smith and Roe are too dogmatic. All classifications and all sequences are manmade. Nevertheless you can't disregard preconceived ideas. They must be as vivid in your mind as Smith's or Jones' or Roe's attitudes and motives, status and interests and needs. In arranging your material you will have to take account of what your recipient thinks is the clearest arrangement, whether he's right or wrong.

The Four Basic Patterns. A second reason why all of us find it hard to arrange material clearly is that we don't realize our resources. We don't know how many patterns are at our disposal. Some of them are so limited in application that you needn't take them up until you get into the more specialized chapters of this book; others are so widely useful that we turn now to a survey of them.

Patterns are usually classified according to (1) the presence or absence of an expressed generalization and (2) the placing of that expressed or implied generalization with respect to the particulars that logically fall under it. This dual basis of classification yields four patterns—patterns for the whole communication, for its grand divisions, for chapters, for paragraphs and sentences. As you would expect, some patterns are more broadly applicable in talk, others in writing. As you might also expect, they have heavy names, which the trained craftsman doesn't use but which constitute a useful shorthand for the apprentice. The names are: the deductive pattern; its opposite, the inductive; the semiductive; and the semi-inductive.

Material deductively arranged leads off with the basic generalization or set of generalizations, followed by the particulars that support or illustrate it. To clinch the generalization you can repeat it at the end, usually in other words. Here is a paragraph that uses this full-circle plan:

Simple improvements in your inspection procedure are herewith recommended. Four profitable and rapid changes would be . . . A week will suffice to put them into effect. They should cut your spoilage to 10 percent or less of the January-June figure. The money saved should amount to not less than \$5000 annually. The ease with which you can change plus the near-certainty of increased profits should lead you to adopt the recommended methods.

The last sentence says in effect what the first sentence and a quarter have said.

Inductive patterns are of two kinds. You can "work up to" an explicit generalization, as is done in the following passage:

Though the tests were unusually hazardous, no accidents occurred. The tests covered all problems assigned for investigation. Their results have proved of commercial value, and the sponsors are enthusiastic. Costs were kept below estimates. In short, the program has been successful beyond expectations.

Or you can leave the generalization to be inferred. Note that in the following paragraph the details add up to some such unexpressed topic statement as this: "Attacking without coordination, the Corps made little headway." Here are the details that carry this implication:

The Corps attacked without plan—not even by divisions but by brigades, by regiments, and in one instance by skeleton companies. Scheele's 1500 men, on the far right, charged before the signal gun was fired. They could advance only three rods before being driven off with heavy loss. To cover their retreat, Berdan's Sharpshooters threw themselves on the advancing Carolina brigade. The five small rifle companies were decimated. Moyer's division on the center, minus the green regiment that had just joined his Third Brigade, gained an eighth of a mile. Then his men were split by Miller's farm buildings and orchards, found themselves pinned down by Pegram's battery, and drifted off to the left. In their retreat they cut across the slow, ill-directed advance of West's brigade. To West's left the Fire Zouaves moved forward with spirit but failed to gain their objective, the famous stone wall. They broke at the same time that West's leaderless men were leaving the field.

The "semi" patterns are so numerous that just a few are named.

A common *semiductive* arrangement begins, not with a summary of what will follow, but with a statement of the topic, such as "Tonight I want to explain our smelting practice." Another form begins with a statement of purpose: "To understand how we are making most of our profits we must look at the details of our smelting practice." Replacing or immediately following this can come what amounts to an expanded table of contents: "The new furnaces will first be described. Their working principle will be analyzed, and compared with that of other furnaces. Test results will be presented and discussed. Plans for commercial production will be outlined."

Less common is the device of opening with a generalization broader than the one you basically wish to put across, and then moving quickly to the pertinent generalization. Here is an example, from a talk to a directors' meeting:

A bird in the hand—-. You men know the rest of it. Let's apply it. Let's quit talking about the European market and *get down into Texas*. Texas is still open, but it won't stay that way. Out in Dallas and Fort Worth you'll find our Memphis friends drumming up business. At the home plant they're retooling to catch this Texas market. We've got to move. We can. We can retool. We can send better men to Texas than Memphis is sending, . . .

A semiductive passage of greater length runs as follows:

It is my thesis that handling frozen coal is not necessary. How is this objective to be accomplished?

First, I believe that coal-cleaning plants can be so designed . . .

Second, I believe . . .

Now it is also a part of my thesis that even with the best dewatering possible, even when the coal has been subjected to thermal drying, chemical treatment of coal is necessary to guarantee normal unloading conditions in cold weather.

Of the *semi-inductive* patterns, some concern you little in your professional talking and writing. The chances are you may someday hear a technical lecture that fundamentally uses the form of the Shakespearian tragedy—with the climax about three-fourths of the way through the communication—but you won't hear many such lectures.

More widely valuable to you are other semi-inductive arrangements. One is that in which you move straight from an attention-getting anecdote or analogy to the topic statement. You know the technique: "Pat and Mike . . . There's a lesson in this. We can . . ." Another semi-inductive form uses the "split generalization":

From medicine-man to good neighbor. That's the history of research during the past few decades. At least it's the history of the changed attitude toward research. And a beneficent change it has been.

The intended generalization is obviously this: "The attitude toward research during the past few decades has changed, for the better, from a mystical to a utilitarian one." Accurate? Yes. Briefer than the split topic statement? Yes. But who would read it except as a duty? It's abstract in phrasing, formal in sentence structure, clogged at one point with commas. Give your reader the mathematically longer version. Its route to his comprehension is shorter.

A third semi-inductive form can be exemplified by this sentence: "At last, with great difficulty and against the obstacles of poor roads and incorrect maps, he brought into action a small force of less than 5000 men—Ewell's, Evans's, Trimble's, and Ransom's brigades." Why is this semi-inductive? Because when you are two-thirds of the way through, you have the basic generalization: "Finally he brought a small force into action."

The Frequency of the Patterns. The commonest pattern in written technical reports is the deductive. A majority of such documents open with a summary—a summary of either the whole report or its salient parts. Long reports may have a final summary as well. In other words, they follow the procedure of the preacher famous in folklore: "First I tells 'em what I'se goin' to tell 'em. Then I tells 'em. Then I tells 'em what I has told 'em."

Measured by the number of words or pages, the deductive pattern seems inefficient. But it is justified by the aid it gives to readers, hearers,

transmitters, and filers. Accordingly, engineers and industrial firms use it for most routine reports and for many special ones.

In a large number of reports, a majority of even the paragraphs are deductively arranged—they start with a topic statement. The more formal the report, the more commonly does the writer make such topic statements very specific. Instead of saying merely, “Now here’s what we’ll gain,” he says, “We’ll gain three advantages” or, going a step further, “We’ll gain in three ways—by cutting cost per item, stepping up total output, and improving the working conditions.” You can profitably follow that plan.

Whenever you want your introductory generalization to be still more detailed you had better make it, not the topic statement of a paragraph, but the topic paragraph of a section:

The plan has two minor advantages—it will cut clerical expenses and speed up mailing. It has two major advantages—it will release needed floor space and will reduce the friction between two of our departments.

Clerical costs can be lowered 15 percent. . . .

A twelve-hour speedup in getting mail out to the Coast is possible if the proposal goes through. . . .

Your committee estimates that 4000 square feet can be turned over to Production if . . .

Most important, both of the departments which have found each other’s operations a source of delay will be satisfied under the proposed arrangement. . . .

As our detailed accounts of reports and articles will show, semideductive and nondeductive patterns have wide application. Nevertheless, the deductive arrangement is the first one that you as an engineer should master.

The Order of the Details. Having discussed at what places within the body of a talk or document you may put your expressed or implied generalizations, let’s turn to another problem of arrangement: In what order shall you give the details? Obviously you can proceed from effects to causes or vice versa; you can describe according to a space arrangement of objects; you can narrate events as they occurred or usually occur or will occur in a time sequence; you can go from what your reader finds simple to what he finds complex; and so on.

Some data seem almost to demand one order, others can be set forth in several ways, still others call for shifting from one basis to another. On the whole your everyday experience and your common sense will guide you, but two recommendations may help.

One is: Though you may shift, don’t jump. You have probably got lost in a baseball story that followed now a topical and now a chronological plan. First you were in “the Browns’ big fifth.” Then you were back in

“the Senators’ unlucky third.” Next, out of nowhere, there came “a resounding triple that led off the home eighth and nullified Washington’s tight seventh-inning defense after St. Louis had matched a sixth-chapter Solon rally.” Such writing confuses everyone.

The second recommendation is: Heed the relative importance of the details. Don’t let your recipient feel that you see no difference between a one-day production drop of 3 percent and a major tragedy.

The simplest arrangements for making clear the relative importance of details are, of course, the climax order and its opposite, the “inverted-pyramid” form. Another possibility is the “hourglass silhouette,” widely used in recommendation reports and in debates. You get it by putting your weakest suggestion or argument between stronger ones.

Report-making presents two other common problems of arrangement.

One is this: When your write-up has two or more similar parts, must you subdivide each of them in exactly the same way? Suppose you are discussing half a dozen similar tests. Suppose your account of the first test is most clearly given in terms of Purpose, Scope, Materials, Equipment, Procedure, Cautions, Findings, Conclusions, Applications. Must your accounts of all other tests have the same subdivisions? Not necessarily. In discussing the third test you will perhaps serve the reader best by combining the descriptions of equipment and procedure into one subsection. In discussing the sixth test you may be unable to say anything about applications. Certainly you don’t want to imitate the geographer who has been a laughingstock for two hundred years because, his 17th chapter on England and his 17th chapter on Scotland having dealt with snakes, he included in his section on Ireland:

“Chapter 17. SNAKES

“There are no snakes in Ireland.”

A related question arises when you divide a chapter into sections. Must your first section heading come at the very beginning of the chapter? The answer is no. For example, the first few paragraphs of the chapter on Digests in this book bear no section label.

Showing the Pattern. Sometimes the reader or hearer does not want to know the nature of your pattern. Most people who read a short story would rather not say, “I see that here is where the introduction ends; now this is the climax; the rest of the conclusion merges at this point into the punch line.” Nor do people reading brief news items and friendly letters want the organization to be too plain; they don’t want to see the skeleton through the flesh. No more do most of us when we listen to informal talks.

However, the person whom you as a technical man will address does commonly wish to perceive both the main and the smaller parts of your communication, and also the connections among those parts. If the subject

matter is complex he wants the divisions and subdivisions to be distinctly visible and yet clearly interrelated. He wants to know how these parts bear upon the whole topic and upon one another. He wants you to mark both separation and linkage.

It is assumed that you have divided the material in your own mind into what your recipient will regard as logical parts. Now you want to make him see what they are, and how they tie together. What means have you for doing these jobs?

Manifestly you can show separation and linkage during the course of your recipient's progress through your communication; that is, you can show the parts and their connections as he reads or listens to the "core" of your communication. Second, you can show boundaries and connections in advance; before the recipient starts in on the "meat" of your communication you can tell him in general what he will find, and you can do the same before giving him each part. Last, you can show boundaries and connections at the end of your communication or any unit of it.

Let's discuss these three methods—not in the order in which they were named but rather in the order of their usual helpfulness to the reader or hearer.

To aid the recipient in grasping linkages as he hears or reads, avoid unnecessary shifts in your point of view. Carry this principle down as far as single sentences. Instead of "These formulas are seen to be applicable, and it is also shown that they hold for . . ." you had better say, "These formulas are seen to be applicable, and also to hold true for . . ." The first version jumps from the writer's attitude to the reader's. The revised version keeps one standpoint throughout. Similarly, "The machine is inexpensive and you will get good service from it" should be changed to "The machine is inexpensive and will give good service."

A corollary suggestion is to treat collective nouns consistently. Though you may say either "the company has" or "the company have," manifestly you shouldn't say "the company has their offices." For the same reason you should say either "this kind of employee is" or "employees of this kind are . . ." "Five miles was laid" is a logical statement; just be sure you don't alternate it with "two miles were . . ." You can say "none is" and you can say "none are," but you shouldn't skip back and forth.

When you do have to shift the point of view, say so. Sometimes you can do this by such expressions as "Moving inside the plant, we see . . ." or "A good deal is to be said on the other side of the question" or "These facts point to three conclusions" or "What can we do to improve the design of this part?"

Expressions like these four are called transitional elements. You have plenty of them at your disposal. Some indicate, not a change in the point

of view, but a continuation of the path you were following; such are *and*, *also*, *further*, *furthermore*, *moreover*, *besides*, *in addition*. Cousins of these seven are *first*, *then*, *next*. To the same family belong *lastly*, *finally*, *in conclusion*. Short transitional elements of other logical sorts include *but*, *however*, *still*, *yet*, *nevertheless*, *on the other hand*, *on the contrary*; *granted*, *true*, *it is true*, *true enough*, *let's admit*, *let's concede*; *so much for that*; *in brief*, *in short*, *in sum*, *in other words*; *so*, *therefore*, *hence*, *accordingly*, *consequently*, *as a consequence*, *as a result*, *the consequence* (*result*, *upshot*) *is*; *to sum up*, *to recapitulate*, *to "recap,"* *not to labor the point*, *in summary let me say*; and a host of others.

Five recommendations about the use of these links.

1. If you find you are cramming a communication with them, see whether you can't reduce the number of *and's*, *then's*, *next's*, and *finally's* and even the number of *but's* and *however's* by using parallel structure—the expressing of similar or contrasted ideas by means of the same or similar grammatical patterns. Here is a paragraph whose topic statement is supported by three sentences parallel in form:

The arrangement has three advantages. It is economical. It is in line with our policy. It keeps us abreast of other firms of our type in this region.

Parallelism must not mislead, even for a moment. "Bring pen, paper, and report" seems clear. But it's not clear in case you mean "and report at ten o'clock." You'll have to add an *and*: "Bring pen and paper, and report at ten o'clock." In the following sentence, on the other hand, you should drop a word: "I hope you will find this assignment interesting rather than being boring."

You can often effectively combine parallelism with deliberate repetition:

Dead and live load moments are reported separately. Live load moment curves are valid only for bridges accommodating two lanes of H-20 truck traffic, with curbs 25.5 feet apart. Dead load moment curves are valid for bridges of any width-span ratio.

2. Guard against repeating transitional elements inadvertently. For "But the tests were inconclusive but they taught us a good deal" you can say "True, the tests were inconclusive, but . . ." If you must use the same transitional element twice in a row, show that you are doing it intentionally. A useful indicator is "in turn."

The production drop was due to the breakdown of No. 5. This was due in turn to a weak baffle shell, which in turn was caused by faulty construction.

A better remedy—better not only because it avoids calling attention to your repetitions but because it sidesteps the slight illogicality in the above passage—is to change the approach and say:

The immediate cause of the production drop was the breakdown of No. 5 on account of a poorly constructed baffle shell.

3. Discriminate among synonyms; *because*, *since*, *for*, and *as*, for example, overlap in meaning but do not coincide.

4. Watch the tone of your transitional expressions. *To "recap"* and *Where do we go from here?* and *Does this make sense?* are informal expressions whose brevity and tactfulness you may have to obtain by some other means in a formal talk or report. On the other hand, *In summary let me say* is too heavy for most informal talks or letters and for many simple reports.

5. Occasionally you will be justified in using a transition that is verbal rather than purely logical. An example from a later chapter of this book is: "The equestrian metaphor brings us to the pedestrian problem. . . ."

Often listed among transitional devices are demonstrative pronouns and adjectives—*this*, *that*, *these*, *those*, *such*. You may combine their use with another method of linking which can be symbolized in this way: *a b c/ c' d/ d'*, etc. That is, you can put related elements at the end of Sentence 1 and the beginning of Sentence 2, at the end of Sentence 2 and the beginning of 3, and so on. The following passage exemplifies this dovetailing.

The maximum draft was limited to 0.06 in. Had as great a draft as 0.10 in. been permitted, the pickup period would have been shortened. Such a reduction . . .

The same principle calls for turning the second of the following sentences end for end:

Crushing strength tests were made on coal packed in 4-in. by 8-in. cylinders. Percentage of moisture, amount of treatment, and temperature were the known variables. Moisture varied . . .

Say, "The known variables were . . ."

This method may call for the use of inversion—putting an element out of the position it commonly occupies. *This* is inverted in "We were asked to approve the entire budget. *This* we cannot do." In "Why he thought he should resign, nobody knows" a noun clause is inverted; we usually say, "Nobody knows why he thought he should resign."

The *abb'c* arrangement often requires also a shift in the voice of the verb:

Table 4 sums up these findings { *They* }
 { *which* } have already been analyzed in
 Bulletin 377.⁹

It therefore is little used by writers who dislike the passive voice.

Topic sentences, it is plain, can be regarded as transitional elements.

⁹ To keep the active voice calls for "Bulletin 377 analyzes them."

They are not so considered in this book, for a psychological reason—many transitional elements must be consciously inserted as you perfect your original draft of a write-up or talk, whereas your topic sentences ought to “come to you” as you write. In other words, they are more like bricks than like mortar.

But transitional paragraphs stand psychologically on another footing. Often you don’t realize that you need them until you consciously put yourself inside the reader’s mind as you make a final revision of your work. Then you may see that you have left a gap which can best be filled by a two-in-one paragraph or section.

Here is a two-in-one sentence that can at the same time be a transitional paragraph: “Though the costs just given prove that the machinery is cheap to install, we must consider its cost of operation.” The first clause points backward and reminds your reader or hearer of what you have just been saying; the second clause names your next topic. Sometimes you can do the job faster: “Installation costs obviously are low. Is the same true of operating costs?” Further cutting will yield: “So much for installation costs. How about operating costs?”

When you have finished a rather complex division and are going on to another that is equally complex, you may need a transitional section rather than just a transitional paragraph. The first part of the section will be a summary of what precedes, the second a summary of what is to follow. Here is a section of that kind:

“Up to this point I have painted the picture in very dark colors indeed. I have never, though, had much use for persons who can only ‘point with alarm’ without offering constructive suggestions. So I propose to make some positive suggestions; but first I want to summarize the salient points of the situation:

“1. Coal still enjoys the position of the leading fuel for residential heating in many parts of the country.

“2. The fuel market will become increasingly competitive.

“3. Fuels will compete on their ability to heat the home with maximum comfort, convenience, cleanliness, and economy.

“4. The public, architects, builders, and coal dealers must be educated to use the best existing methods for handling and burning coal as a fuel in homes of average cost and size.

“5. New methods and equipment for using coal as a fuel must be developed for the new market of small and low-cost homes.

“Now for the brighter side of the picture.

“The first efforts for market development could be aimed at several points: (a) new homes of sufficient size and cost which, if properly planned for its use, will find coal heat to be comfortable, convenient, clean and economical; (b) all new homes in areas where the cost of fuels distinctly favors coal; (c) existing homes which are being converted from space to central heating, particularly involving a change from wood used as fuel.”¹⁰

¹⁰ Courtesy of Professor William Scheick, Coördinator, Small Homes Council, University of Illinois.

You will notice that the foregoing section retells the reader not only what he has been reading but how it was organized, and shows him not only what will be said but in what order it will be said. Sometimes you make your restatement of plan and/or your prestatement of plan even more explicit:

We have now seen that Bronze Age metallurgy is most conveniently treated under three headings. These are . . . Under the first heading we said that . . . Under the second heading we discussed . . . Under the third heading came our attempt to solve four controversies:

1. . . .
2. . . .
3. . . .
4. . . .

We concluded that . . .

Iron Age metallurgy presents fewer problems. In fact, only three need to trouble us. The first one, however, is complex, and I shall treat it under the following headings: . . . I cannot offer complete solutions. The second and third problems, on the other hand, I think we can settle, and I think our conclusion can be that . . .

It is manifest that if the report from which the foregoing excerpt was taken had dealt only with the metallurgy of the Bronze Age, the last of the two paragraphs above would not have been used.

It is equally manifest that this discussion has not only had to touch upon advance and recapitulating indications of pattern as well as current indications; in addition, though supposedly discussing only the ways of showing *connection*, it has had to name some methods commonly employed for showing the *separation* of a talk or write-up into parts. Let us take up this subject more fully.

As the reader peruses your document or as the hearer listens to you, he identifies some of your spacings and pauses as indications of separation. The simplest example is paragraph indention.

But what you can convey by these visual and aural blanks is pretty limited. Hence a common method is to number or letter the various divisions and subdivisions of a communication. You have a number of devices at your disposal, at least when you are writing—A; 10; 10.3; 7c; IIA1; B3a; Dbii; etc.

Another simple method consists of setting material of one kind in a different font of type or in a different color from material of another kind. Thus, explanations of apparatus may be in the usual roman type; directions for using the apparatus, in italic type or in blackface; warnings, in red. Using color is costly, except in a typed document; nevertheless, the added expense is justified in many instructions manuals and similar printed publications.

The commonest method of showing division into parts is of course to use headings and subheadings.¹¹ These may be employed consistently and logically; at the other extreme, they may be employed primarily for typographical reasons—in order to break up a vertical column of type into roughly equal parts. When this is done, the head or subhead usually indicates some change in the direction of the thought, but it may be a minor change.

As you know, written headings and subheadings may be combined in a number of ways with the use of alphabetical or numerical symbols and may be further differentiated by the use of one size or kind of type for main headings, another for subheads of the first level, and so on.

Needless to say, with these devices are usually combined transitional expressions wherever they are absolutely needed. In technical reports, headings and subheadings are often so numerous that expressions like *first*, *next*, *as a result*, and even *on the other hand* are few.

The number of “indicators of pattern” in the body of a communication can sometimes be kept to a minimum by throwing the burden on a preview section. Usually, however, the preview merely gives an additional picture of your pattern. For example, you ordinarily form your table of contents by reproducing the exact wording of the headings and subheadings that you have already inserted into the body. The preview does not replace but intensifies the marks of plan and organization that have just been discussed.

Some writers hold that a progressively clearer view of what a document will contain and how it will be arranged should be afforded by the “preliminaries.”¹² If this opinion is correct, two prevailing practices should be changed: The list of tables and illustrations ought to be thrown into the table of contents along with the headings and subheadings of the text material, and the table of contents should always precede the introductory summary. Indeed, it can be argued that the statement of purpose, scope, and plan should likewise precede the introductory summary.

As a matter of fact, the preliminaries are not usually so constructed and arranged as to give this progressively clearer picture. Let’s look at what actual practice is, though we shall not forget to name some possible improvements.

The title—ordinarily the most noticeable element on the title page—could be used to name the main parts of the body of the document; but

¹¹ In speaking, it is not considered good practice to employ the written kind of heading, which usually consists only of a noun or of a noun plus modifiers. You may, however, use a deliberately incomplete sentence such as “Next for the materials needed” or “How about the assumptions we made?” or “To turn to costs.”

¹² The preliminaries include at the least the title page, the table of contents, the list of tables and illustrations, and an introductory summary; they may include also a full statement of the purpose, the scope, and the plan of your communication.

the truth is that it seldom is given this job. Rarely does it go any further than the following: The Effect of Eccentric Loading, Protective Shells, Slenderness Ratios, and Other Variables in Reinforced Concrete Columns.

Subtitles, once more widely used than they now are, were often assigned one or both of two functions—to serve as introductory summaries or to serve as informal tables of contents. Few subtitles today, however, go into much more detail than this:

ATOMIC ENERGY	(title)
ITS NATURE, POTENTIALITIES, AND CONTROL	(subtitle)

It is with the introductory summary or the table of contents that most complex documents give the reader his first comprehensive preview. Logically the table of contents should precede the introductory summary, but for obvious reasons it seldom does in modern practice. When the summary comes first—as is customary—it may contain at least the main headings used in the full-length document and thus give the reader a general notion of the chief parts and the relationship among them. It does not, though, much advance his understanding of *why* the writer chose exactly the order of divisions and subdivisions that he did. Nor does a table of contents answer this *why* question. Whenever the question needs answering, about the only way you can do it is to have a section that not only describes your organization pattern but explains and justifies it.

Such a complex statement of plan is likely to slow down the reader or even antagonize him. It is, however, justified in two fairly common situations: (1) when you have used an unorthodox method of organization because you think it will cast new light on your facts or generalizations, and (2) when your document logically has only a few main parts but you can serve the reader's convenience and avoid typographical complexity by using eight or ten chapters. You may then want to tell him that these are not all of equal logical importance and that certain chapters logically combine to form one main section.¹³

Now we must backtrack. Neither the usual kind of table of contents nor the fuller outline that sometimes replaces it avoids one almost universal weakness—separating the titles of the text material from the titles of tables and illustrations. Because readers usually want (1) to see quickly the number and scope of these extraverbal aids and (2) to have a rapid way of finding the page which contains a particular table or illustration, it is traditional to list the titles of nonverbal material separately from the titles of text matter. You can, though, attain both goals at once by throwing together into one table of contents the titles of text, tables, and illus-

¹³ This book, for example, has three basic divisions. The first is composed of Chapters 1 and 2, the second of Chapters 3-7, the third of Parts II-VI, plus the Appendix, which could have been called "Using Your Communication Resources."

trations, provided that by special indentions and/or symbols (such as asterisks) you distinguish the one from the other.

There has been some talk about the possibility of replacing tables of contents by organization charts or flow sheets that indicate the organization of the document. We do not know of any actual attempt in this direction. We think it is worth experimenting with, and we suggest that maps as well as organization charts and flow sheets are feasible.

CONCISENESS

One advantage of the forms suggested in the paragraph above is their conciseness. Conciseness means roughly the same as briefness. But it is not briefness as measured mathematically. It does not result from cutting a passage to the fewest syllables that might conceivably be used or a map to the smallest possible size. It is, instead, the greatest degree of briefness that is consistent with clearness, with accuracy, with close dovetailing, with stressing those parts that deserve stressing.

In other words, we can be too brief. Some of us are. The Victorian who wrote, "Ilepzibah fell out of the old elm and broke a limb" was not being concise, she was being vague.

Tautology. But most of us err in the opposite direction. We would speak and write more efficiently if we seldom said "In conclusion I might state" and "because of the fact that." We would speak and write more efficiently if we said "ten tests have been made" rather than "there have been ten tests made."¹⁴ We can often cut *by means of* to *by* or *with*. *In order* is often needless, though for clarity we must keep it after some verbs; contrast "the data are required to permit" with "Jones was required to go." We ought to keep *the*, *a*, and *an* whenever they are called for by the traditional practice of English-speaking people; but we should take advantage of common curtailments and say "Do it the same way Jim does" rather than "Do it in the same way (manner) in which Jim does it." Of course the counsel already given (page 62) concerning stylistic levels is to be applied when you are deciding how far to cut. Formal style is, in general, grammatically fuller than informal style.

At any rate we can avoid the duplication of "return back," "repeat again," "Of the three plans, two of them promise . . .," "He said that if he had known it that he . . .," and "exceed more than."

Equally noticeable to an alert reader or hearer is the waste that often results from using *shape*, *form*, *color*, *size*, *nature*, *character*, *manner*, *proposition*, *case*, *field*, *standpoint*, *viewpoint*. "Of a blue color" means blue. "Large in size" means large. Say *blue* or *large*. Lop off the same kind of deadwood in:

¹⁴ But in "There is available a variety of insulating materials" the writer kept *there* because he wished to stress, not availability, but variety.

an interesting proposition ("interesting")
 round in shape
 in an economical manner
 in a form easy to understand ("easily understandable")
 freshmen in many cases
 research in the field of metallurgy
 satisfactory performance from a heating standpoint (viewpoint)

Whenever "serves to trip" means nothing more than *trips*, use *trips*. When "is dependent on" means only *depends on*, say *depends on*. When "has resulted in a reduction of" means only *has reduced*, say *has reduced*. Unless *all of the piles* means more than *all piles*, say *all piles*.

In numerical statements that need not be precise, use the simplest clear words. Replace "The difference was of such a small magnitude that" by "The difference was so small that." Replace "An insufficient number of tests" by "Too few tests."

In formal writing or speech, cut out nearly all occurrences of *whole* (*entire*), *different* (*various*), and *particular*. Keep them only when you should stress totality or unlikeness or specificness. Be just as harsh toward *absolute(ly)*, *definite(ly)*, *positive(ly)*, *complete(ly)*, and *very*. Except when you can use them exactly, leave them out. Informal communication, of course, gives more leeway.

Ellipsis, a Valuable Tool. An especially useful pruning hook is one that cuts off grammatical elements already expressed or easily inferred. The learned name for this hook is ellipsis. Ellipsis was used in the first sentence of this paragraph, which might have contained "that have been."

Use ellipsis judiciously. Remember that some kinds of ellipses are commoner in a formal than in an informal style. Even so, don't lop off so much that you leave a ludicrous statement. We once wrote, "Some of you are production men, others design engineers." You can see why we put *are* back in after *others*. Nor should you employ ellipses that clog a sentence with commas and semicolons; we don't recommend "Blaine, from a seaboard state, was the first modern American imperialist; McKinley, from a midwestern commonwealth, Ohio, the second." This passage had better be phrased as follows:

Blaine, from a seaboard state, was the first modern American imperialist. McKinley, from the midwestern commonwealth of Ohio, was the second.

Don't carry ellipsis so far that your statements are logically incomplete. "It is reasonable that this machine will give good service" is a torso. You must insert *to suppose* or a synonym. Guard likewise against such comparisons as "Our position is stronger than our competitor." It must be *competitor's*. "After the collision the liner continued for five or six blocks" is illogical if not ridiculous. Insert "a distance equal to."

Finally, observe that ellipses are sometimes wise, and sometimes unwise, for typographical reasons. When you prepare a manuscript for a departmental or company editor who wishes to plan and “dummy” the printed product in some detail, he may want you to make some of your sentences accordionlike; that is, he may want you to phrase them in such a manner that at certain points a few words can be added or dropped without change of essential meaning. His motive is this. A good editor likes to avoid “widows.” By a widow is meant a single line of a paragraph at the end of a page; less than a line and a half of a paragraph at the top of a page; and, as some editors use the term, less than half a line at the end of a paragraph. Whenever you can estimate that passages in your manuscript will, when in type, result in widows, you can use a “that were” or some other expression that may be either kept or cut. You can also use qualifying expressions (“usually,” “in the main,” and the like) that will not be padding if retained but that you can omit when need arises.

Implication. A cutting tool similar to ellipsis is implication. “Clinton’s unsound plans will fail” is a shorter way of saying “Clinton’s plans will fail because they are unsound.” Notice, however, that there are two dangers in the use of implication. The first is ambiguity; the reader or hearer, especially if he is not well educated, may assume that you are trying to draw a distinction between Clinton’s sound plans and his unsound ones, whereas you mean that all the plans Clinton has presented are unsound. The second danger is that you may be tempted to mislead people by a verbal trick. Demagogues have always made much dishonest use of implication. Employed with integrity, however, and in contexts where no uncleanness can result, implication is a helpful device.

Now suppose that occasional pruning is not enough. Suppose that your style is a tangled jungle. In literal terms, suppose you are consistently wordy. What can you do? Nothing that will yield results quickly. Your remedies will have to be long-term ones.

Overcoming Diffuseness. First, see whether you should change your whole approach to the problem of communication. Maybe you never get inside the other person’s mind. If so, you will have to become a better psychologist before you can hope to become a more concise writer and speaker. You will have to learn to analyze your prospective recipients more thoroughly than you now think you can. In particular, find whether you habitually give people details that they know or can readily infer. Perhaps you mention things not worth mentioning. In this event your endeavor to become a better psychologist should include making an inventory of the things which your intended recipient already knows about the subject matter of your talk or write-up. The next step is to outline your report in more detail than most people need to do. The third

step is to delete from this outline all particulars that your recipient is sure to know, except those few of which you must remind him if your communication is to be smooth and coherent.¹⁵

Second, conquer the habit of excusing wordiness by an appeal to scientific dignity or exactitude. Too many research men and engineers needlessly repeat all details (whether concerning the purpose, the procedure, the factual findings, or the conclusions) of a series of tests that differ in only one or two respects. Under the guise of precision, such men write:

The purpose of Test Series 45A was to determine the effect of temperature. The specimens were cut from bars furnished by the IDT and tested, prior to shipment to us, in the IDT laboratories. Each specimen was 12 in. long and was $\frac{1}{2}$ in. in diameter. The composition is given in Table I. They were heated in the College Research Laboratories to 250 deg F.

The purpose of Test Series 45B was likewise to determine the effect of temperature. The specimens were cut from bars furnished by the IDT and tested, prior to shipment to us, in their laboratories. Each specimen was 12 in. long and was $\frac{1}{2}$ in. in diameter. The composition, which is the same as that of the specimens for Test Series 45A, is given in Table I. The specimens were heated in the College Research Laboratories to a temperature of 275 deg F.

On which the sole comment is, "Had enough?" Manifestly such repetition is justified only when each reader of the report will study just one series of tests—a rare situation. The remedy for a passage like the foregoing is obvious:

The purpose of both Test Series 45A and Test Series 45B was to . . . Specimens for each test were furnished by . . . , were of identical composition (see Table I), and were all 12 in. long and $\frac{1}{2}$ in. in diameter. The only difference in the treatment given them in the College Research Laboratories was . . .

Lightening the Sentence Pattern. Perhaps you do get inside the recipient's mind, yet leave him feeling that your style is labored. The trouble probably is that your sentences are too heavy. Count your *if's*, *though's*, *because's*, *in spite of's*. In case you have too many *if's*, try implying them: for "If we have a 20 percent turnover we'll lose money" say "A 20 percent turnover would lose us money." Occasionally, replace an *if*-clause and a

¹⁵ When you must include known facts you will find it generally advisable to say "The self-evident (obvious, universally recognized) fact that . . ." or "This of course means that . . ." Sometimes, however, you cannot thus work a truism into a sentence without making the sentence long and unwieldy. Then you may have to do as Professor W. S. Harris did in a recent University of Illinois *Bulletin*—you may have to come right out with your obvious statement. Professor Harris wrote: "There is often danger of introducing errors by extrapolating test results beyond the range of actual test conditions. However, it may be noted that the total fuel consumption for all days having an average temperature of less than 20 deg F was only 11 percent of the total seasonal fuel consumption. Therefore, even large errors in the daily fuel consumption over the extrapolated part of the curve in Fig. 6 would not appreciably change the estimated total seasonal fuel consumption."

main clause by two main clauses yoked with *and*: "Give us the space and we'll do the job." Excessive *though's* and *in spite of's* can be replaced by *but's*, provided that you don't in turn overwork this word. In many passages the *but*-idea is so clearly implied that it needs no open expression: "Smith's a worker but Pender's a drone" can become "Smith's a worker; Pender's a drone."

Jettisoning needless sentence elements will be made easier if you try to keep all sentences below about 30 words, topic statements and other key sentences below 15. This will be hard, but it's a necessary stage in attaining conciseness.

Simplifying Your Vocabulary. The wordy writer must also check on his vocabulary. Do you use lots of five-dollar words? Try replacing them with short, common words. Whether they are of English, French, Latin, Dutch, Algonquin, Bushman, or Chinese origin doesn't matter. Above all, use fewer abstract terms. If you mean *young men* or *boys* use those words; don't call them *our developing youth*. If you mean *plumbers*, why say *personnel*? Whenever *illumination* means *a light*, what harm in using the short word? You have doubtless seen some of the recent satires—latest in a series that is more than 2000 years old—on "federalese" and other prevailing jargons. Here's an example:

By virtue of this departmental reduction of unnecessary personnel, had it been possible and practicable to carry such curtailment to the designed completion, economy would doubtless have been effectuated of a type which ought to receive priority henceforth in proposals to be reported by this committee.

Such gobbledy-gook probably means:

If we could have kept cutting the number of unnecessary men in this department we could have saved money. This should be our committee's first aim in the future.

You will have noticed likewise that to drive for concreteness—to use picture-making words—usually brings greater conciseness in its train.

EMPHASIS

The final "must" of effective technical presentation is emphasis—what we have called "stressing the parts that deserve stressing." You yourself will have to decide which are the most important things you want to say, which less important, which least and yet worth keeping. Then you must show the reader or hearer what facts and ideas are the big ones, and what are the relative values of the other facts and ideas.

You can do this by fairly simple means. Look into your own mind and you will learn part of the method.

First, don't antagonize the receiver—at least, not intentionally. You

know that you yourself usually reject what a man is trying to tell you if he rubs you the wrong way.

More important still, remember that you are commonly impressed by your first experience with anything, by your latest experience, by bigness, by the sharply distinct, by whatever seems to be out of its usual place or position, often by recurrent events and situations, sometimes by the intentionally small or the deliberately quiet, and sometimes too by things that are formally labeled Important.

We can therefore assume that our readers and hearers will probably heed the beginning of our communication and of each considerable segment. They will heed the final part of each communication unit. They will, unless we become bores, heed whatever we devote much time or space to. They will heed any component that we set off sharply from other components. They will usually heed what we reiterate, and also whatever we "play down" if they realize it's something we could have played up. They will almost always heed a word, phrase, clause, or sentence that we place where they don't expect it to be.

There are big names for these ways of getting the recipient to stress what we want him to stress: Emphasis by Initial Position, Emphasis by Final Position, Emphasis by Proportion (Mass), Emphasis by Separation, Emphasis by Repetition (as in the reiteration of *emphasis* in the list you are now reading), Emphasis by Inversion and Transposition, Emphasis by Understatement, and Emphasis by Labeling.

Another principle is Emphasis by Grammatical Construction. For your purposes it comes down to this: Don't put the main idea of a sentence into a trailing element such as "which reduced . . ." or "thereby reducing . . ."; wherever possible, give a main idea the form of a main clause.

You can sometimes drive points home by using what are called balance and antithesis and combining them with repetition:

"As an inferior he planned badly and fought well; as chief, he planned well and fought badly."¹⁶

We could all communicate better if we used these methods even more effectively than we do in our everyday contacts. Specific suggestions for applying them may be found in each part of this book. The recommendations which follow you can use in nearly all kinds of talks and write-ups. As you would expect, some of these recommendations will make your presentation not merely more emphatic but also clearer or more concise.

For abrupt force, use many short sentences, a few fragmentary ones. Ask direct questions. Turn some *if*-clauses into seeming commands: "Look into your own mind and you will learn part of the method"; "Give us the

¹⁶ F. W. Palfrey, *The Antietam and Fredericksburg* (New York, 1882), p. 55.

space and we will do the job.” Omit dispensable conjunctions, as was done in the first sentence of this paragraph.

Do not assume, though, that emphasis always presupposes conciseness. In fact, sometimes you cannot put stress just where you wish it without using more words than usual. For instance, “The problem is one that concerns all engineers” may be more emphatic than “The problem concerns all engineers.” “It is here that the proposal meets its first challenge” and the more informal “Here’s where we get into trouble” are in some circumstances more forceful than “Here the problem meets its first challenge” and “Here we get into trouble.”

You can often gain emphasis by figurative language. But make that language clear, and as accurate as the occasion requires. Be sure, too, that it’s in keeping with the occasion and with the reader’s or hearer’s temperament. In drawing a figurative comparison from some activity unfamiliar to you, don’t lay yourself open to unsought laughter; don’t speak of the quarterback throwing a goalie out at third base. It is just as important to guard against a mixed metaphor, such as “rolling down the sea of time on Snitkins’ three-ply tires,” and against mingling figurative with literal language—“He was a brother to all his men and father of two sons.” Within these limits, use figures of speech to give your words punch.

Particularly in speaking, but also in writing for well-read people, remember that you often gain forcefulness by ending sentences and paragraphs and chapters with an accented syllable. The last word in the paragraph above was originally *emphasis*, a word which in accentuation falls downhill. It was changed to *punch*, even at the risk of striking some people as slangy.

What is perhaps the commonest way of trying to get emphasis works less well than most of us believe. This is the use of intensive expressions such as *very*, *exceedingly*, *extremely*, *utterly*, *absolutely*, *positively*, *definitely*, and various cusswords. Sometimes effective in speech, they usually seem weak when written or printed.

If one way of getting emphasis won’t work, try others. For example, you can’t always proportion a talk or report or article just as you’d like. You may have to devote 500 words to one topic in order to clarify it, whereas you find that 200 words will tell your particular recipient all he needs to know about a logically bigger topic. What you may be able to do then is to get emphasis by position rather than by proportion; that is, you may be able to begin or end with the 200-word topic. You can supplement that technique by phrasing the shorter passage as memorably as possible; you can supplement, too, by saying “What matters most . . .” or “Of greatest importance is . . .” or “Most significant is another finding . . .”; finally, you can supplement by using some bullet sentences that hit the reader or hearer hard.

But beware of the bullet sentence. Point-blank fire can be overdone; we usually laugh at stories, movies, and advertisements or commercials that are obviously trying to shock us or bowl us over. Intelligent readers and hearers are at times more favorably affected by understatement. Perhaps you'd like to say "This move would be a catastrophe." Would you get better results if you said "This move isn't smart"? Maybe yes, maybe no; but keep in mind the frequent effectiveness of understatement.

TWO OTHER PRINCIPLES

We have by-passed two virtues—virtues of less general importance to you than unity, clearness, and emphasis but far from negligible nevertheless.

Euphony. One of them is known by several names. Euphony is as good a label as any. It means "an arrangement of sounds that is pleasing to the ear."

You may not want to seek it positively but you should avoid obvious departures from it. Guard against rhyme and meter: "Our aim is to name men whose fame has come down through the ages." Avoid near-rhyme too: "This is a machine we can't afford to discard." It is even advisable to shun what is called assonance. For example, on page 1 is a passage that first read as follows: "You can whip the technological problems that you meet. The second and third goals this book does propose to help you reach." *Meet* and *reach* constitute an assonance, one special type of dis euphony in prose. So *meet* was changed to *encounter*. Likewise to be avoided are *difficultly*, *friendlyly*, *increasingly precisely*. Replace these by *with difficulty*, *in a friendly manner*, *with increasing precision*. Maybe you've found also that it's best to keep *-ation* words and nonparallel *-ings* away from one another. "This formation needs consideration" should become "This formation needs to be considered," and "The bracing needs strengthening" should become "The bracing needs to be strengthened."

Try to cut out as many hissing sounds as you can. Of course, have regard for preciseness; on page 92 the "Do not assume, though, that emphasis always presupposes conciseness" could not be changed without sacrificing accuracy. But you could say "for brevity's sake" rather than "for conciseness' sake" and still be exact enough for most practical purposes.

The consonant clusters for which English is as notorious as for its "geese"—its hissing sounds—will also demand your attention. Most hearers, and many readers, notice tongue-twisters like *sixth*, *twelfth*, *asked Smith*, and *tests strengthen*. Get rid of such dis euphonies whenever you can.

Don't use a word in two senses in the same brief passage:

We have long felt the need for a longer runway.

For they are for it.

I take no stock in his stock-promotion plans.

Gould struggled with his enemies with vigor, without success.
He can't be taken in in this way.
Nothing was going on on the field.
I can't figure what they're driving at at the main office.

Don't let sentences end with a bump. "He couldn't tell me where the man I was supposed to see was" doesn't come to a smooth stop; it jerks. You could revise it to read: "He couldn't tell me where the man I was supposed to see might be found." Or you could change the wording considerably and say ". . . where to find the man I was supposed to see." Revision is not always as easy as this. For example, it's hard to change the following sentence without some impairment of meaning: "Smith has only the vaguest notion what the job he was assigned is." But the following will ordinarily do: "Smith has only the vaguest conception of his assigned job."

Avoid the ham-and-egg sentence, named from the vaudeville joke that runs, "If we had some ham we'd have ham and eggs if we had some eggs." In technical writing and speech this error often shows up as a dual use of *with*: "With the blowups repaired we covered five miles with the sander."

Avoid just as carefully the house-that-Jack-built sentence: "After we reached home after a long trip"; "There is much interest in scientific circles in the culture of plants in a water solution of minerals."

Act on your knowledge that many people regard a "violation" of certain grammatical "rules" as a crime. Therefore, avoid the so-called double negative ("haven't never seen") even though it is accepted in several languages and has arguments in its favor. Similarly, though it is unfortunate that English has two genitive-case forms (exemplified by *John's* and *of the machine*), we can only follow traditional usage. We'll have to shun *the car's price* and *the test's results*. Otherwise our words won't "sound right."

To satisfy some readers you'll have to shun the split infinitive too. These people don't like "to more than double" or "to plainly demonstrate." Their distaste is justified if the wedge is awkward. Just as you shouldn't say, "Jones, when he reached home, went . . ." unless you want to contrast Jones with Smith or Brown, so it's not advisable to say, "We will be forced to in any circumstances spend . . ." But when the wedge is almost imperceptible, there are no sound reasons against splitting the infinitive. We have to split, indeed, in such sentences as "We plan to more than double our output."

Whatever you decide about the split infinitive, remember the big principle. Euphony can't be neglected, but it plays second fiddle to accuracy, unity, clearness, conciseness, emphasis.

Variety. In technical speech and writing, variety is like euphony—it

generally plays second fiddle to other qualities. Nevertheless it deserves your care.

The more widely read your recipient is, the more you should avoid monotonous repetition, especially of expressions briefly in vogue, and inadvertent repetition.

The more, also, you should vary the length and the patterns of your clauses, sentences, paragraphs. Seldom should more than three sentences in a row take the same length of time to read or speak. Almost as seldom—except when you are using parallel structure—should more than three sentences in a row begin in exactly the same way. A passage that is varied in pattern will probably contain sentences starting with adverbial clauses (“Since the speed is readily controllable,” “As Devanter has proved,” “When the time comes,” etc.); with phrases (“No matter how much”); with adverbs (*Then, Finally, Furthermore*, etc.); with prepositional groups (“To the solution,” “Without doubt,” “For these reasons,” “During August,” “In warming up the motor,” etc.); with infinitives (“To assure clean packing”); and perhaps with inverted expressions like “Seldom should more than three sentences . . .”

Some variety in your verbs is also desirable. Many technical reports *must* contain a high percentage of passive-voice expressions—“is nailed,” “were analyzed,” “will be computed,” “has been approved,” “might have been sheared.” Do not employ them to the point of monotony. At the least you can use a few combinations of neuter verb and adjective, such as *are separable*. Often you can find an active-voice verb; instead of “from these data it may be concluded” you can say “these data permit (yield) the conclusion.” Generally, without being inaccurate, you can replace “such percentages are given in Table 1” by “such percentages comprise Table 1” or “comprise columns 2 and 3.”

Whenever you give an oral report to people with little schooling, repeat key words and ideas frequently unless study of your hearers’ faces indicates that they feel you are talking down to them. Assuredly, though, you will not go astray if you give fellow engineers and industrialists a considerable measure of variety.

9. Reinforcing the Written Word

Because the alphabet isn't the human voice and body—because the alphabet lacks pitch, timbre, volume, change of pace, gesture, and the attention-holding power of the human eye—written words cannot reproduce the effect of spoken words without reinforcement. The commonest kind of reinforcement is punctuation, including the use of horizontal spacing (indentation) and vertical spacing. Closely allied to punctuation is the use of capital (upper-case) letters for certain purposes. Not to be divorced from punctuation and capitalization are the various ways by which abbreviations are indicated.

The present chapter considers all these ways of “shoring up” the bare words that form the skeleton of written language. The chapter also treats two other matters that logically belong with punctuation although seldom so regarded. These are tabulation and the written presentation of equations and formulas. A moment's thought will show you that both can be called special forms of punctuation and that the equation and the formula also utilize special systems of abbreviation.

A word about the scope of the chapter and its viewpoint. This account does not attempt to be exhaustive; it covers only those principles and procedures on which the engineer most strongly feels the need for guidance. And its attitude toward various “rules” is, it is hoped, similarly practical. Many punctuation practices, and an even greater number of practices employed in drawing up tables and formulating or reproducing equations, are highly uniform. Every experienced writer follows them. They can properly be called rules. But other practices are far less standardized, and there is no gain in discussing them as if they were the laws of the Medes and Persians.

Moreover, even the “rules” change somewhat from decade to decade. Watch trends. Try to keep up with any widespread changes. Some are bound to take place during your professional lifetime. Note them. Unless you see great objections, follow them.

PUNCTUATION, SPACING, AND CAPITALIZATION

The Determinants of Current Practice. Four main factors interact to govern today's rules and procedures:

1. A set of punctuation marks which, though so numerous that they confuse some students, are nevertheless so few that every mark has to do more than one job.

2. A number of practices that are arbitrary but socially convenient or even essential. The standard analogy is our habit of driving on the right-hand side of the road. So with certain uses of one or another punctuation mark, and so likewise with most rules for capitalization; just what the practice is matters less than that all of us should do the same thing.

3. Three philosophies of punctuation. You may have been taught that punctuation (including indentation) is meant to indicate solely the grammatical relationships among sentence and paragraph elements. You may even have been told that capitalization has the same purpose. On the other hand, perhaps you have learned that punctuation marks, capital letters, and some kinds of spacing are substitutes for the pauses of various lengths and the changes of pitch, intonation, and volume that we use when we speak.

The first of these assertions contains a good deal of truth; the second, some. All writers who take pains do, for example, separate from one another all members of a series, or at least all but the last two members ("Tom, Dick, Harry[,] and Bill"). Again, some writers hyphenate every compound adjective ("open-hearth furnace") in order to show that grammatically it is equal to $(a + b)$ rather than only to $a + b$. In short, we do employ punctuation primarily to assist word form and word order in showing grammatical relationships and their degree of closeness. It is not accurate, though, to say that we punctuate on that basis only. At times we all use a comma—or a dash—for emphasis, at a point in the sentence where, if we were speaking, we would pause to let our words sink in. The preceding sentence exemplifies what it describes.

There is an additional source for our practice. Though few textbooks say anything about it, all of us occasionally use punctuation marks, spacing, and capital letters as graphic devices. We replace a comma or semicolon by a dash because the dash hits the eye harder. We replace "This is difficult, but it is not impossible" by "This is difficult. But it is not impossible" or "The axioms are few; they come down to these half-dozen—move goods as little as possible, move them . . ." by "The axioms are few. They come down to these half-dozen: Move goods as little as possible; move them . . ." In like fashion we sometimes employ extra horizontal or vertical spacing to indicate that successive passages differ in grammatical form, in logical purpose, or in emotional tone.

4. Diverse individual reactions. Some people that you have met are

sticklers for all the "rules" they were taught when young, and these rules may be the ones that were in vogue seventy-five or even a hundred years ago. Other people observe many "rules" rigorously themselves but allow their colleagues and subordinates much latitude. Still other people punctuate "by guess and by golly" but consider themselves punctuation experts. There are also a few deliberate innovators—some of them uninformed, some ill advised, a number of them intelligent pioneers—and there are thousands of people who adopt many of the suggestions made by these innovators.¹

General Recommendations. In view of these differences of opinion and practice, what should you do?

The basic suggestion is to walk the chalk line. Keep all the traditional marks. They are all useful. However, employ exclamation points but rarely, and use italics, parentheses, colons, and pairs of dashes as seldom as you can. Do not overuse index fingers, though they have a place in some kinds of reports. Often you can substitute for them such other typographical devices as the blackface circle (●) or a marginal directive word, like ACTION. Be just as sparing in your resort to ellipsis dots, asterisks, unorthodox spacing, and a dash after *And* or *But*.

For the rest, as a beginner in your profession you may have to conform to an organization's or superior's ideas of proper punctuation and capitalization. So far as you have a choice, you should prefer fairly open punctuation to closed punctuation, and a lower-case (small-letter) style to an upper-case one.

Open versus Closed Punctuation. Open punctuation is sometimes defined as "the use of only those marks that the reader needs." This definition is obviously weak, if for no other reason than the great difference among readers. A more nearly accurate statement is that open punctuation uses few if any marks for emphasis only, virtually none as graphic devices, and fewer than the traditional system employs to distinguish kinds and degrees of grammatical separation.² Indeed, many advocates of open punctuation

¹ Many businessmen would like to abolish the semicolon and colon, to use dashes and ellipsis dots (. . .) more freely than general practice allows, to revive the paragraph symbol (§), and to make other changes. Business correspondents, trade-paper editors, and printers experiment daily with new applications of various marks, or "points," and less frequently with new applications of capital letters and spacing.

² For example, closed punctuation calls for commas in "During December, 1948, he . . ." whereas open punctuation omits them. Closed punctuation calls for two commas in "Tom, Dick, and Harry"; open for one. In the last three words above, closed punctuation involves putting a comma after *open*. Again, closed punctuation requires a comma after nearly every adverb phrase or adverb clause at the start of a sentence: "At Detroit, we conferred with the N.A.M. representative"; "Because the material was homogeneous, the results . . ." Open punctuation retains commas only to prevent grammatical unclearness ("For the blind, legislators showed no consideration") or to show that an introductory element is nonrestrictive (see pages 116 ff.). Moreover, closed punctuation uses fewer solid-capital abbreviations such as NAM or ING. It favors N.A.M. or I.N.G.

urge that commas and other internal marks should not exceed an average of $1\frac{1}{2}$ per sentence. Such people are much less disturbed by a large number of periods. The fact is, most of them realize that to cut down the amount of internal punctuation usually entails making the average sentence fairly short.

Readability studies that might prove which system is preferable are few and inconclusive. And, so far as we know, none of these deal with engineers. Personal experience leads us to believe that:

1. Most engineer-readers need somewhat more internal punctuation than is recommended by the extreme advocates of open punctuation.

2. They do not need as many marks as the average engineer-writer gives them.

3. Engineering documents contain more long and relatively complicated sentences than they need to, though it is true that short sentences cannot be as few as in general writing aimed at general readers.

4. To sum up, if you deliberately aim at using a fairly open style you will conquer a common tendency to overpoint and will probably end up about right. A useful by-product of this effort may be the lightening and tightening of your sentence structure.

If you already use one of the systems effectively you probably should not try to change. You might, though, observe the occasions when a temporary resort to the other system will help your reader. For example, a user of open punctuation inserted a comma before *and* in the following sentence so that he could stress the scope of the needless operations he was naming:

We had to unload them by hand, put them on the truck, take them to storage, and unload them again.

And a "closed-punctuation man" dropped the comma before *and* in the following set of numbers: "24,350, 30,110 and 32,908."

Some sentences cannot be ideally punctuated under either system: "If the combustion rate is too low during a long period of holdfire, ignition is lost in all parts of the fuel bed, and the fire must be rekindled." The first comma is needed to keep the sentence from reading as if it meant *holdfire ignition*. The second comma is needed to keep us from reading "lost in all parts of the fuel bed and the fire." Yet clearly the two commas are doing two quite different jobs. The advocate of open punctuation would like to use no commas in this sentence or he would like to keep only the comma after *holdfire*, obviously because all the words following it belong together in the sense that both clauses which they form are modified by the *if*-clause. But he cannot do as he would like.

Lower Case versus Upper Case. Many foreigners and a fair number of English-using people feel that our language employs too many capital

letters. If you are allowed to do so, employ small letters instead of capitals in the following situations.

1. When a man's title follows his name—"John Jones, superintendent of transportation."
2. On most occasions when a man's title is used instead of his name—"The president says," etc.
3. For words originally proper nouns, whenever they are used as adjectives (*diesel engine*) or as common nouns—"The use of diesels has increased."

Of course you will have to follow any rigid pattern laid down by your organization or your immediate boss. If your material is to be printed, you will have to take account also of editorial preferences.

Spacing. Itemized lists which are similar in nature should be indented and vertical-spaced similarly. Do not carry horizontal spacing to such an extent that some lines contain only three or four words before reaching the right-hand margin.

Specific "Rules." Below are statements of current practice, with some recommendations.

I. Marks used as spelling devices.

A. *To indicate certain kinds of plural forms.*

The apostrophe is common in such plurals as *the 1940's*, *his 2's* and *Q's* look alike, and *six 2 by 4's*.

B. *To indicate the so-called possessive case.*

The apostrophe is used in spelling the "possessive" case forms of nouns, and of all pronouns whose possessive forms end in *s*, except *yours*, *hers*, *his*, *its*, *ours*, *theirs*, *whose*. Examples are *John's job*, *Jones's job*, *the company's profits*, *someone else's belief*, *the Joneses' house*, *all companies' profits*, *the one man's view against the other's*, *all the others' prospects*.

NOTES

1. Names of most nonliving things and of most abstractions do not take the possessive case form, but an *of*-phrase instead (*the cost of the machine*, *the proof of his loyalty*).
 2. Most plural possessives merely add the apostrophe to the basic plural form (*executives'*); three common plurals add the apostrophe and an *s*—*men's*, *women's*, *children's*.
 3. Some men prefer *Jones'* to *Jones's*.
- C. *To indicate words contracted in speech.*

The apostrophe is used to show omitted letters in such "telescoped" expressions as *can't*, *aren't*, *won't*, *he's*, *we're*, *they're*, *it's*, and *who's*. Related to this use is the employment of the initial apostrophe in such expressions as *the class of '49*.

NOTES

1. Observe the difference between *its*, meaning *of it*, *belonging to it*; and *it's*, meaning *it is* or *it has*. Similarly for *whose* and *who's*.
 2. Standard practice calls for only one apostrophe in a word. Logically there should be two in *shan't*; observe that the first apostrophe is omitted. For the same reason, careful writers do not put down *the '80's*; they make it *the '80s* or *the eighties*.
 3. For contractions that are only written, not spoken, such as *Wm.*, *Secy.*, and *Chmn.*, the nearly universal practice today is to treat the forms as abbreviations rather than as contractions and therefore to use no apostrophe.
- D. To indicate that *what are usually two or more words combine to form a single word*.

The hyphen is used for this purpose, but not consistently (compare *grandfather*, *half-sister*, *first cousin*). Since at least two weights of hyphen are needed and we have only one, and since the philosophy of hyphenation has never been completely formulated to everyone's satisfaction, the "rules" that you may come across are somewhat confusing. Furthermore, a complete set of such rules would take more time to master than you can spare. But at least use the hyphen in the following cases:

1. Hyphenate all compound words beginning with *self*—e.g., *self-contained* and *self-interest*, but not *selfish*, *selfishness*, and *selfhood*.
2. Hyphenate all cardinal numbers from twenty-one through ninety-nine.
3. Hyphenate the corresponding ordinal numbers.
4. Hyphenate compound adjectives when you must do so in order to prevent unclearness—*the three stress-cycles*, *10 point-gages*.
5. Hyphenate such expressions as *kilowatt-hour* and their abbreviated forms (*kw-hr*).

NOTES

1. Do not hyphenate compound chemical terms used as adjectives. For practice in another major field of science consult the United States Geological Survey manual, *Suggestions to Authors of Papers* (Washington, 4th ed., 1935), pp. 8-9.
2. Do not hyphenate *northeast*, *northwest*, *southeast*, and *southwest*.
3. The trend is away from hyphenation.

E. *To show the relationships among the elements of a complex single word.*

1. Prefixes such as *inter*, *non*, *pre*, *re*, *sub*, *super*, and *un* are usually run right in with the rest of the word. But there are many exceptions to this rule. For example, the hyphen is usually inserted when the rest of the word is a proper noun or an adjective formed from a proper noun, such as *non-Euclidean*, *un-Christian*, and *pre-Newtonian*. Again, some writers and editors hyphenate if the element after any of these prefixes but *un* begins with the same letter that ends the prefix—*nontechnical* but *non-natural*; *retest* and even *reread* but *re-establish*; *interlock* but *inter-related*. Engineering practice is to omit the hyphen.
2. *Pro*, *anti*, and *ante* are usually followed by a hyphen whenever the next letter is a consonant (*pro-labor*, *anti-management*, *ante-war*) and also whenever it is a vowel which should be separated from the final vowel of the prefix to make the word easier to read (*anti-insurgent*, *pro-insurgent*). Most people treat *quasi* in the same way; some always put a hyphen after it. *Semi* and *pseudo* are seldom followed by a hyphen.
3. You may depart from Rules 1 and 2 whenever you know that your reader will apprehend a word or an expression as a unit. Many engineers need no hyphen in *dewater*; most laymen do. Electrical engineers take in *deionize* at one glance; the average reader needs a hyphen to show him how the three successive vowels should be divided.
4. Similar principles govern the use of a hyphen before certain suffixes that might be mistaken for separate words or that under certain conditions give a puzzling succession of letters. Thus *manlike* is not hyphenated, but *flail-like* had better be. *Airtight* need not be hyphenated; for most readers, the hyphen is needed in *dust-tight*.
5. All readers need hyphens to distinguish *re-treat* from *retreat*; *re-form* from *reform*; *re-creation* from *recreation*.
6. Do not put a hyphen between a whole-number numeral and the fraction belonging with it. You should, however, leave a space, so that $2\frac{3}{4}$ will not look like $23/4$.

- F. *To show that part of a word appears on one line and the rest on the next line.*

The hyphen is used for this purpose. It should not be employed on every occasion when it might be. For example, words of one syllable should never be divided; all of *straight*, all of *laughed*, all of *moved* should be written on one line. Nor should only one letter of a word appear on a line; *among* and *across* and many other words should never be divided. In fact, meticulous writers extend the rule to syllables consisting of two letters, and do not divide *tested*, *tester*, and words similar to them. Beyond these principles the average engineer has no time to go. Here are two suggestions: (1) pronunciation is often a helpful guide, as in *he was pres-ent* but *he will present his bill* and *in a prod-uct* but *pro-duction* and *pro-duce*; and (2) a good dictionary is an invaluable guide.

- II. Marks attached to, or inserted in, material quoted from other persons.

- A. *To indicate the exact words used by other persons.*

Two methods are available: (1) the use of quotation marks, and (2) a combination of special indention with other devices. If the quoted matter is inserted in a sentence of your own, enclose it in quotation marks. If the quoted matter is separate from your own words and runs to more than four lines, or if you wish to set off even a short quotation in order to emphasize it, put extra spacing above and below it; you can make it stand out still more clearly if you indent a few extra spaces horizontally. In printed copy you may also ask for a different (almost always a smaller) type. If there is a quotation within the quotation, your practice will differ according as you use Method 1 or Method 2. In the first instance, use single quotation marks within the double:

Richards says, "I cannot agree with Smith's conclusion: 'The process is too expensive.'"

In the second instance, a colon would follow *says*, all Richards' words (including those he quotes from Smith) would be separately indented, and Smith's words would be set within double quotes.

Richards says:

I cannot agree with Smith's conclusion: "The process is too expensive."

- B. *To show that you omit elements from a passage that otherwise is quoted word for word.*

Ellipsis dots (already mentioned and exemplified on page 27) are used for this purpose. If the omitted word or words come within a sentence, three dots are used. If they come at the end of a sentence, a period plus three dots should be used. When a whole paragraph is omitted there may be 3, 5, or 7 dots.

C. *To indicate or correct errors in the quoted matter, and to clarify doubtful points.*

For these related purposes a pair of brackets is the standard punctuation device. The word *sic* is placed within brackets when you wish to call attention to an error or a highly doubtful statement. This and other practices are exemplified below, in a passage containing more brackets than are generally used so close together.

The piles were driven [in the bottom of a sheeted trench] by a steam hamer [*sic*] . . . made by the Vulcan Iron Plant [query: Works?]; weight, 4500 lb; fall, 24 [*sic*; must be 42] in. per minute. . . . The tips of the piles were about 80 ft. below street grade [El. -65].

D. *To indicate the source of matter that you quote or cite.*

The use of various symbols is explained on pages 115 and 194.

III. Marks and spaces used to indicate the grammatical and rhetorical relationships among your own paragraphs, items comprising a list, sentences, clauses, phrases, and words.

A. *To divide your material into paragraphs.*

1. The commonest way is to indent between one-half inch and one inch—on the typewriter, 5 or 7 or 10 spaces.
2. Another way is to single-space material within each paragraph, to double space between paragraphs, and to omit indentation.
3. If you want to show the printer unmistakably where each paragraph begins, you can use the traditional paragraph symbol already mentioned (§).
4. For special emphasis you can, but seldom should, use one of four marks:

The traditional paragraph symbol.

A solid blackface circle.

A solid red circle.

In the margin, the “fist” (hand with index finger extended).

B. *To show what items comprise a list.*

There are two common situations: (1) you run the list into your regular text, as is done here; (2) you give it special indention.

1. In the first instance you may preface each item of the list by (a) a small letter, or (b) an arabic numeral, or (c) a capital letter (rare). The letters or numerals may be in roman type or italicized (underscored when you type or handwriting). They are enclosed by parentheses. To use them without the parentheses but followed by a period and an extra space is permissible but confuses most readers.
2. In the second instance you indent either as for paragraphs, or more deeply. You also have a choice between carrying the second and all following lines of an item farther to the left than the first line, and setting all lines flush; the passage you are now reading is set flush. You almost certainly will wish to letter or number each item. You can reinforce or even replace numbering or lettering by paragraph symbols, circles, and dashes (exemplified below).

Characteristic sources of trouble are

- Reductions in area
- Loose brick or other accumulations at bends
- Broken flue linings

NOTE

Watch the punctuation after each item in a list, particularly if the list is run into the text rather than indented. By and large you can follow the principles given below (III D 4, III E 2, III G 6) for punctuating items in a series.

- C. *To show what words you wish your reader to consider as a sentence.*

There are two situations. Ordinarily your sentences are consecutive. But occasionally you put one grammatically complete sentence inside another.

1. In the first instance the technical writer most commonly uses a period. Sometimes he uses a question mark. Practically never does he use an exclamation point. Once in a while he may use a colon if what is grammatically a complete sentence virtually restates what was said in the preceding sentence. This book offers several examples; here is another.

The company is making little profit: This year it paid no dividends and added nothing to its surplus.

2. In the second instance you may use a pair of dashes or else parentheses to insert one sentence inside another:

Edison was young (he was then twenty) and inexperienced.

In the above sentence, dashes could be used.

NOTES

1. A question mark is not used after an indirect question, such as "He asked me what I wanted."
2. When a colon is used before a full-sentence restatement, the restatement may begin with either a capital or a small letter.
3. Formal lists are commonly introduced by a colon, regardless of whether they consist of complete sentences.
4. Related to the foregoing use is the employment of a colon after the salutation in a letter:

Dear Mr. Brown:

Your request about engineering credits has been referred to me. . . .

5. Sometimes a consecutive sentence is parenthesized:

Edison was inexperienced. (He was only twenty.)

Observe that the period is put within the parentheses.

- D. *To indicate the relationship of a clause to the rest of the sentence.*

Obviously you have no problem if the sentence contains only one clause. The other sentence patterns are so numerous that only a textbook devoted solely to punctuation can treat them all. Five factors, however, must be considered: whether the clause is a main or subordinate clause, whether there are commas within one or more clauses, whether the clause (if subordinate) is restrictive or nonrestrictive, whether its end must be shown by punctuation in order to avoid confusing the reader, and what emphasis you wish to give it.

1. Two main clauses that you think belong together in one sentence are ordinarily separated by a comma if they are joined by any one of these six words—*and*, *but*, *or*, *nor*, *for*, *yet*. They may be separated by a semicolon if (a) you wish to give each clause special emphasis or (b) commas occur at places within either clause which

make advisable a clearer indication of the chief separation point than a comma can give.

2. Two main clauses that you think belong together in one sentence are ordinarily separated by a semicolon if they are not joined by any one of the six coördinating conjunctions named above. Observe that *hence*, *therefore*, *however*, *finally*, and many similar "logical link pins" are not coördinating conjunctions; hence they are preceded by a semicolon when they stand between two main clauses.
3. Sentences containing three or more main clauses are usually punctuated according to the principles just stated. But sentences like "I came, I saw, I conquered" may be treated according to the rule governing the punctuation of elements in series (see III D 4).

NOTES

1. No law keeps you from starting sentences with *And*, *But*, *Or*, *For*, *Nor*, and *Yet*. Don't overdo the practice.
2. At the other extreme, you may omit the comma before an *and*, *but*, *or*, or *nor* which joins two main clauses, provided that (a) neither clause contains internal punctuation and (b) the reader cannot think that the conjunction is joining anything except the main clauses. "Richards was here but Brown was not" is all right. "We have the tools, and the man will start tomorrow" is momentarily unclear without a comma.
3. In informal style, *so* may be treated as a coördinating conjunction along with *and*, *but*, *for*, *or*, *nor*, *yet*.
4. Experienced writers sometimes use a comma between main clauses in a sentence where the ordinary principles call for a semicolon:

Skill of that kind not only is sought, it is rewarded.

The reasons for using a comma in the above sentence are to move the reader quickly to the concept of "reward" and to show that the search and the compensation are closely connected. On the other hand, a semicolon is kept in:

Not only are you willing to analyze situations; you are also fairly capable of doing so

because the writer wishes the reader to pause briefly after the first clause and let its meaning sink in.

5. Many sentences with three main clauses can be symbol-

ized as $(a + b) + c$ rather than as $a + b + c$. In such sentences the mark after a should if possible be a comma whenever the mark after b can or must be a semicolon. If a has to be followed by a semicolon and if c is a restatement of $(a + b)$ you may put a colon after b . Otherwise you may wish to make two sentences of the passage, or even three. An example:

All architects approved Bowman's system; their engineers accordingly complied with his precepts: henceforth, combined and cantilever footings were more carefully proportioned.

4. Dependent clauses that form a series should be separated by commas except when the procedures discussed under III B are applied.

This hypothesis should be provisionally accepted because it best accounts for previous findings, (because) it leaves no data from the current investigation unexplained, and (because) it is the simplest possible hypothesis.

When any such clause contains a comma, you may need to use semicolons between the clauses:

The purchase is practicable if interest rates stay low; if present equipment, in which \$100,000 is invested, can be sold for \$80,000; and if . . .

Clauses punctuated as above should come *after* the main verb of the sentence. The *if*-clauses in the example should stay where they are; they should not start the sentence.

5. A nonrestrictive clause⁸ is regularly preceded by a comma and followed by a comma:

Chicago, which grew rapidly, soon became . . .

His one remark, that we'd lose money, was laughed down.
I favor Smith. He is, whatever most people think, a reliable man.

For special emphasis the commas may be replaced by dashes:

He is—whatever most people think—a reliable man.

Or commas may be replaced by parentheses to show that the enclosed words are a useful but not an essential statement:

Johnson went to Chicago (perhaps just because he wanted a change of scene) before I could talk to him.

⁸ *Nonrestrictive* is explained in the Appendix to this chapter.

Either of the usual commas is omitted whenever some other mark is called for by another principle of punctuation:

. . . Smith. Whatever most people think, he . . .

The most wide-awake city was Chicago, which grew rapidly.

We'll go along, since the majority voted to; but . . .

The single parenthesis, however, is never used. And a single dash is employed only before the nonrestrictive clause, never after it unless a coördinating conjunction and a main clause follow:

He is a reliable man—whatever people may think.

Whatever people may think, he is a reliable man.

6. If your reader might not recognize where a restrictive clause ends, you may conclude it with a comma—as in the sentence you are now reading.
7. If your reader cannot interpret an elliptical clause unless it contains a comma, give him the comma:

All employees in Division 4 are skilled; most of those recently hired in Division 3, unskilled.

8. When a series of clauses which together form the subject of a verb are “caught up” or summated by *all*, *these*, or *none* a dash is common before the summing pronoun:

What he did, why he did it, how he did it—these are mysteries.

9. *That is* and the equivalent *i.e.* are followed by a comma. The commonest mark used before them was the dash, until fairly recently. The comma is now more frequent. They may be preceded by a semicolon (some instructors insist on this) whenever they are followed by a full clause:

He was “in embarrassed circumstances”; that is, he was flat broke.

E. *To indicate the grammatical relationships among phrases and between phrases and other sentence elements.*

1. On the whole, a nonrestrictive phrase is punctuated in the same way as a nonrestrictive clause. However, parentheses are rare, and so are dashes unless the nonrestrictive phrase contains commas:

The whole plant, valued at a million dollars, will . . .
 The whole plant—valued at a million dollars—will . . .
 The whole plant (valued at a million dollars) will . . .
 Being too ill to stay on horseback, Lee rode in an ambulance.
 Lee, too ill to stay on horseback, rode . . .
 All these parts—barrel, stock, sling—are of the best material.

2. Phrases used in a series are ordinarily separated from one another by commas:

Of the people, by the people, for the people.
 To work, to play, to rest.

3. If your reader might not recognize where a restrictive phrase ends, you may conclude it with a comma:

Toward this end, point your every effort.⁴

4. An introductory phrase may be set off for special emphasis:

Within his limitations, Gray does fine work.

F. *To show the grammatical nature and linguistic status of words and terms.*

1. When a word is used as a word—rather than as the indication of a thing, action, or relation—it may either be italicized (underlined) or put within quotation marks:

With is an ambiguous word.
 “Sewage” will be taken to mean . . .

2. A word or term which is not yet considered as belonging to the English language is usually italicized:

Before signing a petition, ask the old question *Cui bono?*

Most dictionaries will tell you whether an expression is regarded as “naturalized.”

3. A word or term coined for the occasion or coined so recently that it may be new to your reader may be put within quotation marks. Such expressions should be used very seldom.

G. *To show the grammatical relationships among words.*

1. Two coördinate words—most of them will be pairs of adjectives—which are not joined by a coördinating conjunction should be separated by a comma:

⁴ But the sentence—taken from an actual report—needs recasting. Neither its tone nor its structure is effective.

An accurate, clear talk.

Observe that no comma is used in *high steam pressure* because *high* and *steam* are not coördinate; *high* modifies *steam pressure*. So with *tall young man* and hundreds of similar expressions.

2. The second element of a date or an address is set off by commas:

December, 1949,
December 10, 1949,
222 Marsh Street, Clio, Ohio,

Observe that, under open punctuation, the first expression above would take no commas. Notice also that 222 Marsh Street is regarded in the United States as forming a single unit within the address.

3. In a typed report the simplest way of indicating the volume and page occupied by an article is to use a colon:

J. Eng. Ed., 12:49-52.

In printed matter, engineering practice favors either of these two forms:

J. Eng. Ed., 12, 49-52.

J. Eng. Ed., 12, 49-52.

4. The colon is likewise used in expressing hours and minutes:

4:15 P.M.

4:00 A.M.

If seconds must be added, a period is used:

4:05.2 A.M.

5. A nonrestrictive word or term is set within commas or—less commonly—within dashes or parentheses. Parentheses, however, are usual when reference is made to a table or figure:

A schedule of coefficients (Table 52) was developed. . . .

A photograph of this wire (Fig. 3a) shows it as so laid that the 2-in. dimension was parallel with the direction of motion of the water.

They are also usual when reference is made to the lettered parts of a figure:

Onto the steel tube (a) is threaded a top nose piece
(b) . . .

(In printed matter, *a* and *b* are italicized.)

6. Words comprising a series are separated by commas:

Lock, stock, and barrel.

Users of open punctuation omit the comma before the coördinating conjunction. *Do not* put a comma after the conjunction.

7. Coördinate elements that are separated only by *not* take a comma before *not*:

This is just a hypothesis, not a theory.

For brevity's sake, the following sections are in rather dogmatic terms, and explanation of the principles which determined their recommendations is omitted. These principles will be plain to you if you look for them. For example, a technical reader finds the standard technical abbreviations clear and concise; they are therefore recommended for you. In deciding how to reproduce equations, you sometimes feel a clash between coherence and emphasis; you should choose a procedure that obtains emphasis and sacrifices only a little of the desired coherence. And so on.

NUMBERS

In your formal and semiformal technical documents, numeralize numbers compared or contrasted, numbers in a series, numbers before units of measurement, and single numbers of two or more digits, with the following exceptions: Spell out a number that starts a sentence, and if the resulting form is cumbersome, recast the sentence; spell out also one of two successive nonparallel numbers ("four 2-in. boards, 22 four-story buildings").

To prevent transcription errors you should put a zero before the period in a decimal fraction, and should handwrite *l* and *l*, which are identical in typescript.

Common fractions should be spelled out and hyphenated, if you use them indefinitely or approximately—"three-fourths of this amount." But give figures for definite weights and measurements—"½ in." In typing, use the diagonal bar and not the hyphen between numerator and denominator.

In tables, separate by spaces a number of four or more digits, grouping the digits by three's from the right. In the text, use no comma for a four-digit number.

Percent is spelled solid, without a period. Use it only if a number pre-

cedes; otherwise the word is *percentage*. Make clear the basis on which you figure your percentages.

SYMBOLS AND ABBREVIATIONS

You can use freely such symbols as ' and ° in tables, sketches, and most other illustrations, and also in memorandum reports or other informal documents. In formal writing, however, avoid them. When your readers are technical men, use accepted scientific and engineering abbreviations instead.

The problem is: which system of abbreviations? The most conservative style is typified by R.P.M.; a middle-of-the-road style by r.p.m.; a liberal and space-saving style by rpm. In all, the same abbreviated form expresses both the singular and the plural (1 bbl; 21 bbl). The most important considerations are to suit your specific reader and to be consistent with yourself. If you can at the same time follow the practices set forth in *American Standard Abbreviations for Scientific and Engineering Terms* (published by the American Standards Association, Incorporated), so much the better.

In writing nontechnical abbreviations, follow general practice (p.; pp.; Ga.; P.M. or p.m.; Dr. rather than dr). The United States *Postal Guide* will tell you the official abbreviations for states, territories, and possessions.

Observe that the symbols < and > (which are related to abbreviations) contain their own verb and therefore require no *is*. Observe also that $a/b = c/d$ is today preferred over $a:b::c:d$.

EQUATIONS AND FORMULAS

Some technical readers want you to treat all equations and formulas like clauses and set them within the running copy. Other readers wish every equation and formula to be numbered—a process that virtually requires setting the equation or the formula on its own line. If you do this you must center the equation or formula horizontally and see that you leave plenty of white space above and below it.

No scientific studies exist that tell us which arrangement is easier to read. We recommend that you separate from the running text all equations and formulas of any complexity and all simple ones which can be called basic for your purposes. When you set formulas in columns, align on equal signs or on plus or minus signs. Otherwise, center horizontally, indenting to the right for the second and all following lines in any formula or equation. Make your line break at some logical place, as before a plus sign:

$$\begin{aligned}
\frac{M}{M_v} = & \frac{1}{1 - k^4} \cdot \frac{1 - n}{\pi} \left\{ \frac{4}{3} \left(1 - \frac{\epsilon_v^2}{\epsilon_1^2} \right)^{\frac{3}{2}} - \frac{4}{3} \left(k^2 - \frac{\epsilon_v^2}{\epsilon_1^2} \right)^{\frac{3}{2}} \right. \\
& + 2 \sqrt{1 - \frac{\epsilon_v^2}{\epsilon_1^2}} - 2k^2 \sqrt{k^2 - \frac{\epsilon_v^2}{\epsilon_1^2}} + 2 \frac{\epsilon_1}{\epsilon_v} \arcsin \frac{\epsilon_v}{\epsilon_1} \\
& \left. - 2k^4 \frac{\epsilon_1}{\epsilon_v} \arcsin \frac{1}{k} \frac{\epsilon_v}{\epsilon_1} \right\} + n \frac{\epsilon_1}{\epsilon_v} .
\end{aligned} \tag{11}$$

You should aid the reader by not making him turn a page in order to finish reading an equation. Get all of an equation on one page. This is desirable if your document is in typescript, and virtually mandatory if it is printed.

Leave no horizontal space between letters forming products, before superscripts indicating powers, and before subscripts.

Handwrite not only *l* and *l* but symbols lacking on the typewriter. Inclusive, integral, and summation signs should be exactly as high as the tallest expression (including division and vinculum rules) between or after them. If in pairs, these signs must be of the same size. Underline algebraic symbols, but not log, sin, cos, tan, cot, and cosec.

When you number any equations and formulas you will ordinarily avoid confusing the reader if you number all. Put the numbers in the right-hand margin of your copy, within parentheses or brackets. Use *1a*, *2b*, etc., for corollary and subsidiary equations if such a method will expedite the reader's first use of your material or his later reference to it.

TABLES

In the body of a document keep to a minimum the tables that contain original data. Give your reader, instead, tables that contain derived data pointing to or summarizing your conclusions.

Shun large and complex tables, first because their unity is hard for the reader to perceive and second because they may have to be "tipped into" your manuscript or inserted in a cumbersome special pocket.

You can leave a short, simple table unnumbered and uncaptioned (untitled) provided that your reader will probably use it only once, will gain nothing by seeing its caption in your formal list of tables, and finds it clearly introduced by the running text that precedes it.

When your typescript or printed document is to contain tables that were originally lantern slides accompanying a talk, be sure that you number these tables and that your manuscript refers to all of them.

Ordinarily you should number and title each table above the body of the table. The caption may be followed by descriptive material, separately indented. You may have to supplement this by notes placed below the table; but avoid these if possible. When you do include them, use

as reference marks either lower-case superscript letters or such symbols as the asterisk and dagger. These are preferable to superscript numerals, which the reader is likely to confuse with exponents. In copy intended for printing, italicize the superscript letters.

Generally, leave a table open at left and right. Use double "rules" (horizontal lines a slight distance apart) at the top of each table of a typescript report, a single rule at the bottom, vertical rules when you must to separate columns within the table, and as few horizontal rules as possible. In a long table, try to group your items, preferably putting no more than five items in any group, and separate the groups by extra vertical spacing rather than by horizontal rules. Some technical magazines cut out all the rules they can, vertical as well as horizontal.

If absolutely necessary, you may run a table broadside, the wrong way of the page, or you may double a table vertically. In this case, use a double vertical rule and repeat your column headings. An example follows.

TABLE 2
RATE OF CRACK PROPAGATION, PLATES WITH STANDARD STRESS-RAISERS⁵

Series Number	Specimen Number	Number of Cycles*	Series Number	Specimen Number	Number of Cycles*
Killed steel normalized—not strain-aged					
1	1-1	31 700	2	2-1	41 800
Tested at	1-2	35 800	Tested at	2-2	40 900
80 deg. F.	1-3	59 600	32 deg. F.	2-3	39 400
	Av.	42 400		Av.	40 700
3	3-1	37 900	4	4-1	50 800
Tested at	3-2	33 100	Tested at	4-2	36 700
0 deg. F.	3-3	43 700	-40 deg. F.	4-3	68 800
	Av.	38 200		Av.	52 100
Rimmed steel as-rolled					
5	5-1	28 600	6	6-1	18 500
Tested at	5-2	26 800	Tested at	6-2	19 500
120 deg. F.	5-3	28 400	80 deg. F.	6-3	20 800
	Av.	27 900		Av.	19 600
7	7-1	9 800	8	8-1	20 900
Tested at	7-2	13 900	Tested at	8-2	20 200
32 deg. F.	7-3	18 100	0 deg. F.	8-3	23 800
	Av.	13 900		Av.	21 600
Rimmed steel strain-aged					
9	9-1	24 900	10	10-1	25 300
Tested at	9-2	23 600	Tested at	10-2	27 400
120 deg. F.	9-3	22 600	80 deg. F.	10-3	23 900
	Av.	23 700		Av.	25 500
11	11-1	29 000	12	12-1	28 800
Tested at	11-2	26 500	Tested at	12-2	29 900
32 deg. F.	11-3	30 200	0 deg. F.	12-3	23 900
	Av.	28 600		Av.	27 500

* Number of cycles to produce fatigue cracks 0.6 in. long. See Fig. 1 for details of specimens and stress-raiser. All specimens tested on a cycle in which the stress varied from +16,000 to -16,000 p.s.i. of net section.

Notice that this table exemplifies the suggestions about avoiding horizontal rules whenever you can group related items and leave extra vertical space between groups. The table also shows the use of the asterisk as a footnote index.

⁵ *Ill. Eng. Exp. Sta. Bul.* 371, p. 12.

To keep a table vertical, you can make long column headings broadside but run the body of the table the usual way of the page. All the practices named in this paragraph are to be avoided whenever possible, but sometimes they are better than making tables long and narrow or breaking a table over from one typescript page to the next.

TABLE 4
FATIGUE STRENGTH OF COMPOSITE JOINTS
Specimens shown in detail in Fig. 3

Number of Specimen	Source of Specimen	Stress Cycle, p.s.i. Tension on Gross Section of Plate	No. of Cycles for Failure	Remarks
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Laymen will often read an otherwise forbidding table if you present the column headings pictorially as well as in words. Brinton's *Graphic Presentation* (New York, 1939), page 38, gives an example.

Within columns, align on decimals. In a long column of decimal fractions that are all less than unity, you may put zero only before the first number and the last. You can do the same with arithmetical, monetary, and degree signs.

Indent averages, totals, and means in the first column of the table.

A short, informal table with only two or three columns should be indented more than the usual amount, so that the reader's eye does not have to make a long jump. To guide him, former practice called for using leaders (.....). This is no longer standard.

Leave enough vertical space above and below superscripts and subscripts to make them stand out. Furthermore, if your report is to be printed you should leave extra vertical space at all places where the editor will need to "mark up" for the compositor.

APPENDIX: RESTRICTIVE AND NONRESTRICTIVE ELEMENTS

The explanation of this rather puzzling subject will be clearest if presented inductively.

Though the world contains many John Smiths, nearly always when we write or say *John Smith* our reader or hearer knows just what man we mean. Therefore, any modifying words that follow his name are not used to distinguish him from some other John Smith. They are not restricting further the application of his name. They are *nonrestrictive*. And the usual punctuation is a pair of commas around them:

John Smith, who was born in Brooklyn, is . . .

The same principle applies whenever *John Smith* is followed by a noun that gives his citizenship, profession, status, etc.:

John Smith, a Brooklynite, is . . .

John Smith, a citizen of Brooklyn, is . . .

John Smith, a freshman, is . . .

But observe that sometimes we do employ such a following noun (known as an appositive) to differentiate one John Smith from another. Then the following noun is restrictive, and takes no commas:

John Smith the banker and John Smith the jeweler are . . .

Similarly, though there are several towns called Jonesville, ordinarily when we write or say *Jonesville* our reader or hearer thinks of the town that we have in mind. Hence any following modifier or appositive is non-restrictive:

Jonesville, a good site for our plant, has . . .

But when a following element (in conjunction with a preceding *the*) is used to keep your reader from thinking of the wrong Jonesville, that following element is restrictive and takes no commas:

The Jonesville we should inspect is in Michigan.

So far we have looked at modifiers and appositives of proper nouns—names of specific persons and places. Now let's look at common nouns.

First for mass words. When *copper* means all copper, or copper everywhere, or copper in general, the word *copper* identifies it; any following modifier or appositive is nonrestrictive:

Copper, which had sold at thirty cents, went . . .

So with *bread*, *salt*, *wood*, *lumber*, *concrete*, *electricity*, and a host of other mass words:

Bread, which is the staff of life,	} is made . . .
Bread, being the staff of life,	
Bread, called the staff of life,	
Bread, the staff of life,	

But notice that nearly all mass words can also be treated as "countables" or "breakables"; we can talk about some copper, some bread, some salt, etc. Hence those words may be followed by expressions that tell which kind or "batch" we refer to:

Bread more than a week old is . . .

Copper from northern Michigan has . . .

Sugar refined by this process costs . . .

Names of abstract qualities such as accuracy, faithfulness, and the like are usually treated like mass words:

Accuracy, a prime requisite in technical reports, must . . .

But we can occasionally treat them as “countables”:

The loyalty he showed attracted attention.

Now for words that are normally “countables” instead of mass words. Whenever we wish to speak of *all* men, lions, cities, or whatnot without exception, any following modifier or appositive is bound to be nonrestrictive:

Men, who are mortal, hope . . .

Lions, called the kings of the animal realm, are . . .

Cities—in the legal and not in the geographical sense—vary in their powers.

The way is now cleared for a discussion of the problem, “How do we punctuate when we want to refer to only one person, place, or thing among two or more that we might be referring to?”

The answer has already been implied. Whenever the modifier or appositive after a noun is used to restrict your reference to one or some out of more that you might be speaking of, the modifier or appositive is restrictive. Suppose you have an elm tree in your yard. I know nothing about it. I do not know whether you have one elm or more than one. In fact, I do not know that you have any elms. If you write:

The elm on the north side of our house

I will assume that you have at least one other elm tree. In case you have only one you will probably say something like this:

There’s an elm in our yard. The (this) elm, on the north side of the house. is . . .

Now you can figure out why the two following passages are punctuated differently:

The city (that) I like best is Minneapolis.

He lived for ten years in Minneapolis. The city, with its many lakes, seemed to him . . .

You can also explain the difference in punctuation between:

King Charles I

and

The Puritans believed that the king, Charles I, wished . . .

Thus far all the examples have consisted of adjective elements and appositives. Adverbial elements present a harder problem. Let’s start by contrasting

I did it because I wanted to
with

I know Brown didn't do it, because he wasn't there.

The first sentence restricts the motive of your action, and the clause which sets forth the one motive is consequently restrictive. The second sentence, however, doesn't mean that Brown's sole reason for not doing something was his absence. In fact, the sentence doesn't give the reason for Brown's behavior at all; it gives the grounds for your own belief. In grammatical terms, the *because*-clause modifies *know*. In sentences of this kind the *because*-clause is nonrestrictive.⁶

Sometimes we use a dependent element where strict logic calls for a main clause:

I hadn't seen him for months, when (= and then) I met him in Dallas.
Stern grabbed the ball, only to fumble it.

Such clauses and phrases are treated as nonrestrictive. Technically adverbial, they are in reality coordinate with what precedes. Indeed, to take the *only*-phrase in the foregoing example as restrictive would make nonsense, for it would imply that Stern's purpose in grabbing the ball was to fumble it.

The meaning of *though* and *although* is such that clauses introduced by these words are nonrestrictive. The meaning of *if* and of *unless* is such that clauses introduced by these words are almost always restrictive, though experienced writers occasionally set off a few such clauses by commas for emphasis.

Some rules for the punctuation of adverbial elements have been made because of the need for showing clearly which meaning of a possibly ambiguous word or expression is intended.

1. When *since* means "from the time that" it introduces a restrictive element; when it means "because," a nonrestrictive one:

Bill hadn't seen Jack since they were in service.
There is a pressure difference, since . . .

2. When *while* means "during the time that" it introduces a restrictive clause; otherwise a nonrestrictive one:

We'll inspect the machine while we're in San Diego but we won't buy it.⁷
While I respect his judgment, I don't agree with it.

⁶ Purists tried for decades to get people to replace *because* by *for* in sentences of this kind, without much success. The punctuation would be the same if *for* were used.

⁷ Many writers would insert a comma after *San Diego*; the reason, however, has nothing to do with the *while*-clause but is a desire to separate main clauses joined by the coordinating conjunction *but*.

The first process is cheaper, while the second is safer.⁸

3. When *so that* expresses purpose its clause is restrictive. When *so that* expresses result its clause is nonrestrictive. When manner or degree is to be expressed, *so* and *that* are separated and the *that*-clause is regarded as restrictive.

A formal vote was taken so that the Board could have a full record.

The day was hot, so that we shucked our coats.

The day was so hot that we shucked our coats.

Always so label each part that it can be identified at once.

4. When *however* means "no matter how (much)" the word *however* itself is restrictive. When *however* means approximately *but*, then *however* is nonrestrictive.

However great the cost may be, the result is worth it.

The cost, however, is high.

5. When *in fact*, *in the first place*, *on the other hand*, and *then* have a literal meaning they are restrictive. Otherwise they are nonrestrictive.

His testimony was true both in fact and in spirit.

It will, in fact, convince the jury.

In the first place we stopped at, Jim was waiting for us.

There are two objections. In the first place, the equipment is obsolete. In the second place, it is poorly set up.

On the other hand he had a livid scar.

On the other hand, we can accept the bid as it stands.

The curves are then drawn.

The data, then, can be interpreted in two ways.

6. When *naturally* means *by nature* it is restrictive. When *naturally* is shorthand for "It is natural under the circumstances that . . ." it is nonrestrictive.

Buck is naturally lazy.

Naturally, we don't want to hire him.

7. *Therefore*, *nevertheless*, *consequently*, *accordingly*, and a host of other adverbs which indicate transitions may usually be looked on as either restrictive or nonrestrictive. Many careful writers punctuate these words on the basis of the desired emphasis rather than to show the distinction between restrictive and nonrestrictive elements.

Soundproofing is therefore recommended.

Therefore, soundproofing seems the best solution.

Hence is most commonly treated as nonrestrictive—perhaps because it

⁸ The passage is more emphatic if *while* is dropped. It can then read either "The first process is cheaper; the second is safer" or "The first process is cheaper. The second is safer."

is so formal a word that it is ordinarily followed by a statement or set of statements before which we wish the reader to stop a moment for thought.

8. *Or* has two meanings: it may show an alternative or it may merely introduce what amounts to a synonym. When it introduces an alternative, the element that it introduces is usually treated as restrictive, even though the element may be a full main clause. See the material after the colon in the first sentence of this paragraph. When, on the other hand, *or* introduces a synonym, the *or*-group is usually treated as nonrestrictive.

Lusk is 5280 feet, or an even mile, above sea level.

But considerations of emphasis may override the usual practice:

We don't care whether he goes, or stays.

You should be equally careful of your facts whether you give an oral report, or a written one; whether you use illustrations, or leave them out; whether your reader is trained, or untrained.

It is clear that experienced writers sometimes depart from the "rules." Wherein, and why, are discussed in many books and articles; especially recommended to your attention is W. P. Jones, "Punctuating Nonrestrictives," *College English*, 10:158-162, December, 1948. It will introduce you to the professional's attitude toward punctuation practices.

10. Complementing Language by Illustrations

ILLUSTRATIONS FOR UNPUBLISHED REPORTS

BASIC PRINCIPLES

You don't need to be told that you should know how to read illustrations, how to plan them, and how to make most of those which you are likely to embody in a report. A written report of much length presented without some form of illustration tends to become such a mass of words that it bewilders a reader and leaves his chances of coming to a quick, definite understanding small indeed.

Thus in technical writing the use of illustrations has become recognized as a necessary adjunct in the expression of ideas.¹ But there are limitations on their use. Never should an illustration be used just because it is an illustration. No matter how attractive a photograph may seem to you, or how "elegant" a curve, omit it unless it conveys a necessary elaboration of some idea in the text or aids an explanation in the text.

The virtues of an effective illustration and effective text are the same. Like spoken or written discourse, an illustration must be accurate. It must be unified. It must be as simple as the data permit. It must be clear. It must hang together internally. It should if possible give the observer a sense of balance and should draw his eye first to its logically salient parts or items.

In any organization making or requiring reports, one of these four conditions regarding the preparation of drawings to accompany reports will be found:

1. No formal set of standards.
2. Poorly drawn and impractical standards.
3. Good standards only partially followed.

¹ Illustrations which tell their story without the use of text are disregarded. Whenever you need to use this type, better hire a specialist to work with you.

4. Good standards carefully followed, and supplemented by good judgment whenever unusual conditions or requirements arise.

Only under the last condition will the drawings for a report or series of reports be complete in detail and uniform in arrangement and appearance. Such uniformity is highly desirable when the reader is comparing similar reports or a series of reports. Furthermore, the effect which drawings thus prepared exert on him will be good. Rough, poorly made drawings detract more from the impression made by a report, article, book, etc., than any other element in its make-up. They may raise the question whether the text was as carelessly prepared.

Because you are an engineer you have become more or less proficient as a draftsman, especially in your particular branch. But you must realize that, to be most effective in a report, drawings should be in a form adapted from the engineering drawing. The reason is made clear later in this chapter.

THE PRELIMINARY DRAWINGS

The planning and preparation of the manuscript and the rough preliminary drawings should be done together. Because your reader nearly always wants the illustrations to be close to the first reference your text makes to them, you must so plan your text that you avoid inadvertent advance references to certain illustrations and keep references from bunching up.

The material for your drawings will be selected from an accumulation of data sheets and drawings made during the progress of the investigation or research project. This selection should be undertaken as the rough draft of the manuscript is planned and written. As each drawing is selected it should be replotted or redrawn in pencil, and accompanied by all notes and material required by the text. This will insure the inclusion of necessary material in both text and drawings and will eliminate repetition between them.

In replotting the curves, the choice of coördinate paper may present a problem. The 8½ by 11 sheets usually available have such narrow margins that it becomes necessary to place coördinates and captions inside the ruled portion. Hence, coördinate axes must be drawn inside the original borders about one inch from the left side and about one-half inch from the bottom.

In the upright position this cuts to six inches the net width of the sheet available for plotting. In order to secure greater width the next choice is to turn the sheet sidewise, with the binding edge at the top. In this position the height may be the limiting factor. If more height is required the 11 by 16 sheets (10 by 15 net) may be used. This gives a height of up to almost 15 inches, with the width the same as in the 8½

by 11 sheet turned sidewise. Again the binding edge is at the top of the sheet.

There may be some objection to using sheets sidewise so that it is necessary to turn the bound report around in order to read them. However, if proper plotting of the data requires the added space you have no alternative.

The discussion above is based on paper in which the inch is the basis for the coördinate ruling. It is often more advantageous to use paper with millimeter ruling.

When making the selection of drawings, consider the possibility of grouping on one sheet two or more drawings that are related in subject matter. This grouping often prevents the undesirable "bunching up" referred to above, simplifies the problem of reference, and, most important, facilitates comparison of the material in the various parts. Of course, each part must have an identifying subtitle to indicate its relation to the other parts in the group. The 11 by 16 sheet may be employed in this grouping.

THE FINAL DRAWINGS

After the rough draft of the manuscript and the pencil drawings are completed, check the drawings against the original data sheets and the text. The final drawings may then be prepared. Whether you yourself or someone else makes them, it is you who should know what requirements and possibilities exist. This applies to both the preliminary and the final drawings.

If only one copy of the report is required, the pencil drawings may be inked and used for final drawings. If more than one copy is required, some method of duplicating the drawings is necessary.

For one or two additional copies a photostat may be used, with the inked final drawing as copy. For relatively few copies and for simple drawings not requiring great accuracy, one of the stencil or carbon-type duplicating machines may be used. However, they are not as satisfactory as the blueprint and various direct-process print methods. The copy for the latter must be on tracing cloth or tracing paper. Drawings inked on standard coördinate sheets on tracing paper, as for the one-copy case above, may also be used.

PHOTOGRAPHS

Photographs may be very important as illustrations for descriptive or test reports. In descriptive reports they may be used in a series to show progress in a project or as single illustrations to show important features discussed in the report. In test reports they may be photomicrographs, pictures of apparatus or equipment, of recording-meter charts, etc.

For use with oral reports they may be presented on lantern slides or used in the form of motion pictures.

Such photographs should be carefully taken, with full attention to the details of technique. The greatest offense is to include in the picture too much unrelated equipment or material. This error may be lessened or prevented by considering the angle or distance at which the picture is to be taken. For interior work an artificial background is helpful. Adequate lighting must be provided in order to eliminate objectionable shadows. Highlights or undesirable spots on machines or machine parts may be painted out by airbrush.²

LANTERN SLIDES

If you are to make an oral report, you may have to prepare drawings for lantern slides. This requires special attention to such details as line weights and sizes of letters and numerals. Otherwise you may get flat and ineffective slides.

The standard lantern slide is 4 inches wide by $3\frac{1}{4}$ inches high. Allowance for binding, label, and mask leaves the maximum net space $3\frac{1}{4}$ by $2\frac{1}{2}$.

If a special drawing is to be made for a slide it should not exceed $9\frac{1}{4}$ inches in width and $7\frac{1}{2}$ inches in height. This proportioning will require a reduction ratio of 3 to 1. For these limits the same line, letter, and numeral sizes as for a reduction ratio of 2 to 1 will give good results. Note that under these conditions the final lines, letters, and numerals will be two-thirds the size used for illustration purposes. These sizes should be considered the lower limits.

Larger or smaller drawings already available may be used for slides. But, depending on the reduction, be sure that lines, letters, and numerals are not less than two-thirds the size given for drawings for printed illustrations at that reduction factor. For these sizes see Table 1, and Fig. 1 in the next section. These requirements may make it necessary to trace and reletter the drawings.

Since the time for viewing a slide projection is limited, the amount of notes, curves, etc., that may be used is also limited. Usually it is better not to attempt to show more than two or three curves unless they form a closely related group. Tables must likewise be kept simple. They should include only such data as are needed for one part of the presentation. The complete data, when numerous, will be more effective if presented in a series of tables.

SUMMARY

Let's repeat the fundamental principles:

² These suggestions are intentionally repeated on p. 143. They are so important that repetition is justified for the sake of emphasis.

Give the reader or listener all the illustrations he must have, only the ones he must have, and in the sequence which he will find most helpful.

Make each illustration accurate, unified, clear, simple, uncluttered, balanced.

Tie every illustration in as closely as you can with the written or spoken word.

Plan for the possibility that you may have to dovetail text and illustrations within the rigid framework of a printed page or column—the consideration of which forms the core of the next section.

ILLUSTRATIONS FOR TECHNICAL PUBLICATION

REASONS FOR SPECIAL DRAWINGS

The chief reason for preparing special photographs and drawings for publication is to utilize to greatest advantage the space available for the final illustration in its printed form. The principle applies especially where two or more original drawings are to be combined. All this involves placing the parts and notes to secure an effective and balanced drawing. Even though the original drawing is of the proper size you may have to redraw because the line weights and letter sizes are not satisfactory from the standpoint of reduction or proper emphasis and legibility.

The services of at least three highly developed skills, in conjunction with specialized equipment, are required in order to reproduce a photograph or drawing in the printed form. These are the skills of the draftsman or photographer, the photoengraver, and the printer.

A poor piece of copy, whether photograph or drawing, permits the photoengraver to make only a second-rate "cut." With a second-rate cut it is impossible for the printer to do a first-class job. Thus the photographer or draftsman starts a chain reaction which results in the final printed illustration. The quality and usefulness of this illustration depend primarily upon the skill and care with which the drawing or photograph was made.

LINE DRAWINGS

Line drawings are drawings made with pen and waterproof black ink, and also drawings made in line or stipple with pencil, crayon, or brush. They must be composed of distinct lines or dots of color strong enough to reproduce by the line etching process. In line drawing there is no continuous blending from a light to a dark shade as in photographs, paintings, etc. All lines are uniformly black. Any effect of blending from black to gray is accomplished by crosshatching or stippling spaced to obtain the desired grading of tones of gray.

The line drawing is the most useful illustration for technical publica-

tion. Its value is due to its limitless adaptability for various purposes—for simple line work, lines in connection with black masses, lines with machine shading added, and any of these in combination on wash drawings or photographs.

Two of the more common processes used for reproducing line drawings in printed form are offset lithography and letter-press printing from line etchings.

In both methods the drawing is photographed on the negative to reduced size. In offsetting, a positive print is made on a sensitized thin aluminum sheet. This print is lightly etched and prepared as the printing plate for the offset press. The press consists essentially of three cylinders of equal circumference—the plate cylinder, the blanket cylinder, and the impression cylinder. The printing plate is mounted on the plate cylinder. In operation, the rubber “blanket” on the blanket cylinder comes in contact first with the inked plate on the plate cylinder, taking an impression from it. During the rest of the revolution this impression is “offset” from the blanket onto the paper on the impression cylinder, giving the final impression as it will appear in a book or magazine or printed report.

For letter-press printing, the negative is “stripped” and reversed, and a print is made on a specially sensitized plate of zinc or copper. After development and preparation the plate is etched in an acid bath for a short period. It is then removed, washed, and given a protective coating along the exposed edges of the lines or dots in the print, to prevent undercutting or ragged, broken lines. This process is repeated until the desired depth of etching is reached. The plate is then cleaned, mounted on a wood block to type height, and finished. It is then ready for use with the type in the printing press.

Line Weights. To secure drawings that meet the general requirements indicated earlier, the elements that constitute such drawings are now considered. The principal ones are *lines* and their *weights*, *lettering*, and *data points and other symbols*. The drawings should be made on smooth white paper or on tracing cloth, to a larger scale than the final cut. The reduction will lessen minor irregularities of handwork and give a sharper and more pleasing result.

Drawings made for reductions ranging from 2 to 1 to $2\frac{1}{2}$ to 1, dimensionally are the most satisfactory. This means that if the final illustration as printed is to be 4 inches wide and 2 inches high, in the first case the drawing will be 8 inches by 4 inches and in the second case 10 by 5. Of course all elements in the drawing will be heavier or larger by the same ratios.

To insure uniform line weights on the final illustrations no matter what the reduction, the proper line weights must be used on the drawing. Table 1 gives line weights for various purposes for various reduction ratios.

Reduction Ratio	Percent Reduction	Line Thickness in 0.01's of an Inch			Letter Height in 32nds of an Inch	Data-Point Symbols				
		Coordinate, Dimension, Hatching	Emphasized Coordinate, Border, Outline	Data Curve or Line		Coordinate Caption and Subtitle	Notes and Numerals	Suggested Lower Limit, (Equiv. to 6-pt. Type Face)	○	□
1:1	0	0.50	1.00	1.50	2½	2¼	2	0.04	0.035+	0.031
1½:1	33⅓	0.75	1.50	2.25	3¾	3⅝	3	0.06	0.053	0.046
1¾:1	43	0.88	1.75	2.63	4⅝	4-	3½	0.07	0.062	0.054
2:1	50	1.00	2.00	3.00	5	4½	4	0.08	0.071	0.062
2¼:1	55½	1.13	2.25	3.38	5⅝	5+	4½	0.09	0.080	0.070
2½:1	60	1.25	2.50	3.75	6¼	5⅝	5	0.10	0.089	0.077
2¾:1	63.6	1.38	2.75	4.13	6⅝	6⅓	5½	0.11	0.097	0.085
3:1	66⅔	1.50	2.90	4.35	7½	6¾	6	0.12	0.106	0.093
3½:1	71.4	1.65	3.30	4.95	8¾	7⅝	7	0.14	0.124	0.108
4:1	75	1.80	3.60	5.40	10	9	8	0.16	0.142	0.124
5:1	80	2.00	4.00	6.00	12½	11¼	10	0.20	0.177	0.155

For 1:1 Ratio the sizes are as they will appear on the printed reproduction.

Letter heights are given in 32nds of an inch in accordance with the scale on most guide-line markers.

In this table the sizes for the 2:1 Ratio were chosen first. It happened that a simple set of sizes could be used and still secure good results, with satisfaction to both draftsman and engraver. The sizes for the other ratios were developed from those for the 2:1 Ratio. For the larger ratios, above 3:1, line weights were reduced for the convenience of the draftsman.

The most convenient working range is from Ratios 2:1 to 2½:1. The larger ratios may be used for special cases, but more care will be required in shaping and spacing of letters.

Sizes given, used at reductions indicated, will give full unbroken lines, clear legible letters, and distinct unfilled data-point symbols. Smallest line and letter sizes may be made slightly smaller, but data-point sizes should be used as given.

TABLE 1. Data for Various Elements Used in Drawing for Reproduction.

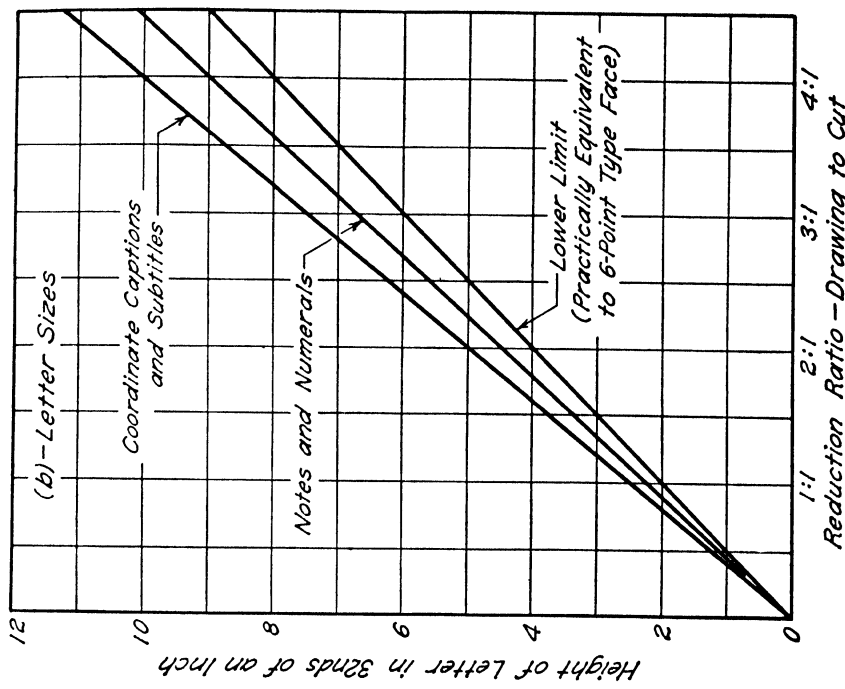
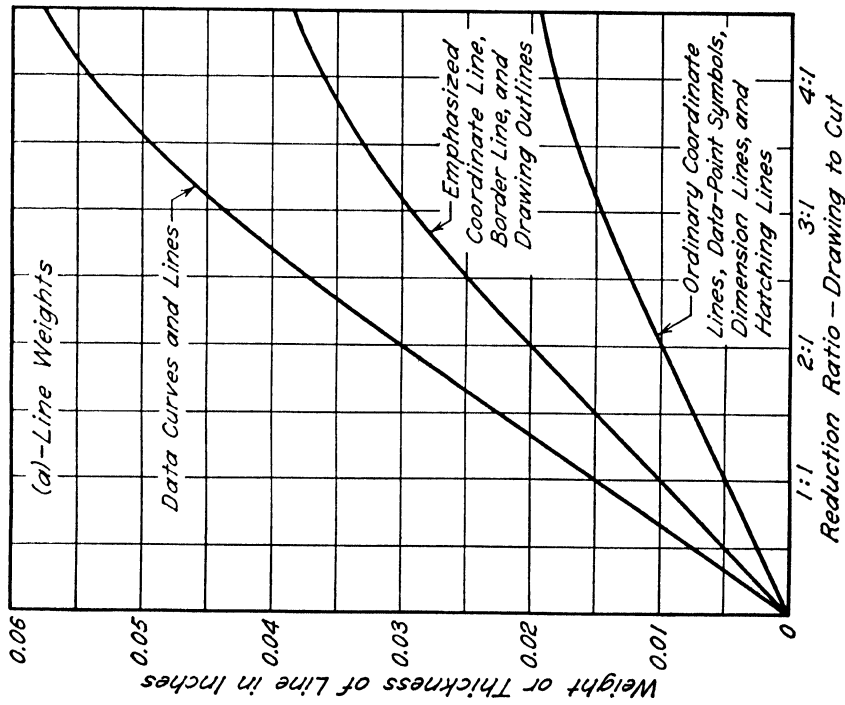


FIG. 1. Line Weights and Letter Sizes for Various Reductions.

These values, plotted in Fig. 1, enable the draftsman to choose values for other ratios.

Uniformity close enough for practical purposes will be secured by using a separate set of values at quarter-point intervals between unit reduction ratios. Thus, if a drawing requires a reduction roughly midway between 2 to 1 and $2\frac{1}{2}$ to 1, a set of values at $2\frac{1}{4}$ to 1 should be chosen. This applies also to letter sizes and data-point sizes, which will be discussed later.

In Table 1 and Fig. 1 only three line weights are given for each reduction. These are usually sufficient, but others may be used. However, for emphasis between two sets of lines appearing near each other the line weight in one set should be twice that in the other. Smaller differences will not be effective. Another important fact is that in the process of reduction to the plate and in printing on the page, light-weight lines do not reduce in weight according to the ratio. Heavy lines reduce in weight more nearly according to the ratio, as does also the space between them. Therefore if curve lines, being heavy, are close together it may be necessary to use lighter weights than those given, in order to prevent running together.

Lettering. Lettering on drawings must be carefully done. The result on the cut must be well arranged, legible, and of pleasing appearance. A drawing whose line work is well executed may be ruined if it is poorly lettered. Conversely, a drawing that is mediocre from the standpoint of line work may be greatly improved by good lettering.

Three methods of placing the letters on the drawing are: by means of type-printed proof strips pasted on, by the use of lettering guides, and by hand lettering. The use of proof strips is bothersome and time-consuming and is not common except for special purposes.

Lettering guides, which make use of templates and stylus-type pens, are useful if the draftsman has not developed the technique of hand lettering. If the ratio of the weight of line in the lettering elements to the overall height of the letter is approximately 0.10, a generally pleasing letter will be secured. Since templates limit the choice of letter heights they sometimes make it difficult to secure the desired results. The lower limit in pen sizes also makes it difficult to obtain the smaller letter heights and still maintain this ratio; hence, drawings for a larger reduction ratio may be necessary when using lettering guides.

The flexibility and adaptability of hand lettering make it the best method for use on drawings for reproduction. This presupposes that a good technique is used. Almost any draftsman who practices honestly and carefully for a few short periods daily will find that he can do a creditable job of lettering.

An adjustable guide-line marker for hand lettering is available for

heights ranging from $\frac{1}{16}$ to $\frac{5}{16}$ inch. The marker makes it possible to secure all the sizes required as shown in the second part of Table 1 and in Fig. 1, and also to secure intermediate heights.

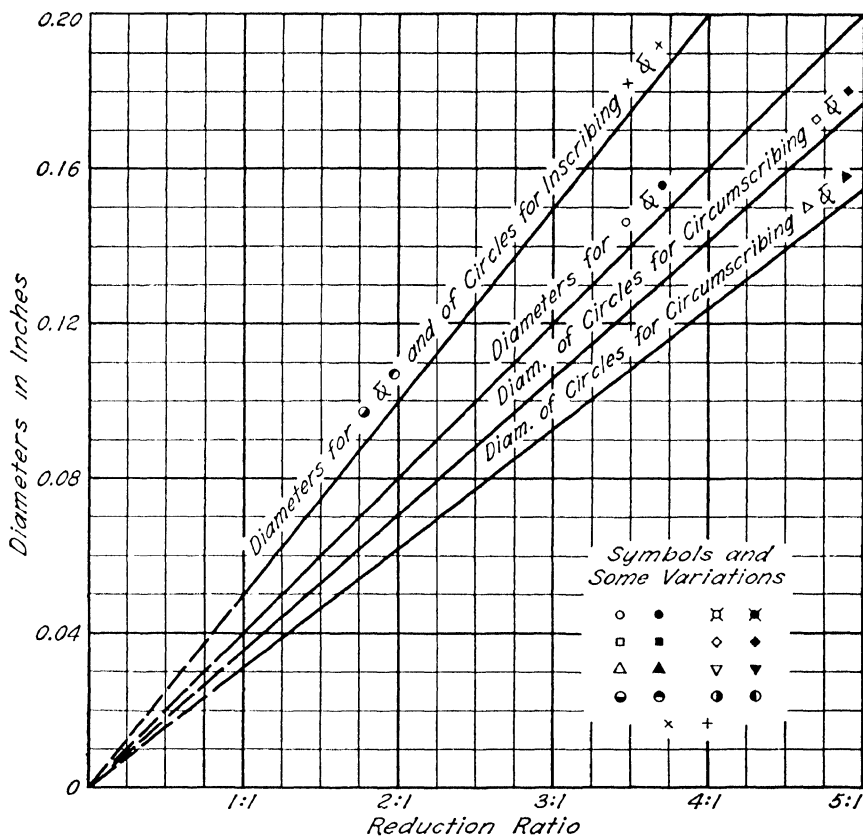


FIG. 2. Sizes for Data-Point Symbols for Various Reductions.

To comply with the ratio of 0.10 of element weights to total height, given above, it will be necessary to have a set of pens ranging from ballpoint or heavier for the larger reduction ratios through Esterbrook 112 and Gillot's 404, 303, and 170, to the crowquill for lettering the smaller reduction ratios, as on photographs.

Data Points and Other Symbols. Data points on a curve diagram represent the graphic recording of data. Therefore they should be accurately located and legibly shown. The simplest symbol is the open circle, followed by the filled circle. Diameters of circles for the various reduction ratios are given in Fig. 2. The square and the equilateral triangle come next. These two should be circumscribed about circles of such

size as to yield squares or triangles with areas equal to the area of the circle data point.

The diameters of these circles for various reductions are also given in Fig. 2, which furthermore shows the square turned 45 degrees and the triangle inverted. The two circles shown with the lower or upper half filled should have diameters about $1\frac{1}{4}$ times those of the ordinary circles. The cross and the plus sign may cause trouble—especially the latter, which may become confused with coördinate lines.

No line, either curve or coördinate, should run across a data-point symbol. Likewise, when any two data points are close enough to overlap, one should be inked entirely and the other should have only that portion inked which is exposed. This procedure leaves each point distinct in printing.

The extent to which tables and curves of sizes could be developed for various other symbols on line drawings is endless. In cases where they might be used often it would be an advantage, from the standpoint of uniformity of printed results, to have such tables. They might be used for pipe fittings, electrical and radio symbols, welding symbols, etc. This idea is carried a step further in some large organizations.³

The use of these elements in the preparation of the various types of drawings will now be considered.

PIE CHARTS

The pie chart, or circle chart with sectors, has been widely used to show graphically the component parts of a total, usually in percentages. Although popular, it presents difficulties. It does not permit convenient placement of captions and numerical values, and it lacks flexibility of arrangement.

For the outline and the division lines the medium-weight line is used, and for the hatching lines the light-weight line. These weights and the sizes of letters and numerals are given in Table 1 and Fig. 1.

³ R. L. Ives, in "Fabrication of Electrical Diagrams," *School Sci. and Math.*, 46:438-446, May, 1946, recommends "cementing standard stock symbols or symbol assemblies in place on a rough guide sketch, drawing the necessary connections, photographing the whole, retouching the copy negative to remove unwanted 'joint lines,' and printing the finished diagram from the retouched copy negative" (p. 438).

Ives further says: "In many instances, where an assembly of symbols is used repeatedly, it is found desirable to make a master drawing of the entire assembly, and from it working prints, in convenient size, for use in diagrams. . . . More complicated electromechanical devices, such as latching relays and stepping switches, can likewise be drawn as single diagram components in large size, and then reduced to working size" (p. 439).

Page 443 of Ives's article names several advantages of using printed words and symbols which can be cemented into place.

BAR CHARTS

Bar charts may be divided into component charts and comparison charts. The component chart shows the component parts either on a percentage basis or as subdivisions of a whole. Comparison bar charts are used in many different arrangements. The simplest form is that for the comparison of magnitudes of an item under various conditions, such as time, temperature, mixtures, etc. This application may be varied to compare items made up of the same number of constituents in varying amounts. In fact, it is impossible to list all the different uses, from the simple form to the complex area bar charts with parts divided both vertically and horizontally.

The greatest disadvantage of charts is that the average reader is likely to compare the wrong things. He is especially prone to compare areas when we want him to compare line lengths. If it is indeed areas which he is to compare, he still has trouble; he often confuses the two kinds of area bar charts.

Pictorial bar charts have further weaknesses. Though they challenge attention, they are easy to misinterpret. The layman often looks at the single pictures that comprise the chart instead of grasping the relationship they are intended to symbolize. He may even judge the units as he would judge a photograph or a realistic painting. Finally, he tends to compare the estimated bulk or weight of the symbolic men and objects when he is meant to compare in one dimension only.

Of greatest concern here is the construction of charts. The outline and the division line should be made with a medium-weight line as shown in Table 1 and Fig. 1. The hatching lines should be light-weight. The lettering is that used for notes.

The width of the bars should be such as to reduce to about $\frac{1}{8}$ inch in the final cut. Horizontal bars with notes as to conditions, and the numerical magnitude at the left end of each bar, are the easiest to fit on a page. A great number of bars may be arranged better in the vertical position. This arrangement may call for more space between bars for notes. If bars are made on a time basis the earliest time should be at the top for horizontal bars and at the left for vertical bars.

Bars adjoining each other, even in small groups, are not as effective as those spaced about one-half bar width apart. Space between groups of bars should of course be greater—approximately two bar widths.

FLOWSHEETS AND ORGANIZATION CHARTS

Process flowsheets, material flowsheets, and organization charts are widely used. They may be employed in many ways for studying, plan-

ning, and improving processes and for channeling work. Figures 3 and 4 show relatively simple forms of these charts.

Both flowsheets and organization charts represent direction of movement—of things, of services, of authority and/or responsibility. Each can be so drawn that it refers to either a reality or a plan and shows differences between intention and performance. The two media are of course unlike in several ways—noticeably in that the flowsheet may indicate natural as well as man-ordered activity, whereas organization charts are confined to the latter.

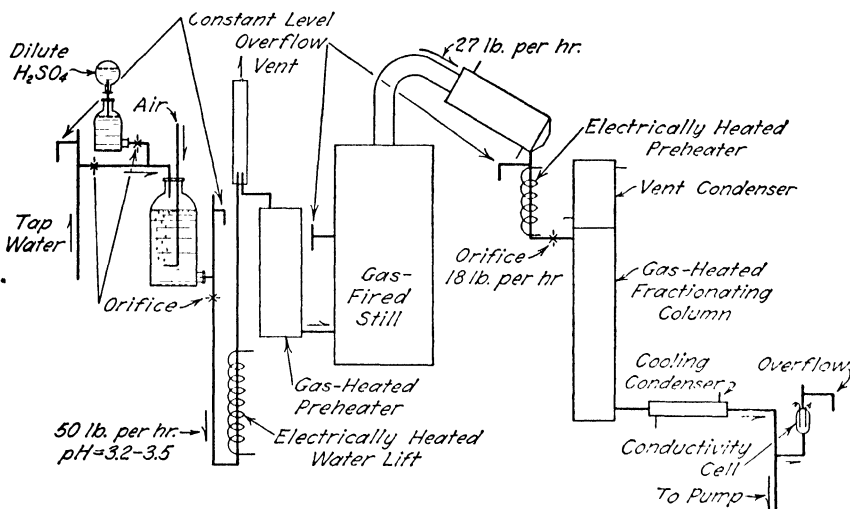


FIG. 3. A Typical Flowsheet. (From Univ. of Ill. Eng. Exp. Sta. Bul. 364, Fig. 28.)

Flowsheets are of all degrees of complexity. They may indicate simple direction. At the other end of the scale they may also convey a fairly clear notion of the size and outward appearance of machines, the bulk or volume of goods in process, and the modes by which these goods are transmitted from one operation to the other.

Organization charts likewise may be complex. They can show a great variety of facts, including the names of present holders of jobs, temporary appointees, honorary appointees, purely nominal authority, the titles of persons who can be "by-passed," and the maximum time allowed for transmitting information and/or commands from one level of authority to another. What they cannot do is show clearly the full extent of the difference between a man's official position and his real effectiveness. This is their most serious shortcoming.

The simple flowsheet is usually made up of rectangles. These represent

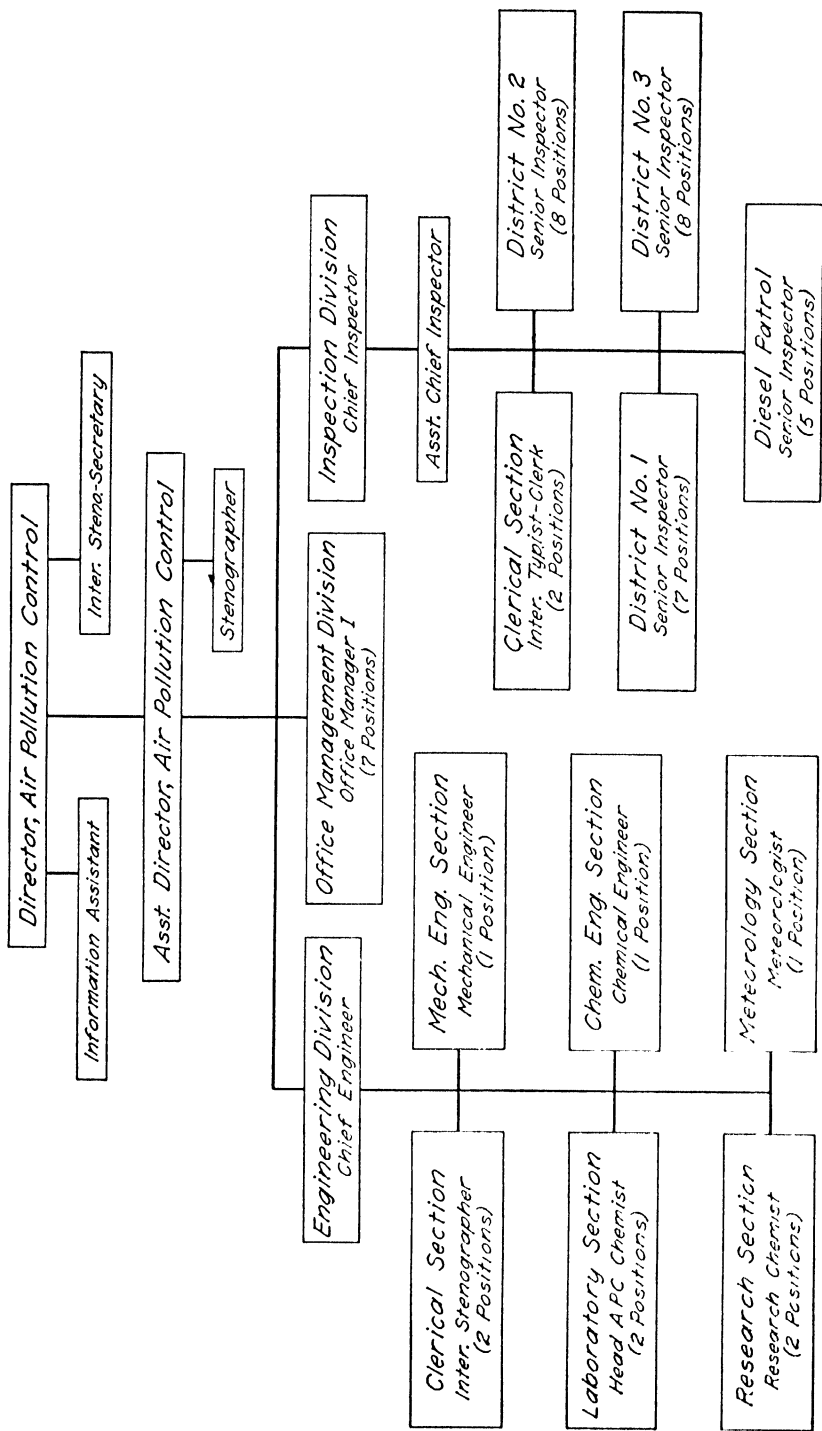


FIG. 4. A Typical Organization Chart.

the steps in a process and are placed in proper relation to each other. They are connected by lines, usually marked with arrows, to show the flow of materials through the various steps in a chemical process or the routing of materials and parts in a manufacturing plant. The rectangles contain the name of the equipment, machine, material, or stage in the process which they represent. Quantity, kind, and composition of material may be indicated on chemical-process sheets. The size of the rectangles is determined by the amount of lettering in them, and their arrangement for the purpose of the diagram and to give balance to the drawing requires a certain amount of skill. The method described later under organization charts will be helpful.

For chemical-process flowsheets a more involved system has come into use; the rectangles are replaced by more or less elaborate drawings of the apparatus or equipment represented.

The usual form for a routing chart in a manufacturing plant makes use of an actual layout of the equipment of the plant, drawn to scale. On this layout is superimposed the route line for materials, parts, and finished product.

Usually students and young engineers are not concerned with organization charts. However, if the occasion to make one does arise there is ample published material on the subject of form. The purpose here is to offer a few suggestions on the drafting involved.

The chart consists of rectangles (rarely of circles) containing the lettering giving the office, title, or subdivision that each represents. Lines showing the passage of authority through the organization connect these rectangles in the proper order.

Rectangles representing similar functions or ranks should be of the same size. This size should be such as properly to contain the name or title in the rank which requires the most lettering. Once the box sizes have been determined for each rank, the grouping and spacing can be arranged.

If the space is limited horizontally, as it will be for publication, the size of rectangles must be determined first for the rank or level having the greatest number. The rest of the chart is laid out from this level, usually upward, but possibly both upward and downward. The space available vertically must be properly proportioned among the various ranks.

On the final drawing for publication, the light-weight line is used for rectangles, apparatus, equipment, and the machines in a shop layout. The medium-weight line is used for lines to show flow, connecting rectangles, apparatus, and equipment, and for the route line.

All lettering except the title should be that used for notes and numerals as shown in Table 1 and Fig. 1. The title should be in the lettering used for captions.

MAPS

As commonly used, maps may be divided into two classes—maps as a form of chart diagram for presenting statistical facts or data, and maps in the usual sense, intended to show locations of both natural and manmade features.

Maps can often say far more than words. Nevertheless they have the disadvantage that many of them distort reality, sometimes beyond our power to discount by noting the scale and the kind of projection used. In one type of map, as a matter of fact, distortion is almost impossible to avoid. This is the flow map, which has to employ different scales for the physical volumes (as of goods and traffic) that it represents and for the geographical area within which the volumes move. The same disadvantage is found in the pictograph map and in most three-dimensional maps.

These limitations will trouble you little so long as you are reading a map or preparing one for an engineer. Technical training has guarded you and him against misinterpreting. But when you draw a map for the layman, keep in mind how easily he misunderstands.

As charts for statistical purposes, maps are used to show relative magnitudes of an item for various geographical divisions or locations. Some of them, for instance, show distribution of water power, minerals, population, etc., by states. This is accomplished by various forms of crosshatching, by circles of varying sizes, or even by bars as in the bar chart. Maps may also be used as a basis for plotting data. Common forms show curves of equal annual rainfall, degree-day curves, and many others. Such charts are usually made on printed outline maps. These maps may be of various sizes and consequently may require unusual reduction ratios for reproduction as cuts. Any required line weights and sizes of letter for any reduction ratio within the usual limits are shown in Table 1 and Fig. 1.

Maps in the sense familiar to the engineer are used for locating and planning engineering projects (structural, mining, and so on). Most of these are topographical-type maps showing elevations, contours, property lines, etc. They are usually on a large scale so that details of the project may be drawn accurately. They are used also as a means of recording such data as the location of gas, water, sewage, and power lines or planning the extension of such services.

There are many kinds of engineering maps, most of which are described in various books on drawing. In preparing such maps for publication, lines somewhat lighter than the light-weight line in Table 1 are used for contours, roads, and secondary features. Structures, shorelines, emphasized contour lines, etc., are slightly lighter than the medium-weight line. An easy method of securing these lighter weights is as follows: Lay out

the map in all details as if it were for a $2\frac{1}{4}$ to 1 reduction. Ink it with lines and letters required for the 2 to 1 reduction ratio in Table 1. Then specify a $2\frac{1}{4}$ to 1 reduction for the engraver. Thus the lighter-weight lines and smaller letters will be secured on the final cut.

SKETCHES OF EQUIPMENT AND APPARATUS

This class of drawing is common in illustrations for reports. It ranges from adaptations of shop drawings through diagrammatic drawings of equipment and apparatus and diagrams of layouts and connections, to simple sketches.

Proper weights of lines are important in the preparation of this type of drawing, for otherwise the drawings will have a flat, uninteresting look and parts will not stand out. The weights for the outline, dimension lines, and hatching lines are given in Table 1 and Fig. 1, as are also the letter sizes.

The parts of the drawing and any necessary notes should be placed in such manner that the final drawing fills the entire rectangular area assigned to it. Proper placement of notes will aid in securing a balanced arrangement. It should not be necessary to place a frame line around the drawing if its parts are properly balanced.

For making effective layout or connection diagrams such as piping, electrical, test apparatus, etc., a few simple suggestions are:

1. Use the light-weight line (see Table 1 and Fig. 1) for symbols or boxes representing pipe fittings, meters, equipment, etc.
2. Use the medium-weight line for connections such as pipe, wire, etc.
3. If more than one piece of equipment of the same kind is used, as for valves, meters, etc., use the same size symbol for each.

A convenient and satisfactory spacing of crosshatching lines for a reduction ratio of 2 to 1 is 2 millimeters; for $2\frac{1}{2}$ to 1, 0.10 inch; and for 3 to 1, 3 mm. If the drawing is on tracing cloth these lines may be traced from printed coördinate paper.

CURVE DIAGRAMS

Every technical writer realizes the importance of curve diagrams as a means for presenting data accurately, clearly, and simply. The curve has been well called "the symbol of science."⁴ It can present likenesses, differences, trends, and the process nature of reality so vividly that it encourages us to intensive thinking and helps minimize the stress which most languages lay upon the static.

Regardless of the form used—whether a rectangular, polar, logarithmic, semilogarithmic, triangular, or isometric coördinate system—the routine

⁴ Wendell Johnson, *People in Quandaries* (New York, 1946), p. 125.

is the same. The limit of space available for the final cut is fixed by the dimensions of the page on which it is to be printed. The relative importance of the drawing determines whether the cut should occupy a full page or part of a page. The width of page and the choice of the reduction ratio fix the range of width for the drawing. As noted earlier under line weights, this range is 8 to 10 inches for a page 4 to 4½ inches wide with reduction ratios from 2 to 1 to 2½ to 1. The abscissa scale is so chosen that all values fall in this range of width. The many types of unit divisions on coördinate papers available usually permit an easy choice of scale. The ordinates are scaled in in such space as will give a full page or part page—whichever is necessary—with no waste space at the top.

The choice of scales is very important. It should be so made as to secure effective use of the coördinate space and thus of the page space. The scales control the slope of the curve, which has a psychological bearing on the interpretation of the curve. The independent-variable scale is the horizontal one, the dependent-variable the vertical. If the zero line is to be shown it should be labeled on both scales. This line should be included if visual comparison of plotted magnitudes is desired; otherwise it may be omitted. Its omission may increase the effectiveness of the presentation.

The scale will also control somewhat the choice of coördinate numbers to be given with the caption, and hence the coördinate lines that will be used on the final drawing.

The preliminary drawings may now be made on standard coördinate paper. The coördinate values with their captions are placed first. Then the data points are plotted and the curves drawn to fit them. Designation of the curves should be made by short lettered labels placed horizontally near the curves, with an arrow connecting label and curves. Notes (if any) are placed in positions that aid in balancing the general arrangement of parts. On the preliminary drawing a title may be necessary. All notes, titles, captions, etc., should be carefully checked with the manuscript for agreement. In general it is best to place not more than three or four curves on the same drawing unless they constitute "a family" of curves or unless there is some special reason.

From the preliminary drawing the final drawing is traced in ink on tracing cloth. The reduction ratio is known, and the corresponding weights of lines, data-point sizes, and letter sizes are taken from Table 1 and Fig. 1.

The data points are traced over the pencil plottings. The curve lines are then ruled in without crossing the data points. At this time the caution regarding lines that run close to each other may have to be considered, to keep the lines from running together. In the case of "a family" or a great number of curves, lighter-weight lines may be needed in order to prevent too much black in the overall appearance.

The border or outline is traced in the medium line weight.

The drawing is now ready for lettering. Guide lines in pencil should be placed on the cloth in the following order. First, the coördinate scale values are penciled. Only the main coördinate lines (usually one-half inch apart if standard paper is used) should be inked, and scale values should be placed on alternate lines only. This avoids too much closeness in the final cut. Next, the coördinate captions which give the variable measured and the unit of measurement are penciled on a separate slip of paper long enough to reach under the caption guide lines on the drawing. This procedure makes it easy to center the captions. The labels for the curves are then placed in the proper relation to the curves, with space for the arrow that will connect them. The subtitles, if any, and the notes are made last, so that they may be located for balancing the entire drawing. If the notes are long, it is better to letter them on a strip as was done with the captions. This procedure makes locating easier.

All lettering is now inked, and all penciling removed with a soft eraser.

The final step is to ink the coördinate lines. They are all of one weight unless emphasized lines are required, as on curves for computation purposes. They are located as explained above.

The arrows for the curve labels are made with the same line weight, and the drawing is finished.

The instructions to the engraver, indicating the width or height required in the finished cut, should be put on before the drawing is removed from the board. The principal or controlling dimension, usually width, is placed in the bottom or right margin of the sheet. These instructions may be written with a blue pencil. Two ordinary extension lines made at the exact limits of the drawing are used in connection with a dimension line. The latter should give the desired width (or height) in picas or inches as required. Final dimensions, both width and height, for the cut may be entered, "ringed in," in the lower right corner for estimate and pagination purposes.

COMBINATION OF DRAWINGS

It is often advisable, especially for publication purposes, to combine two or more drawings when possible. Thus, a group of curves indicating temperatures at various locations in a house at different times of the day is to be shown. An insert on the sheet giving a floor plan of the house with the points where readings were taken will simplify the presentation.

Another form (Fig. 5) of combined curve and diagrammatic drawing shows a temperature gradient through the wall of a house. The temperature drop through each component part is easily read, and the material is distinctly labeled. Note the placing and direction of arrows and the balancing of notes.

If two or more sheets of curves for test results secured under progressively varied conditions are to be used, their combination into a one-page cut is often an advantage for many reasons. Some of these reasons are: it makes comparison of the various results much easier; it saves space; and it reduces publication costs.

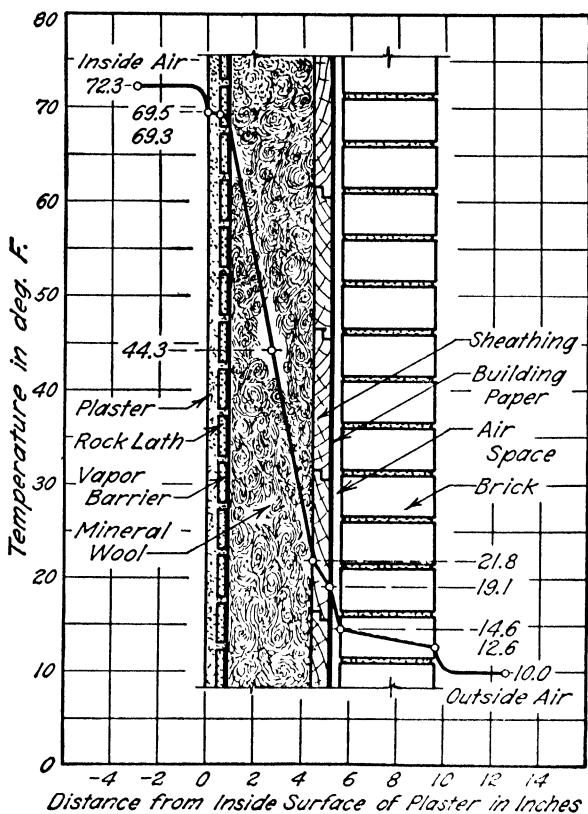


FIG. 5. A Combination Drawing. (From Univ. of Ill. Eng. Exp. Sta. Bul. 349, "Performance of a Hot-Water Heating System in the I-B-R Research Home at the University of Illinois," Fig. 20.)

An example of a variation of this method is shown in Fig. 6. This shows five sets of curves from tests made to determine the relation between head loss in six types of $1\frac{1}{2}$ -inch plug-disk globe valves and average velocity of water in the pipe. The last group of curves shows results with two valves, one of which (No. 106) is No. 105 with the concave underside of the plug filled with lead. The data were originally plotted on 18 sheets of 10-inch logarithmic paper.

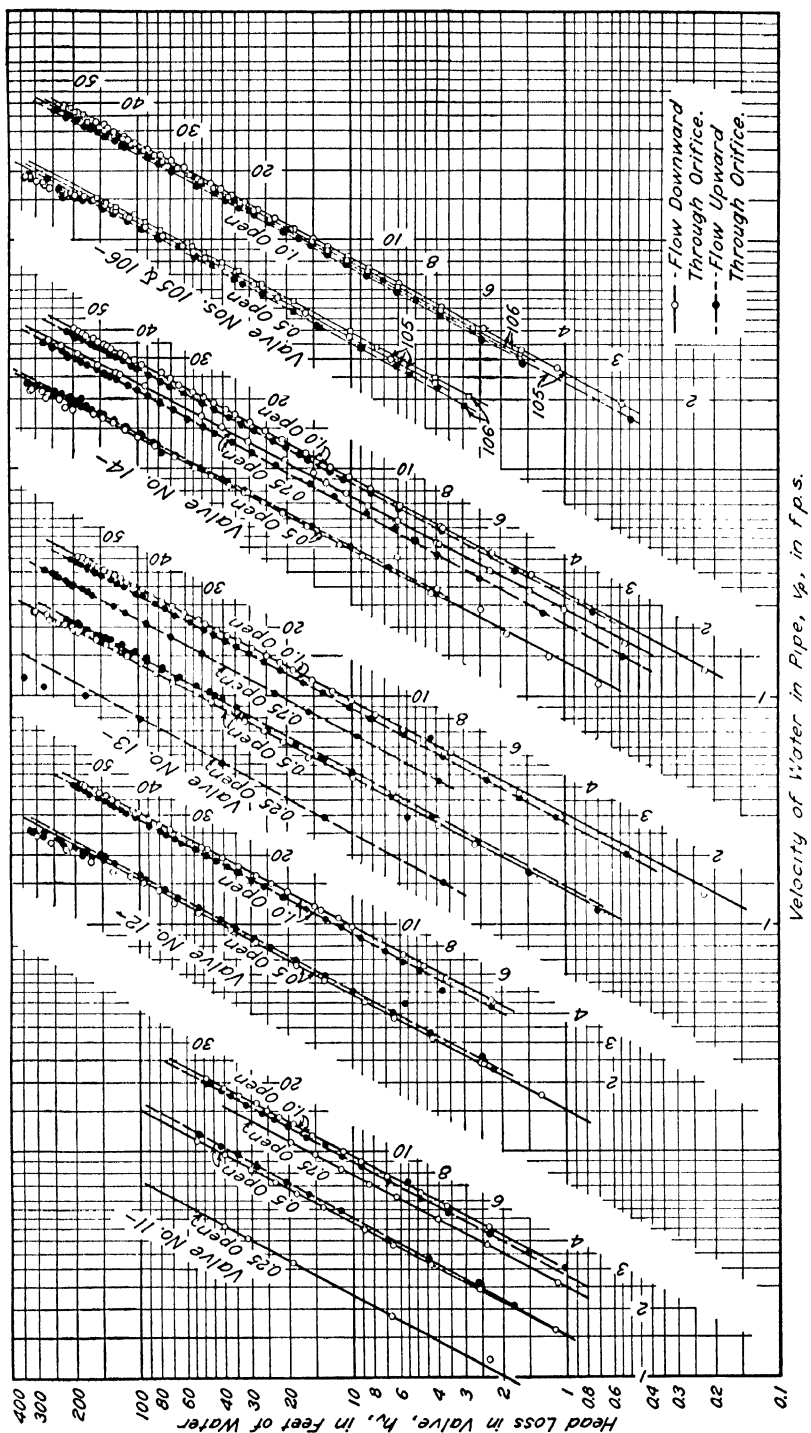


FIG. 6. A Second Kind of Combination Drawing. (From Univ. of Ill. Eng. Exp. Sta. Bul. 340, "Loss of Head in Flow of Fluids Through Various Types of One and One-Half-Inch Valves," Fig. 11).

PHOTOGRAPHS

Photographs may be very useful for certain types of illustration. They are very effective for showing general views of equipment either as a group or as a single piece. Nearly all such photographs must be taken indoors and should usually be made by a professional photographer.

Some aids in securing good indoor photographs are:

1. An artificial background to block out nonessential and confusing material behind the subject.
2. Adequate lighting to eliminate objectionable shadows.
3. The painting out of highlights or objectionable spots on machines or machine parts by means of an airbrush.

Photographs of construction projects at various stages, and photomicrographs of metal sections, are also frequently used. These are only a few of the many forms that may be employed.

A glossy black and white print, sharp in detail, printed without too much contrast, produces the best half-tone. It may be 8 by 10 inches in size, which permits a reduction ratio of about 2 to 1.

A print which is to be sent to the engraver should be unmounted and untrimmed. Trimming or cropping lines are indicated in the margin or on the back. The desired width of cut is marked with a dimension line between the two vertical cropping lines.

Grouping photographs such as photomicrographs or successive views of a failing test specimen is sometimes required. In such cases the size should be marked on each print in the group so that all parts will, if possible, be of the same size on the cut. Any identification markings or title should be placed on each print in letters of such size as is given on the "Lettering Curve for Notes" (Fig. 1) for the required reduction ratio.

The actual grouping is done by the engraver. He trims, strips, and remounts the reversed negatives adjacent to each other in the proper order on a glass plate. From this combined negative the halftone on copper is made; in the finishing a thin white line is routed along the junction line between the individual parts.

Frequently an enlarged view of some detail of a piece of apparatus may be helpful if presented on the same half-tone with the complete view of the apparatus. This is also done by the engraver in essentially the same manner as just described. In this case the negative of the enlarged view is stripped and mounted on the complete-view negative in a place trimmed out to fit it. This requires careful preliminary preparation and choices of size and location for the auxiliary view.

The simplest form of combined half-tone and line etching is made by mounting the two together on the same plate block, usually by nailing. A more costly method is by combining negatives, as above, to permit

etching the entire plate on one piece of metal. The two parts are etched separately. The line portion is painted with resist to protect it while the half-tone portion is etched. The resist is then removed from the line portion, and the procedure reversed. The result gives a combination plate on one piece of metal which is better and more serviceable than the nailed plate.

TRANSPARENCIES

For some years, colored sets of transparencies that can be “peeled off” layer by layer have been used to show the physiological structure of human beings and animals, and more recently to show the structure of mechanisms. In this application they give many readers a clearer understanding than can be got from cross-sectional views or “exploded” sketches.

You should be able to plan transparencies in some detail. The actual manufacture, though, demands the services of experts in illustration—particularly in the use of color—and of engravers and printers.

Part III: Forms of Communication Related to the Report

II. Digests

A good part of the time all normal adults say less than they might. Certainly they say less than runs through their minds. In that sense we can call most communication a digest. Using terms more rigorously, we can speak of many curves, flowsheets, maps, and tables as digests. A large number of business letters too are condensations.

It is with this intentionally craftsmanlike process that we are now concerned, and with five different products of it, products so widely used that each has a name. They are the news story, the *précis*, the abstract, the outline, and the definition.

Not that the nomenclature is in all respects satisfactory. Indeed, we shall find it inadequate and confusing when we deal with the abstract, a term that has no easily pinned-down meaning. Let's look at the situation a minute. Suppose you are compressing a talk or a document, whether one already produced or one in the blueprint stage which according to plan will be fairly detailed. Note that the author of the full-length version may be you or someone else. When you compress you can change, or leave unchanged, any or all of these properties of the original: the number of topics treated, the order of topics, the proportioning, the phrasing, the tone. And obviously you can compress much or a medium amount or little. It is clear that if each practically distinguishable product of compression were to have its own label we should need half a hundred names. In English we have less than a dozen. Nor do we use them efficiently; nothing has come of attempts to get greater uniformity in the application of *abstract*, *synopsis*, *summary*, and other related terms.

However, if you will push through the names to the condensing processes and the resulting products, you will learn some techniques of high value in engineering and industrial practice. Let's list the gains that accrue from learning how to compress, condense, digest.

I. To you as "condenser."

- A. Preparing digests drills you in conciseness.
- B. It facilitates note-taking.

- C. It directly aids you in meeting any requests you may receive from technical publications for
 1. Abstracts.
 2. Book reviews.
 3. Survey types of articles.
 - D. It helps you in checking for unity and coherence any communication you are "blueprinting" and any that is ready for final revision.
- II. To your recipient.
- A. A condensation can often replace the original for a person too busy to read the original.
 - B. It may show a prospective reader whether the full-scale document is worth reading.
 - C. It may guide the reader in his perusal of the full-scale document.
 - D. It may later recall to him the gist and even some of the details of the original.

With this preamble let's turn to the five kinds of condensations. Let's start with the kind that boils down its actual or potential original the least, and end with the kind that is as terse as it well can be.

THE NEWS STORY

You may never have to write news stories. It might pay you, though, to tackle the job in order to increase your powers of observation and discrimination and to make your writing clearer, more concise, more vivid. In addition it is likely that you will be called on to furnish data for news stories or to approve the release of information on new personnel, processes, products, and policies. You can save yourself time by giving the data in about the form in which a newspaper or the news section of a professional magazine wants it. So you need to know what newsmen seek.¹

They seek "a good story." Specifically, they want facts—concrete facts, verifiable facts, facts that will interest their readers. They want particulars rather than mere generalizations. They want, not abstractions, but words that make pictures. They do not want "stale stuff." They want no "past-tense dope" unless it's essential to the understanding of current events. Nor do they want material that is over the heads of their subscribers. They avoid heavy definitions. They run away from bales of statistics.

Finally, few newsmen will accept either a free advertisement or what they call editorialized copy—passages containing personal opinions in the

¹ Excellent summaries of what they want are the papers by H. B. Nichols, J. M. McCullough, and Ron Ross in *Telling the Story of Engineering Research* (Iowa City, Iowa, 1949), pp. 1-22.

guise of unbiased statements. They want objective information as well as live and factual information. They don't call somebody "the distinguished Smithtown manufacturer." They call him John Jones of Smithtown, castings manufacturer. They throw into the wastebasket a handout that says, "In accordance with its enlightened and successful labor policy the Brown Company has greatly increased its medical facilities." Or if they salvage any of the blurb they change it to "Dr. James Quincy of Detroit and three nurses will join the Brown Company staff April 1."

Factual accuracy, objectiveness, liveliness—these are not all that newspapers want. They also want conciseness. Far more than the courts as interpreters of libel laws, more than the business office with its veto of free advertisements, the editor with his blue pencil lives at the forefront of the reporter's mind.

Editors long ago learned many things which you as well as the professional reporter can profit by.

One is the value of the Seven Basic Questions:

<i>Who?</i>	<i>How Much?</i>
<i>What?</i>	<i>How?</i>
<i>Where?</i>	<i>Why?</i> (For what reason? For what purpose?
<i>When?</i>	With what motive? From what physical causes?)

An editorial writer, a feature writer, a commentator, or an analyst may also seek answers to *How Good?*—which means sometimes how rapid, sometimes how efficient, sometimes how safe, etc. The compiler of a straight news story, though, avoids this last question if his answer would be construed as editorializing.

Another lesson which the newsman can teach us is that a most effective way to present news is deductively. This means giving the essence of the news at the start of the story. The "lead," as the newsman calls it, must answer at least four of the Seven Basic Questions—*Who? What? When? Where?* It need not answer them in just that order, but often it does so. Usually, too, it tells why and how events occurred. Indeed, it may begin with that information:

To win yesterday's game at Cleveland the Athletics had to overcome a three-run Indian lead, compiled in the third on four solid hits, with a clouting attack of their own in the eighth.

Note that the lead itself is organized deductively. It opens with the most important fact or the most attention-getting fact—and in a well-built story these two are one.

Most news stories carry the same pattern throughout. That is, they give all their data in the order of decreasing importance. The last paragraph therefore says just enough to get in at all. As a matter of fact, in a later

edition it will probably be dropped; and the process of "cutting from the bottom up" will be repeated as long as the story has any life left, until at last only the lead sentences stay in print. (We are assuming that the reporter could find no "fresh angle" for a rewrite or for a "second-day story.")

There are, of course, disadvantages in using this "inverted-pyramid" arrangement. *Time* and several newspapers feel that an inductive arrangement, with the "meat" at the end, gives more opportunity for including essential background information in a story; they also have felt that readers were getting tired of one pattern. It may happen, then, that data which you have organized on the inverted-pyramid plan will appear in print in some other form.

Nevertheless you will be wise to master the traditional pattern. It will help you to distinguish facts from opinions, and substantiable facts from unprovable facts; it will force you to scrutinize the relative importance of your facts; and it will help you to see and to cut out needless words.

The inverted-pyramid pattern alone, of course, will not make your talk and writing concise. You will have to imagine the editor's blue pencil constantly at work slashing all deadwood. Ask yourself the questions he asks: Does "due to the fact that" mean more than *because*? Does "with a great deal of speed" mean more than *fast*? Does "a high percentage of those who went to hear Mr. Smith speak" mean more than *most of the audience*? Does "water for drinking purposes" mean more than *drinking water*? Does "seemed to have no control over his ability to walk" mean more than *stumbled* or *reeled*?

These examples show that the newsman seeks not only conciseness but also other qualities which are of value when not allowed to obscure the facts—such qualities as life and variety. The good reporter grips the concrete noun. He seizes the verb that makes a picture. He shuns the passive voice whenever he can. He cuts out every needless preposition, adjective, adverb. He makes his story march, and march stripped. If you belong to the Heavy Brigade, get a newsman for your drillmaster and you can end in the Light Infantry.

THE PRÉCIS

The lead of the average news story can be considered as one kind of précis. A précis is a digest. It may be a digest of an event. It may be a digest of a situation. It may be a digest of a document. It is as a digest of a document that the précis concerns us. Certain portions of Part IV deal with the technical reports which eliminate so many detailed data that they can be regarded as précis of events and situations. For the time being, we shall look only at the process of condensing one piece of writing into another.

So considered, the *précis* is a condensate which reduces its original by at least half and more commonly by from two-thirds to three-quarters in bulk, but which leaves unchanged the proportioning of the essential ingredients, their order, and their "flavor."

The *précis*, then, cannot retain all the illustrative material that was in the original. But it can retain enough examples, anecdotes, and the like to make its "specific gravity" similar to that of the original document. It can preserve the general heaviness or lightness which characterized it. It can, indeed, usually keep enough details of various kinds to indicate all significant changes of tone within the original. When a Shakespearian tragedy is cut from a three-hour to a one-hour presentation, some comic scenes as well as the major tragic scenes are left standing.

But in a *précis*, of course, most illustrations and examples disappear. So do most repetitions, however deliberate and effective they may have been in the original document. Nor do the particulars of contrasts, comparisons, historical surveys, and other subsidiary matter remain. Finally, all transitional passages are shortened as far as clearness allows. Connective paragraphs become short sentences or even clauses; clauses become phrases; phrases, words.

Not only in transitional passages but throughout the *précis* such a process of condensation often requires you to paraphrase—to replace the original author's words by your own. This substitution is common in the abridgment of a talk. For example, the first of the following passages was effective as delivered, but needs the shortening shown in the second before it should appear in print.

Now it must be remembered that when you use this kind of packaging and after an article is removed from its package, it is no longer protected. That is, if it is bare steel, once you take it out of our package it is no longer protected. You have to return the articles to the package or to the wrap if continued protection is what you want.

After removal from its package an article is no longer protected. If continued protection is required the article must be returned to the package or wrap.

Observe that the second version not only shortens the first but tightens up the sentence structure and gets rid of the speaker's inadvertent shift from *article* to *articles*.

You must avoid the danger inherent in paraphrasing. You must keep the spirit and tone of the original. As you know, there are few complete synonyms. Of two words identical in meaning, one tends to drop from the language, or else the pair become differentiated. So when you paraphrase you risk losing the flavor of the original document.

The necessity of overcoming this hazard is one thing that makes *précis*-writing a profitable discipline. It will help you increase your active

vocabulary. To compare your version with the original will sharpen your knowledge of the differences between *dust*, *dirt*, *soil*, *earth*; or *advise*, *counsel*, *recommend*, *urge*. It will compel you to find one accurate word for "narrow, steep valley" or "to search blindly and uncertainly" or "to give ground reluctantly."

If the resulting growth in vocabulary were the only benefit, it might not be worth your time and trouble. But words are nothing in themselves. They are valuable only as symbols. To master the meaning of a word, then, often increases your knowledge of likenesses and differences in things, places, people. This knowledge in turn has practical consequences. A child says, "The man walked funny." The foreman, the physician, the lawyer, the judge, the company official, or the good Samaritan is concerned to know whether the man swayed, or staggered, or reeled, or strutted, or minced. And your observation is likely to become more precise if you can put your finger on the word which English-speaking people have adopted to label one gait or another.

For three chief reasons, therefore, you will find *précis*-writing a useful everyday technique. Like the news story, the *précis* causes you to discriminate between main facts or ideas on the one hand and details on the other, and to discriminate further between essential and dispensable details. Again like the news story, by compelling you to focus carefully on words the *précis* compels you to sharpen your perception of the actualities behind the words. Last, by forcing you to heed the spirit of a communication as well as its bare factual or logical reference, *précis*-writing makes you a better practical psychologist and hence a better engineer.

THE ABSTRACT

Many documents and talks do not deserve to have as much as a third or a fourth of their bulk left in your mind and your records. Numerous other communications do deserve such treatment but may not be able to get it because you lack time to make so full a digest. So you frequently evaporate about 90 percent of the original. Sometimes you must get rid of even more. A number of professional magazines refuse to publish any condensation longer than 3 percent of the article from which it is derived. In fact, certain periodicals that publish nothing but condensations try to squeeze documents down to 1 percent of their original length.

For this sort of condensing there is no universally accepted name. The term most widely employed is *abstract*. But *summary*, *résumé*, *digest*, and even *synopsis* and *recapitulation* are used. Two additional labels, indeed, have been affixed; more about them soon. They are *epitome* and *indications*. They are used to name digests, not of all parts of a talk or document, but of only one part or a few parts.

Abstracts, we have said, are always much shorter than *précis*. They may or may not differ from *précis* in the exactitude with which they reproduce the proportioning, organization, and tone of their original. Many an abstract is like the *précis* in adhering to the order of topics in its source. But some abstracts omit altogether certain parts of the full-length document on which they are based. Still others begin where the original ended, and backtrack. Such a change is usually due to a great difference between the situation demanding a full-length account and that demanding a curtailment; sometimes it is due to a shift in media, as when a long document is abridged for oral presentation. Again, when the flavor of the original is unimportant or its sincerity doubtful, an abstracter makes no attempt to preserve the flavor.

These likenesses and unlikenesses obtain whether you publish the summary or merely keep it in your notes; whether, in case you publish it, you bind it in with the original or submit it separately; and whether your bound-in summary is introductory or final.

It is true that you are not always free to decide. Some journals and some industrial or academic superiors insist that an abstract shall faithfully reproduce the order of topics, the proportioning, and the phraseology of its source. Generally, though, you will have much latitude. The easiest procedure then is to compress each part of your original document *pro rata*, lift out its basic words, sentences, and paragraphs, and insert the few additional connectives needed for clarity.

But since ease and efficiency are not always the same, we must survey further the differences that are found in practice.

First let us note that the purpose of many abstracts is to condense all the main sections in the original.

Abstracts of this kind are, in turn, subdivided. Some of them keep to the proportion in the original just as closely as they can. Others, however, change the proportioning in this manner: they include not only the main generalizations and the logically indispensable details of the original but also a digest of *all* new data, no matter how narrow in scope, that the original set forth. "Data" should be interpreted rigidly, as signifying verified facts. Such *résumés*, then, do an indexing as well as a summarizing job. Hence they often use analytical subheadings, under some of which they give only a brief sentence or one or two numerical results. Manifestly this kind of abstract is helpful mainly to research specialists.

Here is an example of such a digest which, however, is so brief that it can dispense with subheadings:

"Results of dusting pears with 2 applications of DDT in 4 mixts. applied 50 and 75-100 lb. per acre are detailed. The dusts contained 10% tech. DDT in pyrophyllite with or without adhesives as follows: dust A 4% fatty acid deriv.; B 4% Vacatone; C 2% light-medium spray oil; D no adhesives. At harvest,

the DDT in p.p.m. retained by the fruit from the 50 and 75-100 lb. dosages, resp., were as follows: A 0.9, 0.8; B 11, 2.3; C 0.7, 0.7; D 0.35, 0.5. The resp. percentages of DDT retained at harvest were: A 12.1, 10.0; B 14.0, 17.3; C 7.6, 5.3; D 4.4, 4.4. The build-up of deposit in the 2nd application period was lower than expected."²

At the opposite extreme from this "analytical abstract" is the summary which condenses only portions of the original. On occasion you will summarize just one part of the original—the findings or the conclusions or the recommendations—and will not even mention the other parts. Much commoner is the summary which gives in brief the findings and conclusions, the conclusions and recommendations, or the purpose of the document plus any one of the other three elements (findings, conclusions, recommendations). You can readily infer what the triple and quadruple combinations are. Especially common is a summary of purpose, scope, findings, and conclusions.

When you prepare an abstract of this kind, you may have to change greatly the proportioning of the original document. Your 500-word complete statement of purpose may not be understandable if you cut it below 200 words, whereas you can often boil down a 750-word chapter of conclusions to 100 words. In the following abstract the statement of purpose is the briefest of the four parts—about 25 words. The statement of scope is about three times as long. The summary of conclusions and the summary of recommendations (neither of which is reproduced in full) are respectively 125 and 400 words. In the original, the proportioning was different: 55 words and then 210, 800, 1050.

To meet requests from architects and builders the Company's research staff has collected all readily available information on effective methods for insulating sound.

This report presents these data systematically. It gives the methods and results of various investigations relating to the action of materials on sound, describing practical installations of soundproofing, and setting forth in accordance with existing knowledge several recommendations that may be applied when sound insulation is desired. The cut-and-try methods common before 1915 are summarized briefly; the scientific investigations that began in considerable numbers at about that date and that have since become very numerous receive the most attention.

Salient conclusions may be summed up as follows:

1. . . .
2. . . .
3. . . .

From these it follows that builders must pay particular attention to a number of recommendations.

A soundproof partition should be as rigid and free from air passages as possible. Any necessary openings for pipes, ventilators, doors, and windows should be placed in outside or corridor walls. If the sound is generated in the building

² C. H. Richardson, *Chem. Abs.*, 42:2710, April 20, 1948.

structure, stopping the compressional waves necessitates making a break in the structure so as to interpose a new medium differing in elasticity and density. Thus the vibrations of a motor may be minimized by . . . [About 100 words of specific suggestions on footings, bolting, edge insulation, and other such media follow.]

Especial attention should be paid to the ventilation system. . . . [About 100 words of detailed suggestions follow.]

All structural details should be considered with respect to the likelihood of transmission of sound. So far as possible, each room should be made an insulated unit. . . . [Eighty words follow concerning air spaces, installation of pipes and ventilators, and use of sound-absorbent material.]

These recommendations, though fairly specific, cannot anticipate all factors. A successful solution to any given soundproofing problem is obtained only when all the possibilities of transfer of sound are foreseen and guarded against. Thorough knowledge of the theory and a wide acquaintance with the literature of practical applications, plus common sense, will solve most problems that arise.

Unfortunately no standard name exists for the partial synopses we have just spoken of, or for any subtypes. A useful though bookish term for the whole lot is *epitome*. To designate the kind of epitome which consists purely of factual findings, a number of engineers use *indications*. This label is often further restricted. It is applied to a digest in which every major factual finding is phrased quantitatively, allowed to occupy no more than one sentence, and further emphasized by letter or number and by special methods of paragraphing. (See the sample cover on page 187.)

Plainly, your choice among the kinds of abstracts depends on your superior's orders or on your wish to serve his convenience. His convenience depends in turn on how well he is acquainted with the subject of your report, how interested he is in it, why he is interested in it, and how busy he is. The ways in which these determinants interact are discussed at more length in Part IV. That part explains to what extent your subject matter, the report user, and other factors influence your choice of type of abstract and related matters.

There is, however, one important recommendation that applies to every abstract, whether the original of the abstract was prepared by you or by someone else. It is this: Except on the few occasions when you should reverse the order of topics in the original, the first sentence of your abstract should stress whatever was emphasized in the introduction to the full-length talk or document. For example, if the introduction stresses authorization, you can begin your abstract with "At the request . . ." If the introduction stresses the purpose of your communication, you can begin your abstract with "To determine . . ." If the introduction stresses the public need for such a study as you submit, you can begin the abstract in this way: "Sewage facilities in the Jonesboro district have been under discussion by the board of aldermen, the township supervisors, and citi-

zens' groups for five years. Controversy has arisen over present methods of disposal, future needs, and probable costs. . . ." And if the introduction emphasizes the scope of the communication you can begin the abstract: "Laboratory tests on fifteen I-beam bridges are reported. All the structures tested were quarter-scale models. . . ."

THE OUTLINE

Although the function of the outline differs considerably from that of other forms of condensation, the outline is fundamentally a form of compression. Usually it is a compression of something yet to be written; but it may be—and often is—a graphic representation of an article or report already written. It can indeed be both of these things, an accessory both before and after the fact.

Purposes of the Outline. The commonest purpose of the outline is implicit in what the outline primarily is: the orderly arrangement of material which is to be presented in writing or in speech. The less frequent purpose is to show the organization and summary content of material which has been presented, or is being presented, in writing or in speech. The present discussion explains how the outline can serve both these purposes.

Developing the Outline. Customarily the outline begins to form in your mind during the early stages of gathering material. The form may be nebulous, but gradually it gains substance—in the shape of notes either mental or written. It then appears as a rough, unlabeled listing of headings which will constitute the *possible* divisions of your subject. Your next step is to select the headings which will constitute the *probable* divisions, and to rearrange your written notes so that they correspond to those headings.

Many people find they should not rush to rearrange. Instead, they let their subconscious minds tackle the problem for a few days. Then the conscious mind takes over. For good suggestions on this matter, read Chapter IV of Flesch's *The Art of Readable Writing*.

Delay the further development of the outline proper for a while and formulate a subject sentence. If you are fortunate enough to know what your findings, conclusions, or recommendations will be, the subject sentence will be a summary of them and will thus resemble the lead of a news story or the epitome of a report. Probably, however, you will find you have not yet gathered enough facts to justify this kind of subject sentence. Then make it a statement of the exact purpose and scope of your communication. It will guide you in subsequently dividing the major headings, will remind you of your goal, and will warn you away from digressions.

Then arrange the major headings in their logical order. This order depends upon several factors: the purpose of the report or talk, the basic

pattern (deductive, inductive, etc.), the method of development (chronological, spatial, etc.), and the requirements of the particular kind of exposition concerned.

Finally, divide the major headings, and further divide these subdivisions. This task is defined by the requirements of the specific material and by the necessary mechanics of outlining, which are discussed in later paragraphs.

Applying the Outline. After you have worked through the stages from architect's drawings to draftsman's blueprints, turn builder. You should of course follow your blueprint-outline closely. But with you, as with the builder, situations may arise which will demand a change in plans. Perhaps you find that in developing one of your major headings you should logically include material which you had allocated to another major heading; possibly you find that a subdivision you hadn't provided for in the outline is necessary for clarity. In that event the plans of the blueprint give way to the requirements of the building. Your outline, in other words, makes all concessions necessary to the logical development of the composition. If the outline itself is to be an integral part of the composition—if it is to supplement or replace an abstract or summary, for example—you must, of course, revise it to accord with any changes you have made in the original plan.

Types of Outlines. However widely outlines differ in pattern and form, they can be classified into four general types.

1. *The rough outline* is an unpolished, unlabeled arrangement of the divisions and subdivisions of a subject. It is used primarily by practiced writers who have no real need for close guidance in construction. It may also serve the unpracticed writer as a preliminary step in the development of a complete outline. In other words, if the edifice is to be a simple one the experienced builder may work directly from the architect's drawing, whereas the amateur must have the blueprints as well.

A brief sample of a rough outline follows:

Title: The Motor-Launch *Hyperia*.

Subject Sentence: This is a report of the present condition of the "H" and of the repairs required.

Introduction

Purpose and scope of report

History of subject (including costs)

Method of investigation (acknowledgments)

Hull

Original construction

Reconstruction and repairs to date

Present condition

Repairs required (cost)

Decks

Description

- Condition
 - Repairs required (cost)
- Superstructure and fittings
 - Description
 - Condition
 - Repairs required (cost)
- Instruments
 - Description
 - Condition
 - Original cost
 - Present value
 - Replacements (cost)
- Power plant
 - Description
 - Efficiency
 - Repairs and replacements (cost)
- Conclusion
 - Summary of findings
 - Conclusions
 - Recommendations

2. *The topic outline* is probably the most useful and the most used. It is so called, logically enough, because the headings and subheadings appear as topics—single words or groups of words, not complete sentences. The example of the rough outline is topical in style. Notice that all divisions are made up of single nouns, or of nouns with adjective or prepositional phrase modifiers. Not all topical headings, however, need be noun groups; verbal, adverbial, and adjectival headings are permissible, so long as parallelism is preserved.

The sample rough outline can easily be developed into an adequate topic outline. Since the subject, subject sentence, and introduction will remain much the same (the treatment of introductions will be mentioned later), the first main division will be used:

- I. The hull
 - A. Original construction
 - 1. Architect
 - 2. Builder
 - 3. Overall cost
 - B. Reconstruction and repairs to date
 - 1. Replanking of port bow
 - a. Reason
 - b. Materials
 - c. Cost
 - 2. Scraping and repainting
 - a. Intervals
 - b. Materials
 - C. Present condition (excellent)
 - D. Repairs required
 - 1. Immediate (none)
 - 2. Ultimate

- a. Scraping
- b. Repainting

3. *The sentence outline* is a somewhat fuller development than the topic outline. Each heading is a complete sentence or part of a complete sentence. The sentence outline, indeed, if carefully and completely prepared, becomes the written composition, lacking only transitions and explanatory details. A simple example follows.

Title: The Green Gulch Property

Subject Sentence: This report states in detail the conclusions concerning the property and recommends its immediate purchase and development.

- I. The reader is reminded of the following facts:
 - A. The Green Gulch property was examined by
 - 1. Jones and Jones, consulting engineers, and
 - 2. The present writer.
 - B. A joint examination report was submitted by the examiners on April 26, 1948.
 - C. The findings of that report were, in the main, favorable.
- II. Conclusions are:
 - A. That the ore body
 - 1. Can be mined by open-pit methods.
 - 2. Will not be exhausted before 1997.
 - B. That transportation to the company's mills is possible by
 - 1. Rail spurs of
 - a. The CKR & V road and
 - b. The Great Western.
 - 2. Conveyor belt.
 - C. That a sufficient labor supply may be drawn from
 - 1. Middleton, population 24,000.
 - 2. Saxbury, population 16,000.
 - 3. Yorkton, population 9000.
- III. Therefore it is recommended that
 - A. The Green Gulch property be purchased immediately.
 - B. Stripping crews begin work not later than June 1, 1949.

4. *The combination topic-sentence outline* is, obviously, a joint use of Types 2 and 3. We scarcely need to exemplify it at length. This combination type customarily uses the topic form for main headings and first-degree subheadings, and sentences for minor divisions. Part of the sentence-outline example can be converted to an adequate illustration:

- II. Conclusions
 - A. Ore body
 - 1. It can be mined by open-pit methods.
 - 2. It will not be exhausted before 1997.
 - B. Transportation
 - 1. Ore can be transported to the company's mills by rail spurs of
 - a. The CKR & V road and
 - b. The Great Western
 - 2. Ore can also be transported by conveyor belt.
 - C. Labor supply

1. Middleton has a population of 24,000.
2. Saxbury has a population of 16,000.
3. Yorkton has a population of 9000.

III. Recommendations (etc.)

Mechanics of the Outline

The word "mechanics" is used here as an omnibus term. It applies to all the principles and practices involved in making an outline both an efficient tool and an accurate reflector. These principles and practices have been exemplified in the sample outlines; here, then, they will be dealt with briefly.

1. *The title* of the outline is a unit alone—it is a label; the headings should not lean upon it. Specifically, no pronoun in the outline itself should have its antecedent in the title.

2. *The subject sentence* is, like the title, a separate unit, and the outline proper should not be dependent upon it. The subject sentence is often omitted in "summary" outlines—those whose main purpose is to reveal the content of material already written.

3. *The introduction and the conclusion* may or may not be part of the body of the outline, depending upon their importance to the subject matter. If the job of the introduction is strictly to introduce the subject and the job of the conclusion to conclude it, they should be considered as introduction and conclusion of the outline as well as of the subject; consequently neither they nor their subdivisions will be labeled. If, however, the introduction and conclusion contain necessary background or essential information they must be considered integral parts of the outline and labeled as such.

4. *The number of divisions* should be determined by the amount and complexity of the subject matter to be outlined. Major headings and subheadings should be ample for full development but not numerous enough to be confusing. Half a dozen main headings suffice for most reports.

5. *Labels* are devices solely for clarity. There are no immutable laws governing them, but practice has set a convenient precedent, which will be suggested here. Major headings are given roman numerals; subheadings of the first degree, capital letters; subheadings of the second degree, arabic numbers; third degree, lower-case (small) letters; fourth degree, arabic numbers with the prime symbol (''); fifth degree, lower-case letters with the same symbol; thereafter, if anyone needs to go that far, the double prime (") and then the triple prime (""') are used. Seldom should an outline be carried beyond the third degree of subdivision; outlines should not split hairs. Indenting labels and subheadings is an obvious organizational device which needs no discussion.

6. *Punctuation* of outlines again follows common practice. Topic outlines have no end-of-line punctuation; sentence outlines are punctu-

ated according to the rules of sentence punctuation. The examples on pages 157-160 illustrate adequately.

7. *Equality of levels* is demanded in the well-made outline. That is, all headings bearing the same label and consequently indented the same should be equal in weight. Perhaps this principle can be better exemplified than explained. The headings in Outline X do not have equality of levels; those in Outline Y do.

Outline X

- I. Combat planes
 - A. Bombing planes
 - B. Interceptor planes
- II. Planes used in pursuit
 - A. The Aircobra
 - B. The Lightning
- III. Transport planes
 - A. Matériel planes
 - B. Personnel planes

Outline Y

- I. Combat planes
 - A. Bombing planes
 - B. Interceptor planes
 - C. Pursuit planes
- II. Transport planes
 - A. Matériel planes
 - B. Personnel planes

In Outline X, obviously, pursuit planes, labeled II, are not equal with combat planes, I, and transport planes, III; likewise, divisions A and B of II are not equal with A and B of I or III. Outline Y remedies these inequalities.

8. *Parallelism of levels* is another requirement of the efficient outline. Headings on equal levels should be parallel in form as well as equal in weight. In Outline X, divisions I and III are composed of an adjective and the noun it modifies, but division II is composed of a noun with a modifying verbal phrase. In Outline Y the offending heading appears as it should be, Pursuit planes, parallel with the other divisions on its level.

9. *Division* into one part is impossible. Therefore an outline should avoid the single subheading; for every I there should be a corresponding II, for every A a B, etc. Below is a simple example of this error, and its remedy:

- I. Combustion
 - A. Internal
 - B. External
- II. Gravity
 - A. Water
 - 1. Hydromechanical
 - 2. Hydroelectric

Division A of II in this outline of sources of power is not properly a division. Leave I as it is; label II as Gravity (Water); then keep the original subdivisions but "lift them up"—that is, label them A and B.

DEFINITIONS

The fifth and final of the types of condensation covered in this chapter may at first glance seem to be a form of expansion rather than compression. Fundamentally, however, definition is condensation. It might indeed be called distillation; for the process of defining is concerned with the boiling off and collecting of those volatile elements which will yield a clear end product.

Technical papers and reports have greater need for definition than other types of writing. You have acquired a professional *patois* fairly unintelligible to the layman. Consequently, your communication job frequently calls for translating your ideas into nontechnical language. A very important phase of this translation is definition.

Definition by Synonyms. Definition by synonyms is usually inadequate for your needs. Dictionaries that try to delimit words by this method often leave a reader wondering which of the synonyms given for a term is applicable in his situation. Nevertheless this kind of definition has its uses, particularly when you can work it unobtrusively into a sentence, as by saying "the alar surface, or wing, . . ." (Notice that an *or*-phrase which gives a synonym is preceded and followed by a comma.) Another way to present synonym definitions is exemplified by this passage:

Shall we, or shall we not, call the Recent Standard English proscription of the double negative illogical? The reasoning behind the veto is mathematical.

The phrasing makes it evident that *proscription* means *veto*.

Paragraph Definitions. To define a technical term adequately you must often move a considerable distance from the synonym definition and use a whole paragraph, or indeed several paragraphs.

Definition by Analogy. When Thomas Huxley at the beginning of his noted lecture, "The Method of Scientific Investigation," wished to make clear to his audience the meaning of his subject terminology, he selected a familiar and homely analogy and built his definition around it:

"The method of scientific investigation is nothing but the expression of the necessary mode of working of the human mind. It is simply the mode at which all phenomena are reasoned about, rendered precise and exact. There is no more difference, but there is just the same kind of difference, between the mental operations of a man of science and those of an ordinary person as there is between the operations and methods of a baker or of a butcher weighing out his goods in common scales, and the operations of a chemist in performing a difficult and complex analysis by means of his balance and finely graduated weights. It is not that the action of the scales in one case, and the balance in the other, differ in the principles of their construction or manner of working;

but the beam of one is set on an infinitely finer axis than the other, and of course turns by the addition of a much smaller weight.”³

Definition by Analysis or Derivation. Often the essential meaning of terms can best be presented by analysis of the term itself or of its origin and background. The following excerpts are from a carefully devised definition of the word “engineer.”

“According to the *New English Dictionary on Historical Principles*, the term *engine* is derived through the old French from the Latin root *ingenere*, meaning to beget or to create, being closely akin to *engender*. The words *ingenious* and *ingenuity* are from the Latin roots and have related meanings. The Latin word *ingenium*, meaning a clever device, either an implement or a plan, may be considered more directly as the ancestral form of ‘engine.’

“The word *engineer*, therefore, means an ingenious designer or planner, and only in a recent and local sense does it signify one who operates an engine, for which vocation *engineman* is more accurate and appropriate. This latter use of the word *engineer* is confined to the United States and almost entirely to the uneducated.”⁴

Definition by Action. Another excellent definition device is that in which “what a thing does” defines it. Many psychologists, indeed, feel that only this kind of definition—the “operational” definition—adds to our practical knowledge. In the following example of this method note that the author makes use of two sentence definitions—one at the beginning of the paragraph and one at the end.

“Economics, or political economy, is the social science which treats of that portion of human activity which is concerned with earning a living. It deals, on the one hand, with man’s wants and, on the other, with the goods (i.e., the commodities and services) upon which the gratification of his wants depends. It analyzes wants, classifies goods with reference to them, and considers all of the circumstances which affect the production and distribution, or sharing, of goods among the individuals of society. In discussing production and distribution economists treat the same problems that engage the attention of business men, but from a social rather than an individual point of view. It is to emphasize this distinction that economics is styled a ‘social science.’ A definition easy to remember is that *economics is the social science of business.*”⁵

Definition by Comparison and Contrast. Frequently you can clarify a meaning by comparing or contrasting the term to be defined with related or opposite terms, as in definitions from the *Encyclopedia Americana*:

“*Thirst*, a craving for water or other drink. As appetite shows a need for the introduction of food into the system, so thirst is a sensation indicating the necessity of an increased supply of water. . . .”

“*Terrigenous*, derived directly from the land, a term applied to those marine

³ *Darwiniana* (New York, 1915).

⁴ From *Building an Engineering Career*, by C. C. Williams. 1934. Courtesy of McGraw-Hill Book Co.

⁵ Henry R. Seager, *Principles of Economics* (New York, 1913), p. 1. Comparison of this paragraph definition with its earlier version in Seager’s *Introduction to Economics* (New York, 1904, p. 1) will teach you a good deal about defining.

sediments like sands and clays, which are of direct land origin, as contrasted with pelagic deposits accumulating in the deep sea as the result of organic agencies which extract their substance from solution in sea water."

Definition by Negation. In defining terms which are too easily confused with other terms in the same technical field it is often necessary to explain what the term is not as well as what it is. The following paragraph is illustrative. (Examine it also for accuracy.)

The *velocity* of a body is the rate of change of displacement. If velocity is constant it may be determined by dividing the distance passed over, by the time required for the body to pass over that distance. *Velocity* and *speed* should not be confused; speed is but a component of velocity. For speed has only magnitude and is therefore a scalar quantity, while velocity has both magnitude and direction and is a vector quantity. Neither should *velocity* be confused with acceleration, which is the rate of change of velocity. The 'pick-up' of an automobile is not its velocity but its acceleration. It is clear, then, that velocity is not speed and it is not acceleration. It may be simply defined as the rate at which a body passes through space.

"Logical Definitions." The term "logical definition" is purely one of convenience. In the narrow sense it covers only sentence definitions which follow a set "logical" pattern; in the broad sense it embraces both sentences and paragraphs whose primary job is definition.

The fundamental pattern of the logical definition is this: the *genus* plus the *differentia*. That is, the word or term to be defined is classified within a group, and then isolated from other entities in the group by pointing out its distinguishing characteristics. A simple example: "Scissors are instruments [*the genus*] used for cutting cloth, paper, and the like by the lever and fulcrum of opposed edges of metal [*the differentia*]."

Do not assume that the logical definition is either simple or easy. You must be both accurate and precise. Often you find a longer explanation less laborious to formulate than a logical definition.

Other One-Sentence Definitions. A sentence definition need not follow the "logical" pattern explicitly. You may imply both *genus* and *differentia*, as in this simple descriptive definition: "A light line is the finest line that can be made with a ruling pen." You may compress an operational definition into one sentence: "A topographical map of an area shows relative distribution of its surface features and their elevations." You may likewise boil down to a sentence the definition of a word in terms of its older or so-called original sense.

Definition by Graphic Representation. As an engineer you are well aware that many terms are most effectively defined by means of pictorial or graphic representations. Complex objects seldom are sufficiently clarified by means of a photograph alone; but a generalized sketch, or a series of sketches—some showing outward appearance and others a cross-sectional view and/or the working relationship of parts—may fill the bill.

12. Business Correspondence

Ability to write all the major kinds of business letters, to prepare inter-office memorandums, and to dictate effectively to a stenographer is highly useful.

For your strictly technological work you must master letters of inquiry, instruction, transmittal. Learn from some good business correspondence text the essentials of several others—application, personal recommendation, order, complaint, adjustment, acceptance, authorization, and sales.

This chapter is confined to what for fifty years has been the standard way of setting up a business letter. Keep in mind, however, that experiments and innovations may change the prevailing mold.

For example, men who stress work simplification urge you to start all parts of a letter flush with the left-hand margin. They urge, too, that you drop the typed signature and the initials of yourself and your typist.

THE BASIC FORMAT

Most business letters are typed on white or virtually white paper. As many carbon copies are made as are needed. All of these, naturally, should be readily legible. Some may be on paper labeled COPY.

The standard sheet is 8½ by 11 inches. For certain purposes a number of organizations use legal-size paper or, at the other extreme, half sheets measuring 8½ by 5½ inches.

Few letters are more than five pages long. Most are one or two. Some evidence indicates that two-page sales letters are more effective than one-page; but you are probably safe in making your letters as short as clearness allows. Every page but the first should carry a guide line such as "Rudnick to T. J. Cowell, 7-31-49," followed by the page number in the right-hand margin.

Leave generous margins—at least an inch at the left and right, slightly more at the bottom, and nearly as much above the guide line, which should be so spaced as to stand out sharply from the first line of the letter.

Letters of one or two paragraphs may be double-spaced. For others,

Mansfield Construction Company
112-116 East Chalmers Street
Champaign, Illinois

January 15, 1949

R. H. Jackson and Sons
20 West Jackson Boulevard
Chicago 4, Illinois

Attention: A. N. Klein, Vice-President

Subject: Changes in specifications for Job No. 711-A

Gentlemen:

The Jonesville City Commission has asked us to make two changes in specifications for Job No. 711-A, the Jonesville Power Plant.

We enclose a copy of the Council's resolution requesting this, and a copy of the transmittal letter written by Jonesville City Attorney Bruce Pelcher.

We write to ask your approval . . .

If you could send a representative next week we could expedite the negotiations. Please name a day and time satisfactory to you. The 8:20 (CST) out of Chicago will get your representative to Champaign at 10:05. We could meet him there.

Sincerely yours,

HTO/ms
2 Encl.

H. T. Ogden, Superintendent

cc. to: A. C. James
T. A. Reid

APPROVED: J. T. Mansfield (signed)
J. T. Mansfield, President

FIG. 7. A Typical Business Letter with Eleven Parts.

single spacing is better. Paragraphs can be shown by double spacing combined—but needlessly—with indention, if you wish. Double spacing is also advisable above and below any list made up of numbered or lettered items that are specially indented.

THE ESSENTIAL PARTS

Standard business letters have at least six parts: heading, inside address, salutation, body, complimentary close, and signature.

They may have at least six other parts: identification of the subject, “Attention” line, guides to routing, indication of enclosures, distribution list, and a division in which a superior—sometimes a staff colleague—authorizes, accepts, or countersigns the letter.

The parts should be so separated by white space that each stands out. Current practice calls for at least two spaces between successive parts. As many as six spaces are permitted between the heading and inside address, and four between the body and the complimentary close. The space between the complimentary close and the typed signature should be enough to keep the handwritten signature from looking cramped.

Figure 7 shows the setup of a standard letter containing eleven parts.

The Heading. If you use letterhead paper you need to type only the date of the letter. Place it where it will be visible and will not disrupt the typographical pattern.

If you use blank paper the heading will have two parts, which usually will occupy three lines. The first line gives your street address. The second gives the city and state, and if necessary the country. The third gives the date.

The longest line should reach the right-hand margin of your letter. The whole heading is most commonly “blocked”; that is, each line begins flush with the line above. You may, however, indent the second and third lines.

You also have a choice between open and closed punctuation. Both call for retaining internal commas (“Akron, Ohio”). They differ in that open punctuation omits end-of-line marks, whereas the closed requires a comma after each line except the last; a period is used after that one.

You have a further choice. You can use standard abbreviations for names of states following names of cities or towns, for names of all months except March through July, and for such words as *Company*, *Corporation*, *Avenue*, *Street*, *Boulevard*. Or you can spell out. Unless you are sure that you know the correct abbreviation, spell the word in full.

The Introductory Address. First make sure who the letter should be addressed to—whether to an organization or an individual. If to the former but for one person’s attention, put the organization’s name on

the first line of the inside address and use various devices to get the letter properly channeled.

The recipient's name and address may take as few as two lines, as many as six. Try to keep the number down to four. In deciding whether to put a man's title on the same line as his name or on the next, be guided by considerations of typographical brevity and symmetry. If an organizational name is long and you are single-spacing, you may divide the name (at some logical point) between two lines and indent the second discernibly, thus:

Department of Civil Engineering
Michigan College of Mining
and Technology

This is far better practice than trying to squeeze the name into one line by means of unorthodox abbreviations.

The introductory address should conform to the heading in the use of end-of-line punctuation, abbreviations, and indention. But the address on the envelope need not conform. In fact, the post office prefers that the lines on the envelope be indented and that names of states be spelled out.

The Salutation. The salutation should agree with the first line of the inside address. If that line reads "The Smith Company" your salutation is "Gentlemen" or (less commonly today) "Dear Sirs"—this even though you may have inserted between the inside address and the salutation the words "Attention: J. K. Hill, Sales Manager." If you prefer to say "Dear Mr. Hill," your inside address must start with his name.

The paragraph above shows how organizations are addressed. Individuals are usually "Dear Mr. (Mrs., Miss)" or else "Dear Sir (Madam)." "Dear Jack" is too informal, "Dear Friend" usually presumptuous, "Friend Smith" quaintly old-fashioned.¹ Governmental, ecclesiastical, and other officials and dignitaries are addressed in various ways; look up the forms in a standard manual for secretaries.

The only accepted punctuation mark after the salutation is the colon (:).

The Body. Most of what this book says about the body of a business letter appears in the sections dealing with specific types of letters. The general remarks that always apply are these:

Start the body two spaces below the salutation. Keep most sentences below 25 words, many below 15, and nearly all paragraphs below seven lines. Do not carry the last line of a paragraph over from one page to another.

¹ Whenever the salutation of a business letter addressed to a personal friend strikes you as too cold, you can of course clip to the letter a small slip with a few lines beginning "Dear Jack" or, for that matter, "Hi Buck."

The Complimentary Close. Keep the complimentary close grammatically separate from the body; that is, do *not* say "Thanking you, I am Yours truly."²

Standard practice calls for a two- or three-word phrase. The most formal is "Respectfully submitted." Commoner and slightly less formal are "Yours very truly" and "Very truly yours." "Yours truly" is a bit more intimate. "Truly yours" is rare today. "Yours sincerely" and "Sincerely yours" are more widely used now than in the 1930's. A form containing "cordially" presupposes greater familiarity with your recipient than students generally possess, but it may become common in your correspondence as you gain rank and prestige.

All forms of the complimentary close capitalize only the first word. Thus in "Very truly yours" the *V* is capitalized but the *y* and the *t* are not; in "Yours very truly" the *Y* is capitalized but the *v* is not.

Even though you employ open punctuation in the first two parts of the letter, put a comma after the complimentary close.

The Signature. In most business letters the signature consists of two parts—the name of the official signer of the letter, plus an identification if necessary; and the initials of the signer and his secretary or typist. These initials, separated by a diagonal bar or a colon, are usually set flush with the left-hand margin, on the same line as the typed signature of the sender, but they may be a line or two below.

Most letters that you send will bear your personal signature. This should be handwritten, and below it your name should be typed, along with any identification of your position that is needed. Nearly always the handwritten form of your name and the typed form should be identical.

Remember that it may make a difference in law whether you or your company is the official signer. When you are not intended to bear personal responsibility, as for purchases, sign thus:

THE SMITH-JONES COMPANY

By John Rupert, Sales Manager

If you sign as "John Rupert, Sales Manager, The Smith-Jones Company" you may find yourself personally liable for debts you did not mean to incur. (Observe that the name of the company is typed in capital letters.)

Even if you employ closed punctuation, put no period after the last line of the signature section or after the secretary's or typist's initials.

² If you feel you should give thanks for favors done or anticipated you can end the body with a paragraphed sentence such as "We are grateful for your coopération" or "I shall appreciate very much any aid you can give."

Some executives end the body with "Kindest regards" or "Kindest personal regards" or "I look forward to seeing you again soon." Though purists object to the use of "kindest" in this way, such a sentence is often advisable as conveying the tone you wish without running the body of the letter into the complimentary close.

OTHER PARTS

Of the six additional parts of some letters, the first three come before the body.

Identification of Subject. You can identify the subject of the letter in any of several ways. The two commonest are a short phrase, and code symbols. Examples of the second method are: 29.3C; PROD—Rec. 2A (meaning: Production Dept., Recommendation on Subject 2A). Two examples of short identifying phrases are: Armington Road Experiments, June 6-11, with Recommendations; Query on Cost Analysis Procedure.

The indication of subject may be put at the head of the letter. More commonly it is centered horizontally on the page between the inside address and the salutation.

"Attention" Line. To aid in channeling the letter you may say "Attention: Vice President Roland Hudson" or "Attention—Research Division, Alloys Department." This line is usually centered horizontally on the page between the inside address and the salutation. If the subject and the specific recipient are both indicated, put the "Attention" line above the line naming the subject.

The channeling system of the organization whom you address will determine whether the attention line goes on the envelope (in the lower left-hand corner) as well as in the letter.

Guides to Channeling. You, your recipient, or both of you may be aided in conducting correspondence if you put into your letter some such expression as "In replying, please address J. T. Jones" or "File #PR-631." This may replace the indication-of-subject line. Or it may be put two spaces below the heading; it is then aligned flush with the left-hand margin of the heading, thus:

221 Orange Street
Jackson, Michigan
April 1, 1949

File #PR-631

Indication of Enclosures. If you enclose one or more other documents in the letter you will aid the recipient by inserting, usually just below your initials and those of your typist, *Encl.* or *Encl.* (2), etc. If any of the enclosures are at all unusual you may want to specify their nature: "Encl.—2 maps, 1 ms. of talk, 1 expense acct."

Distribution List. When others besides the main addressee are to receive original or carbon copies of your letter you may name them in the lower left-hand corner of your letter. Head their names either with "Distribution List" or with some equivalent—"For distribution to" or "cc to." Put a colon after *to*.

Authentication. As was said on page 167, some letters must carry your superior's formal acceptance, his authorization, or at least his countersignature. In this event you should leave enough space below your own signature for him to write whatever he needs to. Type any material in this space that will speed up his job but not trespass on his province.

ORGANIZATION AND TONE

Try to focus on the reader's needs and interests rather than your own. Make your letters unified, clear, simple, and concise.

If in doubt whether your message is unified, make two or more letters out of it.

You can generally promote both unity and clearness by deductive organization. Let your first sentence refer to any previous correspondence or phone calls or other contacts that will orient the reader. Ordinarily you can dovetail this reference with your main generalization:

The machine parts ordered in H. T. Jones's letter of November 3 and referred to in yours of the 6th should reach you tomorrow from Gary by Dugan Freight Company truck.

As you asked in your phone call and letter of May 15, I am sending 12 copies of our confidential bulletin to your colleague Mr. Pritchett.³

In a long letter you can further promote clearness by the use of headings. In shorter messages you can show the main parts by spacing and numeralizing.⁴ To keep the reader following your train of thought, visualize him as sitting across from you, think of what questions would arise in his mind, and use all transitional words, phrases, and sentences that he needs to have. But hold to a minimum such heavy elements as transitional paragraphs and internal summaries.

Make your phrasing as simple as is consistent with accuracy. Forgo the telegraphic style. Avoid as carefully pompous time-wasters like "yours of the 12th ultimo" and "in reply would say." Don't flaunt technical terms; use them only when they are more precise than any equivalent expressions and are acceptable to your reader. Follow the same plan in abbreviating.

Virtually all letters should be courteous. If you feel you must blast someone, sleep on your first version, reread it for childish and libelous statements, see whether you can't produce a more temperate letter. Only after doing these things should you ever send out a diatribe.

Far commoner than letters that are intentionally rude are those which slap your reader's face without meaning to. Never use without full con-

³ Shun "your Mr. Pritchett" and "our Mr. Smith."

⁴ Many nontechnical readers, however, don't like numbered parts.

sideration such expressions as "You are wrong," "You claim (assert)," "This is nonsense."

Reinforce courtesy by conciseness. But don't carry ellipsis and similar devices so far that you lose the *you* tone. Thus it may be better to say "that you specified in your memorandum" than "specified in your memorandum."

LETTERS OF INQUIRY

Letters of inquiry are written for many purposes. Our concern here is with the sort which is designed to gain information that you need in preparing a technical report, article, or talk. Seldom is the recipient under obligation to give you the data. In blunt terms, you are imposing on his kindness. The letter should therefore impress him as authentic, legitimate, and clear. In addition it should throw as few burdens on him as possible.

Sometimes you must start by authenticating yourself. You can do this indirectly:

Secretary James Reed of the Bellevue Chamber of Commerce suggests that I write you concerning your Better Business Bureau.

Professor D. M. Holtz, whom I believe you know, has asked me to gather certain highway data and thinks you can furnish some of it without too much inconvenience.

As a senior student in electrical engineering at Roe College I have been assigned by Mr. K. H. Clark, instructor in radio, to investigate your recent design studies.

Observe that the first two introductory sentences are in the third person; accordingly they are preferable to the last. Better yet would be a second-person (*you*) opening, but this is seldom easy to devise for a letter of inquiry.

Observe too that all three of the above examples name the general subject on which you wish information. You should always do this job early in the letter.

You must likewise make clear in your first paragraph, or at the latest in your second, the use you plan to make of the information which you are seeking. If you don't tell the reader this, you may draw a quick No.

Then should come a brief, immediately clear set of particular questions. They may be preceded by a statement such as this:

Specifically, I need (would appreciate) answers to four questions (data on six matters).

Keep the number of questions down to half a dozen main ones and as few subquestions as possible. Arrange them in an order that will strike your recipient as logical. Number or letter each item. Give each item its

own clear intention. Leave white space above and below the list of questions.

In formulating questions you will benefit from some of the discoveries made by professional interviewers, who have found that factors which make an interview unsatisfactory include:

- A long set of questions.

- Individual questions that are long and complicated.

- Several ideas in the same question.

- Ambiguous reference of such pronouns as *he*, *who* and *this*.

- Irrelevant or repetitious words and phrases.

- Questions that lead to endless qualifications of the answer.

- Involved series of subquestions.

- Use of more than a few free-answer questions such as *Why?* and *In what way?*

- Opening questions that arouse suspicion.

- Opening questions that are too difficult.

- Confused order of questions, and especially abrupt shifts from one topic to another.

- Questions that often lead to answers in irrelevant terms—for example, answers stating hopes when you wish to get at expectations, and answers that tell what should be done instead of what is being done, or vice versa.⁵

Make the last part of the letter a courtesy section. If you are an undergraduate or a young engineer you can seldom offer more than thanks: "I shall be grateful for any assistance you can give." Men of higher rank may offer a real return of the favor sought: "If information on our practice would be of use to you, please let me know." At the least, they can frequently offer a nominal return: "If you'd like a copy of the talk incorporating your material, I'll be glad to send it."⁶

On occasion you may have to enlarge a letter of inquiry into a questionnaire. Do so as rarely as possible; the golden rule for questionnaires is "Don't."

If you must send them, accompany them with a brief personal letter. In this letter you must of course authenticate yourself thoroughly; and you should also explain why you must resort to a questionnaire, tell clearly what practical value the tabulated replies will have, and offer some worth-while return for the expenditure of time and thought which you are requesting.

⁵ The foregoing list is taken, with a few verbal changes, from P. B. Sheatsley, "Some Uses of Interview-Report Forms," *Public Opinion Quarterly*, 11:601-611, Winter, 1947-1948.

⁶ You can infer what your reply to an inquiry should be like. It should follow the pattern of the inquiry itself. That is, your "lead" should identify the inquiry and answer it in general terms. Each question in the inquiry letter should be answered in a separate paragraph (numbered, if the questions were). The last paragraph should say you hope you have been of assistance.

In determining the nature and number of the questions you may have to choose between ease of tabulating the replies and ease of answering. Let ease of answering govern; you must bear a heavier burden than you throw on the recipient.

So far as possible, frame questions that are answerable by a check mark or other symbol, by *yes* or *no* (or *always*, *generally*, *seldom*, *never*), or by statistics which you believe can be gathered for you quickly and easily.

It is not enough to avoid questions that *are* illegitimate. You must avoid any that *seem* illegitimate.

LETTERS OF INSTRUCTION

These may differ from letters of inquiry fundamentally in just one respect—the difference in status between writer and recipient. Even so, the tone of the two is generally similar. Once in a while, true, the letter of instruction must blast a subordinate, but usually it gives orders in the form of requests.

Its chief virtue must be perfect clearness. Hence it often carries an indication-of-subject line, which may be expanded upon in the first paragraph of the body. For additional clarity it may specify the steps or stages in the operation which the subordinate is to perform. These are usually treated in the same way as are the specific questions in a letter of inquiry—each is numbered or lettered, each is subparagraphed, and the whole list is set off by white space.

Materials, procedures, deadlines, places of performance, and personnel must be named as definitely as is necessary in order to get results.

Some executives prefer to word all instructions positively. Those of you who have served in the armed forces know the advantages of this practice but will also realize that negative phrasing is usually clear. You must, though, copyread the letter carefully to make sure that it contains all intended *nots*, and you must avoid confusing the reader with such rhetorical devices as “not seldom” and “it is by no means unlikely that we will not obtain . . .”

Letters of instruction end in many different ways, depending on the situation and on the official and personal relationship between writer and recipient.

Here are two instructions letters—one short and rather general, one detailed.

Before Thursday noon, December 16, will you bring our maintenance-inspection schedule up to date by checking on these three things in the Concrete Laboratory:

1. . . .
2. . . .
3. . . .

Have Parks inspect the layout of the new office (Will's) with you.

Please spend some time getting Davidson's opinion of the equipment we got him last month. When you report his reactions to me, don't pull any punches.

Phone me at once if things aren't going right. Otherwise we can talk it over when you hit the office again on Friday morning.

Because our sponsor finds our schedule of research reports unsatisfactory, I am asking you to see what can be done about speeding them up.

The trouble may be partly in the way we're conducting the research, partly at the writing stage, and partly in our use of slow duplicating methods. We can't tell. That's why I'm sending you over.

Check on all those things, and on anything else you find that seems to be holding our output down. Stick as closely as you can to the following time schedule. It names the jobs to do, the dates when we think you can do them, and the main people you should talk to.

- | | | |
|---|----------------|------------------------|
| A. Research planning | Aug. 21 - 22 | Rudy George |
| B. Testing procedure | Aug. 23 - 26 | Hicks, Parelli, McGraw |
| C. Help given to writers of reports, including your view of the need for an editor | Before Sept. 2 | Morgan, Schmidt |
| D. Reasons for delays in mimeographing and for the sloppy appearance of the mimeo'd reports | Sept. 4 | Miss Stewart |

This isn't an easy assignment. Some of these people feel the sponsors are needling them. They may feel we're making it worse. Follow the style you used in getting at the Burnham Plant hitch and you'll get the story. Your sum-up report should reach me a couple of days before Sept. 16, when the Board meets.

LETTERS OF SUBMITTAL AND TRANSMITTAL

Strictly speaking, a letter of submittal is from a subordinate and a letter of transmittal from an equal. In actual practice, though, a report accompanied by only the letter from the author is usually said to contain a letter of transmittal—perhaps because Americans find the word *submittal* displeasing on account of its implication of bowing low to authority. Furthermore, if the recipient sends the report on to his own superior, the letter by which he does so is always called a letter of transmittal rather than Submittal Letter No. 2. So we shall refer hereafter to letters of transmittal, regardless of exact nomenclature.

The “skeleton” letter of transmittal has a one-sentence body. This does three things. It announces that you are submitting a report, it identifies the report by title or an equivalent expression, and it states the authorization of the report. The jobs need not be done in the order named. An example is:

In accordance with your instructions of May 10, I herewith submit an inspection report of the Electrical Engineering Laboratories.⁷

Manifestly each of the three can be done at greater length. In fact, you may devote a paragraph or more to each:

On May 9, 1948, the Board of Directors authorized a thorough study of physical plant and operations. As an immediate sequel, on May 10 the General Superintendent requested his six department heads each to inspect the departments for which they are responsible, and to prepare a report.

I therefore submit a 60-page account of my inspection of the Electrical Engineering Laboratories both at Chicago and at Milwaukee, along with a summary of my findings (pages 59-60).

I respectfully request that copies of my report be struck off for distribution to the Advisory Committee.

At times some one of the three parts is even more complex. In particular, the statute, resolution, or other document authorizing the report may be reproduced in part or in full.

The letter of transmittal may do many jobs in addition to those named. It may contain the introductory summary of the report, a statement of the purpose and scope of the report, background information that the reader must have but that would misproportion the main document if included in it, names of persons or groups who might wish copies or digests of the report, and still other material.

⁷ Observe that the adverb modifying *submit* is *herewith*, not *hereby*. Note, too, that you can of course use synonymous expressions for “in accordance with your instructions.” You can, for example, say “as you requested.”

MEMORANDUMS

Much of the correspondence within organizations is carried on by memorandums. Some of these are merely "FYI" (for your information) records. Others are inquiries. Others are instructions. Still others are brief reports on which action is to be taken.

You will probably find printed forms available. If not, you can use a setup such as this:

4-26-49

To: H. M. Rowe, General Manager

From: John Quinn, Chief Inspector

Subject: Rejects in Plant 5

Rejects for the week ending April 23, from all assembly lines, ran 12.7 percent above the average for the first quarter. The reason . . .

Memorandums seldom have a formal signature; they may be initialed or at most have a handwritten signature.

Those that will be destroyed as soon as read may be very informal. They may, for example, omit subjects of verbs, use any abbreviations that the recipient will understand, and open a sentence with a numeral.

Will be Gr Bay next Tu and can see Aitken for Blake re shipmt. Pls confirm with Nadler. \$250 expenses. If not OK, call before Sat, when I lv on Zephyr for West.

DICTATION

You may dictate to a stenographer, direct to a typist, or to recording machines. Some such machines are nearly foolproof—you can pace the floor, mumble, even stammer, and your words will still come through. By and large, though, you had better make a deliberate attempt to dictate clearly.

The first stage is preparation. Have all needed documents and statistics at hand. Know the exact name, spelling, and address of your correspondent. Have pretty clearly in mind the main outline of what you want to say. Check on all factors affecting your comfort and that of the stenographer.

In actually dictating, specify any departure from the usual kind of paper, number of carbons, and typographical setup. Whenever you can, tell the stenographer how long the letter will be. Spell out all proper names that present any peculiarities and all other words that might trip her. Often it is wise to say "I'll spell" before pronouncing any difficult word. Tell the stenographer in advance that this is your practice.

Some stenographers do not want you to give the punctuation as you go along. Many do. Learn to drop your voice a bit before saying *comma*, *semi*, *quote*, *close quote*, *cap*, *paren*, etc.

Numbers are likely to cause trouble. Some dictators say "one hundred ten thousand six hundred fifty" (pause) "one one zero six five zero." Others write the number on a slip of paper and give it to the stenographer.

Speak rather slowly, and distinctly. Don't cover your face with your hand. Don't talk around a cigar, cigarette or pipe. If you must walk, dictate in the intervals between your paces; at least don't toss words over your shoulder from a dozen feet away. Whether walking or sitting still, pronounce clearly such words as *a*, *the*, and *to*. Be especially careful not to swallow or muffle them before such directions as "spell out" or "cap" or "comma."

Part IV: Written Reports

13. Formats and Patterns of Written Reports

We have surveyed nearly all the determinants of effective technical communication and have indeed gone further by discussing some forms, such as digests and business letters, which are components of many larger engineering communications. As we turn to the written technical report we encounter the last of the determinants—the influence exerted by prescribed and prevalent formats and patterns. A moment's thought will make clear that these formats and patterns are in the last analysis the product of the other determinants. In plainer language, individual engineers and engineering or industrial firms have found from experience that such patterns and formats suit their needs for immediate understanding and for efficient channeling and filing. These reasons account for the frequency of the “hind-end-to” arrangement in which the report opens with a summary.

All patterns tend to become too rigid, tend to be used in situations which they do not wholly fit. In fact, forms tend to take on a life of their own and to be regarded or even revered as ends in themselves rather than as the means which they are. While you are a student and a novice engineer you will have to heed this attitude toward certain patterns of report-making. You will probably have to follow rigid specifications. For this reason you should know some of the commonest patterns that you are likely to find prescribed.

But you should have even more information than this. As you move upward in your profession you will find more and more that rigid patterns cannot accurately show the relationships among complex facts, conclusions, and recommendations. You will find that such patterns are psychologically ineffective for many a recipient facing an unorthodox set of circumstances. Hence the adaptation of patterns to varying needs is emphasized in this and the following chapters. They give enough information on standardized formats and arrangements to help you while you are still an apprentice, but they try primarily to drive home the principle that you

should depart widely from standardized formats and patterns whenever the situation, the action in view, and the recipient demand.

THE MEMORANDUM REPORT

To what has been said on page 177 about the memorandum report there needs to be added only this caution: You had better not use extremely informal phrasing unless you are sure the report will be discarded almost at once, and unless you are just as sure that it will not be seen by a man who insists on formal style.

THE SEMIMEMORANDUM REPORT

Some short reports combine a printed form with running discourse. The first page contains printed headings and subheadings. After filling in the blanks beside or below these, you add material of your own, in full-sentence-and-paragraph style. Such a report seldom has a cover. It may be stapled in the upper left-hand corner, and may carry your signature.

Reports of this sort—and some business-letter and short-form reports as well—contain in the margin such expressions as ACTION or ACTION BY or *Attention of*. The person who must heed or act should be identified by his title or function. His name may be added if you can in that way speed up channeling.

A typical semimemorandum report is given below in outline. The first six headings are printed on the first page; the other four were provided by the author.

Number of the Experiment:_____

Date:_____

General Subject:_____

Specific Purpose:_____

Source of Sample:_____

List of Apparatus

1. _____

2. _____

3. _____

etc.

Description of Method

Results

Value of the Test

Data and Calculations

The author made his description of method short. His results he gave in brief arithmetical statements. He took only two sentences to sum up the value of the test. His data and computation sheets, however, were full.

THE BUSINESS-LETTER REPORT

Business-letter reports may differ from ordinary business letters in three ways. First, they may use centered headings more freely than do ordinary business letters, and even subheadings if the report runs to three or four pages. Second, some of them include tables, charts, and graphs, though few include photographs and fewer still include flow-sheets. Third, they may drop the introductory address and replace the ordinary salutation by "To the Board of Directors . . ." or a similar phrase.

THE NOTEBOOK REPORT

If you employ the notebook format, you generally prepare only a single notebook, which may leave your hands permanently or be returned to your files after the recipient has studied it. You can use the left-hand pages for setting forth your raw data and the right-hand pages for your processed data; or you can use the left-hand pages for computations and remarks, and the right-hand for the report proper.

Some organizations prefer that preliminary and progress reports be in notebooks and that the consolidated report based on them be in the usual typescript form. When you follow this procedure you should number the tables and figures in the typescript report as they were numbered in the notebook report. If some tables and figures that were in the notebook are not retained, the typescript-report numbering of such nonverbal aids will of course not be consecutive. The preliminary section of your typescript report should tell why.

A few organizations prefer the double-notebook method of submitting reports. One notebook, returned by the reader after he has studied it, contains raw and semiprocessed data. The other, kept in organizational files, is virtually an abstract of the first notebook.

Below are reproduced the chapter headings used in a report on undergraduate chemical tests which was submitted in a loose-leaf notebook.

Conclusions, Including Possible Practical Applications¹
Instruction Sheet as Furnished by Superior
Original Data Sheet
Theoretical Principles Illustrated by the Test

¹ Teachers may prefer the conclusions after the discussion of results.

Many superiors, in college and out, like to have the Applications section run somewhat as follows:

- a. Chemical and Engineering Flowsheet
- b. Information on Material and Heat Balances
- c. Technological Difficulties That May Be Met
- d. Size of Equipment
- e. Cost of Equipment
- f. Cost of Fuel, Materials, Labor, etc.

Discussion of Results, Including Sample Calculations
Answers to Questions Put by the Instructor or the Textbook
Graphs

When several men make a consolidated report on the tests comprising a series, a common practice is to head each page of the body of the report—whether the report is in a notebook or in some other format—about as follows:

This page prepared by _____	Page _____ of _____ pages
Approved by _____	Project _____
Date _____	Machine (material, etc.) tested _____

SHORT-FORM REPORTS

Short-form reports are of many kinds and there will be more, because engineers frequently experiment with new formats and new methods of arranging content. Only the commonest traditional kinds are discussed here.

Few such reports are printed. The usual reproduction methods include typing, hectographing (commonly called dittoing), stenciling (mimeographing), and two sorts of offset printing—multilithing and photo-offsetting. For an excellent survey of the merits and costs of these processes, and of binding methods also, consult B. H. Weil and John C. Lane, "Reproduction Techniques for Reports and Information Service," *J. Chem. Ed.*, 25:134-141, March, 1948.

The Cover. Almost every short-form report has a stiff paper cover. This is usually stapled or bradded to the manuscript. You may, however, staple or brad the manuscript pages only and then attach them to the cover with gummed cloth. A third method of binding is by the use of metal or plastic spirals or rings. As Weil and Lane point out, the third method helps the reader who wants to have absolutely flat pages in front of him. The left-hand pages may carry the tables and illustrations, the right-hand the text. This "portfolio format" virtually demands the use of a cover.

The cover may be blank. More commonly it contains a good deal, and sometimes all, of the title-page data. When the information on the covers of reports in series differs only in the specific titles of the various reports, the identical data may be printed, and a window cut in each cover to leave visible the typewritten title on the title page that immediately follows. Kodapak or some similar plastic constitutes the window "glass."

Some readers prefer a manuscript that opens from the bottom. The back cover is then of full length but the front "cover" extends only two or three inches down from the top. The first sheet of the manuscript either is the

title page or contains such of the title-page data as would normally appear on a complete cover.

The Title Page. In any event the short-form report must have a title page. At the least this contains:

Title of the report (without end punctuation except for a question mark if the title is a direct question).

Your name and that of any other author.

Positions or functions of the authors.

Your recipient's name.

His position or function.

Date of the report.

Place of submittal.

Make the title highly specific. Though you should try to keep it to less than a dozen words, you may have to use more if the report is to be briefly listed in a published index or bibliography. In any event, help your recipient to channel and file the report quickly. Do this by including in the title such words as Report on, Recommendations for, Investigation of.

Phrase accurately. The following title puzzled some people and had to be changed: Steady, Gradually Varied Flow in Mildly Sloping Channels. How would you reword it?

Other information that you should often give includes:

The number of the job or project you are reporting on.

The serial number and subtitle of your report itself if it is one of a set.

The date the report was due, if you submit it early or late.

The title page may even contain your table of contents when this is brief, a short set of indications, and the distribution list. Two sample title pages are shown in Figs. 8 and 9.

You should place title-page items symmetrically. Draw the reader's eye to the optical center of the page, which is slightly more than one-third of the way down from the top. Ideally, the words near the optical center—they almost always are the title of the report—should be so lined and grouped that the size of each group will be inversely proportional to the distance from the optical center. In addition, the lines comprising the title should if possible form some pattern—block, inverted pyramid, lozenge, etc.

Keep the title page free of embellishments.

The Letter of Transmittal. Many short-form reports are accompanied by a letter of transmittal, also known as a covering letter. This is usually bound in with the report and placed right after the title page. Two typical letters are given on page 188. The first is, strictly speaking, a letter of submittal.

PRELIMINARY REPORT
ON THE OWOSSO EXPERIMENTAL ROAD
Project R-631 No. A-1

Submitted to
Charles M. French, State Highway Commissioner

Submitted by
Arthur J. Johnson, Deputy Highway Commissioner

CONTENTS:

	Page
Purpose of the Report	1
Purpose of the Experiments	2
Extent of the Experiments	3
Personnel	5
Work Done June 20-August 31	6

September 1, 1947
Metropolis, New Acadia

Copies to:

N. D. Ernest, Secretary to the Governor
K. E. Wright, Head, State Planning Board of New Acadia
John Ralph, Chairman, Citizens' Committee of New Acadia

FIG. 8. A Fairly Full Title Page. The Cover Was Identical.

REPORT ON
FEASIBILITY OF BENEFICIATING
THE ORES OF THE PENGUIN RANGE

To: The Department of Conservation

By: Quincy Maas, Mine Appraiser

Date: August 15, 1949

Indications

1. Present supplies of high-grade ores in this state will near exhaustion within 15 years at the present rate of extraction.

2. That rate may rise within two years.

3. If so, the supply will last less than 12 years.

4. Two beneficiation processes for low-grade ores appear feasible.

5. These processes need further testing and refinement, as explained on pp. 11-15 of this report.

Penguin, Alasota

FIG. 9. A Fairly Full Title Page. The Cover Was Briefer.

I submit herewith an inspection report of Plant 1, Howe Chemical Company, Eastland, Ohio. The inspection, authorized by your letter of January 3, 1950, was made January 5 and 6.

The report contains incidental recommendations.

To F. G. Smith, general manager, and M. K. Rodney, plant superintendent, I am indebted for facilitating the inspection and for arranging interviews with several engineers named in the Acknowledgments section of the report.

I transmit herewith the report, submitted January 16 by James D. Markey, of his recent inspection of Plant 1, Howe Chemical Company, Eastland, Ohio.

You may be interested in the recommendations at the end of his third chapter. If you wish, I will have him draw up detailed plans, with cost estimates, for putting them into effect.

Table of Contents. The next part of the short-form report may be a table of contents. You may prefer instead to enumerate the main divisions of your report in your letter of transmittal or in the statement of scope. But you should generally give a formal table if you subdivide more than two of your main divisions or if you employ headings of the third level.

You will expedite cross reference from chapter to chapter, section to section, and subsection to subsection within your report if you number each of these various divisions. Common practice is to use capital roman numerals for chapters, arabic for sections, and parenthesized small letters for subsections. The practice is exemplified by the following reproduction of the first part of a table of contents:

CONTENTS²

	PAGE
I. INTRODUCTION	1
1. Object and Scope of Investigation	1
2. Personnel	2
II. TEST SPECIMENS ³	3
3. Shape of Specimens	4
4. Bodies Tested	6
5. Preparation of Laboratory Body	9
(a) Source of Specimens	9
(b) Mixing	9
(c) Molding	10
(d) Burning	10

Notice that the table of contents omits mention of the letter of transmittal unless the letter follows the table—which it seldom does. Notice also that the titles of nonverbal aids constitute a List of Illustrations, or a List of Figures and a List of Tables, placed immediately after the list of verbal headings.

² Note that *Contents* suffices. You do not need the words *Table of*.

³ This chapter opens, as the pagination shows, with introductory material that does not comprise part of a section. (See the last paragraph in the section on the order of the details in chapter 8.)

The smallest number of divisions under any superior heading is two.

All headings and subheadings in the table of contents must be worded exactly as they are worded in the report itself, even down to *a* and *the*. In the list of illustrations, also, identity of descriptive wording is essential; if the caption of a figure says "First Floor of Mill" the list of illustrations must not say "The First Floor of the Mill." But explanatory matter—such as "Exports are given in long tons"—which appears under descriptive captions in the body of the report can usually be omitted from the list.

Introductory Summary. Though some reports go at once from the table of contents to the body, the value of an introductory summary can hardly be overestimated.

You may keep it to one sentence or extend it to several paragraphs.

You may leave it unlabeled or give it any one of the several labels named on page 152—abstract, summary, résumé, synopsis, indications. The longer it is, the more you will help the reader by giving it a title.

When you do formally label the summary, you may provide for its being detached by the recipient so that he may keep it in his files or send it to another reader. If this disposition is in view, head the summary page with your basic title-page data, see to it that the page can be easily removed from your manuscript, and include in your report a final summary which the recipient will have available if he has sent the introductory summary elsewhere.

You may also find it wise to sign the introductory summary.

Include in the summary no graphs or flowsheets, and only such tables as are short and simple enough to require no formal captions.

Completing the "Frame of Reference." Whether you do or don't give the reader an introductory summary, you must furnish him with a complete frame of reference. He needs most if not all of the following information. You may concentrate it in the letter of transmittal or in the first chapter of the report proper, or you may split it between these two parts of the document.

1. *Any needed expansion of the formal title.* This expansion often takes the form of defining, both positively and negatively, any words or phrases in the title which are momentarily unclear. For example, some readers have to be told what *dust* or *sewage* or *rate* do and do not mean in technical parlance.

2. A statement of *the purpose (objective or mission) of the report*, including your statement of its authorization unless this is self-evident or has been put into the letter of transmittal. Your superior may require that the statement of purpose be quoted directly from the instructions governing the project. Regardless of its origin, the statement is often formulated as a semitabular list of questions that the report must answer or of problems that it must solve.

3. Related to both the items named above, a statement of *the scope of the report*. The statement may be as brief as this:

"This bulletin describes a simple graphical procedure for computing vertical displacements at the surface or within the interior of an elastic, homogeneous, isotropic solid body bounded by a plane horizontal surface and loaded by distributed vertical loads at the surface."⁴

Or it may be fairly full, expanding not only the title but also the table of contents. It may go beyond the latter in that it may tell not only how extensive your report is, but why you have covered all that you do and why you have omitted some material that your reader might expect to find. Make such an explanation concise. You might like to expound at length your reasons for leaving out certain topics and for seeming to understress others. But you can seriously misproportion a short report by accounting for omissions or abridgments as fully as you wish to do. Of course, don't sacrifice tact; you cannot afford to make the reader feel that you have disregarded certain topics arbitrarily or, on the other hand, that you are wringing your hands in apology. Be businesslike and impersonal in telling why some expected data are irrelevant or unobtainable.

Put yourself in your reader's shoes when you select the verb tense you employ in the statement of scope. Most readers view even a long report as a unit. You must adopt their attitude. You yourself may be painfully aware that you have built up the report block by block over a period of time, and you may therefore be tempted to say, "This report will present . . ." Your reader should be told, "This report presents . . ."

4. *Recapitulation of whatever data the reader needs in order to grasp the information in the report*. The following excerpt shows how this "recap" can be dovetailed smoothly with the statement of scope.

"In homes heated with steam or hot-water heating systems, the practice of using the house heating boiler to supply hot water for domestic uses the year around is becoming prevalent. The advantages claimed for this practice are that an abundant supply of hot water is available at all times, fewer units of mechanical equipment are required, the operation is economical, and a minimum amount of floor space is required for the equipment involved. Data necessary for the correct sizing of this type of equipment are very meager, as are also data on the cost of operation, maximum load imposed on the boiler under actual service conditions, and the rate at which water can be heated. In view of this lack of data, a program of tests was undertaken in the I-B-R Research Home in order to determine the operating characteristics of an indirect storage type water heater located in the house heating boiler and connected to a horizontal, insulated, 30-gal. hot-water storage tank. The program was initiated by the Advisory Research Committee of the Institute of Boiler and Radiator Manufacturers. This bulletin, the fifth to be published under the coöperative agreement between the Institute of Boiler and Radiator Manufacturers and the University of Illinois, is devoted to a discussion of the hot-

⁴ By courtesy of Professor N. M. Newmark, University of Illinois.

water heater tests made in the I-B-R Research Home during the summers of 1942 and 1943.”⁵

Some superiors prefer to have you put the introductory summary of procedure, findings, and conclusions and recommendations (if any) at this point, after you have explained the general nature of your subject matter and have set forth your purpose, the scope of your report, and essential background information.

5. An *overview of the physical subject* of the report—the place, person, process, machine, or substance that your report essentially deals with. In some reports you must place this overview between the statements of purpose and of scope in order to make the scope fully understandable. When you can put it after the statement of scope it may constitute the first section of the body proper.⁶

More rarely, other kinds of introductory material also appear in the short-form report. Most of these are discussed under the book-form report. The rest are named in the account of the functional types of reports.

The Body. It is the nature of the functional types which will mainly determine what you put into the *body* of your report and how you arrange and proportion it. But reports are enough alike to permit these generalizations:

1. Even a brief report answers most of the Seven Basic Questions that were named in the discussion of news stories: who, what, when, where, why, how, and how much.

2. Of these seven, one or a few are primary. Answers to the others identify the subject matter and the data-gathering method but they do not carry the “message” of the report.

3. Every report should keep as many virtues of the nonverbal communication as possible. A map or chart is compact and economical. A simple one can in fact be apprehended as a unit; the gist of what it says can be gathered in one look. Similar readability is a major ideal of the written report.

4. To preserve the virtues of nonverbal communications, the body of most short reports follows a deductive arrangement. Indeed, it is occasionally wise to use that extreme form of deductive order, the inverted pyramid. One further subform is favored by some readers: the inverted pyramid followed a concluding summary that in essence though not in phrasing duplicates the introductory one.

Manifestly, however, a semi-inductive arrangement is preferable in most situations where you know you will have to overcome a considerable amount of ignorance, inertia, or opposition. You will have to weigh the

⁵ A. P. Kratz and W. S. Harris, “Performance of an Indirect Storage Type of Hot-Water Heater,” *Univ. of Ill. Eng. Exp. Sta. Bul.* 366, 1947, p. 7.

⁶ See the table of contents on page 196.

gains from using such a nondeductive pattern against the loss that could result from violating superiors' orders or desires for a deductive pattern.

Deductively arranged or not, your report should from the first word focus on whatever you wish to stress most—who authorized the report, or why it is being submitted, or why it may be needed immediately, or what its scope is, or what are its major findings, conclusions, or recommendations. (See "The Abstract," page 155.) In focusing, try to use an active-voice rather than a passive-voice verb; replace "From the data herein reported the conclusions are drawn that . . ." by "The data herein reported indicate (yield the conclusions, point to the conclusions) that . . ."

If the reader or hearer will find your subject matter rather hard to comprehend, you would like to do one of two things—either go slowly and steadily from the less difficult material to the more difficult, or else give him a breathing space right after an especially tough passage or table or figure. But to do these things is nearly impossible in some technical reports; you can only hope that he will put forth all his energies to grasp what you are saying. Do not, however, say "impossible" until you have done all you can to save his energy. So steer away from needlessly abstract wording. Phrase everything as simply as is consistent with accuracy. Break up long sentences and long paragraphs whenever you can. Moreover, if you have the space and your reader has the time, insert a few specific examples to reduce the "density" of your generalizations. And if you can't cut down the gradient of difficulty by words alone, see whether your illustrations can't help you to do so. Perhaps you can complement a taxing passage by a photograph or a simple curve or a pictograph rather than by a heavy table or a complicated chart. Once in a while you will even be justified in disregarding the advice on page 122 and using illustrations merely to let the reader get his second wind.

Many of your short-form reports must include footnotes or their equivalent. Since many engineers dislike them, you may be able to avoid them by referring the reader directly to numbered entries in the bibliography at the end of the report. This is done as follows:

"The discharge into the channel was measured by two elbow meters⁽⁵⁾ which were calibrated in place."

Reference to Entry 5 of the bibliography shows that the statement has been borrowed from W. M. Lansford's *University of Illinois Engineering Experiment Station Bulletin* 289 (1936) entitled "The Use of an Elbow in a Pipe Line for Determining the Rate of Flow in the Pipe."

You will notice that even this method has three disadvantages. It forces you to omit, or else to wedge into the running text, subsidiary data on personnel, methodology, and controversial matters that you can't neglect

altogether. Second, it increases the difficulty of citing lectures, interviews, and other sources of information that do not, strictly speaking, belong in a bibliography. Finally, it increases the reader's job of verifying some sources, because it fails to provide specific page references even for the printed documents that it cites.⁷

The engineer seldom needs to footnote as heavily as the scientist. At times he can get along with the meager documentation common in newspapers and public talks. But he must substantiate his statements enough to protect himself against suits for violation of copyright laws, enough to serve his readers, and enough to fulfill his obligations to people from whom he borrows facts and judgments. Hence he rarely escapes the duty of at least enumerating sources of information.

You can run the names of all these sources in with the list of references for your whole report or for each chapter. A commoner method is to set up two lists—one of acknowledgments and one of printed sources (bibliography).⁸ Such a procedure safeguards you and fulfills your minimum obligation to all your informants, but it does not sufficiently aid the readers who want to see whether you have used your sources competently. Such readers wish every citation to be as specific as it can be made. So, ideally, you ought to give full references in the text itself or else in footnotes.

Either method, however, slows down most readers. Your problem is to solve this conflict between the authoritativeness and the economy of your report. A compromise solution which often works well is to put your documentary footnotes into an appendix, where the reader can use them or disregard them at will. You can do the same for controversial matter as well. Though such a method goes counter to the principle of accessibility, it does promote immediate readability. Then you can put into the body of the report, rather than into footnotes, all cross references from one page or part of your report to another. The research scholar or scientist does not favor this procedure but the technical reader often benefits from it.

In short, most engineering reports let some element other than the footnote do these three chores:

⁷ You can overcome this disadvantage by using a dual index number, the first member of which identifies your printed source by the number which you have assigned to the source in the bibliography, and the second of which designates the specific page that your reader should look at. Here is an example: "According to one investigator^(8, 16) the best flotation method . . ." The quoted sentence rests on a statement made on page 16 of the document which is numbered 8 in the bibliography.

⁸ No universal practice for arranging items in your bibliography exists. There is much to be said in favor of listing items of like form together (government publications; magazine articles; books; typescript reports, etc.) *Within* each group you can then follow an alphabetical, a topical, or a chronological order. The chronological arrangement may be from past to present or from present to past.

1. Tell the reader about evidence and views that confirm or conflict with the report-maker's own judgments.
2. Refer the reader backward and forward within the report.
3. Give information tangential to the main subject of the report.

They usually restrict footnotes to two duties:

1. Refer the reader specifically to the sources of all direct quotations and all directly borrowed tables and illustrations.
2. Acknowledge the services of previous writers whose data the report utilizes in a changed form.

Footnote forms are numerous. Adopt as simple a one as will be accurate, and clear to your reader; then stick to it. You can follow the form used in this book if you wish. Observe that:

1. The footnote-index symbol in the body of the document and at the beginning of the footnote itself is an arabic number set a half-space above the line of type. Many engineers and engineering societies prefer such symbols as the asterisk (*), dagger (†), double dagger (‡), section mark (§), and parallels (||) used in that order. The reason is the one that applies to the choice of such symbols in the preparation of tables—to avoid confusion of superior footnote numbers with exponents.⁹ Like the superior numbers, these symbols are set half a space above the line of type. No symbol should follow a noun or pronoun in the possessive case.
2. Footnotes are single spaced in typewritten material, and are set in smaller type in printed material.
3. Names of articles and of parts of such documents as books and reports are put in quotation marks, and names of books and magazines are italicized (underlined).
4. Abbreviations that your reader will grasp at once should be used except in the title of an article or a division of a document.

The Final Summary. Most short reports need no final summary unless the recipient will send the introductory summary onward. When you do prepare a final summary, govern its nature and length mainly by your recipient's orders or preferences but somewhat by the complexity of the data in the body. If possible, leave out flowsheets, graphs, and tables. At the most, use a few summing ones. When the body is detailed, you may repeat major findings and conclusions. Here you can help the reader by limiting each paragraph to one finding or conclusion and by lettering or numbering the paragraphs—in short, by a final set of indications.

Your final summary may point forward to another phase of the job or to a project that will follow the present one. But be sure that such a sequel

⁹ See page 115.

has been named or at least implied in your statements of purpose and scope. Above all, guard against introducing a broad new subject and then dropping it. In other words, don't let any part of your final summary look like the opening of a subsequent report.

Appendix Material. Few short-form reports contain appendixes—at least, appendixes other than a bibliography or its equivalent. Nevertheless you should use an appendix whenever you can thus save your reader from needless detours into footnotes or from heavy going in the body of the report. What are some major uses of the appendix? For one thing, as a repository for pertinent written material that is too long to be quoted in the text or even in footnotes. For another thing, as a repository of tables and illustrations that are of collateral value only. In the third place, as a repository of controversial matter that would distract the reader from mastering the gist of the report.

Typographical Principles. Bound or not, reports should be page-numbered. Count the title page in the paginating but do not put a number on it. Follow the same procedure for a letter of transmittal that precedes your table of contents. You may number all other prefatory pages in small roman numerals, preferably at the bottom of the page (a drop-folio). Thus the drop-folio of the first contents page in a report that contains a title page and a one-page letter of transmittal would be iii. Number the pages of the body in arabic, preferably in the upper right-hand corner. Appendixes usually continue the arabic pagination of the body.

Some superiors request that each chapter or other main division start on a separate page.

Caption and number every nonverbal element except a short informal table which is introduced directly by text matter. The commonest practice is to use arabic for numbering your figures and roman caps for numbering your tables. Most engineers prefer that flowsheets be numbered in the same series as other types of figures. Methods of identifying plates vary; a widespread practice is to use capital letters (Plate A). Roman numerals are preferable if there are more than 26 plates.

Sign the report only when direct orders or standard operating procedure calls for doing so.

Typical short-form reports are given below, in outline. The second and third, both from industrial files, were fairly long and complicated documents. The fourth might better have been in semimemorandum form.

FOUR SAMPLE PATTERNS OF SHORT-FORM REPORTS

Cover (including table of contents and the distribution list)

Title Page

Letter of Submittal, with centered headings for the following parts of the letter:

Summary (in this report, an epitome)

Acknowledgments

Purpose and Scope

Body

Equipment, Materials, and Procedure

Results

Discussion of Results

Recommendations Concerning Further Work

Cover

Title Page

Letter of Submittal, including reproduction of the letter of authorization

Letter of Transmittal

Abstract

[Table of] Contents

List of Illustrations

Body

The Problem

Purpose of the Report

Scope of the Report

Acknowledgments

Nomenclature and Notations

Theory

History of Previous Investigations

Equipment and Materials

Procedure

Data

Raw

Analyzed

Discussed

Conclusions

Recommendations

Appendix A: Bibliography

Appendix B: Costs

Cover

Title Page

Letter of Transmittal

Indications

Problem (Statement of Scope)

Description of the Plant Inspected

References

Sponsors of Inspection

Guides

Interviews

Letters

Technical Literature

Previous Personal Experience

Manufacturing Methods

Special Processes

The Company's Plans

Costs

Unit

Total

Conclusions

Printed cover, with "window"
Title Page
Main Conclusions
Purpose of the Tests
Complete Nameplate Rating of Apparatus
Nomenclature and Notation
Theory
Testing Procedure
Circuit Diagrams
Corrected Data Sheet
Discussion of Results
Sample Calculations
Curves

BOOK-FORM REPORTS

Many book-form reports are printed. More are not. All are rather complex in organization and a number are complex in their physical setup.

They may run to more than one volume. In any event, they are bound in paper, in "boards," or even in leather. The illustrations may include kinds that only specialists can prepare. Several of the curves, charts, and tables may be relegated to the appendix. Some indeed may be so bulky that they have to be placed in a manila pocket attached to the inside of the back cover. If this problem arises, consult a specialist in illustration. You may have to call also on experts in the use of color and in typography. It will pay you, though, to know at least the ABC's of these matters.¹⁰ Ways of captioning illustrations and of numbering pages are similar to those you employ in the short-form report.

Generally, the book-form report includes *at least* all the divisions that are customarily included in briefer reports, except when you give your document the guise of a business letter. You may then omit the table of contents and also appendixes. You will usually leave out such ordinary parts of the letter as the heading and the complimentary close, and you may combine the introductory address and the salutation.

In addition, most book-form reports contain a number of sections seldom found in the short-form report. These are discussed in the next few pages.

¹⁰ A digest of present knowledge on "near" ("warm") colors, color purity, and visibility measurement is R. E. Lewis and James Prestini, "The Place of Scientific Research in Design," *The Frontier*, March, 1948, pp. 4 ff. For a list of color combinations in order of legibility, see *Inland Printer*, November, 1946, p. 33. For information on effective use of space, margins, type styles and forms, borders, and illustrations both functional and decorative, study J. L. Frazier, *Modern Type Display* (Chicago, 1929), a conservative book. Experimental findings that may change some printing practices are set forth by D. G. Paterson and M. A. Tinker, *How to Make Type Readable* (New York, 1940); pp. 156-159 give recommendations and specifications for an ideal page.

Taking up the parts of the report in order, we note:

The *cover* almost always contains some of the title-page material—title, abridged if necessary; place of the report in a set or series; and date of submittal or publication. The cover of a printed report may carry adornments.

The *title page* remains, regardless of what data the cover may give. It is usually full.

Except when the pseudobusiness letter format is used, a table of *contents* is indispensable. Its entries may comprise four or five levels of headings. Sometimes you are justified in running the captions of certain tables and curves in the table of contents, particularly when a section of your report consists only of one or more tables and/or illustrations. Even so, you nearly always include a *List of Illustrations* or both a *List of Figures* and a *List of Tables*. The list of figures usually precedes the tables, unless the tables are primary and the illustrations are based upon them.

Other prefatory material may be extensive. Many of the variations found in practice are treated in the discussion of the five functional types of reports, but much should be said now.

Not only a *letter of transmittal* but also a *letter of submittal* is bound in with some reports. The letter of submittal comes first. Nor does your use of both prevent you from sending additional letters of transmittal to individuals comprising your distribution list. The “official” letter of transmittal may be addressed to (say) the president of your company; you may also write a separate letter of transmittal for each of the following men: the head of the company’s research department, the research director of the trade association to which the company belongs, the editor of a technical magazine. These supplementary letters are mailed separately from the report or are clipped to copies of it.

Even when you write one or more letters of transmittal, your report may still need a *Foreword*, an *Introduction*, or both. The question of which should come first has never been answered to everybody’s satisfaction; common practice is to have the foreword precede the introduction. In many reports that carry both these preliminaries, the foreword is written—or at least signed—by a superior, and the introduction by the author of the report. The foreword may tell the significance of the report or it may offer data on the report-maker’s qualifications, data which the author cannot in modesty set forth over his own signature.

Very full reports may include one or more of the following: a *letter of authorization*, a *letter of confirmation*, a *letter of acceptance*, and a *letter of approval*. How these can be incorporated in the introduction is exemplified on the next page.

Early in 1946 it became evident that further study of trucking equipment in all our plants was advisable. The President therefore requested the undersigned to investigate and report. The body of his letter reads as follows:

"You will make a tour of inspection of all plants, including the branch at Hillside, N. Y., in conjunction with H. J. French of the consulting firm of French and Sallee. At least one week should be spent at each plant. The managers have been requested to give you every facility for investigation. Your report should be ready for my study on May 1, 1946."

The report which Mr. French and I submitted on April 25, 1946, was officially accepted by the President in the following letter:

May 3, 1946

Mr. K. R. Rodebush
Apex Manufacturing Company
Zaneway, Ohio

Dear Mr. Rodebush:

I am placing before the Board the report you prepared on our trucking equipment and routing. I am glad you extended your inquiries to cover the latter problem.

It may be that a further study of routing will be in order. If so, you and Mr. French will hear from me soon.

Very truly yours,
S. L. Greene

The present study resulted from an order to investigate routing in more detail.

On occasion, much of the prefatory material is intended for a type of reader unlike the man who will use the body of the report. The total product is then known as a *double report*. It is useful when sponsors wish to publish part of a report in a magazine or in newspapers or as a set of reprints. The preliminary section which is most frequently chosen for reissue is the introduction, but at times either the foreword or the body of the letter of transmittal serves more effectively.¹¹

Several federal bureaus and some corporate and individual investors prefer that nearly all details be placed in appendixes, that the body be brief, and that it be preceded by an epitome-type of abstract. Essentially though not formally, the resulting communication is a *triple report*. Here is an example:

Synopsis (= Abstract).

Main report, a brief general discussion of all features of the project.

Appendixes, which may include details of:

Land classification and soil surveys.

Water supply studies.

Storage plans, surveys, capacities, geological reports, exploration results, materials, rights of way, water rights, designs, cost estimates.

¹¹ Some short-form reports are double, but there are so few of them that it seemed advisable to treat the subject only under the Book-form report.

Existing and proposed canal, lateral and drainage systems, with cost estimates.

Economic surveys.

Other uses of project works (flood control, domestic water supply, power, etc.).

Conferences with local interests on the desirability of the project.

List of personnel.

The foreword of some triple reports is intended for the simon-pure layman, the body for the entrepreneur or executive, and the appendixes for the technical specialist only.

A formally labeled *abstract* is general though not universal. It tends to be a full résumé. But if the introduction is itself a full résumé or contains one, then a set of indications or some other kind of epitome suffices.

However labeled and divided, the prefatory and introductory material usually has to perform more functions than in a short report. Besides summarizing the body, stating its purpose and scope, and recapitulating pertinent data, the preliminary sections can:

1. Challenge the reader's attention and arouse his interest.
2. Explain how he will profit by studying the report (or its summary).
3. Tell which sections are of special concern to various types of readers.
4. State the writer's attitude toward his subject matter.
5. Set forth in unmistakable terms any assumptions and hypotheses upon which he proceeds.
6. Define symbols and expressions to which he gives a special meaning.
7. Define any "key" symbols and expressions that the reader may not know.
8. Indicate the writer's capabilities and qualifications.
9. Show the basic pattern of the report.

The first two of these nine jobs are seldom worth attempting unless the persuasive passages are part of a section that will be published separately. The third job is more frequently justified.

Obviously Nos. 4, 5, and 6 are especially suited to reports on controversial subjects. They may then be supplemented by No. 8; the latter may become indispensable if the report is volunteered rather than called for.

Of No. 7, all that can be said is this: For laymen a passage consisting purely of definitions is unwise. Try to spread them throughout the report. For technical readers a heavier concentration is possible, often in the form of a section labeled *Nomenclature*, which may be combined with or followed by a *Notation* section. Nevertheless, a glossary should be ap-

pended to the report if a good many solid blocks of definition would otherwise prove necessary.

It is, lastly, clear that the table of contents affords the most logical means for showing the design of the report (No. 9 above). To impose such a job upon the introduction is often to confess that the table of contents, and hence the body itself, are unclear or excessively complex.

Acknowledgments may be numerous. Their nature and position are dictated somewhat by courtesy but more by self-interest. You must show as soon as possible the extent to which the authoritativeness of your report is affected by the aid you have received. When acknowledgments are few they may go into the letter of transmittal; otherwise not. They may occupy part of the foreword or of the introduction. But they may also go into the body, usually either in or just after the statement of scope, because the scope is often greatly influenced by the coöperation given the writer. If included in the letter of transmittal, acknowledgments almost never bear either a main heading or a subheading. If included in the foreword or introduction they occasionally carry a subheading; if put into the body they frequently do.

In place of acknowledgments some reports have a section called *Personnel*. At its simplest this is a mere list of names, positions, and functions. But by including explicit thanks for jobs well done it may come to resemble the acknowledgments section.

Many long reports have to contain passages that evaluate the knowledge, capabilities, and trustworthiness of people who have been kind enough to furnish data and opinions.

Such passages of course do not belong in the personnel section. Nor should they be put into the acknowledgments. They would violate the unity of tone of that section, whose core consists of an expression of thanks. Ordinarily the best place for these evaluations is in the discussion of investigative procedures or of sources of data.

Not only their placing but their phrasing demands thought. Some report-writers make themselves look foolish by expressing such judgments as this:

President G_____ of the Corporation, who supplied information on its policies, created the impression of being honest, intelligent, and coöperative, and there seem to be no grounds for believing the contrary.

You can see what the writer was trying to do. He wished to be temperate and cautious. He also wanted to safeguard himself in case President G_____ should sometime turn out to be a rascal or a fool. But the writer went much too far, especially since President G_____ is a man of international standing. The connotations of "created the impression" and "seem to be no grounds for believing the contrary" are unfortunate.

The words don't harm President G———; they harm only the man silly enough to write them.

The *body* of the book-form report is less likely to follow a deductive order than is the body of the brief report. One reason is plain. Owing to the normally greater complexity of the subject matter it may become necessary to "lead the reader by the hand." You may have to conduct him from simple details up to conclusions and recommendations.

Occasionally a division or subdivision of the body consists entirely of one or more tables, charts, flowsheets, and the like. Then, as has already been said, the table of contents must contain not only the headings of verbal material but captions of some of the nonverbal.

Main divisions generally start on a new page.

Problems connected with headings and subheadings may become complicated. In many long reports logic will demand six or seven levels. But to indicate them clearly and economically will strain typographical resources. There can then be no objection to italicizing or blackfacing some of the words in the text so as to make them equivalent to subheadings of the lowest logical rank.

In extremely long book-form reports, a table of contents at the head of each part or chapter is by no means rare. Similarly, some or all of the chapters may end with a bibliography.

Another practice is to include two tables of contents—at the beginning, a list of sectional and chapter headings only; at the end, a complete synoptic list. This is the plan followed in the Beveridge report, *Social Insurance and Allied Services*. Manifestly, bibliographical data may be treated analogously. The complete list of printed sources may be relegated to an appendix, and each part or chapter of the report may name only those documents of highest immediate value.

Consistency in the use of numbers, in abbreviation, in hyphenation, and in other matters of typographical style is even more important than in the short report. Readers have plenty of time to notice discrepancies.

The *final summary* can sometimes be as brief as one paragraph. When it has to be long, you can often employ the technique explained in the discussion of short reports; that is, you can separate sharply from one another each of the recapitulated findings and conclusions. It is obvious that the conclusions must answer at least such of the following questions as are relevant for the investigation on which you are reporting: What degree of success or failure do the data indicate? What were the causes of the success or failure? How effective were the equipment, procedures, and personnel employed? What hypotheses or theories used in treating the problem proved helpful? What changes might be made if the work were repeated in whole or in part? To answer these and other questions properly may demand such close-linked reasoning that the principle of

"one sentence should equal one paragraph" will obscure the trend of the thought. Hence it is not uncommon to find a semitabular résumé of the findings followed by a more tightly organized résumé of the conclusions.

The problem of pointing forward to future investigations is often acute. The more complex a report becomes, the more legitimate is this prospectus. But your first duty is to the report you are now submitting. You must not detract from its getting due attention. Therefore, even when your final summary does refer to future work, the last sentence or paragraph in it should revert to the subject matter of the present report.

Appendixes may be of many kinds—one or more bibliographies; several types of nonverbal forms; a glossary; originals or copies of such documents as balance sheets, affidavits, charters, franchises, abstracts of title, mortgages, contracts, and the like; and lengthy excerpts from printed matter, especially if controversial.

Though the task of preparing or assembling some of these appendixes is frequently assigned to juniors or to specialists hired for the occasion, you should make your own *Index*. This is not the place for detailed recommendations concerning this job, but you might note that you will help the reader if you italicize the references to your illustrations and keep references to the text in roman type.¹²

The following outline serves for either a short-form or a book-form report.

REPORT ON CHEMICAL TESTS¹³

Summary

Introduction

- Statement of Problem

- Analysis of Problem

- Review of Previous Work

- Approach Used in This Work

Experimental Work

- Apparatus and Equipment

- Materials and Reagents

- Procedure

- Data

Discussion

- Theoretical Background

¹² A brief useful guide to the preparation of indexes is Vera Avery and Frieda Kaines's *Indexing and Alphabetizing Simplified* (obtainable through the Pamphlet Distributing Company, New York City). An excellent condensed statement of the principles is given by W. E. Spahr and R. J. Swenson, *Methods and Status of Scientific Research* (New York, 1930), pp. 283-285. Problems involved in the indexing of names containing hyphens or preceded by what were originally geographic or patronymic syllables are treated in the University of Chicago *Manual of Style* and other standard typographical handbooks.

¹³ F. O. Slate, "Organization of the Technical Report," *J. Chem. Ed.*, 23:439-440, September, 1946.

Obscure and Involved Parts of Experimental Work
Meaning of Data
Errors (Known and Possible)
Deficiencies of the Work
 of perspective
 of attack
 of completeness
Suggested Further Study¹⁴
Conclusions
References

Here is an outline of a typical printed book-form report.

	PAGE
Flyleaf	
Series Half Title	i
Report Title	ii
Title Page	iii
Letter of Authorization	iv
Letter of Submittal	v
Letter of Approval	vi
Abstract	vii
Contents	ix
List of Figures	xi
List of Tables	xii
I. Introduction	1
1. Object, Scope, and Acknowledgments	1
2. Method of Analysis	2
3. Notation and Nomenclature	3
II. Results of Analyses for Concentrated Loads	5
4. Tables of Influence Values for Moments in Slab and in Beams	8
.	
III. Moments in I-Beam Bridges for Standard Truck Loads	23
12. Description of Bridges Analyzed	23
.	
17. Maximum Moments in Beams	34
.	
V. Discussion of Results	48
22. Significance of Results	48
.	
25. Moments in Continuous I-Beam Bridges	51
VI. Summary	52
Appendix A. Tables of Influence Coefficients	55
Appendix B: Influence Surfaces for Moments in I-Beam Bridges	131

¹⁴ See page 248 of the present text.

14. A Work Schedule for Report-Making

This chapter brings together in concise check-list form the gist of counsels given in preceding chapters. A working schedule that serves well for most complex reports and can be easily adjusted to simpler tasks is as follows:

- I. Setting the bounds
 - A. Through conference and correspondence with superiors or clients, defining the main purpose of the report.
 - B. Formulating a tentative but clear statement of the scope.
 - C. Formulating a tentative but clear statement of the basic procedure to be followed, including latitude allowed you in changing the procedure.
 - D. Recording all mutual understandings about the time deadline, costs, and fees (if any).
- II. The assembly stage
 - A. Selecting data sheets from the test files or other files.
 - B. Assembling further factual data needed.
 - C. Dividing, classifying, and roughly arranging the data.
 - D. Tabulating and graphing all data which should be thus treated.
- III. The rough processing
 - A. Triple-checking all calculations, tables, curves, graphs, and quotations.
 - B. Selecting from your material the facts that *must* go into the report.
 - C. Deciding which belong in the report proper, which in an appendix.
 - D. Interpreting those facts—specifically, seeing what conclusions they point to, even though the conclusions may not be desired in your final version.
 - E. In some report-making tasks, drawing recommendations from the conclusions.
 - F. Determining where and how to preserve the other facts you have gathered.
- IV. The semifinal processing
 - A. Phrasing a subject sentence which if possible sums up your findings, conclusions, and/or recommendations and which at least states the purpose of your report as you finally settle upon it.¹

¹ This statement will probably be shorter than the statement of purpose that you formulated earlier for your own guidance. In particular, the statement that is embodied in the subject sentence usually does not name the recipient of your report and may not be so explicit concerning the final action that is sought and the contribution your report will make to it.

- B. Making a preliminary outline or at any rate a preliminary table of contents.
- C. Getting the report down on paper, unless it is to be a short oral one.²
- V. The inspection stage
 - A. Double-checking the organization of your report by:
 - 1. Determining whether you have actually carried out your announced purpose and plan.
 - 2. Determining whether any introductory or final summary you employ jibes with your subject sentence.
 - 3. Making sure that text, tables, and illustrations do not needlessly duplicate one another but complement one another.
 - B. Double-checking the proportioning of the report.
 - C. Reading the report aloud, preferably to someone else.
- VI. The final processing
 - A. Revising the report, perhaps several times.
 - B. Preparing the final table of contents and list of illustrations and/or tables.
 - C. Copyreading the manuscript.
 - D. Correcting all errors, and retyping where necessary (see below).
 - E. Presenting and submitting the report.

The foregoing check list needs a few annotations.

Of course, before you formulate the purpose of the report you must have analyzed with care:

- 1. The situation.
- 2. The recipient.
- 3. The action to which you will contribute.
- 4. The kinds of data that you should and can assemble.

Then you must answer such questions as these: Why does the recipient want this talk or write-up from me anyway? Is it so that he can keep his records accurate, up to date, and complete? So that he can get from me some factual information to help him make decisions? So that he can get judgments (indirect advice) that will guide his own thinking? Or so that he can get from me some advice that is positive and direct? If this latter is the case, does he desire advice on the necessity for action, on the direction in which it should proceed, on the obstacles he will face, or on the probable benefits that the recommended action will yield?

After answering this set of questions, many efficient report-makers an-

² Different men do this job differently. The following is a common and usually an efficient order in which to write the parts of the report: full statement of purpose, statement of scope, rest of the body of the report, final summary (if any), appendixes, introductory summary, preliminary table of contents, preliminary list of illustrations, preliminary list of tables, letter of transmittal, title page, cover. It is best to write your first draft in short sentences, but don't omit such simple thought links as *and*, *but*, *therefore*, *granted*, *next*. After your report is all down on paper you can work for smoothness, dovetailing, proper emphasis, conciseness, and complete consistency in such matters as spelling, punctuation, abbreviation, tabulation, and the writing of equations or formulas.

swer another set: What are the essential facts, conclusions, and recommendations that my recipient expects? Should I try to give them in the order in which I can most readily get the answers or in the order of their importance to him? Are there any of these questions which should be answered, not in this report, but in a sequel?

Looking ahead now to a much later job, note that every document ought to be copyread at least four times before submittal—once for content and continuity, once for phrasing and sentence structure, once for spelling and punctuation and abbreviations and other mechanics, once for spacing and symmetry. In fact, it would do no harm to read the copy a fifth time in order to check the numbers of your tables and figures. This is particularly wise if you have consolidated or rearranged figures or tables. Check on their new numbers. See that they are properly given in the list of illustrations, and that they are likewise correct in the text references.

Make corrections in the line or above the faulty element. Material to be deleted should not be bracketed or parenthesized; a line should be drawn through it.

The final manuscript of a legal document should contain no corrections; of a business letter or a report, no discernible corrections; of any document, no more than three corrections on any one page.

It is evident that the check list gives operations rather than purely chronological stages. For example, you sometimes find that you can jot down a provisional outline or table of contents before you begin assembling your data. You often find that what you had hoped would be your final interpretation is only tentative and that you must gather more information or redivide and reclassify what you have assembled. On occasion you are allowed to submit a semifinal draft for your superior's private eye. But whatever the order in which you do the jobs named in the check list, you can readily deduce that all of them are essential in making most written reports.

If the report is to be printed, it may be channeled through a departmental or company editor. Get in touch with him as soon as you have a fairly clear idea of the scope and size of your manuscript and the number and kinds of nonverbal media it will contain. Be sure to tell him about any tables, charts, and equations whose physical size is unusual or which contain unfamiliar symbols.

You will aid him if you type the text in such a manner as to expedite his calculation of its printed length. The margin widths and the number of lines per page should be uniform. Quoted matter should all be either double-spaced or single-spaced. Sometimes you can help the editor still more—you ought to do so when your publication must fill a specified space or, as is true of some reports and many instructions manuals, should break over from page to page at predetermined places. Ask the editor to

tell you what line length he plans to use, in terms of number of spaces per line. Make each line of typescript slightly longer, as thus measured, than the printed line will be, or slightly longer than a direct multiple or some simple fraction of that length. For example, if your document is to appear in a column 37 spaces wide you can set up your script at 38, 57, or 76 spaces.

Leave space for the editor to "mark up" your copy, especially above and below equations. Find whether he wants footnotes to be numbered consecutively throughout each page only, consecutively throughout a chapter, or consecutively throughout the document. Put index numbers or symbols, and footnotes also, in the form the editor wants. Underscore all elements that are to be set in italics. Remember that algebraic symbols and small superscript letters used as footnote index symbols must be underscored, even though in your typescript reports you may not follow this practice. Draw a wavy line under elements that are to appear in blackface type.

Type all tables on separate sheets. Do not put them on the same page with the text. A short, informal table that has no caption must carry a penciled identification so that when the editor "pastes up" he can put it into its proper place. Never submit blueprinted tables. To indicate lack of certain data, use ellipsis dots rather than blank spaces, hyphens, asterisks, or dashes.

Expect the editor to make changes not only in typography but in phrasing. He may ask your permission or he may not. In any event, he will have good reasons for departing from your system of hyphenating or capitalizing, for deleting a word or phrase or sentence, for adding material, or for substituting *structure* for *building*. To avoid an unduly short line at the bottom or top of a page he may even use a drastic ellipsis; instead of "Managers should direct freight agents, and they should direct their receivers, to refuse such freight" he may have you say "Managers should direct freight agents, and they their receivers, to refuse such freight." No good editor will change the meaning of your passage or its technical connotation.

To have your report printed will mean one last job for you—proofreading. The editor or publisher will tell you the policies and practices to follow in correcting proof and will send you a list of proofreading symbols. A conscientious author will read galley proof three times—once aloud to an alert "copyholder"—and page proof four times. A company editor may give as many readings again.

If you wish to study proofreading further, use Skillin and Gay's *Words Into Type* (New York, 1948), Joseph Lasky's *Proofreading and Copy-Preparation* (New York, 1946), or the material on proofreading in the *American College Dictionary*.

15. Reports Classified by Function

Sometimes you classify a group of buildings or machines in terms of their size, form, or frequency of use. The same holds for reports; and in preceding chapters we have referred to types of reports based on these three characteristics. On the whole, however, you can most fruitfully classify not only buildings and machines, but reports also, in terms of their essential function.

Such a basis gives five kinds of reports:

1. The record of routine performance.
2. The descriptive report.
3. The analytical report.
4. Evaluative reports of several kinds—the report of an inspection, the report of tests, the progress report, the completion report, and the comprehensive account of a large organization.
5. Recommendation reports.

Advantages of this classification include two interrelated ones: the classification takes into account the differences between facts, conclusions, and recommendations; and it conforms roughly to the responsibility classification of engineering jobs. For, generally speaking, the young engineer first turns in reports that are primarily factual—either almost wholly quantitative (records of routine performance) or largely quantitative (descriptive reports). As he shows his capabilities he is trusted to do analytical work or to present judgments.

Within the category of judgment reports—evaluative reports—the same principle of increasing responsibility is at work. It is true that a novice may submit accounts of inspections or tests. He is less likely, however, to prepare completion reports of any complexity; whatever periodic reports he may submit will probably not carry him far beyond the record of routine performance; and his contributions to reports of large-scale investigations will ordinarily be made from such a subordinate level that

he has nothing to do with determining the content and pattern of either the investigation or the document resulting from it.

Finally, as he proves his worth he will be assigned the making of major recommendations, and will be oftener heard with respect when he voluntarily offers suggestions for improvement.

16. The Record of Routine Performance

FOR TECHNICAL USERS

Definition. This kind of report is submitted in a situation that calls for regular, usually periodic, mainly quantitative records. In most organizations these records are submitted simultaneously by a number of people who are on the same level of responsibility—for example, foremen. If the immediate recipient is in the same organization, he is almost always familiar with the units in terms of which performance is measured and reported. He, not the report-maker, interprets the significance of the picture he gets from the many reports coming to him. He wants this interpreting job facilitated, however, by his subordinates. These subordinates seldom have to make any special effort to get the needed data, which are regularly gathered as operations proceed.

In other words, the record of routine performance answers primarily the question *How Much?* or *How Many?* It answers in terms of items which are produced, repaired, inspected, or consumed regularly, so regularly that your report does not need to analyze or describe the items but merely identifies them by a number or a symbol or a few words. The items may be goods or they may be services. Hence the routine-performance record is found outside engineering (for example, in sales) as well as within that field. What concerns us here is that it's likely to be the first kind of report you will make after you go on the job.

In general you are told both how to gather the data and how to present them. Your superiors commonly request tabular or graphic presentation. Often, then, you fill in printed blanks. Sometimes, analogously, you work with single or serialized maps, plats, curves, graphs. Prevailing practice is to ink them; but some organizations mark changes in "output" by means of colored thread, colored string, or both, and photograph periodically the maps and charts carrying these indicators.¹

¹ The map used by SHAEF, now on display in the National Archives, was employed as follows: "This map was at all times completely covered with acetate and the progress of all military operations was accurately plotted on the acetate by means

As you know, standardization is often carried so far that some of the human recorders are replaced by automatic recorders.

The foregoing facts indicate what is expected of you. You must attain a machine-like exactness in both enumerating and consolidating the items that comprise the record. Make sure you show clearly where and when an operation was carried on, and by whom. See to it that the same kinds of items appear in the same relative positions throughout all members of a series of reports.

Suggestions for Making Your Own Report Pattern. Follow the same principles when you have no prescribed pattern but are expected to make your own.

For one thing, model your report as closely as you can upon prescribed models that are widely used in your organization.

For instance, draw up facsimiles of the printed forms that seem most applicable to your problem. Or reproduce the same kinds of maps and graphs that are used by the men in your organization who have to submit records of routine performance similar to yours.

Even when you cannot observe these suggestions—that is, when your report has to consist mainly of text—you can keep the virtues of the tabular or graphic record. How? First, by making sure that you let the recipient know at once the subject, time covered, place in series, authorization, and your name, rank, and connection with the job you are reporting on. Next, by presenting your data in the same order which a tabular or graphic record would use. Third, by sticking to this order throughout all reports in a series.

It is not enough to make every single item of information as accessible as it would be in a table or map. If your nonverbal record would stress total achievement over the period you are covering, then the verbal record can devote a few lines to summation. Unless you are otherwise instructed by your boss, limit the summation to facts; do not draw conclusions.

To keep even more of the compactness of table or map, use short sentences, short paragraphs, and parallel structure. Reinforce parallelism by numbering, lettering, or indenting the items in each series. Improve the effectiveness of this device by punctuating the members of the series clearly.

Make sure that your statistics project out sharply from other elements. To do so, you can put the major statistics in the naturally prominent

of grease pencils, strings, and unit symbols. No markings were ever made on the map itself. The map was photographed daily and the situation made of permanent record. All plans for projected operations of a large scale were prepared on overlays which in turn were superimposed over the map.”—Caption of the map in National Archives Building, Washington, D. C. Used by permission. The caption was prepared by the Historical Properties Branch, Army Headquarters Commandant, Military District of Washington, D. C.

parts of sentences and paragraphs—the beginning and the end. Use numerals rather than words. Guard against cramming too many statistics into a short passage.

Avail yourself of all other temperate methods for showing which are the salient items in your report. For example, repeat basic words. Use headings and subheadings, underlining, capital letters, special indentation, and extra vertical space. But avoid exclamation points, index fingers, and similar melodramatic signs.

Thus far it has been assumed that you are confining yourself to current or recent accomplishments. Often, though, you will be expected to incorporate data from past periods as a yardstick for measuring the progress just made. Or you may be expected to list quotas. In either event the criteria must stand out. They must be so set up in the report that your boss can quickly compare what was done with what should have been done. Therefore, place the criteria close to the current record. Employ nonverbal means of facilitating the comparison—red ink, underlining, or even the “thermometer” familiar to all of us from its use in sales campaigns, membership drives, and safety programs.

When your report includes quotas and norms you often face two further problems: “Shall I explain why we have fallen short of our quota or exceeded it? If I should explain, how do I do it?” No rules will cover all contingencies, but you can guide yourself by your answers to six interrelated questions:

1. What is your organization’s policy and “temperament”? In some firms, bosses want subordinates to volunteer an explanation of every departure from quotas. In other firms, subordinates wait till they are asked.
2. How large is the surplus of achievement, how large the deficit? A small deficit usually needs to be accounted for more fully than a small surplus.
3. What is the personality of the report user? Is he a perfectionist? Is he impatient? Does he think that explanations of deficits are excuses?
4. How big a job does your report cover? If it is narrow and brief, you should generally postpone explanations; by the time you are to submit a cumulative record, the peaks and valleys may have been smoothed out.
5. What form does your report take? Many nonverbal reports provide no way of making explanations. Among verbal reports, the oral usually give better opportunity than the written, for two obvious reasons: you can tell from your hearer’s facial expressions, tone, and actions whether it’s wise to stop with a bare account of performance; and your voice and bearing can convey your attitude more clearly than the written word allows.

6. What is your organization's filing system? If, under that system, you would seem to violate unity of content or tone by combining output data and explanations, make two reports.

The Problem of Offering Recommendations. Both the filing system and the organization's policy become especially important when you have to ask yourself, "Shall I make this more than a record of routine performance? Shall I add recommendations to it?" Ideally, and nowadays to a large extent actually, organizations wish employees to think about simplifying work and cutting costs. But some firms provide no channel for getting these suggestions from you to a responsible officer. So no dogmatic advice is possible. Year in and year out, however, a separate recommendation report seems to do best.

This separate report is desirable when you wish to recommend, not changes in the techniques about which you report, but changes in the techniques of reporting. Think about such problems as these: What records now called for can be dropped? At what stage in the operation being reported upon should the document be prepared? At how many points should entries be made as the document moves from the point where the data are first recorded to its destination?² In most organizations it will pay you to submit recommendations based on your answers to these questions.

FOR NONTECHNICAL USERS

It won't surprise you to learn that some of the counsels in this book don't apply when your recipient is a semitechnical man or a layman.

If he's a semitechnical man, you can't use all the kinds of graphic devices that a specialist understands. You may also need to define the units in terms of which you are measuring accomplishment. And you almost always have to state your production quotas or norms explicitly, instead of only in terms of last week's or last month's or last year's output.

For laymen you may have to omit tables and curves altogether. Try to keep at least some of the curves, though, for they say much quickly. Perhaps you can combine them with pictorial devices. Sales psychologists can often suggest still other means.

Keep firmly in mind that what is routine to an engineer or industrial man is often far from routine to a layman. The layman therefore needs even more definition (of products, processes, and apparatus) than the semitechnical man. He may even need some description; in this event, parts of the record of routine performance will include material similar

²For much of this paragraph we are indebted to H. H. Punke, "‘Factory System’ in American Educational Expansion," *School and Society*, 67:3-4, January 3, 1948.

to that treated in the next chapter. Indeed, you may have to complement definitions and descriptions by interpretation. You may have to say, "What all this adds up to is . . ." or "This means that we have fallen two years behind Jonesboro in our street-paving program."

17. Descriptive Reports

DEFINITION AND APPLICATIONS

In logic and sometimes in practice the question primarily answered by a record of routine performance must be preceded by another. That is, before telling *How Much*, you must tell *What* a material, machine, process, site, or structure looks like and what its basic nature is.

Several kinds of reports do this job. Some give their answers in terms of the actual; they describe a material, machine, process, site, structure, person, or group of persons that now exists or has existed. Other reports go beyond the descriptive and give their answers in terms of the possible, the probable, or the desirable.

A descriptive report, then, is one kind of answer to the question *What?* It is the kind that is based on observation—usually the report-maker's own observation—and that avoids hypotheses, evaluations, and recommendations. It stays away from the *How Well?* and the *How Better?* It cannot keep away from the *Why?* But it puts the answer in terms of actual reasons, not merely possible or probable ones; in terms of causes that do or did govern a choice (as among possible sites, processes, etc.), not of causes that might have governed or should govern. Nor can the descriptive report always avoid presenting plans and controversies. If it includes these, however, it merely delineates them. It does not defend or attack the plans and it does not assail any controversialist.

Its prototypes among nonverbal communications include photographs, motion pictures, maps, structure sections, machine sketches, diagrams, flowsheets, and organization charts.

It is clear that the descriptive report is often the first type which the engineer produces during his training period. He is expected to prove he can accurately describe materials, processes, and products before he is given a task which calls for his using some material, process, or product as the unit whereby his performance is measured. Indeed, after he is out of the apprentice stage he may still be asked for a descriptive report

before he is asked for a record of routine operations. Thus, many young civil engineers and geologists submit survey maps and other delineations of routes or areas before they are asked to report the number of surveys they have made.

Furthermore, a descriptive report may be requested whenever routine proves unsatisfactory or insufficient. Suppose that performance records show something wrong with current practices or imply that operations ought to be expanded. An official will often want a thorough description of sites, materials, machines, or processes to aid him in deciding what corrective or developmental action should be undertaken. Adequate description cannot, it is true, always result from observation alone. The official may then order a test. Nor will he necessarily be satisfied with a mere description, however obtained. He sometimes demands that the report-maker evaluate or recommend. But on the whole the young engineer will first have to prove that he can describe accurately.

A few reports written in descriptive style are at bottom instructions. They say by implication, "To get the results described in these pages, install the apparatus described, and operate it in the manner set forth." One of the 31 sections comprising a camouflaged set of instructions is quoted below, without reproduction of the illustration which complemented the text.

"15. *Recorder Apparatus.*—Figure 17 shows the operator's side of the recording table and the panel board mounted on the table top directly in front of him and in line with his vision. This arrangement makes it possible for one man to operate the table in an emergency or during simple tests that require a minimum amount of data. Generally the recorder is operated by two men, one of whom is continually in telephone communication with an observer on the locomotive.

"At the left on the panel board is the Micromax speed recorder which was removed from the old car. Under normal operation it gives a speed ordinate of 10 mi. per hr. per inch of pen travel up to 100 mi. per hr. Next is a vertical rod ending in a bell crank on its lower end. This rod goes through the roof of the car and is attached to a wind vane which gives a record on the chart of wind direction with respect to the car. Next is an electric type of speed indicator which is connected in series with one placed in the cab of the locomotive. A toggle switch to the left of the indicator changes from a high to a low reading scale. The eight switches control the operation of various pieces of apparatus used in making different tests. The single switch above the 'eight group' operates the paper-driving motor.

"The General Electric timer operates the two outside pens, through a relay, to give a record of time in $\frac{1}{2}$ -sec., 1-sec., or 5-sec. intervals. On the right side are shown two of four electric counters which are used in connection with pens on the table to indicate the number of times a circuit has been closed. One may be employed in connection with the integrator to indicate work units or area under the drawbar pull curve; another is operated by a stoker contactor to show

- (12) Width of roadway
- (13) Clearances:
 - Above roadway { Horizontal
 - { Vertical
 - Under roadway
- (14) Floor system:
 - (a) Flooring
 - (b) Stringers and floor beams
 - (c) Curbs, handrails
- (20) Maximum loads: Now using bridge . . . Reported capacity . . .

DESCRIPTION OF CROSSING

- (22) One of . . . bridges involved in crossing
- (23) Character of stream. Maximum depth { Low water
- { High water
- { Observed
- (24) Velocity: Feet per second
- (26) Amount and character of debris carried at high water
- (27) Character of bed and banks of stream
- (28) Approaches:
- (30) Description of connecting roadway between several bridges involved in crossing

Written Reports. If you have more freedom in determining the content (and pattern) of the report, and above all if your report is to contain written material, your observational job will probably not be cut and dried.

At the least you will want to obtain check lists that tell you what items of information are commonly sought. For instance, inspection of any physical plant may entail gathering data on the surrounding area in terms of climate, physiography, and perhaps geology; the effect of these on the economics of the region; and the plant itself, in terms of land, buildings, power, and machinery both general and special. Each of these will of course be divided. For example, under physiography you would consider relief, any glaciation, special topographical features, and hydrology (including its effect on sanitation and disposal of wastes).⁴

But you should go beyond standard check lists. Observation demands a searching use of both eye and brain. This in turn demands two qualities.

The first is careful attention to the psychology of the people who give you informal interviews or who you hope will facilitate your inspection

⁴ Very useful check lists are given in Walter Rautenstrauch, *Industrial Surveys and Reports* (New York, 1940), pp. 41-42 and 131-132. More specialized guides may be found in C. H. Baxter and R. D. Parks, *Mine Examination and Valuation* (Houghton, Mich., 2nd ed., 1939), pp. 99-100 and 9-12; Robert Peele, *Mining Engineers' Handbook* (New York, 3rd ed., 1941), vol. 2, section 25; A. F. Buddington, *Field Geology Manual for Students* (Ann Arbor, 1928), pp. 51-52; and several USGS authors' manuals.

of a site, machine, or plant. Indifference, hurt pride, conceit, natural secretiveness, surliness in the presence of a trained man—you will find these and other emotions in people whose aid you must have if you are to do even a routine observational job competently. So you must provide yourself with full authority for every observation you are to make. You must exercise this authority with due regard for the age, seniority, rank, and prestige of those who facilitate your observations. And though candor and fairness usually beget candor and fairness, stay unobtrusively on your guard against attempts to deceive you. “Salting” at one extreme and sabotage at the other are rare, but you must at times expect deliberate concealment of certain things which you ought to see. Since a reputation for gullibility will harm you, add to candor and fairness a name for acumen, for refusal to be hoodwinked.

The second necessary trait is “the simplicity to wonder.”⁵ Analyze into its components an operation that has traditionally been considered a unit. Note what is done, by man or machine, in all three dimensions and not merely in a plane; you may see a waste of energy that no one has seen before. “Factor” into several skills and attitudes what you may have regarded as an indivisible personal trait, such as ambition or intelligence or initiative. True enough, a purely descriptive report is no place for your opinions; but often the mere impersonal account of what you saw when you had “the simplicity to wonder” will cause your superiors to make improvements and to credit you with having called the possibility to their attention.

In justice both to yourself and to the managers of whatever plant you are describing, state whether any operation is being conducted at less than usual speed or efficiency or safety. Quote or summarize the reasons given you for this drop. In a purely descriptive report, do not comment on those reasons unless they are demonstrably false.

These counsels will help you little unless you master verbal description. Many descriptive reports and still more reports of other kinds that include descriptive passages go to laymen. Laymen must have words as well as maps and pictures. Indeed, in a high percentage of descriptive reports aimed at engineers you cannot employ nonverbal media alone.

Why can't you? Because the average descriptive report is not restricted to what both the engineer and the rhetorician call description: a still photograph or a map, or the verbal equivalent of them—a delineation of something at rest. It also generally embodies what the rhetorician calls narrative; it treats of changes, of dynamic sequences; it is, or is analogous to, a flowsheet or a motion picture. Third, it contains pure explanation in the form of answers to *Why* questions.

⁵ From *Human Relations Manual for Executives* by Carl Heyel. 1939. Courtesy of McGraw-Hill Book Co., Inc.

Nor are these kinds of discourse set off sharply from one another in the report. Within brief compass you often have to include delineation, narrative, and pure explanation.

"In shrinkage stoping the stopes are advanced upward, the ore being removed in horizontal or slightly inclined slices. Only enough ore is drawn from the stope to afford working space to the miners, who stand on the broken ore and advance the stope upward while drilling. Since broken ore occupies more volume than ore in place, chutes closely spaced along the bottom of the stope draw off about 40 percent of the ore as it is broken. This method was found suitable to the physical conditions encountered in the steeply dipping (40° to 65°) magnetite veins. The broken ore afforded temporary support for the walls, and timbering was eliminated. Whereas the open stopes supported by timbers were dangerous, the shrinkage stopes were comparatively safe. Moreover, ore could be loaded into cars by gravity instead of by hand shoveling. As a result of these changes, the mine was able to increase its production to 300,000 tons of crude ore per year without increasing the number of men required. This represents a tenfold increase in output per man."⁶

Words are needed to help make clear the sequence of operations and the motives for several of them.

You still need nonverbal forms. Generally you should put them in the text of the report and consistently refer the reader to them. As a matter of fact, technical readers wish an even more extensive use of such aids; they want many of the verbal accounts to be built *around* the numbered or lettered parts of a map, machine sketch, organization chart, or flow-sheet.

By following the principles set forth above, you will solve many of the problems you meet in preparing descriptive reports. But a number of others likewise demand attention. Three relate mainly to content.

1. How much detail shall you include? Novices believe that the decision is governed entirely by the nature of what they are describing. They fail to realize that a 100 percent complete description of a simple object (say, a pencil sharpener) or a simple process (say, tying a shoelace) runs to great length.⁷

What primarily does determine the amount of detail is of course the reader's commands or needs. When these two clash, his needs should generally take precedence. By word, map, sketch, and curve, give every particular which he will find essential.

⁶ N. Yaworski, O. E. Kiessling, C. H. Baxter, Lucien Eaton, and E. W. Davis, *Technology, Employment, and Output per Man in Iron Mining* (Philadelphia, June, 1940): Report No. E-13, National Research Project, Work Projects Administration.

⁷ As an apprentice, though, you might try writing a 100 percent complete description. Such a drill has three advantages: It may prove to superiors your intimate knowledge of the thing, place, or person you are describing; it will train you in remembering all essential facts—a requisite when, in actual practice, you write an abridged description; and, since you will have to write descriptive reports for laymen, it will keep you from taking for granted a knowledge laymen lack.

For the technical man, it is usually wise to be very precise and specific. Replace "the cycle for the hoist" by "the energy cycle for the double cylindroconical drum hoist operating Ilgner-Ward Leonard from the 7000-ft depth." Replace "several boilers" by "twenty-four 512-hp Babcock and Wilcox boilers." Remember also that objects have three dimensions, and that all three should be given if your verbal description ought to be analogous to a layout sketch rather than to a diagram. Furthermore, it is almost always wise to tell exactly how one part or portion is physically connected to another. That is, replace such a word as *fastened* by *soldered*, *riveted*, *oxyacetylene-welded*, and the like. Or, with a different type of subject matter, use such specific verbs as *nailed*, *embedded*, *sloping gently*, etc. In translating a flowsheet, be similarly specific. The technical reader usually needs more information than that "coal runs to a conveyor and then to a crusher." Precision requires: "From the bins, coal runs by gravity to a 24-in. apron conveyor traveling east 12 ft per minute, which delivers the coal to a 26-in. belt-driven 2-roll crusher."

When writing for laymen, however, be fairly general, except that you can employ such verbs showing physical connection as *welded*, *embedded*, *mortised*, *trucked*, etc. Remember also the benefits of using analogy. Finally, observe that a layman will need reasons (as for the choice of one machine over another) that an engineer knows without being told.

2. Shall you stay on the same level throughout the report? For example, shall your account deal wholly with the present, or should you depict earlier forms of apparatus and cruder stages of a current process? Should you consistently name the scientific principles that machines embody, consistently avoid doing so, or vary your procedure? Should you make only the comparisons demanded by the subject matter, or should you employ comparison freely for purposes of illustration?

This problem, like the first, you can generally solve by keeping only those data that the report user requests or obviously needs. Above all, don't exploit your own hobbies. (See page 57.) Neither overstress a principle that interests you, nor neglect scientific explanations that your reader ought to have. Don't overwork comparative examples—but remember that the layman may need more of these than does the technical man. If you are fascinated by the history of engineering or some of its branches, don't indulge yourself; include only such past-tense material as will help your reader to understand things as they are and to take practical action.

3. Still another problem concerns the interpolation or extrapolation of data that you cannot directly observe. (Reread the quoted material on page 218.) You seldom meet this problem until you go beyond mere observation reports. Nevertheless, into some of the latter you may be forced to put a few inferential data: consider "logical contouring" in a

map; consider also the sort of account to which a reconnoitering party must confine itself when it has tried to observe under hostile fire. If you must put estimates into your report, tell the reader how reliable you think they are.

A real source of danger at this point is unrecognized emotionalism. This may lead you to "slant" a description inadvertently.⁸ Some engineers distort their descriptions of certain substances and processes. In effect, though not with intention, they turn themselves into special pleaders for or against a particular process or material or make of machine.

PROBLEMS OF STRUCTURE

The Abstract. Should your descriptive report carry an abstract? The answer is that you should almost always try to formulate one; but don't worry if you cannot do it or if you must depart from the usual pattern of an abstract. The value of your report may consist, not in any generalizations you can draw, but in the fullness and accuracy of the specific detail. In this event about all that your abstract could do would be to condense what you say in the body as to the purpose, scope, and proportioning of your report. Such a digest may be of too little value to deserve being submitted, except when your communication is to be listed in publications devoted to technical abstracting.

The Overview. The lack of an abstract does not mean, however, that you should jump at once into descriptive details. Instead, give your reader an "overview" that identifies the physical subject of your report. This overview may well include all or nearly all of the following data regarding an area, machine, or process:

1. Its name. Sometimes you should give this in several forms—trade name, scientific name, and colloquial name.
2. Its present function, unless the name makes the function clear;⁹ and sometimes, its possible function.
3. Its uses, both regular and occasional.
4. Its users, taking that term in a very broad sense to include such persons as owners, managers, supervisors, operators, and consumers; and sometimes, possible additional users.

⁸ A famous example is General McClellan's inability to perceive offensive positions accurately, and his consequent obsession with defensive positions. His civilian spies, in their turn, exaggerated the size, matériel, and fire power of Lee's army. As a result he often did not press his attack home and indeed sometimes failed to attack at all on occasions when he should have thrown in horse, foot, and dragoon.

The opposite consequences of the same fault have often been just as momentous. On August 28, 1914, General von Bulow's air reconnaissance reported: "In the Valley of the Oise there are only weak rear guards." The statement proved to have been highly colored by emotional interpretation; the scouts had unwittingly extrapolated. Allied advance guards struck in force, and the Germans retreated.

⁹ In describing human beings, or human as distinguished from mechanical and "natural" processes, you may need to differentiate function from purpose.

5. Its size.
6. Its shape.
7. Its materials, including details of finish.
8. Its location, whenever this is not obvious, has not already been indicated, and is significant. Many descriptions of location must be couched in legal phraseology, and an attorney's aid may have to be sought in formulating them.
9. Reasons which govern or governed the choice of uses, size, materials, and location.
10. The main parts of the area or object, or, in accounts of a process, the unit operations or the main stages.

To help the reader, you can describe a complicated mechanism in its basic or generalized form before describing it in full.

In order to compress into one sentence the essential information about the name, function, uses, and other properties of a physical subject, you may employ a formal definition. Do not feel that you must always do so.

Many reports need still further overview material: (1) definitions of technical terms; (2) explanation of the mathematical, physical, or other principles on which a machine or process is based; (3) explanation of the methods used for powering the equipment employed in the basic process; (4) identification of either the topographical determinants (critical points) of an area, such as its drainage lines, or of those elevations and other features which stand out to the eye (control points); and (5) data concerning the efficiency of a structure or machine.¹⁰

The list of overview elements looks formidable. You may feel, "It would take a dozen pages to do all these jobs." Fortunately, such discursiveness is seldom required. The following quotation shows in what manner several essential "indicia" can be incorporated in one sentence and how almost all of them can be summed up in 250 words:

"The Boulder Dam power plant, located immediately downstream from the dam, is designed for an ultimate installation of 15 generating units of 82,500-kva. capacity each, two generating units of 40,000-kva. capacity each, and two station-service generating units of 3,000-kva. each, making a total ultimate installation of 1,323,500 kva. The initial installation consisted of four 82,500-kva. units, one 40,000-kva. unit, and the two station-service units. At the close of 1940, eight 82,500-kva. units and one 40,000-kva. unit, besides the station-service units, were in operation, and contracts had been awarded for the construction of three additional large units.

"The power plant building consists of two wings, one on each side of the river channel, and a connecting structure built along the downstream edge of the dam. The generating equipment is installed in the wings, each of which is

¹⁰ Data on efficiency belong more strictly in an inspection report. But if they are matters of common technical knowledge or can be gathered by the trained observer without special effort, they find a place in many descriptive reports.

650 feet long, about 120 feet in maximum width, 110 feet high above normal tailwater surface, and about 230 feet above the lowest part of the foundation. The central part of the building houses the offices, shops, control, and storage rooms. Construction of the power plant building required 455 thousand cubic yards of excavation, 255 thousand cubic yards of concrete, 24 million pounds of structural steel. Figure 103 shows a general view of the power plant with Boulder Dam in the background.”¹¹

Coherence. In both the abstract and the report itself you may want to look at your physical subject from many points of view—from a distance and from close up; from above, from below; from each side; and from within. Whenever you change the point of view, say so. Don’t allow your readers to assume that they are still looking at a building from the outside after you have opened the door and gone in. Don’t whisk them from basement to attic without warning.

The same principle applies to a change in the mental point of view. Don’t appear to list the hazards of a process among its advantages. In short, by sensible arrangement of your data and by the use of signpost words, keep your reader oriented at all times.

In narrative, your main problem concerns simultaneous operations. Let the reader know at what point in a process the “assembly line” becomes double or multiple. If advisable, tell him why. Then inform him which of the simultaneous operations you will describe first. If your reader is a layman you had best start with the simpler of the simultaneous operations; if an engineer, with the more essential. At times the choice is a matter solely of convenience.

“A strict observance of the order of time would perhaps dictate changing the scene at the point now reached to the Federal left, but when a battle is to be described in which large numbers of troops are engaged at different parts of a long line, there are objections to observing too closely the connections of either time or place. Upon the whole, the balance of convenience seems to incline in the direction of completing the story of the operations on the Federal right before returning to Franklin on the left.”¹²

Description in the rhetorician’s sense of the term offers a more complicated choice. After you have given the overview, you have six main ways of presenting details:

1. Linearly.
 - a. From near to remote (from here to there; from observer to “horizon”).
 - b. From remote to near.
 - c. From a visually prominent feature (control point) to the

¹¹ Boulder Canyon Project, *Final Reports, Part IV, Bulletin 1*, p. 199. Reproduced by permission of the Bureau of Reclamation, United States Department of the Interior.

¹² F. W. Palfrey, *The Antietam and Fredericksburg* (New York, 1882), p. 169.

“horizon” and thence back again from the control point to the observer.

2. From critical point to features that depend upon it either naturally or technologically.
3. Circularly.
 - a. Clockwise.
 - b. Counterclockwise.
4. In the order in which parts of a tool or machine are assembled; or, analogously, in the order in which geological strata were deposited, etc.
5. In the order in which the parts of a device are set into operation.
6. In the order of climax—an arrangement virtually restricted to descriptions of persons.

In a few descriptive jobs other arrangements of material may seem advisable. For instance, for *from near to remote* you should sometimes substitute *from top to bottom*, *from bottom to top*, *from this side to that*, or *from outside to inside*. It is just as obvious that *circular motion* does not exhaust the possibilities in its category; at times you will trace concentric or spiral motion. Again, a verbal account of the flow of authority within an organization can seldom follow unvaryingly any one of the arrangements named above. But this verbal organization chart generally starts by naming the “critical point”—the man or group in whom supreme authority resides. A delineation of a man may likewise open with a statement of his determining trait. In short, nearly all other methods of arranging descriptive details can be adapted from the basic six.

A comparison of two or more objects or processes must be written with care. If your reader is familiar with one of them, it can serve as the yardstick by which you measure the rest. If all are new to him, you can first describe the simplest, which then becomes the yardstick. Or you can adopt one of the three following arrangements: point-for-point comparison; full description of each of the objects in turn; or a compromise method, exemplified below, whereby you open with a short overview of each and then give a point-for-point comparison.

“The first commercial model consisted of an integral assembly of a number of parts, including a coking chamber, a coke-burning chamber, a baffle wall, three separate air orifices, and two forms of grates. In the coking chamber each charge of fresh coal is converted to coke, while that converted from the previous charge is burned in the coke-burning chamber at the back. The volatile matter released from the fresh coal mixes with the secondary air introduced through vertical air passages in the baffle wall. The mixture then passes over live coals in the coke-burning chamber, where it is ignited. The burning is completed in the combustion flues and the auxiliary combustion chamber located above the flues. Provision is made in the furnace for the control of the rate of gas release and the air supply for the thorough mixture of gas with secondary air, and for the ignition of the gas-air mixtures.

"The new furnace has resulted from a simplification of this earlier design. Both incorporate the same downdraft coking principle. The shape of the furnace has been changed, the baffle wall simplified, the passage of secondary air made more direct, and certain details improved. The general appearance and operation are not greatly different.

"Specifically, a round body has been substituted for the square one. The baffle wall is now . . . The secondary air is now brought into the furnace through . . . and passes . . . The inclined pinhole grate has been eliminated. The shaking grate has been expanded to cover the entire area of the firepot . . ." ¹³

MINUTES OF MEETINGS

A special kind of descriptive report is the set of minutes covering a meeting. Young engineers may be asked to prepare these; older engineers often get stuck with the job. We shall assume that your minutes need not reproduce all the parliamentary details of events. When they must do so, you had better check *Roberts' Rules of Order* or some similar handbook to be sure you omit nothing.

Most meetings have unity but lack coherence. Speakers interrupt one another, "back into" a subject, stumble, retrace their steps. Motions are proposed out of logical sequence, are sometimes phrased ambiguously, on occasion are passed without having been seconded. What was done at three o'clock is undone at five, what was left to do is settled by nods and grunts in a last-minute rush.

You as secretary must give order and continuity to this confusion. You may have to disregard chronology and impose a logical pattern on events.

You must also drop from the record all trivia, usually all personalities, and frequently the details of controversies.

You can generally fulfill these requirements by using a deductive and topical arrangement. That is, start with an epitome. Here is a sample of the form that is suggested.

MINUTES OF THE MEETING OF THE EXECUTIVE COMMITTEE RESEARCH DIVISION SMITH-JONES CORPORATION

January 3, 1950

Called to order 4:00 P.M.

Adjourned 5:10 P.M.

The Executive Committee received two announcements from its Chairman, took up five matters, and passed three motions on two of these.

The Chairman announced: (a) that the Battelle Memorial Institute representatives whose visit was approved by the Committee at its November 6 meeting will reach here January 10 and plan to spend the entire day in inspection and consultation; and (b) that preliminary reports on Project A-63 and Project C-4 are to be in J. B. Jones's hands before 5.00 P.M. May 17.

1. Difficulties in getting less than 4-month delivery on equipment needed for Project D-12a were discussed. No action was taken.

¹³ Courtesy of Professor J. R. Fellows, College of Engineering, University of Illinois.

2. Vice-chairman A. M. Richards reported on in-service training of technicians as carried out by the Howe Metallurgical Company. Charles Fisher pointed out differences in our procedure which call for adoption of a slightly different plan. It was moved by Fisher and seconded by J. S. Zimmerman:

“That the Research Division, through its Executive Committee, recommend to the Board of Directors the adoption of the attached plan for in-service training of technicians and request that this or a closely similar plan shall go into effect not later than January 1, 1951.”

The motion was passed.

[The remaining three numeralized agenda are treated similarly.]

Members Present:

C. K. Abbe

Charles Fisher

J. B. Jones

R. T. Martel (for I. L. Polowski)

J. S. Zimmerman, Secretary

A. M. Richards, Vice-chairman

R. O. Wilson, Chairman

Members Absent:

José Ayala (excused)

Present on Invitation:

E. C. Eklund

The lists of men attending and absent should come before the introduction if a quorum was not present, if invited guests explained or recommended certain items of business taken up at the session, or if committees met jointly.

18. Analytical Reports

Some engineering problems can be solved only by physical and mathematical analysis. Before undertaking such an analysis, be sure you have firmly in mind the differences among the five main categories of engineering information and knowledge:

- “1. Generic principles such as the basic concept of conservation of energy.
- “2. Basic assumptions (not always true but practically useful) which are made for the purpose of simplifying the mathematical analysis of physical phenomena.
- “3. Empiricisms, such as the properties of materials which have been observed and measured in the laboratory.
- “4. Derived principles, or working formulas which have been developed in various fields of practice.
- “5. Specifications and standards or codes of practice.”¹

In every problem-solving situation that demands an analytical report, decide what weight to give each category. You may need to guard against two opposite faults—attaching undue importance to local and perhaps temporary specifications, and disregarding the economic costs of meeting specifications for materials, procedures, and products.

Except for the foregoing advice, there is little that can be said about the ways of performing physical and mathematical analyses. The rest of this chapter is limited to a brief account of the reports that result from such analyses.

Obviously six main divisions must be incorporated in every analytical report:

1. Statement of purpose and scope.
2. Assumptions on which you proceeded.
3. Data on which your results rest.
4. Analysis of the data (in many reports, the longest part).
5. Results.

¹ H. S. Rogers, “Gaps Between the Statement and Achievement of Objectives in the Education of the Engineer,” *J. Eng. Ed.*, 10:158, November, 1948; from the 1944 Report of SPEE.

6. Discussion of results.

A good many reports should add some or all of the following:

1. Abstract.
2. Nomenclature and definitions.
3. Notation.
4. Numerically stated application of the results.
5. Corollary and subsidiary data.

When you put these two lists together and take into account the general principles of arrangement that were set forth in Chapter 8, you will see that a common pattern is this:

1. Abstract.
2. Purpose (often labeled The Problem).
3. Scope.
4. Nomenclature and definitions.
5. Assumptions.
6. Results (including their applications, numerically stated, whenever pertinent).
7. Discussion of the results.
8. Data on which the results rest.
9. Detailed analysis of the data.
10. Appendixes: Corollary and subsidiary data, computations, and analyses; if advisable, statement of assumptions and procedures that proved unfruitful or erroneous.

You must show clearly whether your assumptions are separate or cumulative, for conclusions that rest on cumulative assumptions are often frail.

Your chapter on assumptions may have to be preceded by the material on notation and nomenclature, and perhaps by a chapter on the work of previous investigators, in order to make the account of your assumptions clear and the report cohesive. In some manuscripts it is unwise to make notation, nomenclature, and definitions separate divisions; it is advisable, instead, to put at the point where you first use them your definitions of all symbols and terms that need clarifying.

Most analytical reports lean heavily on equations and curves. You should follow some consistent method of distinguishing basic from derived or subsidiary equations. You should employ few curves that show preliminary hypotheses or calculations. You should keep verbal explanations to a minimum, but give enough so that you will not puzzle the reader by your equations and curves. Try to make all words neutral and unemotional even if you are setting forth assumptions or conclusions that conflict with those of other men.

19. Evaluative Reports

Somewhere along the road from fact-gathering to the decision "We'll do this" or "We won't do that" or "We'll keep on as we are," one or more people must answer such questions as

How safe	}	was	}	this method
How accurate		has been		this machine
How efficient		is		this man or group
How profitable		presumably will be		this policy or program

—questions that can be generalized as *How Good?* problems.

The maker of a routine-performance report, a descriptive report, or even an analytical report leaves these questions for his recipient to answer. *The maker of an evaluative report gives the answers himself.* Whether they are accepted and whether they supply the basis for final action is still up to the recipient; the point is that the report-maker comes out in the open with his expression of value judgments, and makes the expression of those judgments his main objective.

It is obvious that printed forms may be provided for the expression of such judgments as well as of the facts and/or the summated statement of factual findings on which the judgments rest. It is, indeed, clear that in outward form and appearance an evaluative report may closely resemble a record of routine performance or a descriptive report or an analytical report. Thus at first glance the Football Scouting Report that follows might be taken for a description only. But reading it shows that the scout is to set forth, not merely facts that all experts would see and report identically, but his own judgments as well.

FOOTBALL SCOUTING REPORT¹

Game _____ Field & City _____ Date _____
 _____ Time _____
 Weather _____ Wind strength and direction _____
 Condition of field _____ Direction of field _____
 Color jerseys _____ Headgears _____

¹ Courtesy of Professor Douglas R. Mills, Director of Intercollegiate Athletics, University of Illinois.

Preliminary Practice

Punters_____

Kick-offs_____

Place or Drop kickers_____

Passing_____ Passers & Receivers_____

Starting Lineup

Kick-off Offense

Holder of ball?

First down field? Who made tackle?

Does anybody stay back?

Side line defense?

Kick-off Defense

Position of each man.

Movement of men.

Retreat or block at once?

Wedge? Criss Cross? Backward or lateral passes?

Sleeper near side line?

Summary

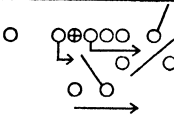
1. List reasons why plays were or were not effective.
2. What type of attack must be stopped first of all?
3. Strong plays that must be stopped.
4. Outstanding men on offense.
5. Method of calling signals. Huddle?
6. Charging signals? Cadence?
7. Additional?

Summary of Defensive formations:

A. Technical situations.

Regular Punt Sideline Goal

Running Chart of Game

Down	Position	Play	Yardage	Offense	Defense
1-10	20-R	36	5		5-3-2-1

In fact, any descriptive report can be turned into an evaluative one if to its usual content you add your considered judgments about the adaptability of sites, machines, and men to their present or proposed functions or if you put a financial value on plant, operations, or products.²

At the other extreme from such relatively simple evaluative reports are the reports covering large-scale investigations of a big organization which are made by a team of engineers, accountants, economists, market analysts, and sometimes industrial psychologists and scientific-management experts. You may never have charge of studies as broad as these. It's a

² Value may be measured in one or more of eight ways: in terms of original cost, replacement cost, present depreciated cost, value as previously appraised by another engineer, assessed value, insured value, forced-sale value, junk value.

certainly that you won't until many years after you graduate from college. Nevertheless, you know that the reports which they yield may embody every kind of material thus far treated in this part (record of routine performance, descriptive matter, technological and mathematical analyses) and also the four types of evaluative accounts:

Reports of inspections.

Reports on tests.

Progress reports.

Completion reports.

For some years to come you will be preparing each of these four types rather than a big document that synthesizes all of them. Even so, you have plenty of work cut out for you. In particular, five problems are common to these four or to most of them.

1. Sometimes it is not easy to make your reader see clearly and immediately that your report *is* evaluative. The problem is commonest in reports of inspections, and is treated in some detail under that head. What is said there you can apply without much difficulty to the other types of evaluative reports, and indeed to recommendation reports (Chapter 20).

2. Special problems arise when you volunteer an evaluative report or go considerably beyond the appraisals that you were ordered or expected to make. You will seldom meet the problem when you prepare a completion report; it may arise when you submit an inspection, tests, or progress report. The suggestions in the discussion of inspection reports furnish some guidance. For the rest, use your common sense.

3. You may go astray at the stage of making your evaluations. It is assumed that in general you will follow the advice given in Chapters 4 and 5 and the warnings against unrecognized emotionalism offered in the discussion of descriptive reports (Chapter 17). But you need one further caution, particularly whenever you are to submit on printed forms your judgments of human beings. When we use rating sheets, all of us tend toward three errors: ranking below-average men as average; disregarding, or even considering as virtues, the weaknesses of people who in general are superior; and rating too highly the men and women that we think of as belonging to our own professional, economic, and social class. Just being aware of these human foibles is often enough to make us avoid them, though the Army's experience shows that the people who devise rating forms have a heavy responsibility too.

4. Now for pitfalls into which some engineers drop when making evaluations and into which others drop when presenting them.

Be sure you tell the reader enough about how you gathered your information and how you evaluated it to make him trust your judgment and assent to your evaluations. Such care on your part is especially necessary when you are making a report on tests. You should take into account, and

should let your recipient know that you have done so, at least the following questions:

Was your test based on full-size objects, models, samples, or sectioned specimens?

If on the first, were they materials or machines?

If materials, were they supposedly homogeneous?

In case they were models, were they to scale?

If the test dealt with specimens or samples, how were these chosen, obtained, and prepared?

On what scientific, industrial, or economic premises did you as the tester proceed?

What assumptions did you make regarding your materials, equipment, or procedure?

What warnings must you give in order to prevent error, damage to apparatus, and risks to personnel if the test is to be duplicated?

Were your tests original or confirmatory?

Were they on a laboratory, pilot-plant, or commercial scale?

How many did you consider necessary for valid results?

To what extent were the raw data capable of being recorded automatically?

To what extent did you actually secure them in this way?

What influence was exerted by weather, personnel, lack of adequate personnel, and lack of time?

What kind of average did you seek—the arithmetic mean alone, or the mode and the median also?

By what method did you derive your curves and formulas?

What individual findings did you throw out?

Why?

Did you have a right to anticipate some standard kind of distribution?

If so, did you wrench your data in order to get it?

If not, what proved to be the degree of skewness?

When your inspection or set of tests follows an inspection or test made by someone else, be fair to your predecessor. A danger signal is your feeling that he was stupid. Remember, situations and facilities change; your forerunner may have done a better inspecting or testing job than you could have done under the circumstances. Of course, if you are sure he was narrow, short-sighted, guilty of failing to see the real problem before him, or careless in his investigations, you may legitimately say so. But be temperate and modest. Do not blacken him so that you may shine. The same principles hold when you succeed another man on a job that calls for progress reports. They hold likewise when you make broader and/or more precise completion reports than your predecessor did. Don't run him down. Don't crow.

A person is protected by the law against some kinds of unfair statement. This you must keep in mind when you write inspection and tests reports, particularly reports of structures and machines that have failed. You should always seek one basic cause for the failure or breakdown.

At the same time, though, you must guard against a hasty simplification for three reasons—professional, ethical, and legal.

The professional reason is obvious. As an engineer, it is one of your obligations to prove yourself a careful thinker. The causes of many failures and breakdowns cannot be directly observed but have to be inferred. Human inferences are fallible. Therefore, self-interest warns you not to be too positive too soon.

You also have a duty to other persons. Barring a few “acts of God,” responsibility for failures and breakdowns must somewhere attach to human beings. It may seem to you that you are dealing only with inanimate things. But back of them are individuals who have openly or tacitly said, “These things are O.K. to use.” Remembering this, you must proceed with care when you impute blame.

Finally, if neither professional nor general ethics can keep you from rushing into faulty conclusions, the law may step in. By no means all reports are privileged communications. Not even all reports demanded by superiors are privileged. Neither will all parts of a generally privileged communication receive the protection of the law. In judging the causes of failures and breakdowns, then, you must avoid laying yourself open to suits for libel or slander.³

5. Assume that you have gathered all the facts needed to make the judgments you should make in a particular report. Assume that your judgments are as sound as they can be in view of the situation, your investigative facilities, and your ability to think logically. You still face one problem common to all kinds of evaluative reports—“What tone shall I give to my report?” You may face also the problem of organizing your material, and special problems if your report is intended for laymen. And manifestly these problems may intertwine.

As for tone, the ordinary questions confronting you are three: How much should I qualify and “hedge” my broad, general evaluations? Is a contentious tone ever justifiable? Is a jubilant tone ever justifiable?

To the first question no blanket answer is possible. Scientific reports must state fully all special circumstances and limitations that keep the conclusions from being universally or even widely applicable. Engineering decisions, however, must often rest on probability rather than absolute certainty. An engineering report, therefore, can legitimately make many of its statements more definite than can a pure-science report. Of course this does not mean playing fast and loose with human lives, human health, or money. When you feel that you must “hedge” your statements considerably, it may be best to do so in your introduction or in the letter

³ Julien Elfenbein, *Business Journalism* (New York, 1945), pp. 271-274, is a good brief discussion of libel, slander, and privacy. Most encyclopedias discuss the matter thoroughly.

of transmittal, and to make both your conclusions chapter and the brief version of it in your abstract fairly forthright and definitive.

The answer to the second question—"Is a contentious tone ever justifiable?"—is No, except in some oral reports where circumstances require you to overcome uninformed opposition and where they permit you to supplement your bare words by the power of the eye, of gestures, and of movement.

A jubilant tone is acceptable in some oral reports. Your reader may approve it in a business-letter report if he is a personal friend, and may even find it justifiable in some formal reports. Thus the recipient's reaction to the following letter was favorable.

The big job is done! We will move into the new laboratory tomorrow, ten days ahead of schedule. This means that John Daniels's projects can start at once. The vacuum-tube research will get going before June 1.

Our next progress report to you will cover these three Tasks.

Plans for the new lab were followed almost to the letter. Only one change was made in the layout sketch that you and I drew up a month ago.

The cost ran a bit over our highest estimate but the difference was negligible—\$252.50. This is under one percent. I think we can all congratulate ourselves.

And presumably the following passage met with acclaim when it appeared in a report made by Headquarters XX Corps on March 22, 1945.

"The enemy artillery west of the Rhine is *alles Kaput*. Only a few isolated guns are singing their swan song. It is believed that very little, if any, of his artillery got away to 'fight another day.' The swift encircling movement, the destructive power of the artillery and air, combined to eliminate the artillery from the picture.

"He had two choices: to sit and be overrun or to retreat and be destroyed on the road.

"On the road between Frankenstein and Bad Durkheim, two names faintly suggestive of the conditions on the road, is one of the greatest scenes of destruction we have ever seen. Here on the road, the trains and the artillery of what appears to be a division were caught in a defile and massacred by the Air Corps. Running down the curving roadway, the passer-by first notices a few scattered vehicles and dead horses; then it seems to grow in crescendo until finally he is in the midst of such a twisted mass of death and destruction that single items can no longer stand out. It is so enormous that the mind cannot measure it! The only impression made is that this is the acme and ultimate of death, destruction and chaos. It is the scene that should be photographed for the Master Race. Let them see the 'Road to Glory' by courtesy of the Air Corps."⁴

Problems of organizing your material differ noticeably from one type of evaluative report to another. Some of the difficulties you may face in deciding what method of arrangement to use are therefore treated later

⁴ Quoted in Col. R. J. Browne, "Eggcup Was the Call Sign," *Infantry Journal*, July, 1948, p. 32.

in this chapter. At this point you are urged to reread the parts of Chapter 8 that deal with effective rhetorical organization; those pages are supplemented with the following suggestions.

The readers of many accounts of preliminary investigations need to see just how a minor project developed justifiably into a major one or how a seemingly unconquerable problem yielded to patient study. Such "reconnaissance reports" should therefore be organized inductively. Parallelism will be served by using the same pattern for the account of the final full-scale investigation. But you are not to make a fetish of parallelism. You may still find it advisable to give the main "story" a deductive pattern.

When observation, inspection, and testing are done in that order, the report based upon them can follow the same sequence: "In this investigation, such and such was observed. . . . Inspection disclosed . . . Preliminary tests suggested as an explanation . . . Detailed tests confirmed these hypotheses. . . ." Even in this case, however, most engineering readers and writers prefer to follow a deductive plan. This means the conclusions and value judgments first, no matter how they were arrived at.

If your results are inconclusive, however, an inductive arrangement may work better. It enables your recipient to comprehend obstacles and to appreciate intelligent though unsuccessful attempts to get over them. But unfortunately it gives some recipients the impression that you are trying to excuse yourself. Let such men have a deductive report.

The principles given in earlier chapters for adapting your write-ups and talks to individual laymen and to groups of laymen apply as well to evaluative reports as to other kinds. However, a few special suggestions are included in two sections—those on tests reports and on progress reports—of the four which end this chapter. These four sections form a sort of trouble-shooting manual for those of you who need, or are sure you will need, a more detailed treatment of inspection reports, tests reports, progress reports, and completion reports than the usual textbook offers.

INSPECTION REPORTS

In many inspection reports, the biggest difficulty is to keep from burying your evaluations. Of course you should have no trouble if your report is made by means of a rating sheet that your superior provides. Nor should you have any trouble in a report made primarily by means of the written or spoken word, if the report contains little descriptive matter and adheres to the purpose and scope assigned by your boss. You need only apply the principle of Emphasis by Initial Position, and the simplest way to do so is to give the recipient an abstract that devotes most of its space to your evaluations, or an epitome that is confined to evaluations. An example of such an epitome follows.

Hassel is already well adapted to its proposed use by the Commerce Depart-

ment. All present equipment can be utilized. Most of this is now in place. The rest is stored in the basement of the Hall. Better lighting is needed in Room 204. If the small amount of new furniture that Commerce will require cannot be obtained from War Surplus, it can be bought in the open market for \$2500-\$3000. Two hundred man-hours, about 180 of them by our own crews, will put the building into condition.

A similar epitome is feasible in most reports of reinspections. Such reports generally go to the man or group that received the account of the previous inspection. The recipient may have its details clearly in mind. If not, they are probably available in his files. At any rate he should know what *kinds* of facts your reinspection secured, and therefore he can understand an introductory evaluative digest; he can grasp the meaning of your judgments before he studies all the specific facts on which they rest.

But there are three common situations in which you cannot well use an introductory summary as the chief means of stressing your evaluations:

1. When the reader can't understand your evaluations without having studied numerous facts on which the evaluations are based.
2. When the reader needs to comprehend, not so much the purpose of your inspection as its motivation; he has got to know why you felt that you should make an inspection voluntarily or why you went beyond your instructions and directives.
3. When the reader—especially the reader of a report that is wholly or partly volunteered—needs to know your capabilities.

In these situations you can seldom use the principle of Emphasis by Initial Position as a method of stressing your evaluations. Why not? Because, for one thing, there will often be a clash between Emphasis by Initial Position and Emphasis by Proportion. That is, in terms of its mass or bulk the descriptive material seems more important than the evaluative, whereas by starting with the evaluative you imply that it is the latter which will predominate. Or there may be a clash between emphasis and clearness, or between emphasis and convincingness. That is, either your reader will not comprehend the judgments that your abstract offers, because he has not seen and cannot anticipate the facts which led you to form those judgments, or else he will doubt your disinterestedness and perhaps your competence—he will wonder what ax you want to grind.

You may then think of turning to the use of a long abstract that will contain enough data on your motives and purpose, the scope of your inspection, and the physical subject to make your evaluations as set forth in the abstract wholly clear and convincing. But such a *précis* will usually bury your condensed statement of evaluations.

What other principles of emphasis might you apply?

Not, by and large, that of Emphasis by End Position. As we already

know, technical readers and businessmen rarely wish to wait until the end of any except the briefest report before they discover its basic nature and content. On the occasions when you must use a final summary in an inspection report, signpost it. First, have the title page contain the word *Inspection*. Second, in your statements of purpose and scope make it plain that the report is not descriptive but basically evaluative. Third, if possible see to it that each descriptive section in the body of the report ends with evaluative conclusions. By doing these things you can prepare the reader for the final summary. Nevertheless, in the inspection report a final summary is on the whole a makeshift.

Once in a while you can give evaluations prominence by using a portfolio format, with descriptive material and your expressions of judgment on facing pages. This plan, however, often calls for leaving a good many pages blank and annoys most readers. On the whole it doesn't work.

As was said earlier, another principle of emphasis is Emphasis by Proportion. What bulks largest tends to attract the most attention. You can therefore try either to shorten the space that you give to description or to lengthen the space that you give to your evaluations. In many reports, however, this procedure will make the description meager and therefore unclear, and the statements of your judgments verbose.

One remedy that sometimes works is to emphasize your evaluations by forceful phrasing. *Phrasing* can be taken to mean not only your vocabulary but your sentence structure, and the use not only of literal but of figurative language. You can try setting forth your evaluations in words more vivid than you use in the descriptive passages, and you can reinforce this method by rhetorical questions, bullet sentences and paragraphs, and such figurative language as "Gooseneck Creek is a stench" and "Installation of this equipment has turned red ink into black." Most technical readers, however, are suspicious of these devices.

So much for negative counsel. Now for positive. It is plain that we must make clear our purposes and gain the reader's sympathetic interest as early in the report as possible. If we decide that no early summary of evaluations is practicable, the clarifying and contacting jobs can be done by our statement of purpose and scope.

If we are volunteering the report, this statement may well end with data bearing on our own capabilities. When the report is for an engineer, these data can usually take the form of a professional biography; when it is for laymen, we may have to offer direct evaluations of our competence. In case part of the report is volunteered—that is, if we have been authorized to make an inspection but have gone beyond our instructions—no general rules can be laid down. We shall have to determine whether our reader thinks we are as competent in the field we "invade" as in the field to which he assigned us. For instance, let us assume that we were

asked to study the efficiency of machines, men, and methods in a given department, and that we decide we must also inspect and report upon the safety methods used; our reader may feel that we are good judges of efficiency in the narrow sense of that term, but that we are not specialists in safety practices.

Still other complications may arise. Sometimes, not only in volunteered reports but in assigned ones, we would be likely to confuse our reader by telling him the scope of our inspection before we give him an overview of the site or plant that we inspected. It is then vital that the statement of scope, which normally precedes the overview, shall warn him by stating explicitly, "This is not a descriptive report only; it will offer judgments." (Naturally, this is not the exact phrasing but the gist of what we must say.)

There are two further ways of emphasizing that the report is evaluative. One is to put a "semi-introductory" summary of our judgments immediately after the statements of purpose, self-evaluation, scope, and allied matters. For further emphasis, this summary may be a separate chapter. Our report would then show the following organization:

Chapter I:

1. Purpose of the report.
2. Evaluation of our own competence (direct or indirect).
3. Scope of the report, emphasizing that it offers judgments.
4. Overview of the physical subject.

Chapter II: Summary of evaluations.

Chapters III, IV, . . . : Descriptive details, with incidental evaluations.

Last chapter: Final summary of the main evaluations; or final summary of the whole report, ending with the main evaluations.

The other way is to put all the preliminaries, or most of them, into a letter of transmittal, which can generally take a more personal tone than any part of the report proper. The following example shows the use of such a letter to explain briefly the assigned purpose and scope of a report, the purpose and scope as enlarged by the report-maker, his qualifications for going beyond his assignment, a brief overview of the physical subject, and a summary of his judgments.

Dear Hudson:

Your letter of June 15 asked me to inspect, for a period of not less than 30 consecutive working hours, the equipment and production operations of Division 3. Your records showed a drop in the accuracy and efficiency of the Division's work.

The attached report, I trust, meets your request. However, it does not stop there. The first few hours of my inspection made it clear that inefficient practices and poorly operating equipment cannot be separated from various unsafe methods. These have come into being with the recent great increase in the number of green employees. Related factors are the obsolescence of some

of our tool room equipment, and the maintenance crew's inability to keep up with their repair jobs.

Having had considerable safety training while with the A. H. Howe Company during the war years, I took it on myself to cover the matter of safety as well as the aspects you allocated to me. With our safety expert still on loan to the Government, I felt that this course would meet with your approval.

The Division occupies 5120 feet of floor space in the right wing of Plant 2. Ceiling heights vary from . . . Equipment includes . . .

My main findings and conclusions are:

1. . . .
2. . . .
3. . . . etc.

REPORTS ON TESTS

Each type and subtype of report thus far surveyed answers primarily one question. Such a limitation is not characteristic of reports on tests. Whether grounded in field work or laboratory work, they answer a number of questions. In fact, many an individual report of this kind answers half a dozen: *What* is a material composed of? *How* are its constituents combined? *How well* can the material perform a specified job? *Why*—and often *Where* and *When*—did it fail or will it fail?

But the greater range of findings cannot serve as the distinguishing trait of a test report. What does differentiate it is shown by the word "test" itself. Since any test entails a deliberately induced change in the conditions, status, or actions of things and people, the validity and the reliability of the testing procedure assume vital importance.

Problems of Content and Structure. This difference between test reports and others is, true enough, a difference of degree rather than of kind; the manner in which you have assembled your data is always important. But the difference in degree has significant practical effects. For whereas the users of many routine-performance records, descriptive reports, and inspection reports can infer the nature of the methods which you employed in gathering data, the user of a test report often cannot.

Of course, if he has already viewed the testing technique so often that it is familiar to him, he is like the average recipient of the simpler accounts; he need not have it described again, let alone evaluated. This is frequently the situation. Numerous ways of testing certain materials and equipment are standardized. Such methods require no identification at all, or else a mere reference to specifications laid down by the employer or by the ASTM, the SAE, the API, or some other such national agency.

When procedure can thus be taken for granted or briefly labeled, and when in addition you have to discuss only *How much* or *What*, your document may be similar to a routine-performance record. Hence young

assayers, chemical technicians, and men engaged in electrical and mechanical maintenance will find a knowledge of how to prepare the record of routine performance as useful as do production men.

But even in some reports of routine tests, you must set forth the testing procedure explicitly. This is particularly true while you are a novice and are therefore yourself being tested. Many college instructors demand a description of equipment and procedure which will be full enough to permit someone else to duplicate your work. As you become experienced, you are rarely held to such a degree of detail when your tests are of a routine nature.

Describing Your Procedures. In many reports a nonverbal or verbal picture of materials, of testing equipment, and of the testing and analytical processes is enough. Even description, however, sometimes poses one problem. Should the materials, the apparatus, and the procedure all be described in one division of the report? Or should you distribute the account between two or even three divisions?

The solution varies according to the nature of your materials and apparatus. If these are few and need only to be named, your reader will gain by your listing them in semitabular form—whether under headings or subheadings is immaterial. If they are numerous but still require only to be named, there is little advantage in listing them separately from the description of procedure. By the time your reader is in the midst of that description, he may have forgotten the list. He will be better served if you name each material and each piece of testing equipment at the time when its use is discussed in the account of procedure.⁵

A third situation often arises. Mere enumeration of materials and apparatus may prove insufficient, nor may photographs and diagrams and three-view drawings alone give a clear enough picture. Some verbal definition and description become necessary—especially when you must show the relationship of the items of equipment to one another so that interference effects can be recognized and allowed for. In this case, most readers will be glad to have the account of materials and equipment separated from that of procedure, to prevent the narrative part of the report from being obstructed by descriptive passages.

Evaluating Your Procedures. Just as you may have to supplement or replace pure enumeration by definition and description, so these in turn you must often supplement by evaluation. That is, you must tell the strong and weak points, the virtues and the limitations, of your procedure.

⁵ Such an arrangement is unwelcome to many college instructors. The reason is that they are not concerned with the validity of tests conducted by a student except in so far as these help in evaluating the student himself. So they want a rapid means of checking to see that he followed orders—that he used all materials and mechanisms which he was supposed to employ. Whenever the experienced engineer knows that he will be treated similarly, he should react similarly. Otherwise he should not.

When both descriptions and evaluations prove essential, the practicing engineer sometimes fuses the two. He evaluates while he describes. On the other hand, he often does as students are commonly required to do. He puts his evaluation into a division labeled Discussion of Results. Still a third plan is to include a division on theory. This becomes wise when the testing technique is new, when it is based on an original and fruitful study of the literature, or when its own inherent limitations greatly influence its reliability.

In preparing a theory section you are likely to encounter four problems: one of ethics, one of phrasing, and two of arrangement.

The ethical problem concerns plagiarism. Many undergraduates merely copy the section on theory from some textbook or article, without acknowledgment. Good engineering practice demands that the investigator check several reliable sources to be sure they are in fundamental agreement, and that he acknowledge their aid.

A problem of phrasing then often arises. You may slip into the careless habit of using *the writer (author)* to refer now to you and now to the author of published material. Avoid such ambiguousness; refer to yourself as *the present author (writer)*.

One of the two problems of arrangement concerns the basic pattern that you should adopt within the section on theory. You have three ways of summarizing previous experimentation:

1. In terms of previous investigators.
2. In terms of previous assumptions, hypotheses, theories, or research techniques.
3. In terms of previous findings and conclusions.

Though frequently used, the first method is the least advisable except when you aim at laymen, most of whom think better in terms of living beings than of abstractions. Which of the last two arrangements you should prefer will ordinarily depend on the fullness and practical value of results obtained in previous studies. If the results are not so significant as the methodology, then your historical account should stress assumptions, hypotheses, theories, or research techniques. Otherwise it should stress findings and conclusions.

The second problem of arrangement is even more important. To include a section on theory influences the manner and order in which you treat materials, equipment, and procedure. Readers want to move straight from any discussion of theory to the description of techniques based upon it. Hence the account of materials and equipment must not block traffic. You must not put it between the divisions on theory and procedure but must work it smoothly into the latter division.

Justifying Your Procedures. There are times when evaluation does not fully indicate how trustworthy a testing technique may be. If you will

meet skepticism because you have gone beyond or perhaps counter to accepted methods, you must defend what you have done. You must do the same in reporting on retests of another man's work, both when you depart from his techniques and when you adopt them.

Regardless of whether your tests are originals or repetitions, or variants, avoid a personal tone. Defend not yourself but your procedure. Be temperate, businesslike, and as brief as you can. And if you are doing over, in whole or in part, what another man has done, you not only must justify yourself but must point out which parts of his work have proved sound and which, though in need of revision, were conscientious and intelligent. In many reports you should do more. You should point out that in the original test a truly representative specimen was unobtainable, or that the testing apparatus has since been improved and refined, or that more trustworthy recording devices or personnel, or both, are now available.

There is yet another way of aiding your reader to judge your tests—by including original data sheets and calculations. In most undergraduate papers these are considered essential. At the least, samples are required. But an experienced engineer seldom clogs the body of the report with them. Instead he puts them into the appendix or into organizational files. In those places, too, he can preserve a full record of such conditions and special difficulties of the test as might prove useful later but would misproportion his present report if stated at length.

Writing for Laymen. A test report for laymen must be “contoured” in such a way that the importance and significance of your tests will stand out. Indeed, you should normally explain these matters before you set forth (if you do) the virtues of your testing procedure. Here is an example of what we mean:

“In homes heated with steam or hot-water heating systems, the practice of using the house heating boiler to supply hot water for domestic uses the year around is becoming prevalent. The advantages claimed for this practice are that an abundant supply of hot water is available at all times, fewer units of mechanical equipment are required, the operation is economical, and a minimum amount of floor space is required for the equipment involved. Data necessary for the correct sizing of this type of equipment are very meager, as are also data on the cost of operation, maximum load imposed on the boiler under actual service conditions, and the rate at which water can be heated. In view of this lack of data, a program of tests was undertaken in the I-B-R Research Home in order to determine the operating characteristics of an indirect storage type water heater located in the house heating boiler and connected to a horizontal, insulated, 30-gal. hot-water storage tank. The program was initiated by the Advisory Research Committee of the Institute of Boiler and Radiator Manufacturers and the University of Illinois. This bulletin, the fifth to be published under the cooperative agreement between the Institute of Boiler and Radiator Manufacturers and the University of Illinois, is devoted

to a discussion of the hot-water heater tests made in the I-B-R Research Home during the summers of 1942 and 1943.

"The investigation is still in progress, and subsequent data will be obtained on the operation of this same system used in connection with a vertical 30-gal. storage tank, and with both vertical and horizontal storage tanks having capacities other than 30-gal. Tests on heaters of various sizes and on tankless heaters will also eventually be included in the program."⁶

The significance should often be made clear in terms that come home to the average man—to his pocketbook, his desire for good health, his sense of self-preservation, his obligations and ambitions as the head of a family. Recall what was said on page 49 about "skin, kin, and cash." But since engineers and industrial superiors still wish to have the full record of your procedure and the technological evaluation of it, you face a problem that you may be able to solve only by making a double report. Your version for laymen will emphasize results and significance. The technologist's version, though not disregarding these matters, will also supply enough data to permit a thorough check on how you did your job.

To give the causes of failures or breakdowns is even harder than usual when the report is for laymen. Phrasing that reflects your professional caution and sincerity may strike laymen as a sign of cowardice or "politics." You must lead them to perceive what scientific care means. You must so word your findings and conclusions that laymen understand the boundaries within which you must stay if you are to be faithful to the facts. You may even have to work into the report an explanation of scientific or engineering method. If so, keep it short and phrase it informally.

PROGRESS REPORTS

Some engineers make no distinction between a progress report and a record of routine performance. Two likenesses are of course plain. One is that both types may cover not only physical production but also jobs in the realms of policy-making, planning, design, inspection, testing, or research. The second is that most reports of each kind are submitted serially, according to some predetermined schedule. The similarities don't add up, however, to identity.

On the other hand, certain men are so impressed by differences between the two types that they see lines of demarcation where none exist. For example, it has been asserted that records of routine performance are based on "endless" jobs whereas progress reports deal with special and terminable jobs. This statement goes beyond the facts. Another mistaken belief is that records of routine performance are always periodic whereas progress reports are always submitted at either the beginning or the end

⁶ A. P. Kratz and W. S. Harris, "Performance of an Indirect Storage Type of Hot-Water Heater," *Univ. of Ill. Eng. Exp. Sta. Bul.* 366, 1947, p. 7. Most of this passage has been used earlier in this book, to exemplify another matter of style.

(more commonly the end) of a block of work. Finally, a distinction has been sought in the alleged simplicity of routine-performance records as contrasted with the complexity of progress reports.

This third difference is common, no doubt. It is, however, only a by-product of the essential dissimilarity, which is primarily psychological: *The progress report stresses planning, foresight, initiative, and the conquest of obstacles* rather than bare quantitative accomplishment. The difference is roughly that between an answer to *How Much?* and an answer to *How Well?*

Consequently most progress reports cover a longer period of time than the average routine-performance record. They also give a fuller summary of previous periods or of previous blocks of work. More important, few routine-performance records point to the future, but most progress reports must do so.

Further differences concern the forms of discourse. Many records of routine performance are nonverbal. No progress report can be. However much statistical information it may give, it must also contain descriptive and narrative material that cannot be set forth without words, and it should often include recommendations as well.

In arrangement, a noticeable number of printed progress reports are double reports. Their first section is for the layman; their details are for persons better informed and more interested. A few progress reports are even triple reports.

Choice Between Progress Report and Record of Routine Performance. When you can choose which type of report you will produce, govern yourself both by the nature of your data and by the report-user's probable reaction. Heed especially his belief concerning the kinds of operations that ought to be routinized. The more closely accomplishments pertain to human beings rather than to things, the more desirable a progress report becomes. Therefore, many readers want labor policies and their results or the incidence of industrial injuries, illnesses, and fatalities interpreted and judged; they resent a "cold" arithmetical or graphic summary. Other readers, however, think that only top-level officials should interpret, evaluate, and plan. Some administrators accordingly wish a subordinate to give them nothing but bare factual information. They themselves will turn this record of routine performance into a progress report by personally questioning the report-maker about his exercise of initiative, his ways of getting over hurdles, and his future aims.

Time Schedule for Submittal. Once you have decided that you should prepare a progress report, you probably must accept your superior's choice between a chronological and a block-of-work submittal schedule. One plain advantage of the chronological basis is that most businesses run on a calendar system. Among research men there is the further advantage

that this sort of schedule gets them used to writing frequently and thus eases the task they face when they must produce a long and complex investigation report. On the other hand, chronologically regular progress reports dealing with a special job are often undesirable because some of them may have to be prepared at a time when only minor activities are being carried on and there is therefore little to say.

A few progress reports cover neither a chronological nor a logical segment but are prepared intermittently—whenever a superior calls for them (interim reports) or as it becomes evident that an enterprise stands in need of further aid. This last type is highly undesirable, for it usually implies an unbusinesslike attitude and a lack of foresight.

Structure of the Progress Report. Regardless of the intervals at which it is submitted, the true progress report tells a unified story. It tries to reduce half a dozen, possibly half a hundred, divisional or departmental or subdepartmental “production charts” to a single composite one.

In many progress reports, as in nearly all records of routine performance, the unifying element stays the same over a considerable period of time—in each of your reports you are to express achievement in terms of unit cost, profits, accident rate, or some other “permanent” criterion.

When your yardstick is thus furnished, your reporting task is not especially hard. In an introductory summary you set forth the big accomplishments. Of course you include information about previous achievements, and usually give your plans for the future. But your résumé casts light mainly upon the period of time or the block of work under review. In the body of the report you give an account of each phase of the whole job or each department of your organization. In so doing, proportion your descriptions and evaluations of plant, personnel, and performance according to the contribution made by each phase or department in terms of the fundamental criterion. The bigger the contribution, the more space you should give it. Govern yourself similarly in determining the order in which you treat the phases or departments. Start with those which are closest to the essential job performed by the whole organization; then discuss the indispensable service departments; and finally take up dispensable ones. Expect that managers of “dispensables” won’t agree with you.

Conciseness, always important, becomes vital whenever progress has fallen below expectations. Don’t give a long explanation of shortcomings. It will sound like a set of excuses.

Nor is conciseness the only requisite. You must scrutinize the connotations of all words in which you set forth the nature and degree of achievement, reasons for inadequacies, remedies attempted, and results.

Quantitatively and qualitatively, then, your presentation should meet a high standard. Make it temperate in discussing both “failures and breakdowns” and unusual successes. Keep optimism within reasonable bounds.

If you include a section on acknowledgments or personnel, don't let it be perfunctory; specify the contribution made to the total achievement by each man or group you name. Last, let your report show that you have mastered not only the broad lines of your activity but the particulars as well. If the report is oral you must expect to be asked questions both about your work as a whole and about any detail of it, and to have them fired at you unsystematically. Hence you must have in mind (1) all basic statistics, especially on total and unit costs; (2) a concise formulation of your conclusions on efficiency and economy; and (3) a clear explanation of any special studies or operations you have undertaken.

The last part of a progress report is a variable. Most production reports end with a brief account of projects next on the schedule and give proposed completion dates if these are fairly definite. A similar passage concludes a good many reports of research projects. That is, the authors enumerate investigations which they are now undertaking or assuredly will undertake; recommend projects that ought to be attempted by men or groups with better facilities or more time; and, in order to get the views of other investigators, ask questions concerning projects that may perhaps prove feasible.⁷

Some technical societies, however, forbid the inclusion of such information and queries in articles submitted to their journals. They feel that the proposed work may have to be dropped and that readers will waste time looking for an account to appear; or they feel that if the work is finished later, the society will have committed itself to publishing what may prove to be a poor report. Going a step further, some professional groups therefore refuse to accept progress reports at all for their learned publications.

Modern Trends. Many young engineers are expected to build up their progress reports in approximately the manner just described. Most annual reports of corporations followed the same plan until the early 1930's. Here is an example.

- I. Preliminary Data
 - A. Capital Stock
 - 1. Issued
 - 2. Authorized
 - B. Officers and Directors
 - C. Place and Date of Annual Meeting of Stockholders
- II. Body
 - A. The Company as a Whole
 - 1. Physical Production
 - 2. Average Price Received

⁷ A report that ends with a well-phrased "Suggested Topics for Discussion" is J. O. Draffin, "Progress Report on Study of Achievement Tests," *J. Eng. Educ.*, n.s. 33:228-234, November, 1942.

- 3. Profits
- 4. Dividends
- B. Subsidiaries and/or Divisions of the Company
 - 1, 2, 3, and 4 as above, if possible
- III. Appendixes
 - A. Financial Statements
 - B. Brief Summary of Service Departments
 - C. Plans for the Future

Such an arrangement has two big advantages. One, which it shares with the record of routine performance, is that because the gauge of achievement is left unchanged from year to year, you can pattern the report quickly. The second is that if you regularly follow this pattern you avoid many problems of structure and phrasing in periods when output or profits drop.

However, it has one great disadvantage: it neglects the psychology both of many employees and of many members of the general public. Increasingly, in fact, it has failed to suit stockholders themselves. Companies strongly dependent on public good will have therefore tended to follow a triple-report pattern somewhat like this:

Preliminary Data (The Corporation as a Legal Entity)

- I. Directors
- II. Officers and Offices
- III. Legal Counsel
- IV. Changes in Constitution and By-Laws
- V. Names and Addresses of Subsidiaries

Body

Review of the year—signed by the president or by the chairman of the board of directors, and stressing the corporation's public services

- A. Production and Shipments
- B. Operations
- C. Research Methods and Projects
- D. New Products
- E. Employees' Wages, Hours, and Working Conditions

Appendixes

- I. Physical Output of Major Products (over a period of years)
- II. Shipments and Sales (over a period of years)
- III. Consolidated General Balance Sheet of the Corporation and Its Subsidiaries
 - A. Tabular Statements (current year and preceding year)
 - B. Accounting Principles Applied in Drawing up the Balance Sheet
 - C. Auditors' Report to the Stockholders
- IV. "Breakdown" of Consolidated Financial Statements

Virtually the same plan has often been adapted to the public-relations problems of corporations that sell services rather than tangible goods.

An excellent example is the set of annual reports of the American Telephone and Telegraph Company.

A few corporations have dramatized their problems and achievements even more strikingly. General Foods Corporation, for instance, has presented its report in the form of a narrative of a stockholders' annual meeting. You can readily infer that the report utilizes the question-and-answer technique, that it has many photographs and pictographs, and that the tables are few and simple.⁸ Recently, General Mills hired a famous novelist to humanize its yearly "story."

A still later development is the televising of the annual report. What forms the published version of the video presentation may take are yet to be seen.

If you are in government service or are likely to be, you should read *Annual Reports and How to Improve Them*.⁹ You might also study the "guides" to report preparation which have been issued by such organizations as the Committee on Municipal Standards, the International Association of Chiefs of Police, and the American Public Health Association. Acquaint yourself too with the specifications laid down by the National Committee on Municipal Standards as well as by the National Committee on Municipal Reporting, on which were represented the American Municipal Association, Governmental Research Association, International City Managers' Association, and National Municipal League. Several articles in issues of *Public Management* and the *National Municipal Review* are valuable.

The substance of the recommendations offered by these varied agencies is this: Much can be gained by building each annual report around a specific theme, which should if possible be phrased in a few words that can form a challenging title for the report. Such stress on concreteness and vividness should be carried throughout the entire "message." This means

⁸ Such reports, of course, take care not to swamp the essential financial information. Small stockholders, and many members of the general public, want the report to show clearly and beyond possibility of misinterpretation such facts as earnings, dividends paid, amount of money owed by the company, amount of money which the company has available, size of the concern, number of people working for it, and total sales and/or revenues. In addition, many people like to know what service the company gives the community, where its plants and offices are situated, where its raw materials came from, and who audited the figures. For a clear, interesting discussion of the small stockholder's interests and needs, see Stuart Chase, "How to Read an Annual Report," *The Lamp*, March, 1948, pp. 20-25.

For a detailed account and analysis, see T. C. Sanders, *Company Annual Reports to Stockholders, Employees, and the Public* (Boston, 1949).

⁹ Mary S. Routzahn (ed.), (New York, 1941). See also C. E. Ridley, "Improving the Annual Municipal Report," in *Public Documents . . . Papers Presented at the 1933 Conference of the American Library Association* (Chicago, 1934), pp. 84-91; and J. Magee, Jr., "Springfield, Massachusetts, Takes Lesson from Best Sellers; Citizens Enjoy Streamlined Annual Report," *Nat. Munic. Rev.*, 34:89-91, February, 1945.

among other things that the reader should have service and financial statements combined for him, preferably by means of pictographs supplemented by action photographs; that statistics must be made vivid; and often that he must be told in simple, clear words what the valid yardsticks are for measuring efficient operation.¹⁰

Finally, a double or even triple report is frequently advisable. The report should be so organized and written that not only news stories but feature articles, editorials, and radio talks and interviews may easily stem from it. If they do not merely stem from it but can be taken bodily from its pages, so much the better.

COMPLETION REPORTS

The final progress report upon a job is sometimes omitted. Data which it would have carried are synthesized with data previously submitted and with additional information, to form a completion report.

Whether built up in this way or in some other, a completion report is at the least a two-in-one sort of communication.

None of its components is new to you now that you have followed the discussion thus far. For example, every completion report contains a digest of a series of progress reports. It also contains a description of the finished product—usually a physical object, but sometimes a completed survey, a policy, a set of plans, or even a theory or hypothesis.

Whether you should open the report with historical or current information depends chiefly on your reader's interest and knowledge. Most people prefer the present to the past. This means description first. But if they cannot easily visualize the finished product or cannot easily interpret its significance unless you trace its development from the beginning, then lead off with your historical account.

Just what you should regard as the beginning will sometimes puzzle you. The engineer pure and simple can almost always start with "the first shovelful of dirt." But the administrator and the executive must often explain the legal inception of the project or even the notion out of which it developed.

Completion reports that confine themselves to doing historical and "pictorial" jobs are descriptive only. But most completion reports are evaluative. They offer predictions or recommendations, or both—the recommendations, of course, being intended to save money or time on similar jobs by the lessons drawn from the work just completed. Other completion reports proceed from describing the finished product to analyzing it. A few documents are five-in-one reports; they include every

¹⁰ Many engineers are well aware of this requirement when they draw up *investigation* reports on how to spend the taxpayers' money; they tend to forget it as the number of their *progress* reports on how the money was spent increases.

kind of material just named—history, description, analytical interpretation, predictions, and recommendations.

Most reports as complex as this are double or triple in form as well as multiple in purpose. The summary that they contain for the layman may differ noticeably from the abstract intended for the engineer. The core, and hence the technical reader's abstract, can then be arranged as follows:

- Description of the completed project
- Design data
- Differences between plans and performance
- Costs
- Personnel
- History of the project
- Significance of the project (or may be put just before costs)
- Predictions
- Recommendations
- Appendixes (statutes, contracts, specifications)¹¹

The layman's résumé, on the other hand, can go this way:

- Significance of the project
- Description
- History (very brief, unless "picturesque" obstacles were overcome)
- Reference to sources of information on costs, plans, statutes, and specifications

When you report on a repair job or a remedial project, you can use facing pages. On the left-hand page you tell what was wrong; on the right-hand you tell what method of correction you used, and why.

¹¹ The abstract, of course, merely names these documents.

20. Recommendation Reports

Neither the factual core nor the ways in which that core is built up can differentiate the recommendation report from other kinds. In fact, you can turn any of those kinds into a recommendation report by making it your main, not your subsidiary, job to offer definite advice—that is, by not merely giving judgments but by urging their acceptance.

Though not to be undertaken nonchalantly, the oral report urging simple changes is on the whole the easiest kind of recommendation report to make. So at this point you might well look up the discussion of that relatively uncomplicated form (pages 283-285).

Of written reports, a fairly simple type is the one prepared as a matter of record in order to preserve an account of a decision reached by oral give-and-take. Some men find the portfolio format helpful in setting forth this sort of record; on the left-hand pages they summarize the facts and conclusions governing the decisions; on the right-hand pages they put the decisions.

Generally you don't face as easy a job as this. At times, indeed, the recommendation report will demand all the ability you can muster. This need arises most often when your recipient is at rest and must be both logically convinced and subconsciously persuaded that he should move. Then you must take even more pains than usual to analyze his knowledge—and half-knowledge; his attitudes, including his prejudices; his status; his motives. Find out why he is reluctant to act.

More often he wants to move and has asked you for recommendations regarding the distance, direction, or manner. Your task is then easier than when you must push him from a state of rest, but it still demands thoughtful planning.

Sometimes he is going too fast and should be slowed down or halted. In this case it may be advisable to talk to him informally three or four times and “soften his punch” before you submit a formal report.

Whether your report is to serve as starter, brake, engine, or steering wheel, keep your thinking free from false dilemmas. Don't say to yourself

or the recipient, "We must do either A or B" unless you are sure there is no C. Don't say, "We must do this in either January or February" unless you are sure December and March are inadvisable times.

No matter how many possible lines of action you explore, you must convince the recipient that yours is the best. You must show that your recommendation will solve, or go far toward solving, his problem. You must show that the merits of your recommendation outweigh (1) its disadvantages and (2) the merits of other actual and possible proposals.

You thus see that the questions you must answer in making a good recommendation report are in the main familiar to you. Others are analogous to the questions confronting you when you make an inspection report. You might turn back to pages 237-241 and review the account of inspection reports, substituting "recommendations" for "evaluations."

There are, though, a number of additional counsels that you can use.

Remember that recommendations do not rest directly upon facts. They rest instead on conclusions derived from facts. A major problem, then, is to decide how much purely factual data you should put into a recommendation report. In two opposite circumstances the decision is "none." For example, such a common recommendation as "I move we adjourn" seldom requires that you tell the audience what business they were to transact, how much of it they've done, what time is left. They know these things. You simply offer your recommendation. In engineering practice a good many oral reports and some in memorandum form are as bare as this. So are some produced in a quite different set of circumstances. A busy expert's judgment may be valued so highly that he is allowed to submit recommendations alone; he is trusted to get the pertinent facts and to draw sound conclusions from them without proving in detail that he has done so.

All other situations demand that at least some of your substratum facts go into the report. You can often give them by summary. Suppose your recommendation report follows a report containing the relevant facts and conclusions. You can merely epitomize the preceding report—perhaps quote its abstract—and then swing into the recommendations that logically result.

Ordinarily you embody in your recommendation report a good deal of factual (descriptive) matter. But just as inspection reports that in bulk are primarily descriptive must focus on evaluations, so recommendation reports must keep the reader's mind focused on future action as desirable or even imperative. Hence you can (1) put on the title page *Suggested*, *Recommended*, *Advisable*, *Feasible*, *Desirable* or the corresponding nouns, (2) make your abstract either consist of or end with your major

recommendations, and (3) have the statement of purpose say "This is a recommendation report."

There are exceptions to all practices. Therefore, if you volunteer the report or if you know its recommendations will be unpalatable, you may have to do the job differently. You may have to arrange the report inductively, leave out a formal statement of purpose, keep *Recommended* or its synonyms off the title page—in short, present a camouflaged recommendation. If you think this course hypocritical or otherwise inadvisable, apply the techniques discussed under inspection reports as helpful in overcoming opposition.¹

Volunteered or not, palatable or not, your report should avoid a beligerent tone. Though your basic purpose may be argumentative, your style should be explanatory and your temper cool. You may find it worth while to understate somewhat. You will discover—may already have discovered—that "I suggest" or "These results point to the need . . ." can be more effective than "You must" or even "We must"; that "Smith's plan has advantages but seems to underestimate the difficulty of getting skilled men" may get action faster than "Smith's idea's no good—can't get the men." You should not, of course, be unforceful or servile or dishonest. No one expects you to cringe or lie. But neither should you slap a sincere and thoughtful colleague down.

Many writers ask whether a communication that says "Let's keep on as we're going" ought to be briefer than one which says "Here's an undesirable situation and the remedies." Because report users differ greatly in temperament, no blanket answer is possible. Some superiors, for instance, are always looking for remedies. To sell them on "no change needed" is often harder than to sell others on the need for corrective measures.

There is more justification for the belief that reports which advise expansion are often longer, and harder to prepare, than "no change" or "remedy this" reports. Why? Partly because experienced administrators are more fully aware of obstacles to new development than are novices. Consequently, when you grow enthusiastic over an idea for enlarging operations, count on spending a great deal of time and thought in check-

¹ As you move up the ladder you will see increasingly broader opportunities for making recommendations, either expressed or implied. Whenever people say, "The need for keeping this procedure (layout, policy) is self-evident," "We have always done it this way," "Our business (our problem, our staff) is different," remedies or innovations may be long overdue. Just how far *you* can go in contributing to the remedies or innovations you yourself will have to decide. If you make careful time- and cost-studies and lay out detailed plans for improvement or pioneering, don't hesitate to urge your ideas. But be sure they have not already been turned down for good reasons or that they are not now being acted on.

ing its practicality, and more time and thought in getting your recommendations accepted.

One thing you will almost surely have to do is to make a detailed cost analysis. Learn how much money, time, skill, and energy will be needed to realize your proposals. Keep in mind possible interruptions of regular work, decrease in customer and employee good will, and increase in taxes, insurance, and other overhead charges.

Moreover, in such a report you must generally give specific plans for putting your recommendations into effect. You may even have to prepare a time and work schedule showing precisely how facilities or processes can be expanded with the least hindrance to routine and the least expenditure of money and intangibles. If this schedule is fairly complex it probably belongs in an appendix. Sometimes you should not put it into the report at all but hold it in reserve. In this event, either the body of the report or the letter of transmittal should say that the plan is available on request.

In preparing this schedule, as in making a cost analysis, bear in mind two counsels that the novice thinks can't be reconciled but that the executive knows must be. Here is the first:

"Incorrect estimates of the amount of time required for the distribution of orders, for the movement of units to new locations and for the necessary reconnaissances by subordinates, frequently lead to tactical failure. . . . Obstacles will arise, mishaps will occur, hostile activities will intervene—and without ample allowance for these unforeseen inevitabilities . . . the most promising plans will, at the outset, be sadly disjointed."²

Here is the other: Once you are certain your recommendations are feasible, your cost estimates accurate, your plans as accident-proof as they can be, push—tactfully but forthrightly and steadily—until a final decision is reached.

On occasion a recommendation report must be organized—though it should seldom be worded—like a formal argument. Then your choice of basic arrangement pattern becomes very important.

At least five patterns are available:

1. Arrangement of material on the basis of purposes to which your organization's policy logically points.
2. Arrangement of material on the basis of clear-cut differences of opinion regarding procedures and techniques.
3. Organization of material on the basis of initial agreement with your opponents' views.

² *Infantry in Battle* (Washington, D. C., 1934; Col. George Marshall, project director), p. 237. Reproduced by permission of the *Infantry Journal*.

4. Organization of material on the basis of refuting your opponents' contentions.
5. Organization on the basis of methods of proof.

You can readily see how to work out Nos. 1, 2, and 4. No. 3 often leads to the following main divisions:

- A. Summary of facts presented by your opponents which you admit are true.
- B. Conclusions offered by your opponents which you admit are valid.
- C. Statement, with proof, of your opponents' errors of fact and fallacies in reasoning.
- D. Summary of your own contentions.
- E. Arguments to support them.

No. 5 permits two procedures: your chapter headings may name either the kinds of evidence you use—eyewitness accounts, statistics, results of tests, etc.—or the forms of reasoning you use—analogy, inductive reasoning, argument from effect to cause, argument from cause to effect, etc.

The need for mastering formal argumentation arises just frequently enough to justify your using these patterns on occasion. In general, though, restrict them to your preliminary versions, where you check on the accuracy and force of your own reasoning.

Part V: Oral Reports

21. Fundamentals of Speech Delivery

SPEAKING IN TECHNICAL SITUATIONS

Writing letters, abstracts, reports, and articles is only a part of your communications job. At least equally important is the oral phase of the task. We turn to a discussion of the factors in some of the many speech situations that confront the engineer.

Let's begin with an assumption, one that you as an engineer will accept without reservation: Public speaking, for the technical and scientific man, is not a fine art. Rather it is a physical and mental skill based on mastery of fundamental principles and their correct application. It is like pitching horseshoes or designing a machine.

Another assumption will not be far wrong: The type of speaking for which the engineer has greatest need is that which is called extemporaneous. Don't confuse this with impromptu speaking. Impromptu implies lack of previous preparation. Extemporaneous demands careful preparation. But the two kinds are alike in that neither permits you to memorize or read the words and sentences of your talk. Both require you to fashion your language as you go along.

Why extemporaneous speaking has far more effect than other kinds is plain. It gives you only one job to do. Impromptu speaking, on the other hand, loads you with a double burden; you must design your language vehicle as you progress, and you must assemble and pack the cargo. Memorization also has a serious disadvantage. It confines you to a speech pattern formulated under conditions quite different from those which face you at the time of delivery. It gives you little opportunity for adapting to audience reaction or unforeseen circumstances. True, memorization used wisely and moderately may aid extemporaneous speaking; but in the main you should avoid it until experience has taught you when and where to make it work. Even less desirable is reading your speech. Reading tends to destroy speaker-audience contact. There are times, to be sure, when you ought to read a speech. But those times are limited to very specific

occasions. Generally a speech is to be spoken, and is effective only when it is spoken.

Extemporaneous speaking, remember, is not inspiration. Inspiration may come; its source, however, is not a benevolent genie but an audience made responsive by a speaker's hard work.

Good extemporaneous speaking, then, is what you need in a great majority of speech situations. The function of the following chapters is to discuss this kind of oral communication, with stress upon oral reports.

COMPONENTS OF SPEECH DELIVERY

The primary function of speech is to communicate facts, judgments, ideas. The matter of a speech, then, is far more important than the manner; if you have nothing to say you have no excuse for speaking. But it is equally obvious that matter depends greatly on manner. The effectiveness of what is said is governed by how it is said. Delivery is the physical medium of oral communication, and hence must be carefully considered.

The Body. Bodily conduct is not the most important factor in speaking, but the apprentice usually finds it an early source of trouble.

An enormous amount of nonsense has been written and taught about how a speaker should conduct himself on the platform, rostrum, or soap-box. In the days of Bryanesque oratory, teachers of elocution cluttered up the floors with colored chalk diagrams to show precisely where each foot should be at various times during the course of the canned effusion. There were moments when the right hand should come forth, palm upward to register supplication or palm outward to denote repulsion.

Even today we often detect an odor of mustiness about the practice of public speaking. We find speakers taking a step forward or a step backward—usually robot-like—to denote a shift in the direction of their thought; we find them standing resolutely on the balls of their feet, with their arms, ramrod-stiff or pendulum-loose, at their sides.

These things are not evils in themselves. Many good speakers move, and gesture, and stand on the balls of their feet; and they do these things with excellent effect. The point is that no one can establish detailed rules of bodily conduct and then design specific formulas to fit them. The practical public speaker does not try to memorize movements and gestures. He recognizes that perfect synchronization is unlikely, and he knows that movement and gesture are genuine only when they arise as natural, necessary aids to the speech itself.

If there is a definite rule for platform conduct it is this: Any bodily movement that interferes with efficient communication is bad; any bodily movement that aids communication is good.

To accept this rule means that the nature of the speech and the personality of the speaker ordinarily decide what is good and what is bad in

platform conduct. There are, however, some general principles that you can follow.

Few speakers can be effective if they are subject to jitterbugism. Most audiences are lazy; people find it less laborious to watch than to listen. So if you are in constant motion your audience focuses on your movement rather than on your words. Scraping feet, teetering knees, swaying hips, wandering hands, twisting fingers interfere with the speaker's immediate business.¹ Extraneous noise interferes too; drumming fingers or jingling coins divert the attention of those in the audience who can hear them.

The Eyes. Another safe assumption is that shifty eyes interfere with good speaking. Hearers unconsciously remember the adage that an honest man looks you in the eye. This old saw may or may not be true, but you had better assume it is. Eye contact is an attention-compelling force. If that contact is too often broken you may "lose" your audience. Of course, you can't look into every eye, but you can and should keep your eyes on the audience generally. The simplest and most effective way is not to look at ceiling, floor, windows, furniture, feet. However, don't let your eyes sweep the audience regularly. You are not watching a tennis match.

The Face. Of all the physical machinery that can make or mar a speech, the face offers the greatest possibilities. An audience will not respond to a man who shows no response to himself. An expressive face, on the contrary, may enliven a difficult or dull subject. The lift of an eyebrow can convey more meaning than any amount of desk pounding.

Cultivating an expressive face is largely a matter for individual experiment. Like other gestures, facial expressions cannot be memorized and turned on and off at will—except of course by those who are skilled. The beginner should first become aware of any dead-panness with which he may be cursed, and then practice expressiveness before a mirror, relying on the stimulus of the actual speech situation to put the practice into use.

Now to summarize. The practical garden variety of public speaking makes demands both positive and negative on your bodily conduct. It excludes memorized gestures and jitterbugism; it requires facial animation and also eye-to-eye contact with your audience.

The Voice. Our voices, like our vices, help greatly to determine what kind of persons we are. And our voices, unlike our vices, do even more to determine what kind of speakers we are. Our voices have been given us by a capricious nature; short of surgical science, we can't alter their essential qualities. We can, though, make the most of what we have.

¹ The attractions of movement may sometimes work to the advantage of the speaker; the wandering attention of an audience can be refocused by judicious use of bodily action.

The mechanics of the voice-producing organs are not discussed here. There are excellent chapters on voice mechanics in most standard public-speaking textbooks, and you are invited to consult them.²

Lack of Animation. Of all vocal evils the greatest is dullness. Few of us have escaped the "hideous hum" of some classroom drone. The avoidance of this criminal monotone is devoutly to be desired.

Remember that the voice mechanism is essentially a musical instrument. As it is stupid of the violinist to saw away on the same unfingered string, so it is stupid of the speaker to drone away in the same tone of voice. Just as the musician takes advantage of the tonal range of his instrument, so should the speaker take advantage of the tonal range of his voice.

Tonal variety can be cultivated by exercises, but it needn't be. After all, it is much more natural than monotone. Children don't scream "I'm gonna tell teacher!" in a monotone, nor do policemen speak in a monotone when they ask you where the fire is. Tonal variety will come naturally if you let it. And the best way to let it is to be interested in what you are saying—know the meaning of the words you use, and give them the shading that their implications demand. A simple, bewhiskered example will illustrate. Say "What am I doing?" four times, each time stressing a different one of the four words; change the question to an exclamation and repeat the process. You get eight distinct implications from the same four words in the same sequence.

Now obviously you cannot, while speaking, scrutinize each word you employ to be sure you're giving it the proper shade of emphasis and inflection. But you will come pretty close to proper shading if you are interested in your ideas and in expressing them in the best words you can find. These words pop up or are dragged up, as the case may be, out of your vocabulary; and they have definite meanings which your voice will reproduce naturally.

This quality of tonal variety plus sincere interest in meaning is usually called animation. As far as the voice is concerned, then, animation is the *sine qua non* of public speaking.

Blasting. But we must not confuse animation with that regrettable trait sometimes known as blasting. Rarely, indeed, does a speaker have real occasion to shout; and even more rarely is shouting the real thing for the occasion. A quiet intensity is far more effective in most circumstances than a basso boom or a soprano shriek.

Rate of Flow. Another factor in making the most of the voices we have is the rate of flow—the speed at which we talk. Every individual has a

² Perhaps the best summary treatment is in Chapter 22 of James A. Winan's *Speech Making* (New York, 1938).

normal rate of flow and should not attempt to change it drastically. But slight adjustments may be made easily and harmlessly.

Three types of faulty flow commonly need adjustment. One is the rapid-fire attack, in which the vocal organs are too busy to form the words clearly; this results in badly blurred enunciation. Another is the staccato delivery, in which the words come in separated bursts; this chops up sentences and ideas. The third is the snail's-pace progress, in which each word emerges singly and at its leisure; the result is a series of unconnected words which the audience has to piece together.

With the aid of your critics you will become aware of your faulty flow, and over a period of time you can correct it. Remember that the desired ends are clear enunciation, logical grouping of words, and a fairly even rate of speed. Experience soon teaches you the device of varying your rate of flow to fit the needs of your material—to suggest speed or sluggishness, to create tension, to gain emphasis. The few objective studies of pause length which have been made indicate that experienced speakers make the second longest pauses before nonrestrictive appositive words or expressions (“This phenomenon, alkalization”) and the third longest before the second member of a pair or the second and following members of a series (“Florida, Alabama, and Mississippi”). Manifestly, the longest pauses almost always come at the ends of sentences. Another expected finding is that trained speakers pause not only in order to separate elements which are grammatically different or discrete but also—and often—to show where emphasis should fall.

Fillers. Probably the commonest weakness is the almost universal tendency to fill in with a motley host of *er*'s, *ah*'s, *oh*'s, and *ug*'s. Many speakers abhor a vacuum. They feel that the entire time allotted for their talk must be filled with sound. So they sprinkle in meaningless purrs to fill the spaces between sentences, to occupy the instants between phrases, to pack all the nooks and crannies of the speech.

Now, an occasional *er* or *ah* is not bad—at times it may even be effective—but there is a limit to tolerable *ering* and *ahing*. Many audiences find it easier to count the fillers than to grasp the ideas which they obscure.

There is no easy cure for this. You can help yourself by remembering that *er*'s and *ah*'s don't mean anything; it is as illogical to say them as it is to write them. Even remembering this, you may find it difficult to catch yourself using them. One teacher has had some success in curing the excessive *ah*-user by enlisting the aid of his class; when the obnoxious *ah* appears, the class repeats it, loudly and in chorus. The reminder is convincing. Another teacher, very determined indeed, once discovered that the most immediately effective method was to appoint two or three *er*- and *ah*-killers, who, seated in the audience and amply supplied with ammunition, opened fire, at the first sound of an *er* or *ah*, with chunks of

chalk. While that remedy may be too extreme, keep in mind that every member of your audience is at heart an *er-* and *ah-*killer and is possessed with an itch to fling things.

Enunciation. Second only to animation in vocal importance is enunciation. Theoretically, enunciation is distinct from pronunciation in that enunciation is the *clear* articulation of sounds, whereas pronunciation is *correct* articulation and accent. In reality the two cannot be so definitely separated. True, “vocabulary” pronounced to rhyme with “tomfoolery” is a clear case of bad pronunciation; and there are divers other clear cases. But for our general purpose pronunciation and enunciation overlap to the extent that we can use “enunciation” conveniently to cover both. For example, when *just* emerges as *jist* or *can* as *kin* or *for* as *fer* we may say that the enunciation is bad, even though the fault is technically a mispronunciation of the vowel.

Most bad enunciation comes from not opening the mouth adequately. Many people talk *in spite of* their mouths rather than *with the aid of* them. The words come out crushed flat and squeezed dry by lips like the rolls of a clothes wringer. One of the more practical uses of the lips is to form sounds. So give your lips plenty of exercise when you speak. Another ancient drill is of help here. Go into conference again with the mirror. Repeat the vowel sounds aloud, exaggerating the lip movement. Notice that the position of the lips is distinctly different for each vowel sound. Then go through the entire alphabet, still exaggerating the lip movement. This exercise should convince you how important it is to use your mouth.

Don't carry over too much of the exaggerated lip movement to actual speaking. Slight exaggeration is all right, but excessive mouthing irritates an audience. The golden mean is determined by the amount necessary to clear enunciation. Experiment a bit; your critics will give a verdict.

Even when you enunciate as best you can, you may find some combinations of sounds difficult to “put across.” English has many tongue-twisters. Consequently, when you are to give orders, instructions, and definitions, phrase them in advance if possible, say them aloud to yourself, and rephrase any parts that you find are hard to speak clearly.

This brief discussion has by no means covered all the principles of voice use. It has merely pointed out a few of the salient factors for immediately practical purposes. You are again invited to consult standard texts. Nor has this chapter given an exhaustive treatment of delivery. The fundamental principles alone have been suggested and exemplified. Practice and criticism will be the best teachers of further details.

22. Speech Construction

In dealing with the manner of public speaking we have thus far given scant attention to the matter. But as has already been said, what a speaker says is far more important than how he says it—provided, of course, that what he says is said intelligently and effectively. The present chapter deals with some of the problems involved in building speeches. The first step, both logically and chronologically, is selecting and limiting the subject matter.

SELECTING SUBJECTS

Choosing a subject is not often a serious problem outside a public-speaking course. Seldom are you called upon to speak about “just anything”; the general subject, if not its particular limits, is usually predetermined by the specific situation. Your job is largely one of limiting and organizing.

You cannot hope to talk well about a subject in which you have no interest or about which you have no knowledge. The chances are good that if you talk about something you understand and find interesting you can keep your audience listening. For example, “The Food Habits of the Giant Panda” may sound like a pretty dull subject, but if you’re a giant-panda fan and a good speaker you can make an audience feel for half an hour that there is nothing more fascinating than what and how a panda eats. Be it panda or polymerization, if you know it and want to talk about it, it’s good for a speech. Hobbies, personal experiences, ideas, beliefs, loves, and hatreds—all are grist for the speaker’s mill.

But the speaker’s mill, like the mills of the gods, must grind exceeding fine. For there is a danger in talking about what interests you. It lies in the tendency to forget that what you are talking about must also interest your audience. Speakers too frequently leap onto their hobbyhorses and gallop away gloriously, leaving the audience choking on their dust or sleeping by the side of the road.

LIMITING SUBJECTS

The equestrian metaphor brings us to the pedestrian problem of limiting the subject matter of the speech. The job of limitation is one that all speakers must face, whether their topic is selected for them or by them. The principle is simple: The content of a speech must be so limited in scope that it can be adequately treated within the allotted time.

Let's use our friend the panda to illustrate. Given an hour, the panda expert might choose as his subject "Pandas in Captivity" and offer a fairly comprehensive discussion of panda-ology. But given half an hour he would have to narrow his subject; so he might consider as possibilities "The Home Life of the Panda," "The Panda at Play," or "The Food Habits of the Panda." Suppose he chose the last. In thirty minutes he could do justice to it. But were his time cut to ten minutes, further delimitation would become necessary and he might decide to discuss "The Panda at Breakfast." Unless pandas eat ponderous breakfasts the subject could be covered easily in ten minutes.

UNITY

Limiting the subject matter brings up an attendant problem—that of presenting the narrowed subject as a complete unit in itself. It should be able to stand alone without too much help from the greater subject of which it is a part.

The job of unifying a chunk of a larger subject is usually best done by a very careful introductory statement of background when background is necessary; otherwise by a definite implication of scope. If your limited subject is "Man Overboard" and the incident to be described is one of many that occurred on a long canoe trip, your opening remarks should contain enough antecedent information to satisfy your audience's natural curiosity. You might begin: "It has always been the fate of pioneers to meet, in the course of their travels, moments which dampen their ardor. One such moment came to my brother and me in the summer of 1948, during which we paddled our frail craft, a home-made canoe, down the Red River." In this sentence you tell the audience all they need to know about background. To tell more would waste valuable time and violate the unity of the incident to be treated; to tell less would leave your hearers wondering.

Technical talks often require the same type of introductory background. An explanation of a radio direction finder, for example, might begin: "Among the manifold developments within the broad field of radio there is one which has proved an invaluable aid to navigation, both on the sea and in the air. That is the direction finder." This statement neatly extracts the subject from a larger area and presents it as a unit.

As has been suggested, some limited subjects need no background. To use the panda again, let's assume that your talk is to be about his morning meal. You scarcely need to discuss his ancestry or his condition previous to servitude; it is enough to imply the scope of your present talk. You might begin, "The giant panda displays his nicest manners at the breakfast table," and go on from there.

To select only those details which are significant or illuminating is another way to unify a single phase of a broad subject. Don't try the patience of your audience by describing the laces in your brother's shoes, the early experiments of Marconi, or the hairs on the panda's tail unless these things are particularly interesting or important. Determine your choice of detail at the outset.

ANALYZING THE OCCASION AND THE AUDIENCE

It has been previously suggested that too many speakers leave their audiences in the lurch—a cardinal sin. Usually the speaker adjusts his manner and content in a general way to fit the specific occasion and audience. Often, however, the adjustment is too unconscious and too general, and the speaker suddenly discovers that neither his subject nor his treatment of it seems to fit the situation.

The Occasion. In preparing your talk, consider four factors relative to the specific occasion.

The first is the purpose of the gathering at which you are to speak. The purpose may or may not affect the content and manner of your talk; but in either case you must ask yourself why these people are gathered, and you must determine whether the *why* of the gathering should govern the *what* and the *how* of the speech.

The second factor is the tone of the meeting. Will the atmosphere be formal or informal, placid or tense? Can you indulge in easy digression and casual mannerisms, or must you employ formal delivery and adhere rigidly to the subject?

The third consideration is your position on the program. What will precede your talk? What will follow it? Will your turn come early, when the patience of the audience is still untried, or must you deal with an audience already exhausted by other speakers?

The fourth factor is the physical setup. Is the room large or small? Is there a raised platform? Is there a table or lectern? Is there a public-address system? Is there likely to be extraneous noise?

Careful consideration of these four things—purpose, tone, position on the program, and physical conditions—will be helpful to the speaker and kind to the audience. And kindness to the audience is a virtue than which there is no greater.

The Audience. This virtue may be further cultivated by analyzing

carefully the object of the kindness. It is true that at times the speech is not affected by the nature of the audience to which it is given, but more often it is. Obviously one cannot say the same things in the same way to both illiterate infants and intelligent adults. It becomes, then, your job as speaker to take your audience apart and see what makes them tick; the object of course is to adjust the speech to the ticking.

Basically your analytical task is the same as when you are to prepare a written report; but because audiences differ from readers, and still more from a single reader, it is wise to look at the problem again.

First of all make a *general survey*. The size of the group may help to determine the tone of the talk. The age factor is also of consequence; it affects both manner and content. Frequently the sex of the audience will affect your speech in numerous ways; the interests of men and women, while they overlap considerably, are widely separated at times. The occupation of members of the group may give you helpful suggestions. The education—both formal and practical—of the audience often governs your treatment of your subject. And finally, business and social connections may be significant. To prepare both well and wisely, consider these things, first to discover which of them will affect your talk, and second to decide just how they will affect it.

After taking into account these general considerations, determine as best you can what the *interests* of the audience are. Most important, of course, are those interests which are connected with the subject at hand. Of only slightly less importance are other interests, even though they be totally divorced from your subject matter. For you can catch and hold the attention of many audiences by frequent reference—usually illustrative—to their ordinary everyday interests.

Allied to interests and equally important in your analysis is the audience's *knowledge*. A subject with which your audience is wholly unfamiliar must be treated differently from a subject that they know well.

In some types of speeches you must also analyze audience *attitudes and beliefs*. The toes of an audience are tender and shoulders are chip-laden. Move warily. As a considerate speaker you will not—to mix the metaphor somewhat—ride roughshod over the sensibilities, preferences, and prejudices of the people to whom you are talking. If your subject is a dangerous one, prepare your treatment with extreme care and make provisions for altering the treatment as you talk.

Only after considerable experience can you see or sense the less obvious audience reactions during the talk itself and adapt your treatment accordingly. But there is no law against your attempting to do so.

A final factor is one that overlaps several of the others: *vocabulary level*. Obviously you must not talk over the heads of your audience, nor yet below their understanding. Determine the approximate practicable

level of vocabulary and stay on it. Remember that most people understand more words than they use but are less willing to absorb uncommon spoken words than uncommon written ones.

There remains one question. How are you to accumulate all the information necessary to the careful analysis of the occasion and audience? There is, sad to say, no full answer. But you can at least direct inquiries to persons who are well acquainted with the situation that will confront you. Furthermore, general knowledge and common sense will, in this case as in others, furnish valuable aid.

Probably you have noticed in these paragraphs a conspicuous absence of specific example and illustration. The omission is intentional. Class discussion and self-analysis will serve the purpose far better than any hypothetical case conjured up by the authors.

BUILDING THE SPEECH

Though it is unwise to establish an arbitrary blueprint for building a speech, it is practicable to point out certain functions necessary to all good speech building. What should always be kept in mind, of course, is that they are general functions and permit a variety of treatment.

Perhaps it will be well to assume a specific speech job and follow it through the stages of construction. Let's say that we are to speak to the local chamber of commerce at a noon luncheon. Our time allotment is twenty minutes, and our subject is "Pigs."

Gathering Material. In case we are pig experts the first step in constructing the talk is not difficult; but if our acquaintance with pigs is only casual the job of gathering material becomes more troublesome. For the present purpose we shall assume that we are pig-ignorant. We cannot, then, talk for twenty minutes about pigs unless we learn something about them. One way to acquire the necessary knowledge is by reading; so we go to the library in search of pig lore. We may start with encyclopedias, then go to the *Reader's Guide* and thence to the articles it mentions, and perhaps employ the *Agricultural Index*. We may use these printed sources in many ways. Perhaps we will take detailed notes on everything we read, perhaps on only such material as we think we may want to use; perhaps we'll take no notes at all. The quantity of notes we take and the way we take them will depend entirely upon our mental habits, our memory, and our judgment of what is necessary or preferable.

If we do take notes, we may find it wise to take them on small cards or slips. These will be of great value later in limiting and organizing our material. Also, we shall probably label each card. The labels we may at first make very general; later we can go over our cards and change the labels or make them more specific. For example, we may label one of our cards "Ancestry"; later we may add "Inherited Obesity." The more de-

tailed designation will help us to put that particular card into its proper place in the pack when we are organizing the material.

Printed material is of course not the only possible source of information. Interviews and personal investigation are often helpful. We could easily question a stock farmer about pigs, and personally observe their conduct and characteristics. The findings of our inquiries and investigations we would probably record on cards like those we used for the printed sources.

Now let's assume for the moment that sources are not necessary: we are pig experts. Are we excused, then, from the gathering-material step of speech-building? Probably not. In all likelihood we will have to assemble our material from our memories and put it in some form tangible enough to facilitate organization. Again we may use cards, for we will want to dig the material out of our minds and have it before us in a visible form. Our building materials, regardless of where they come from, must be at hand when the construction work starts.

Determining the Purpose. Now that we have gathered a considerable amount of information about pigs, we must decide how much of it we can use. The primary step in making this decision is to determine the purpose of the speech. We discover that we cannot do this confidently unless we have analyzed the audience and the occasion. So if we have not already done that we do it now. Our occasion analysis leads us to conclude that the tone of the talk should be informal and that we'll have no physical obstacles to overcome. Our audience analysis warns us that the talk must be of interest to a rather heterogeneous group who prefer entertainment to instruction. So we decide that the *general* purpose of our talk is to amuse. Next we must determine the specific purpose, which will in turn define the subject of the speech. Considering the available material, we decide that our *specific* purpose will be to describe the actions and reactions of pigs in such a way that pigs will appear to be only slightly less than human. We can now choose our exact subject. Let's make it "Pigs Are Philosophers."

Limiting the Material. Having determined our specific purpose and chosen our exact subject, we go through all the material we have gathered and throw out everything that is not pertinent. This is the process of limiting the material, which has been previously discussed in some detail. After completing this step we have before us all the stuff the speech is to be made of, but only that; we know that the material can be covered in the twenty minutes we will have at our disposal, and we know that it will comprise a complete unit; we know exactly what our purpose is. In short, we know what we are going to build, and we have at hand the building materials.

Organization. The next problem of course is organization. The likeli-

hood is that we shall want to outline our material. Before we can begin doing this we must determine which method of arrangement to follow. Shall we organize deductively, inductively, or semi-inductively?

Deductive arrangement is the most common and probably the least difficult. So we might begin our pig talk with a statement to the effect that pigs conduct themselves very much after the fashion of human beings, and then go on to elaborate with examples and details and conclude with a restatement of our opening assertion.

Inductive arrangement is often more effective than deductive in certain types of speaking. We could begin with an interesting but fairly isolated fact or observation. To this we could add others until finally the thesis or conclusion develops inevitably. In our projected pig talk we might open with a reference to one or several pigs of some renown; then we might discuss the habits of pigs, mention their social customs, and describe their reactions. We would do this in such a manner that the audience would gradually realize that we are talking about pigs as though they were persons. Then when we stated our conclusion—that pigs conduct themselves after the fashion of human beings—the audience would already have reached that conclusion and would feel rather pleased with themselves for having anticipated us. If our talk is to follow that method, then, we shall arrange our material accordingly.

The semi-inductive method is also available. We can start with an anecdote or an analogy, state the conclusion or thesis at some point in the body of the speech, develop it at some length, and perhaps end by restating it in vivid words.

While most talks can be organized in any of the three ways, you commonly find that certain types of talks suggest deductive arrangement and that other types suggest the inductive or semi-inductive.

Expository material, in general, you can best handle deductively. That is, when there is any possibility of your audience becoming confused in a series of steps or directions, it is advisable for you to state definitely at the beginning just where the talk is going. As we have already implied, the deductive arrangement achieves clarity more safely than do the other types; it leads the audience step by step through a prestated plan.

Inductive arrangement is frequently the most effective when you want to convert or convince. It has the advantage of leading your listeners gradually into the subject and logically up to the conclusion. It avoids the danger of your setting up a formidable audience-resistance at the very beginning. It is dangerous, however, in that it must be used carefully enough to avoid utter confusion. You must arrange and select details in such a manner that they stick closely together and move inevitably toward the desired end.

The semi-inductive method lends itself to any type of speech, the indi-

vidual subject and situation usually determining the degree of inductiveness or deductiveness of the arrangement. It may be the best pattern whenever you can refer to some recent event that will at once attract your audience's interest.

Thus far in our discussion of building the speech we have considered the problems of gathering the material, determining the purpose of the speech, analyzing the occasion and the audience, limiting the material, and determining the method of organization. Now we may consider the actual construction work.

OUTLINING

A speech, like any other creative project, first takes form in the mind. Expert speakers sometimes manage to transfer directly from the mind to the tongue. But for nearly all of us that kind of transfer is too abrupt to be practicable. So we make outlines to aid us in methodical organization. We may, and probably do, differ widely in the kind of outlines we make. This is as it should be; for obviously our different habits of study require different forms of aid, and we should not permit the means to interfere with our effective attainment of the end.

Therefore no particular method of outlining speeches is advocated. The point is that speeches *should* be outlined, and it may be well to experiment a bit to determine what kind of outline is most helpful. Let's consider some of the parts of the speech that should be worked out carefully in the outline.

Regardless of what kind of outlining we use, our first step is probably jotting down the main divisions of the speech. Let's assume that we are preparing a ten-minute talk on—not pigs this time, but pessimists.

We have gathered our material, analyzed our occasion and audience, determined our purpose, limited our subject, decided upon an inductive method of arrangement, and organized our material accordingly. We decide that our talk will have three main points. Our first outline, then, may look like this:

- Introduction
- Earmarks of pessimism
- Effects of pessimism
- Abolition of pessimists
- Conclusion

With this basis upon which to work we can follow either of two procedures. We may work through the entire outline from the beginning, expanding and developing detail, or we may disregard the introduction and conclusion temporarily and develop the three major points. Either procedure is good, and each has its advantages and disadvantages. The choice lies with you.

Since the expansion of the major points of the body of the talk depends largely on the material at hand and on the particular kind of outlining used, no attempt is made here to develop those points. However, it will be helpful to discuss some of the principles of handling introductions and conclusions.

BEGINNING AND ENDING

Preliminaries. As with reports, so with talks: Most introductions are composed of two parts—the preliminaries and the introduction proper. The preliminaries are the remarks dealing with the chairman's or toastmaster's introduction of the speaker and with the customary amenities. You seldom need to prepare the preliminary remarks. They are more natural and effective when they arise spontaneously from the immediate stimulus of the occasion. As a matter of sober fact, the preliminary remarks are often of value only because they give the audience time to settle down and look the speaker over. They have the added advantage, of course, of giving the speaker a similar chance to look his audience over before he plunges into his talk.

But don't assume that the preliminaries are not important. They are. In your first half dozen sentences you may win or lose your battle.

Salutation. For example, the ponderous classification and listing of the members of the audience often seems pompous. There is no reason for beginning a talk this way: "Mr. Chairman, Esteemed Host, Honored Guests, Fellow Statesmen, Members of the Board, and Ladies and Gentlemen." All those persons are present, and it is obvious that the speaker is addressing them; the cataloguing is superfluous. It is much more sensible either to ignore the formal address entirely or confine it to "Mr. Chairman" or "Mr. Chairman, Ladies, and Gentlemen."

Response to Presentation. The response to the chairman's introduction is another preliminary worth considering. In general there are three ways in which a speaker may be introduced.

The first, very common at technical conventions and conferences, is the bare announcement of the speaker's name, position, and subject. This requires no response except usually a quiet "thank you."

Too frequent is the laudatory presentation in which the chairman heaps compliments upon the speaker, reviewing his alleged achievements and perfections. The best response is an attempt to shed the laurels quickly and modestly. Often you can relieve the embarrassment by poking fun at yourself. Booth Tarkington was once introduced by a loquacious toastmaster who informed the audience that Tarkington's speaking ability had been noticed by that great orator, William Jennings Bryan. Tarkington replied that the toastmaster was quite correct. Bryan had commented on two of his speeches, thus: "On the occasion of Mr. Tarkington's first

effort he is reported to have suffered from stage fright to the extent that he was not able to utter a syllable. From what we have heard of the second effort, it seems a pity that he didn't have stage fright both times."

The third and most devastating type of presentation is the toastmaster's roast, in which the speaker is introduced with an anecdote which may be kind or unkind, complimentary or jovially insulting, clean or soiled. Against this variable attack, which men of every profession encounter often enough to need a few pieces of advice, there is no impregnable defense. Some speakers rely on inspiration for a suitable rejoinder; others have on hand a fund of anecdotes from which to draw; some prepare a specific story to use if the occasion warrants; others simply ignore the toastmaster's introduction. The speaker's object, of course, is usually to turn the joke on the toastmaster. But unless this can be done deftly it is better left undone; there is no real obligation to reply in kind. The apprentice speaker may, if he wishes, experiment with the methods suggested above.

Amenities. By "amenities" is meant reference to the honor, pleasure, privilege, or whatever the distinction may be, of speaking to the group. Modern practice tends to soft-pedal remarks of this kind. Some speakers skip them entirely, some dispose of them with a sentence, and some twist them about jokingly. For instance, a speaker may say, "Whatever pleasure it originally gave me to be asked to speak to you is now drowned in a sea of consternation."

Introduction Proper. The preliminaries out of the way, we are free to consider the introduction proper. But we must be cautious. For there should not be an obvious break between the preliminaries and what follows them. Too often the speaker disposes of his preliminary remarks, and then with a sudden shift of tone or attitude plunges into his prepared introduction. The effect is not good. It gives the audience a chance to think, "Well, now we're in for it." You should build an almost imperceptible bridge between your preliminaries and your introduction proper. Usually the bridge grows out of one of your preliminary remarks and leads into your actual introduction. Let's continue, for example, the previously suggested sentence which disposes of the amenities: "Whatever pleasure it originally gave me to be asked to speak to you is now drowned in a sea of consternation." The speaker might then add the bridge-building clause, "for after such a sumptuous meal it seems startlingly pertinent for me to talk about pigs." With that clause he has slipped easily into his real subject. Similar but varying devices may be used to suit the situation. The important point is: Use a transition sufficiently smooth to avoid leaving a perceptible gap between the two parts of the introduction.

The transitional bridge built, or at least provided for, the next ques-

tion is the *content* of the introduction proper. The amount, kind, and arrangement of content depends largely upon the type of speech involved. But all introductions, regardless of the type of speech, have one major purpose: to get the attention and interest of the audience.

Talks arranged deductively may, and usually do, start with a statement of the primary thesis. If such a statement cannot be made interesting or startling, it may be preceded by a statement that is. In other words, even in a deductively arranged talk the introduction may well be arranged inductively. Besides stating the thesis, the introduction of the deductive talk may include definitions, standards or criteria, and background material. A preview or preliminary summary of the entire talk may also be used. The inclusion of these elements depends, of course, upon the specific demands of the subject.

The introduction proper of the inductive or semi-inductive talk customarily concentrates on interesting details. As has been noted before, however, you must use care in selecting and presenting these details; they must not be confusing or misleading—they must be pertinent. Whenever possible, the introduction should encourage curiosity and create suspense.

A word of caution about introductions in general. They must be in proportion to the body of the talk; they must be neither too long nor too short. Of these extremes the first is more common. The introduction of a speech corresponds roughly to the head of the human body: the vertical length of the head should be one-ninth that of the entire body. About the same proportion applies to speech construction.

Although memorizing talks is bad policy, it is often wise to memorize introductions. Pat introductions often alleviate the suffering (both the speaker's and the audience's) which is most acute during the first few minutes of the talk. In memorizing, however, make allowance for smooth transition from the impromptu preliminaries to the introduction proper.

Conclusion. The importance of the conclusion cannot be overemphasized. If the purpose of the introduction is to make a good impression *on* the audience, the purpose of the conclusion is to leave a good impression *with* the audience. Not only a good impression, but a clear one as well. For it is the job of the conclusion to formulate briefly and give clearly a unified picture of the major idea of the entire talk.

It is perhaps harder to finish than to begin. We have all heard speakers who can't turn off the faucet. Long after they have said all that they had to say they dribble on, and at last drip off. To avoid this danger, prepare your conclusion with great care.

Generally the function of the conclusion is to compress the stuff of the talk into a nice compact little ball and toss it into the minds of the audience. In the deductively arranged talk the compression is largely a matter of summary and restatement; you draw together and restate the major

points of the speech and stress their primary significance or application. When your purpose is to persuade or convince, you may phrase this peroration (as it is called) more vividly and forcefully than you did those parts of the body that it summarizes. In the inductively arranged talk you draw the details together closely, and show their relation to each other.

Remember that clearness is paramount and that you get it only through carefully detailed planning. For that reason some skilled speakers commit to memory either all or part of their conclusion.

TRANSITIONS

In speaking, your transitions—your bridges—must be built even more carefully than in writing. A reader can go through your material again and build his own bridges if necessary. The ideas are there in print. He can determine at leisure their relationship to each other. But the listener cannot relisten. You have got to build his bridges for him. Let's see how one craftsman made a bridge that was strong and effective.

In a lecture on biological conservation Julian Huxley discussed in one paragraph the preservation of certain species of animals; in his next paragraph, the preservation of nature as a whole. Had he been aiming at readers he might have begun the second paragraph with "Nature as a whole must also be studied and preserved." But because his material was given orally he said instead: "But as well as the preservation of particular species, there is the preservation of nature as a whole to think about." Huxley made sure that his bridge was firmly anchored to each of the two banks.

Short Transitions. As you know from pages 79-81, there are several types of common transitions. Let us repeat a little of what those pages have said.

The first and probably the most economical transition is attained by the use of demonstrative and personal pronouns. *These* and *those*, *them* and *it* are frequently used in the opening sentence of a paragraph when their antecedents are in the final sentence of the preceding paragraph. A second kind of transition involves the use of words like *however*, *consequently*, *therefore*, and *thus*. A third common type is achieved by the repetition of key words—the use in the transitional sentence of a word or words that occupied a strong position in the last sentence of the preceding paragraph.

Transitional Paragraphs. Another possibility, somewhat different from those already mentioned, is the use of the transitional paragraph (see page 82). Often the shift from one thought to another is too great to be covered by a simple transitional word or phrase. Then you must build a bigger bridge; you must devote a paragraph to the job.

Internal Summaries. It is not enough, however, to build bridges. In a

speech of any length you must also build a few observation platforms from which the audience may look back over the ground you have covered. These observation platforms are the internal summaries and re-statements of the talk. In short talks there is little need for internal recapitulation; the concluding summary is usually enough. But in speeches of greater length you will avoid confusing your audience and losing their interest if you pause in your forward progress and look backward for a moment.

23. Types of Oral Reports

A high majority of all speeches, regardless of their classification, have as either their primary or their secondary purpose the conveyance of information. The speech to convince usually employs information as a basis for "conversion"; the speech to entertain—which you may now and then have to deliver—often depends for its effectiveness as much on the information it contains as on the laughs it raises; and group discussions, conferences, and interviews frequently call for a review of information or for a careful interpretation of it.

The speech designed to inform is obviously, therefore, the kind of greatest use to the engineer. It cannot be wholly equated with the oral report, but the likenesses are great enough to permit treating the two as practically identical.

THE SPEECH TO INFORM

As implied above, there are various kinds of speeches whose aim is to inform: the record of routine performance, exposition of a process or a method, report of a condition, explanation of relationships. The treatment of all of them is more or less the same, so this discussion will be generally applicable.

You have noticed that the descriptive report and the analytical report were omitted from the list just given. The ear is not a good channel through which to receive complex static descriptions or material heavy with statements of assumptions, with equations, and with hypothetical conclusions. Oral reports may contain *some* static description, some statements of assumptions and of hypotheses, even simple equations; but their core should not consist of any of these elements, still less of a synthesis of all of them.

If there were ten commandments governing the informative speech all ten of them would be "Thou shalt be clear." Without clarity the informative speech is not informative. The speech to convince may sometimes be effective through the sheer personality of the speaker and the urgency of

his voice, but the speech to inform fails unless its content is completely understandable.

Types of Organization. Logically enough, the first step toward attaining clarity is to organize your subject matter with care. Of the many arrangements available to all communicators, four are most widely useful to speakers.

The first is "chronological" organization. If the process or situation you are to explain is one in which there are consecutive steps or incidents, follow this arrangement. It is a fairly simple method of organization, but it presents some difficulties. Often, for example, the foundation for one step lies two or three steps back in the chronology, and frequently the effect of an early step is not apparent until after several other steps have been described. In situations of this kind it becomes your job to prepare for later tie-ups as you go along and to go back to previous steps occasionally—and you must do this without confusing the audience in any way. Some useful hints have been given on pages 82-83 and 225.

The second type is the arrangement of steps or items in the order of their position in space. If we were describing the Empire State Building we would not hop indiscriminately about the structure and trust to the agility of the audience to follow us: As page 225 has implied, we would start either at the bottom or at the top and would work up or down, being very careful to take the audience with us from room to room and floor to floor. In this type of organization, obviously, transitions are of paramount importance.

The third type of organization we may call the "cause-to-effect or effect-to-cause" order. Some subjects require this type of treatment, and others permit its use in combination with one of the other types. A simple illustration of the cause-to-effect type of organization is the old saw: "For want of a nail the shoe was lost, for want of a shoe the horse was lost, for want of a horse the rider was lost." Were we to reverse the order of the elements in the quotation we would have an example of the effect-to-cause arrangement: "The rider was lost for want of a horse, the horse was lost for want of a shoe, the shoe was lost for want of a nail."

A considerable number of subjects do not call for any of the treatments described. Consequently there is a fourth division, which may be called the "circumstantial" method of organization. Within it fall those subjects whose treatment is pretty well determined by standard practice or immediate circumstances. For example, a treasurer's report—which may well be an informative speech—ordinarily follows a set procedure; an oral record of routine performance may do the same; and a discussion of current affairs, technical or nontechnical, may be organized to take advantage of the most significant events and developments of the moment.

As was suggested above, two or more of the four methods may at times

be combined. You will be wise, however, to stick to one of them consistently in organizing your major points, and resort to the others, if you choose, in developing some of the minor points.

But regardless of which type or combination of types you use, the principles of clear exposition apply. In the following paragraphs we consider briefly some of those principles as applied to oral exposition.

Introduction and Conclusion. In informative talks, as in all others, the introduction and conclusion require careful preparation. In the informative talk, indeed, the problem takes on added proportions. For not only may the introduction have to capture the interest of the audience, but also it must indicate clearly just where the talk is going, and it must set the audience on the proper track and give them a solid footing. The conclusion must tie together all the loose ends of the speech and leave in the minds of the audience a unified impression of an often complicated subject.

Audience Analysis. As always, audience analysis plays an important part. You must be sure that your level of language, your use of example, and your selection of detail are in keeping with the audience's knowledge and understanding. You must be sure that their primary interests are used as tie-ups to achieve clarity. In a host of other respects, too, you must keep your audience in mind. For a simple example let's return to our old much-abused friend, the giant panda. Were you discussing the panda for a learned biological society you might speak of *Aelurus fulgens*; but for an audience of children or laymen you might speak of an animated teddy-bear. And the bulk of your discussion would differ in like manner.

Simplicity. Another principle of special importance to oral exposition is this: As far as possible, stick to lowest common denominators. That is, make use of the simplest form of things when you can, and stay away from too much explanatory detail. If your purpose is to explain the function of an egg beater, for instance, choose a simple egg beater to start with; don't complicate your basic explanation with unnecessary gadgets, and don't include all possible details—use only enough to insure clarity and at the same time avoid confusion.

Expository Devices. Several expository devices prove invaluable. One is the use of examples and illustrations. A simple instance may at once clarify the statement of an action or a condition; notice the panda illustration on page 269. Other effective aids are comparison and contrast. They also clarify by using material already familiar to your audience; the teddy-bear comparison exemplifies this use. Slightly more intricate is analogy, which frequently is more effective in spoken than in written discourse.

In using all this apparatus of exposition, heed the warning already sounded: employ only enough details and devices to insure clearness and

avoid confusion. This advice is particularly important whenever you are to follow a standardized pattern, as in most oral reports on routine performance and in many on inspections and tests. Do not bore the listener with operational details that he doesn't want, or with comparisons, contrasts, and examples that fail to point up performance or financial trends and may waste the time of busy hearers.

You can often attain clarity by using graphic devices and distributed sheets. When you employ the commonest of these—blackboard drawings—your drawings must be sufficiently simple, you must hold the attention of the audience while you are sketching, and you must not turn your back to the audience and talk to the drawings. Mimeographed material, a second kind of supplement to word-of-mouth explanation, should be used in such a way that the audience does not become absorbed in it to the exclusion of your words. You must distribute such material at the proper time, and you may go through it with your audience, commenting as you progress. Every apparatus demonstration must be simple, quick, and easily understandable, and must sufficiently satisfy the curiosity of the audience so that their minds are ready to turn to the next point when the demonstration is finished. The use of nonverbal aids is treated more fully in Chapter 24.

Delivery. The delivery of the informative speech depends greatly on the subject. If your material is difficult to grasp, speak somewhat more slowly than usual. Be sure to do this when you give production statistics (as in a report of routine performance) or dimensions (as in a report of an inspection) or ratings (as in many test reports). Speak slowly too in describing the parts of a machine and their connections or relationships. Of course, speak fast enough to keep your hearers awake. Remember also that most Americans talk on a dead level and that you will gain hearer interest and understanding if you vary pitch and volume as well as pace.

Transitions and summaries naturally play an important part in speeches to inform, as in all kinds of speeches. What has already been said about them should be applied here.

THE SPEECH TO CONVINCE

For a full discussion of the speech to convince, see standard speech textbooks; the remarks here are limited to the factors and problems most closely allied with oral reports.

Two Types. Speeches to convince can be arbitrarily divided into two kinds: those which attempt to establish facts, and those which attempt directly to stimulate action. Determine carefully just which type your subject demands, because the treatment of each differs somewhat from the treatment of the other.

If, for example, you were to try to convince your audience that a pro-

posed process is inefficient you would be concerned with the first type; you would attempt to establish your contention as a fact. In organizing your material you would make two major, but not necessarily equal, divisions: (1) establishment of definitions and criteria, and (2) application of the criteria to the evidence. You would first define the process and then define inefficiency, or else remind your readers of the definition which they ordinarily employ; and as you define, you would set up criteria of efficiency. Then in the second, and probably longer, division of your talk you would apply the criteria to the process. It goes without saying that this procedure is not invariable. Inductive arrangement of material often reverses the order of the two divisions of the speech, and frequently the divisions are combined or alternated. The two principles, however, are always present in some form or other.

The second type of speech to convince—that whose purpose is directly to stimulate action—customarily has four steps. The first is usually called the “need step”; its purpose is to show that the conditions involved in the question require a change. The second may be called the “satisfaction step”; it tries to show that the proposition being presented will satisfy the need and that it is a practicable solution to the problem. The third is the “advantage step”; it proves that the advantages of the solution greatly outweigh its disadvantages. The fourth is the “superiority step”; it argues that the proposed plan is superior to any other plan that might be set forth. These steps are, of course, present in every effective recommendation report; but when we speak we make them more obvious than often proves necessary when we write.

Let's see how to do the job. Assume we will try to convince our audience that they should vote for a new method of nominating party candidates for the Presidency. In the first step we would point out that the present system is undignified, inefficient, and undemocratic; therefore a change is needed. In the second step we would show that our plan would remedy these evils and would be practicable. In the third step we might admit a few minor disadvantages in our plan but we'd show that they would be greatly outweighed by the advantages. In the fourth step we would show that other possible plans for repairing the evils of party conventions are inferior to ours.

Again it should be remembered that these steps may be varied or combined to suit the subject and the method of arrangement. For instance, the fourth step, somewhat modified, might follow the first; then what is usually the second step might follow what is usually the third—so we end with the second, the “feasibility” step.

Although the treatment of the two types of speeches to convince differs in the number and kind of so-called steps, there is little or no difference in some very important factors of organization and content. The following

paragraphs point out several of these factors and discuss them briefly.

Audience Analysis. In speeches to convince, probably more than in any other type, audience analysis becomes of major importance. You cannot begin to build your talk until you have a fairly detailed audience analysis in mind or on paper. You must know what your hearers' primary interests are, so that your illustrations and arguments and appeals may be properly directed. You must realize what your hearers' fundamental beliefs are, so that you may use them if possible or change them if necessary. You must understand their attitude toward your subject. If they are unaware of the existence of the problem you must make them know and *feel* that the problem does exist; if they are apathetic you must stimulate them to interest and concern; if they are hostile you must tread warily and gradually win them over.

Support and Proof. Another important factor in preparing the convincing talk is the nature of the support and proof you give to your contentions. Simple facts and concrete illustrations are invaluable. Use them liberally. Comparisons and contrasts are great aids to clearness and quick understanding. Perhaps most important is simple, direct, easy-to-follow reasoning—the two-plus-two-is-four kind, the logic of which is immediately obvious.

Introduction and Conclusion. The importance of carefully prepared introductions and conclusion stands out strongly in speeches designed to convince.

A bungling introduction may erect barriers that you cannot overcome; a weak conclusion may obscure the primary argument of the talk and destroy its effectiveness. An excellent technique often used in introductions is the "yes-response." In its simplest form it consists of asking rhetorical questions or of suggesting propositions to which the audience's response is surely affirmative. The psychology is simple; get them into the habit of thinking *yes*.

Conclusions are most effective when they summarize carefully and clearly only the major points of the argument; too much detail is confusing. Conclusions may also include—if the talk demands—an appeal for action; but this appeal should be brief and should be directed primarily to the minds of the hearers rather than to their emotions.

Delivery. In a speech to convince, the delivery must be convincing. Convincing delivery is not necessarily loud; a quiet sincerity is often the best tone. Vocal fireworks and overenthusiastic persuasion may make the audience feel that the speaker "doth protest too much."

24. Special Techniques

The presentation of technical material often makes certain demands uncommon in nontechnical speaking. The skills described in the present chapter will aid in meeting those demands.

THE PROBLEM OF NOTES

Inevitably the question of when and how to use notes confronts the novice. There is no rule-of-thumb answer. There are, however, a number of suggestions that may help in determining solutions for individual problems.

Dangers. Most experienced speakers believe that notes should be avoided whenever possible. Too often they interfere with the progress of the speech much more than they aid it. There are two pitfalls, into either or both of which the speaker may fall with disastrous results. The first is the physical hazard of handling the notes before an audience, the second is the mental hazard of utterly depending on the content of the notes.

The victim of the first may find himself facing an audience with a sheaf of carefully prepared notes in his hand and no place to put them; often there is neither table nor lectern. What can he do? He may, of course, put them behind his back; but when they are needed they must be hauled out with the motion and sound of the flutter of wings. He may hold them in front of his stomach; but if he does he is likely to fold or fiddle with the corners and to look like a little girl twisting her handkerchief in Sunday school; if he can contrive to refrain from mangling them he finds it necessary either to dive into them with his eyes or to haul them up in front of his face, hiding behind them while he is consulting them.

The victim of the mental hazard plans to use his notes as crutches rather than as the cane they should be. Consequently he appears before his audience as a sort of self-made cripple. His mind is divided between the business of expressing ideas clearly and the necessity of getting those ideas from notations made on the paper or cards he carries. The result is

a constant triple play, from notes to speaker to audience; and the audience begins to wish that the man would either read or talk—or neither.

Generally, then, notes are dangerous and should be avoided. If your preparation is sufficient and the subject matter is not studded with figures or formulas you should not need notes. At times, however, notes may be both advisable and necessary. Often they give you a feeling of security, and frequently the content of a talk depends to a great extent on facts or figures that cannot be trusted to the memory.

Size. First in importance are the papers or cards upon which the notes are written. Since notes should interfere as little as possible with the talk, make them as inconspicuous as you can. Small sheets of paper or small cards are therefore best. Ordinary 3 by 5 cards serve very well. They are more easily handled than are slips of paper; and they are small enough to be held inconspicuously in one hand, yet large enough to contain sufficient material. Notes which are too small, incidentally, are just as bad as those which are too large; their smallness intrigues the audience—with a consequent loss in the attention given the speaker—and they necessitate very small writing, hard to read at a glance. Practice indicates that notes should be written on one side of the card only, that the writing should be large, and that abbreviations should be avoided unless they can be read quickly.

Content. The content of notes depends to a great extent on the speaker and the speech; after many trials, each individual discovers what form suits him best. Usually topical outline notes, with indentations and labels, are most easily followed. The notes should not include too much material; the words or phrases should act as catalysts to speed up the speaker's mental reaction.

Handling. With the notes carefully prepared, your battle is half won; but it may turn into a dismal rout unless you handle them properly during the speech itself.

If a lectern is available the problem of using the notes is minor. You can put your cards on the lectern and shift them easily as the necessity arises. A table is much less useful but offers some advantages. Notes placed on a table and handled wisely may escape undue notice. But you must avoid the danger of bending low over the table, burying your eyes in the notes, and presenting the top of your head to an audience which probably isn't interested in the tops of heads.

When neither lectern nor table is available the job of handling notes becomes difficult. To avoid the evils described earlier you can follow a few time-tried principles. In the first place, hold the notes in one hand, not two; for one hand cannot easily twist and maul the cards and give the impression that a feat of legerdemain is in progress. Usually the left hand is better for holding the notes. The right then remains free for shift-

ing the cards when necessary and for the spontaneous gestures that arise during the talk. The best position for the notes is in front of the chest. Then, when you must refer to them, a slight forward motion and a simultaneous dropping of the eyes will serve the purpose.

Never interrupt your talk by referring to your notes. This too often happens when a speaker finishes a sentence or the development of an idea, pauses, glances at his notes, and then goes on. The audience feels that he is tossing them chunks of talk from his basket of notes much as he might toss chunks of fish to a herd of seals. Also, of course, dropping the eyes during a second of silence breaks contact with the audience, a contact often hard to regain. Probably the best way to avoid this danger is to glance at the notes so that you get the "new" idea while finishing the sentence that completes your "old" idea. A little practice will make this easier than it may at first appear.

Summary. The important fact to keep in mind when you prepare and use notes is that they should be inconspicuous enough so that they interfere little with the smooth progress of the speech.

FIGURES AND FACTS

One of the commoner weaknesses in talks dealing with technical subjects is the abuse of figures and facts—not through inaccuracy but through poor presentation. Too many speakers forget that a dimensional or quantitative figure in its purely mathematical form means little to most audiences; hearers have no time to convert the possibly unfamiliar mathematics to familiar terms. You as speaker must present your figures in terms that will be immediately understood.

One way is to use nonverbal aids, which are discussed in the next section. But since these are complicated and offer some risks, you will find it wise to employ other means if you can.

Size, content, distance, and extent are best made clear by comparison with simple, familiar, nontechnical things. The old "end-to-end" device usually works well. For example: "If all the rivets in a B-29 bomber were laid end to end they would reach from here to Milwaukee." The "side-by-side" device is equally old and equally effective: "If the Great Pyramid of Cheops were placed side by side with the National Bank Building the apex would reach the twenty-fifth story." Even in an oral report on routine performance, whose hearers generally are trained to grasp the meaning of statistics, these analogies find a place. Other devices will suggest themselves to you.

NONVERBAL AIDS

Presenting scientific and technological material orally often calls for your using blackboard drawings, charts, graphs, mimeographed material,

and demonstrations. The problem of employing them to the best advantage deserves careful study.

Remember that these devices are *aids*. They must be used to supplement and clarify the material of the speech proper. They are seldom ends in themselves. In your use of them, consequently, take extreme pains to keep them in their place—to keep them from interfering with the major job, which is the talk.

The extent to which you employ nonverbal aids is always determined by the need for them. Don't use them at all unless you feel they are necessary. In determining whether or not they should be used, and to what extent, your subject matter and your audience are customarily excellent guides. There is, however, one general precept: What an audience sees, it remembers better and finds more meaningful than what it hears. Accordingly, complicated figures or relationships that are important to an understanding of the material of the talk may best be presented in a visual form.

Blackboard Drawings. The commonest of the many kinds of nonverbal aids is the blackboard drawing. It is also one of the most abused. Many blackboard "artists" commit two major crimes against the peace and comfort of the audience. First, they stand with back to the audience and draw sketches or write figures while the audience either wriggles in boredom or cranes its neck. Second, back still to the audience, they talk while they draw—talking directly to the blackboard and obscuring the very thing they are talking about.

These crimes you may avoid in several ways. First, maybe you can put the drawings on the board before the audience assembles. Although this solves the major problem it creates a minor one. For when your hearers do assemble, their primary interest will naturally be directed toward the drawings; and if you wish to discuss other material first—as you commonly do—you observe that the audience is 'way ahead of you. If you can cover up the blackboard with a map, a screen, or a curtain, this danger is circumvented.

Generally, though, you will find it impossible or inadvisable to put the drawings on the board before the talk begins. Then you face the job of talking and drawing at the same time. This is by no means impracticable. It can, in fact, be done easily and effectively. The best way is to stand to the audience's right of the drawing space (if you are right-handed), keeping the body at right angles to both the board and the audience. Then with a slight movement of the head you can direct your eyes toward either the board or the audience as the situation demands. Your right arm and hand are left free to sketch without twisting your body away from the audience, and you can talk to the audience rather than to the board.

Obviously you will need some practice before your technique becomes easy and smooth.

Keep blackboard drawings simple and easy to see, and omit unessential details; sometimes you must be inaccurate; occasionally you must distort either outline or proportion. You should of course tell your audience that the omissions, inaccuracies, and distortions are intentional. To make the drawings readable, use very heavy lines and draw all figures large enough to be easily seen by people in the back of the hall. If you can, experiment with lines and sizes in advance.

As a rule you ought to show the audience an overview or general picture before sketching details. However, some machines and even some sites would be unclear if thus presented. Then your drawings must be given to the audience inductively: you must sketch the various parts of the object before you show these parts assembled into a complete unit.

A final caution. *Always rehearse before you give your performance.* Perhaps you can rehearse only on paper, but even that is invaluable. For it is platform suicide to try to use nonverbal aids without having practiced them. You must know exactly what you are going to draw on the blackboard, how you are going to draw it, and what you are going to say about it. Leave nothing to either chance or inspiration.

Poster-Type Aids. Similar in function and effectiveness to blackboard drawings are charts, graphs, and tables of the poster type. These are customarily stood or hung before the audience. They are used to clarify conditions or relationships that may be hard to explain verbally. Like other extraverbal aids they can be badly misused and can defeat their own purpose. For example, if they are visible before you begin your talk they distract the attention of the audience, and if they are too small or too complicated they may confuse rather than clarify.

It is a simple matter to conceal these aids until the time comes for using them. You may place them face down on a table or lean them face inward against a convenient wall. Other equally good methods will suggest themselves.

Like blackboard drawings, your charts and graphs and tables must be large enough, and placed high enough, to be easily seen by all members of the audience. You can insure this visibility by brief experimentation. Colors help make the poster-type of aid effective; take care, though, that the colors are contrasting and not too numerous.

Another important consideration is simplicity. A graph may be useless if it contains more than two or three curves. A flowsheet may mean nothing to an audience if it is crowded with minor steps and processes. You should often resort to omission and distortion in order to make the major point clear; the sacrifice of detail and accuracy is justified by the understanding that your hearers gain.

In using charts, graphs, and tables, don't let your body or arm obscure them. Usually some kind of pointer will serve better than your hand; the pointer should, of course, be long enough to keep you from awkward calisthenics.

Distribution Material. Another kind of nonverbal aid, which presents problems somewhat different from those so far discussed, is distribution material. Usually this is in the form of printed or mimeographed sheets that must be handed out to the audience. Again there are pitfalls. Don't distribute the material before it is needed. If you do, hearers will become engrossed in it to the exclusion of the speaker who is trying to lay a foundation for the use of the material. Moreover, people shuffle and crackle the sheets. And do not give out too much material. Usually two or three pieces is all a person can conveniently handle. Last of all, distribute the material quickly, smoothly, quietly.

If you decide to use distribution material you must plan in detail. First compile the material carefully, making sure that it is clear, accurate, and convenient to handle. Then arrange to have it distributed at the exact point in your talk when it is needed. Ordinarily you should enlist assistants, each with an assigned section of the audience to cover. To insure against confusion and loss of time, instruct the assistants carefully. Some interruption in the progress of the talk is bound to occur, but by thorough planning it can be kept fairly inconspicuous.

You should also plan in detail the use of the material after it has been distributed. You must know exactly how you are going to refer the audience to the content; you must allow ample time for reading and understanding; you must be certain that your explanations and amplifications are adequate, understandable, and as brief as they can be; and you must know how you are going to make clear that you have finished discussing the distribution material and that the audience may now put it aside.

Demonstration. In demonstrating products and processes you either use your own body as a sort of three-dimensional symbol or else you employ other full-scale physical objects which you assemble, disassemble, operate, or repair while you speak.

The advantages of a well-conducted demonstration are clear. It is dynamic, it feeds and sometimes feasts the eye, it usually combines our interest in the human and in the technological.

A clue to the disadvantages is the word "well-conducted." Many poor tables and maps and curves are nevertheless informative, but a poor demonstration is almost always confusing. It is definitely harmful. This drawback would not matter much except that most demonstrations *are* poor. To present a good demonstration is hard. But since demonstration is the only method by which some subjects can be made wholly clear, you should master the fundamentals of the technique.

These fundamentals, obviously, are often matters of scientific and technical expertness. Nevertheless, because our primary concern is the use of demonstrations as aids to talks and not as ends in themselves, some suggestions concerning the general procedure are justified.

Again the principle of timeliness is involved. The materials and apparatus for the demonstration should be kept as inconspicuous as possible until the moment arrives when they are needed. Perhaps you can conceal the setup behind a desk or beneath a cover. If it is too large or too complicated to be hidden you may temporarily allay curiosity by assuring the audience that the mysterious-looking paraphernalia is perfectly harmless and that you will make its function plain in due time. When the moment comes for using it you should justify its presence by explaining clearly why you are using it. Then give a general description of the setup as a whole, just as you would if you were writing a descriptive report (see pages 223-225). The terminology and detail of this account will of course depend on the audience's knowledge, training, and interests. Thereafter you proceed with the demonstration step by step, synchronizing the oral explanation with the procedure. In this synchronizing, remember that the audience's attention is naturally attracted more to action than to words; whenever possible you should avoid action during important verbal explanations. Usually this can be done without an effect of choppiness if you plan and rehearse. In your verbal explanations you should of course keep in mind the audience's "understanding level" and not take too much knowledge for granted.

Be sure the demonstration will work; practice it, and be thoroughly familiar with all its possibilities. Don't fiddle and fuss with the apparatus when it is not being used. By keeping your hands and eyes off it you set a good example for the audience. When you are through with the demonstration leave the apparatus alone; keep the audience's attention upon what you are saying and let them understand that the setup has served its purpose.

Lantern Slides. A final kind of nonverbal aid is the lantern slide. The use of lantern slides requires a technique that can be mastered only after much practice and some experience. A few suggestions, though, can be offered.

First, recall what was said in Chapter 10 about preparing drawings for slides. If your slides are poor, no presentation technique will leave the audience satisfied.

Next, make your preparations for the talk itself meticulous and extensive. Examine the room in which you are to speak. Check on darkening facilities (with attention to ventilation also), convenient electrical outlets, and projection possibilities. Inspect the projection machine to make sure it will handle your slides. Examine the projection screen. Most impor-

tant, instruct the operator of the machine, and rehearse him until he works smoothly with you. Have a clearly audible or visible signal—one that will not distract the audience—for indicating when to shift slides. It goes without saying that you should make sure, before the talk, that the slides are in the right order. Consider too a host of small but not negligible matters such as the distribution of furniture on the platform, the availability of a long enough pointer, and so on.

Besides all these physical considerations you have the problem of the talk itself. You must decide how large a part the slides are to play. You must make sure that they play their predetermined part, and only their predetermined part. It is all too easy for slides to steal the show. Again synchronization has a major role; your verbal exposition must be carefully adjusted to the slides, or the slides to the verbal exposition. Leave nothing to chance. If you do you'll produce chaos. Your audience must have time enough to take in the detail of each slide but no opportunity to look at the slides after you are through with them. Nor, of course, must slides be shown before your discussion calls for them.

READING PAPERS

Ideally, talks should not be read. But there is a kind of oral exposition that calls for reading. The results of many investigations must be presented in written form, and time then allowed for audience discussion. Analytical reports in particular can seldom be delivered extemporaneously. They must be read.

Though much of what has already been said about speaking applies as well to the reading of papers, further advice may come in handy.¹

First, keep in mind that writing for reading aloud differs from writing for silent reading. Unlike the silent reader, your audience will have to go along, or try to go along, at whatever pace you set. Nor can they back-track. So you must aim at immediate clearness. This means that you must so organize the paper that its goal, and its route to that goal, are unmistakable. You must also use many transitions, restatements, and internal summaries. The task is lightened but not removed if the audience has received a printed or mimeographed abstract of your paper.

Your manuscript must be easy to handle, and you must be wholly familiar with its form and content. Like notes, the manuscript should be as inconspicuous as you can make it. Indeed, much of the counsel about the use of notes applies here also.

You must speak clearly and with enough variety of pace, pitch, and volume to keep the hearers alert. Read the paper aloud to yourself four

¹ An excellent discussion is W. L. Everitt, "The Presentation of Technical Developments Before Professional Societies," *Proceedings of the I.R.E.*, 33:423-425, July, 1945.

or five times in advance of delivery. On those rare occasions when this isn't feasible, start the public reading slowly, and speed up as you get (or regain) the feel of the content and style. On the whole, accentuate as you normally do; if you are to say "The first precaution is . . . ; the second precaution is . . . ," you should stress the ordinal adjectives more than you stress *precaution*. At times, though, you must be unorthodox; for clarity's sake you may have to overstress a syllable or change its pronunciation—"I mean *il-lusion*, not *dl-lusion*" or "You must *déscribe* before you *préscribe*."

When you have to read another man's paper, give it six or seven rehearsals. If circumstances prevent your doing this, read the paper to your audience quite slowly. Pause after each period to look ahead a bit. Unless what you are reading is an official order or a formal definition, you can usually feel free to use synonyms for any tongue-twisters or awkwardly repeated words.

ANSWERING QUESTIONS

Sooner or later you will face the terrors of the "question session." Customarily this comes at the end of a prepared talk and permits members of the audience to ask questions concerning the material presented. Since each situation differs from every other, you cannot establish a set routine for handling the questions and the questioners. However, certain factors appear in any question session, and you should be prepared for these likely contingencies.

For example, many questioners speak too quietly for the entire audience to hear and understand. It then becomes your job as speaker to repeat the questions clearly and if necessary to reword or amplify them so that they will be easily understandable. Repeating the question also gives you a moment in which to formulate your answer. After a little practice, you can begin to organize your answer while you are repeating the question.

There may come from the "floor" a question which has little or no bearing on the subject of the discussion. If you can change the direction of the question slightly to make it relevant, do so. If you cannot, you may either answer the question in a few words or say, simply, that you aren't prepared to answer it. Seldom should you indicate that the question was not pertinent.

In the same category with the off-the-subject question is the obviously unanswerable question. Often this type deals with personalities or opinions in such a way that any answer will be embarrassing or stupid. Then all your powers of tact are called upon. You must drop the question without offending the questioner. Again the simplest device is "not competent to answer."

Perhaps the most devastating question of all is the logical, pertinent

question which you *should* be able to answer, but *can't*. The temptation to evade or bluff is great; but yielding to it is disastrous. Audiences perceive the evasion and penetrate the bluff. There is only one honorable way out—a frank admission that you just don't know the answer. And that, after all, is not a damning admission; none of us can know everything we should, even in our own field of specialization.

How to close the question session is important. The effect of the talk and discussion may be spoiled by an inept conclusion. When a time limit is imposed upon the meeting you must observe it to the minute. Usually it is wise to tell the audience, shortly before the deadline, that only one more question can be answered. Questioning may begin to lag before the time limit is reached. Then it is better to end the session prematurely; otherwise the audience may feel embarrassed during the intervals between questions, and the discussion will lose point. When no deadline has been set, use your best judgment. You can be guided by the sustained interest—or lack of it—on the part of the audience and by the quality and pertinence of the questions being asked. In closing the question session it is good practice to conclude with a brief remark thanking the audience for their part in the discussion and assuring them that the pleasure has not been theirs alone.

GROUP DISCUSSIONS

The term group discussions covers a variety of situations. Although you will be most frequently concerned with the conference type, you will participate often in round-table discussions, panel discussions, or some variant of them. There is no need to treat each kind of group discussion individually, for the fundamental principles of all are much the same and can be adapted to specific needs and conditions rather easily. Therefore this discussion will concern these fundamental principles and their application to general requirements.

Analyzing Your Objective. Any group discussion worth the time and effort of busy people has a definite objective. To determine and analyze this objective is your first step in getting ready to participate.

The objective of many group discussions is explicitly named by whoever calls the meeting. Then your primary task is analysis. You must examine the statement of the objective to discover possible implications or hints of aims deeper than those expressed.

When the objective is not explicitly stated, your job is to determine the probable objective. You will certainly know the subject to be discussed, the identity of the other speakers, and the nature of the audience, if any. In that knowledge—all of it, not merely the nature of the subject—lies the key to the solution. Pay special attention to what you can learn about the preferences and pet projects of the other participants.

Assembling Your Material. Once you have analyzed the objective, use the analysis as a guide in succeeding steps, and above all in selecting and assembling your material. Never assume that you can neglect to assemble material. However much information you have in your mind, it may not be enough. So take an inventory. Write down and evaluate the facts you know which bear or might bear on the subject to be discussed; if you note gaps or inadequacies, collect more data. In short, assemble and organize your material as you would for any other kind of talk.

Moreover, once you have assembled and organized the material, make written notes. These notes may well be used in the actual discussion. In that event it is wise to arrange them carefully according to the probable divisions and subdivisions of the general subject.

When preparing material for use in a group discussion, remember that *facts* are of paramount importance. Too often opinions form the major basis of contentions; and opinions without the sound support of facts have little power to persuade. In some discussions, it is true, the expression of opinions and personal evaluations is demanded, but almost without exception they should and can be founded on facts.

Analyzing the Situation. After you have determined and analyzed the objective, assembled and organized your material, and prepared your written notes you have completed most of your preparation job. There remains, however, one step: analysis of the situation. This analysis is threefold—the occasion, the audience (if there is to be one), and the other participants.

What has been said about occasion and audience analysis in Chapter 22 applies here as well; the procedure is the same. Analysis of the other participants, however, is a somewhat different job, and specific suggestions may be helpful.

First of all, it is prudent to learn something of the background—educational, experiential, perhaps political—of the other members of the group. This knowledge will not only indicate their capabilities but also suggest their probable attitudes, opinions, and prejudices. Second, some understanding of personalities, business and social relationships, and habits may contribute to better teamwork and supplementation. Supplementation and teamwork, of course, do not always characterize the relationship between discussion-group members. Frequently there is a clash of opinions and purposes. When this happens, the man who has most carefully analyzed his opponent has a distinct advantage.

Delivery. Logically, the manner of group-discussion speaking should not be called “delivery”; the connotations of the word suggest a continuous solo performance. Psychologically, though, “delivery” is the correct word to use, for each of the separate bits of speaking the participant

may do should be considered as a brief talk in itself. Therefore the standards of good speech delivery must be observed.

As delivery has already been discussed in some detail, little space is given to it here. One important reminder may be enough. The speaking in group discussion should be extemporaneous—not memorized, not read. Extemporaneous speaking, indeed, is the only type that is adjustable to the rapidly changing conditions and demands of a group discussion.

Cautions. Perhaps positive suggestions concerning participation in group talks may best be offered by discussion of some negatives; the *do's* may be clearer in the light of the *don'ts*.

1. Don't forget time restrictions. Time is precious. Customarily, specific time limits are set, both to the discussion as a whole and to the participation of individuals. Often the chairman or mediator, by means of a bell or gavel, confines the speakers to the prescribed limits; if he doesn't, the responsibility falls on each speaker. And it is a responsibility which must be fulfilled. For it is a forensic misdemeanor to monopolize the time of other speakers; it breeds exasperation and often dislike. But don't lean over backward—don't be overlaconic. Use the full time allotted to your part in the proceedings. Conspicuous verbal brevity is often mistaken for verbal poverty.

2. Don't waste time. First, don't forget the purpose of the discussion. Make sure that what you say will contribute directly. If the purpose is purely exploratory, don't waste time on specific recommendations, which are likely to be premature. Second, don't waste time with unnecessary details or overillustration. There is no gain in offering details or illustrations after your point has been clearly supported or illumined. Third, don't quibble over nomenclature. Don't insist that a spade be called a spade if another speaker has called it a flat shovel. If everyone concerned understands exactly what is meant, complete agreement on terminology is unnecessary. There are situations, of course, in which exact nomenclature should be insisted upon, but insistence or haggling is more often wasteful. Fourth, don't be a stickler for parliamentary procedure. Except in the proceedings of formal official bodies, *Roberts' Rules of Order* should be an elastic guide rather than an immutable ritual. Usually it is wise to follow the lead of the chairman, whose privilege it is to observe or disregard established rules of group conduct.

3. Don't be discourteous or tactless. Above all, show respect for the opinions of others. You may disagree completely with another man's opinions and you may distrust his "facts," but he has a right to state those opinions and facts. Usually disagreement is best expressed when preceded by the preliminary, "Mr. X may be absolutely right, but I feel that . . ." Often it is wise to agree in part with a contending opinion: "I agree with Mr. X's major premise, but I might suggest . . ." A belligerent or

sententious frontal attack on the other fellow's position is usually less successful than these strategic approaches. Oftentimes courtesy and tact are demanded by protocol. When a superior in rank is among your co-discussors you must observe the practices and rules in general effect. The temporary status of equality created by the situation does not give you "buddy" privileges. This caution, however, should not be interpreted as advocating subservience; for subservience in any form—be it Uriah Heaping or apple polishing—is both distasteful and embarrassing.

4. Don't heckle. A certain amount of questioning and cross-questioning makes a group discussion lively and interesting; too much of it carried on by any one contestant becomes heckling. And heckling not only disturbs and offends the speaker but also stalls the discussion. Unsound reasoning and inaccuracies of fact should, of course, be challenged; but this can be done without badgering.

5. Don't be stubborn. Compromise plays an important part in group discussions, as in all democratic relationships. Compromise is not a sign of weakness. Often it shows common sense and mental honesty. Moreover, willingness to admit being convinced in some matters may justify a determination to convince in others.

6. Don't get excited. A heated discussion may produce excellent results. But a boiling one may produce chaos and, what is worse, it may "descend to personalities." So it is wise to control tempers and emotions. Keep cool. Coolness also helps to prevent confusion and contradiction in answering questions, a task which is the Achilles heel of many a fluent discussor.

Group-Discussion Leadership. The leader of the group discussion, who is generally called either chairman or moderator, customarily has had considerable experience as a participant and has therefore learned the procedure by observation. Only a brief summary of his duties and privileges is needed here.

The leader's job is primarily to guide and control. He should speak only often enough and long enough to keep the discussion rolling in the right direction at the right speed. His first duty is to state and, if necessary, to explain and limit the subject. Next he may introduce the members of the group to each other or to the audience. Then he calls on the first speaker and thus gets the discussion under way. Thereafter he takes care of contingencies as they arise. He may stop a long-winded speaker or may draw out an unduly laconic one with suggestions and questions; he may challenge weak arguments and call for proof of unsupported contentions; he may steer a wandering speaker back to the route or suggest the development of an interesting digression; he may settle quibbles over nomenclature or demand definitions. In short, he may do anything—and should

do everything—necessary to keep the discussion lively, pertinent, and productive. Experience and experiment will develop this skill.

Chairmen of many industrial or business meetings, conferences, and group discussions have found that time is saved if everyone attending is asked to bring an analysis of the situation that the group will discuss, a brief statement of possible plans, and a short list of recommendations. It is manifest that this method cuts out much of the needless talk that makes many group discussions boring and some fruitless. It is just as plain that the method will seldom work unless the group is fairly homogeneous in its interests and its background information. Even then, most if not all participants must be willing to subordinate their predilections and accept a little concealed regimentation.

The chairman should usually terminate the discussion. In doing so, he can summarize the points upon which agreement has been reached. He may precede this digest by stating points about which there is still difference of opinion. If he can honestly say that the group feels these differences may vanish after more data have been gathered and that Mr. X or the staff of Division Y will assemble these data, so much the better. Whether the chairman should end the session by emphasizing concurrence or divergence of views depends on the situation. Most Americans feel better if the final word is harmony; but sometimes the greatest practical good results from stressing disagreements. If the discussion is to be reported in formal minutes, the chairman should consider how his final words will look when set down or summarized in cold type.

25. Problems and Projects

To facilitate application of the principles discussed, the following seven speech problems and three projects are suggested. They are designed to permit practice in speech-building and in the different "special" types of speech.

Of the three projects, the first affords practice in purely expository speaking; the five talks deal with general types of technical exposition. The second project is composed of six consecutive steps in the building of a complete oral examination report. In the third project preliminary steps in the construction of a fifteen- or twenty-minute "lay" treatment of a technical subject constitute five brief talks leading up to the finished product of the sixth talk.

PROBLEM 1

LIMITATION OF SUBJECT

The Subject. One phase of one of these broad topics:

Science and the Plain Man
Government and Technology
War in the Air
Engineering Education

The Time. Not less than five or more than eight minutes.

The Purpose. To select and limit a part of a larger subject and present it as a complete unit within the prescribed time.

PROBLEM 2

OCCASION AND AUDIENCE ANALYSIS

The Subject and Audience. To be selected or assigned from the following list:

<i>Subject</i>	<i>Audience</i>
1. Atomic Fission	High-School Physics Class
2. Women in Science	Women's Civic Club
3. Abrasives	College Freshmen
4. Alchemy	Rotary Club
5. Soil Erosion	Lumbermen's Convention

- | | |
|-------------------------|-----------------------------|
| 6. The Aluminum Crisis | Women's Club |
| 7. Explosives | High-School Chemistry Class |
| 8. Color Photography | Junior Camera Club |
| 9. The Cyclotron | Businessmen's Club |
| 10. Commercial Diamonds | Women's Club |

The Time. From five to eight minutes.

The Purpose. To adjust your treatment of the subject to the audience and the occasion and to show clear evidence of that adjustment. Before you begin preparation of the talk itself write—to hand in—a detailed outline analysis of the occasion and the audience. In your outline follow the principles discussed on pp. 269-271. If you wish, you may add details not suggested in the text. Use your imagination, if necessary.

PROBLEM 3

INDUCTIVE ORGANIZATION

The Subject. May be of your own choice, but it should be one that lends itself to inductive or semi-inductive arrangement. Perhaps you will advocate the purchase or adoption of a certain machine, apparatus, or process; possibly you will argue that certain changes should be made in the curriculum. Let your choice be guided by the suggestions on pp. 272-274.

The Time. From five to seven minutes.

The Purpose. To present your material in a definitely inductive or semi-inductive arrangement, following the precepts outlined in the text.

PROBLEM 4

INTRODUCTION AND CONCLUSION

The Subject. May be of your own choice. It should be one that lends itself to a twenty-minute treatment.

The Time. To be determined by the length of your introduction and conclusion.

The Purpose. To prepare in detail an introduction and conclusion for a twenty-minute talk. Write out in full both the introduction and the conclusion. Before the class, do the following:

1. Make brief, extemporaneous preliminary remarks.
2. Read the introduction.
3. State briefly the major points or divisions of your talk.
4. Read the conclusion.

(This is not to be a twenty-minute talk; do not develop your major points, merely state them.)

PROBLEM 5

TRANSITIONS

The Subject. Select from any convenient source a printed speech which deals at some length with a technical subject. Study it carefully; make marginal notes, if possible; and prepare to discuss it—with illustrative excerpts—according to the following plan:

1. Give background data, including the nature of the original audience and occasion.

2. Give a brief summary of the thesis of the talk.
3. Analyze the cohesiveness of the talk, with particular attention to:
 - a. Word and sentence transitions—types, frequency, effectiveness.
 - b. Transitional paragraphs.
 - c. Internal summaries and restatements.
4. Suggest possible improvements in the use of transitional devices.

The Time. About eight minutes.

PROBLEM 6

THE SPEECH TO INFORM

The Subject. May be of your own choice insofar as it fits the requirements. The project is this: Assume that you are speaking two, ten, fifty, or a hundred years ago and that your task is to describe to a general adult audience a “recent” invention. (Select an invention—a machine or a process—that is commonly understood today.) Present the exposition so that your fancied audience will understand it. Beware of anachronisms. As a preliminary to your talk, announce the hypothetical period and situation. Suggested topics: the steam engine, the sewing machine, the telegraph, the egg beater, the machine lathe.

The Time. About ten minutes.

The Purpose. Apparent.

PROBLEM 7

THE SPEECH TO CONVINCE

The Subject. May be of your own choice. It should, however, be debatable. Attempt to convince your audience (assume a hypothetical audience, if you wish) that a certain machine, process, plan, or method should be purchased or adopted. Your talk may be either of the two general types described on pp. 283-285.

The Time. From seven to ten minutes.

The Purpose. To apply the principles outlined in the text.

PROJECT 1, TALK 1

Assignment. Definition of a technical term. The choice need not be confined strictly to the field of engineering, but it should be limited to terms not generally understood by the layman.

Time. Three to four minutes.

Audience. Small, general in interests.

Extraverbal Aids. None.

Sample Subjects. Electrolysis, welding, soldering, superelevation, aerodynamics, catalyst, unearned increment, diminishing returns.

Suggested Steps in Procedure.

1. Introduction, explaining the importance or frequency of the term.
2. Brief logical definition; if it is quoted, say so and give the source.
3. Development of the logical definition by one or more of the following methods:

Enumeration of details.

Comparison or contrast.

Specific example.

Elimination.

4. Conclusion, emphasizing the important feature or features of the definition and rounding out the talk.

Aids and Cautions.

1. Do not give a process exposition; keep the talk definitive.
2. Do not read; use notes, if necessary, but use them carefully.
3. Do not memorize; compose your sentences as you go along.

PROJECT 1, TALK 2

Assignment. A nontechnical exposition of the physical layout or plan of a building, structure, or group of buildings or structures.

Time. About four minutes.

Audience. Small, general in interests.

Extraverbal Aids. None.

Sample Subjects. A post office, a theater, a school building, a gymnasium, a large camp, a stadium, a shop, a store.

Suggested Steps in Procedure.

1. Determine and state the basis of your talk (personal experience, photographs, printed sources, etc.).
2. Give information concerning location, age, size, materials of construction, function, importance, surroundings.
3. Begin at a definite point (top, bottom, entrance, exit, etc.) and proceed logically throughout.
4. Come to a definite conclusion—summarize, restate, or return to the point of entry.

Aids and Cautions.

1. Take great care with transitions; make them frequent, logical, and clear; don't jump.
2. Use metaphors and similes, comparisons and contrasts freely.
3. Keep your audience interested; be interested yourself. But above all, be clear.

PROJECT 1, TALK 3

Assignment. A nontechnical description of the physical appearance of a fairly complicated machine or mechanism.

Time. About four minutes.

Audience. Small; general in interests.

Extraverbal Aids. Brief blackboard sketches.

Sample Subjects. A surveyor's transit, a drill press, a blast furnace, a cherry pitter, an anti-aircraft gun, a linotype machine.

Suggested Steps in Procedure.

1. Define the thing you are to describe.
2. Give your subject a background; state where the machine or mechanism is to be found, and what its general function is in relation to the larger unit of which it is a part.
3. Give the audience a broad view—an idea of size, shape, etc.
4. Present details, beginning at a certain point and working ahead logically.
5. Finish the talk with a summary or restatement; leave a unified impression of the object with the audience.

Aids and Cautions.

1. Be sure that your definition is clear; don't confuse the audience at the outset.
2. Remember that a talk of this nature demands use of simile and metaphor, comparison and contrast, enumeration and inference, formal or informal division.
3. Be interested and keep your audience interested.

PROJECT 1, TALK 4

Assignment. A semitechnical explanation of a theory, principle, or function in chemistry, physics, or mechanics.

Time. About five minutes.

Audience. Small group with some understanding of the fundamentals of science and technology.

Extraverbal Aids. Simple sketches permissible.

Sample Subjects. Qualitative analysis, conservation of matter, conservation of energy, lever and fulcrum, internal combustion.

Suggested Steps in Procedure.

1. Define the subject.
2. Give historical background if possible and if time permits.
3. Explain the necessity or importance of the subject to the larger unit of which it is a part.
4. Develop the subject in detail.
5. Summarize and restate the most important features of the subject.

Aids and Cautions.

1. Be neither abstruse nor esoteric; remember that the talk is to be semi-technical.
2. To gain clarity use similes, metaphors, analogies.

PROJECT 1, TALK 5

Assignment. A semitechnical explanation of the working principle of a machine or mechanism.

Time. About five minutes.

Audience. Small group with some understanding of the fundamentals of science and technology.

Extraverbal Aids. Simple blackboard sketches, photographs, or actual demonstration.

Sample Subjects. An electric razor, a mechanical pencil-sharpener, a camera, an electrocardiograph, directional antenna.

Suggested Steps in Procedure.

1. Locate the machine or mechanism in its specific field of service; tell what it is used for.
2. Give brief historical background if possible.
3. If the object is not available for demonstration, give a brief physical description.
4. Develop the working principle.
5. Conclude briefly, possibly with mention of existing defects and chances of future improvement.

Aids and Cautions.

1. Don't waste time on nonessential details; be brief when brevity is advisable.

2. Concentrate on the principle involved and its application in the object.
3. Take care with extraverbal aids or demonstration. Practice before you give the talk.

PROJECT 2, TALK 1

Assignment. A description of the subject of an examination report and of the circumstances of request and submittal.

Time. About three minutes.

Audience. The class.

Sample Subjects. A laboratory, classroom lighting, a heating plant, a projection machine, a rebuilt airplane, a used motorboat, a bridge, a cottage.

Suggested Steps in Procedure.

1. State the subject of the examination and explain briefly why you have chosen it.
2. Construct the hypothetical situation of request—by whom the report is requested and for what purpose; and what action may result.
3. Describe the scope of the report—what it will include and exclude.

Aids and Cautions.

1. Select a subject about which you know something or about which you can readily learn something. But before you make a final choice, examine subsequent assignments in this project to make sure that your subject is adaptable to them.
2. In suggested step 3 be fairly brief; do not trespass on the ground of the second talk. (Before beginning the preparation of this talk examine the other assignments in this project.)

PROJECT 2, TALK 2

Assignment. A plan of the examination report, including a survey of sources of information.

Time. About four minutes.

Audience. The class.

Suggested Steps in Procedure.

1. Review very briefly the information covered in the first talk.
2. State the major divisions of the report and indicate briefly the content of each.
3. Survey the possible sources of information.
4. Conclude with identification of persons to be interviewed or questioned.

Aids and Cautions.

1. In the development of suggested step 2 a brief blackboard outline may be of aid.
2. Be specific in your survey of sources of information. For example, if you refer to "printed matter" tell exactly what types of printed matter may be used.

PROJECT 2, TALK 3

Assignment. A plan for interviews and questionnaires dealing with the subject of the examination report.

Time. About five minutes.

Audience. The class.

Suggested Steps in Procedure.

1. Restate the subject and indicate which divisions of it are to be developed with the aid of interviews or questionnaires.
2. Reidentify briefly the persons to be questioned.
3. Present from a written plan the questions you intend to ask.
4. Conclude with an evaluation of the information you expect to get.

Aids and Cautions.

1. Careful classification of questions is usually advisable in preparing questionnaires and interviews.
2. In using the written plan read slowly and clearly; give the class a chance to evaluate your questions.

PROJECT 2, TALK 4

Assignment. The examination report—with conclusions but without recommendations and instructions.

Time. About twelve minutes.

Audience. A group representing the hypothetical recipient of the report.

Suggested Steps in Procedure.

1. Introduce the report by reviewing briefly the subject and the circumstances of request. (This is the equivalent of the letter of transmittal in a written report.)
2. State in some detail the method of investigation used.
3. Give a broad view—location, ownership, history.
4. Give the report proper, section by section.
5. Conclude with a restatement of the essential findings and a clear statement of the conclusions reached.

Aids and Cautions.

1. Prepare adequate transitions carefully and use internal summaries and restatements freely.
2. Use extraverbal aids if they will increase clarity, but use them cautiously.
3. Rearrange the suggested steps in procedure if the nature of your subject suggests a different treatment.

PROJECT 2, TALK 5

Assignment. The recommendation report.

Time. About four minutes.

Audience. Same as that for Talk 4.

Suggested Steps in Procedure.

1. Give necessary background material—subject, purpose and scope, reference to circumstances of request.
2. Review in detail the conclusions reached in the examination report.
3. State your recommendations in detail. Include, if possible, costs of materials and labor; and estimate time required.
4. Conclude with an offer to supervise the carrying out of the recommendations.

Aids and Cautions.

1. The first step, though brief, is important; be sure to give all information necessary to an understanding of what has preceded the present talk.
2. Steps 2 and 3 may be combined; a specific recommendation may follow each separate conclusion. The nature of your subject will determine which is the better method.

PROJECT 2, TALK 6

Assignment. Oral instructions to carry out the recommendations of the preceding talk.

Time. About five minutes.

Audience. A group of technicians, foremen, or laborers. (The nature of the group will depend upon the work to be done; it may possibly be a mixed group.)

Suggested Steps in Procedure.

1. Give background material, including identification of the subject and reference to your authorization to speak.
2. Give a broad view of the work to be done—the nature and purpose of it and the time allotted for its completion.
3. Give each instruction in detail; include materials to be used, methods of procedure, etc.
4. Conclude with a restatement of each instruction and the person responsible for its execution.

Aids and Cautions.

1. Adjust carefully to the audience the language and tone of your talk.
2. Remember that in actual practice your success or failure will depend greatly on clarity. Above all things, be clear.

PROJECT 3, TALK 1

Assignment. Presentation of three technical subjects, one of which is to be chosen for a fifteen-minute nontechnical talk.

Time. About three minutes.

Audience. The class.

Sample Subjects. The iconoscope, color photography, mineral flotation, the new alloys, plastics, the diesel motor, reforestation, flood control, electricity in medicine, television.

Suggested Steps in Procedure.

1. Name the three subjects, one of which you will choose as your project talk, and explain why you have selected them as possibilities. Let your reasons be based on your knowledge and interest and on probable audience interest.
2. Discuss the difficulties and disadvantages presented by each subject—problems of terminology, clarification, source material, etc.
3. Discuss the relative advantages of each.
4. Conclude with a statement of your probable choice and give the reasons for it.

Aids and Cautions.

1. Before preparing the talk, study carefully the project assignments which follow.
2. In this talk do not develop the subjects; merely define and describe them briefly.
3. This assignment lends itself nicely to a semi-inductive arrangement.

PROJECT 3, TALK 2

Assignment. Description of the project subject and exact limitation of its boundaries.

Time. About four minutes.

Audience. The class.

Suggested Steps in Procedure.

1. Refer briefly to the three subjects considered in the first talk; state your choice and give the reasons for it.
2. Explain briefly the relationship of the chosen subject to the broader technical field of which it is a part.
3. Discuss the necessity for limiting your subject and explain in some detail just how and to what you intend to limit it.

PROJECT 3, TALK 3

Assignment. Discussion of the major divisions of the project talk.

Time. About three minutes.

Audience. The class.

Suggested Steps in Procedure.

1. Review briefly the limitations of the subject, as described in Talk 2.
2. State the major divisions of the talk, describe briefly the general content of each, and indicate what types of extraverbal aids may be used in the development of each.
3. Conclude with a "tie-up" restatement of the major divisions.

Caution.

In step 2 do not include too much of the actual material of the subject; it is to be a general description of the content, not a development of it.

PROJECT 3, TALK 4

Assignment. Presentation of the actual introduction and conclusion of the project talk.

Time. About five minutes.

Audience. The class.

Suggested Steps in Procedure.

1. Make preliminary remarks in which you may indicate to the class what particular problems are involved in your introduction and conclusion.
2. Give your prepared introduction.
3. State very briefly the major divisions of the talk.
4. Give your prepared conclusion.

Aids and Cautions.

1. In step 3 don't expand; merely state.
2. Your introduction and conclusion should, of course, be revised later according to class suggestions.

PROJECT 3, TALK 5

Assignment. A detailed discussion, with the aid of a blackboard outline of the talk, of the transitions, summaries, and restatements to be used.

Time. About five minutes.

Audience. The class.

Suggested Steps in Procedure.

1. Write on the board a bare outline of the major divisions of the talk, including "Introduction" and "Conclusion." (The outline may be put on the board either before or during the talk.)

2. Beginning with the introduction, describe very briefly the content of each division of the talk and give *in detail* the transition from each division to the one which follows it. Include internal summaries and restatements in their proper places.

Aids and Cautions.

1. Use the blackboard outline to help the class keep in mind the continuity of the talk.
2. Give the transitions as they may actually appear in the finished talk; don't merely describe them.

PROJECT 3, TALK 6

Assignment. The final talk.

Time. About fifteen minutes.

Audience. About fifty adults of average education and intelligence.

Part VI: Articles on Technical Subjects

26. Preliminary Jobs

SURVEYING THE POSSIBILITIES

How many strings you want your bow to have, you alone can decide. To the three essential ones—business letters, digests, and reports—you will probably wish to add a fourth: articles on scientific, engineering, and industrial topics. Why? Because to publish articles may yield you these benefits:

1. Growth in:
 - Ability to observe widely and carefully.
 - Initiative.
 - General information.
 - Technological knowledge.
 - Personal contacts.
 - Psychological knowledge.
 - Writing craftsmanship—particularly, a gain in the conciseness and variety of your style.
 - Value to your organization.
 - Cash income.
2. Service to:
 - Your profession.
 - Businesses allied to it.
 - Segments of the general public.

The markets for articles are varied. They include journals and magazines of many kinds; Proceedings and Transactions of societies; house organs; daily newspapers; and special departments or sections of Sunday and syndicated weekly newspapers. The readers, it is therefore obvious, are also varied—scientists and engineers; industrialists and businessmen with technological interests; and laymen of numerous sorts. Articles aimed at the first group are conveniently though inexactly called technical, those aimed at the second group semitechnical, those aimed at the third group nontechnical. As you know, many journals publish both technical and semitechnical articles.

While you are still a novice, several of the benefits that accrue from writing articles may be greater for your superiors than for you, because your technical articles and many of your semitechnical ones will doubtless result from a collaboration in which you will be only a junior partner; a superior's name will precede yours at the head of the article that you and he produce. It may even pay you to be anonymous; in many organizations an engineer can profit by "ghosting"—by preparing articles that carry the signature of some high official. Two cautions are in order: (1) Don't try to ghost unless you know the supposed author's mind and temperament so well that your words will sound like his; and (2) Don't let yourself become wholly anonymous. Publish under your own name also. In fact, work toward the position in which you become known as the senior or indeed the sole author of a good many articles.

What percentage of those articles should be nontechnical is up to you. Of course you don't want to jeopardize your chances for advancement, and top men in many organizations dislike such writings. They condemn "stories" for the layman as skimpy, inaccurate, beneath the dignity of a scientist or engineer, and hence not only valueless but indeed downright harmful. However understandable, to many others this feeling seems narrow and socially imprudent. Nor on an overall view does it appear wise to let just one special department handle all of an organization's written contacts with laymen. It is probable that science, engineering, and industry will benefit if a large number of technical men publish material that not merely interests, but accurately informs, considerable groups of intelligent general readers. The decision, though, is of course yours. Don't crusade against the policy of your organization merely for the sake of crusading, or unless you see some likelihood of winning the point and sincerely wish to win it.

STUDYING THE MARKET

If you are serious in your desire to write articles—which normally implies trying to get them published—your first step is to inventory possible markets. True, when you are the junior author of an article it is the senior who usually "places" the manuscript; and anyone for whom you ghost has normally been solicited by an editor. On occasion, however, even the ghost takes the initiative by proposing to some magazine the submittal of an article "by" Superintendent X or President Y or Board Chairman Z.

This exercise of your own initiative becomes the rule rather than the exception whenever you are to appear as the sole or major author. You should then break down this first step—the lining up of markets—into several operations.

Making a Supply-and-Demand Survey. Begin by inventorying the possibilities. And right here we recommend that you work on a long-term basis

—that you assume you will be writing a number of articles over a period of years. On that assumption, proceed as follows.

List the broad subjects and subject-matter fields on which you are at present fairly well informed. List separately several further subjects and subject-matter fields on which you can readily gain additional information. In making these inventories, don't forget your hobbies.

By conversation, observation, and reading discover which of the topics or subject-matter fields you have listed are likely to have an increasing technical or general appeal, and also which may enable you to speed up your professional advancement if you learn more about them.

Keeping in mind that most articles on technical subjects should be illustrated, estimate what kinds of required or desirable pictures, curves, and maps you yourself can make and how much it will probably cost to get the rest made.

Determine what approaches to a technical subject, and what "tones" of treatment, are natural to you. Decide whether any that are now foreign will probably come to seem natural if you try them. This kind of inventory will tell you whether you should attempt to write articles that are primarily factual, or articles that exercise your constructive imagination (as by presenting hypotheses, theories, recommendations, plans, professional or industrial ideals); whether you prefer to write only about materials, machines, and processes, or about people as well; whether your interest lies entirely in the present and the immediate future, or also in the past and in the more distant future; and, if you have in mind the nontechnical markets, whether you want to aim at women readers as well as men and perhaps at young people as well as adults.

So much for your present and prospective wishes as a supplier. Now for the potential demand.

First, refresh your knowledge of the magazines and the *Proceedings and Transactions* in your own fields of activity and interest. Then familiarize yourself with two indispensable guides to current publications—Ayer's *Directory of Newspapers and Periodicals* and *Standard Rate and Data Service*. Nearly all libraries have the first, and many have both. To get data on house organs, query both technical librarians and also firms large enough so that they probably issue such a publication.

Study thoroughly some two or three issues of each publication that you believe is a possible market.

If you find it advisable to learn still more about publication opportunities you can use *Writer's Digest*, *Writer's Markets and Methods*, and *Editor and Publisher International Year Book*.

At this stage you may want to classify markets more fully than was done in the first paragraph of this chapter; that is, you may want to group them as follows:

1. Newspapers (especially the Sunday editions).
2. Syndicates.
3. Magazines.
 - a. "Class" magazines.
 - Undergraduate.
 - Professional.
 - Trade.
 - b. General magazines.
4. House organs.
5. Society Proceedings and Transactions.

Observe that undergraduate magazines, Proceedings and Transactions, many professional journals, and most house organs do not pay cash.

Name of publication: NEW INVENTIONS

Publisher: Clark-Hinton Publishing Company
42 East Payne Avenue
Cleveland 4, Ohio

Editor: James Ralph (as of 1-1-50)

Preferences: Elec. and mech. eng. topics

Subscribers: Mostly business executives in U.S.
and Canada

Slant: Profits

Length: 500-2000 words; mostly about 1000

No. copies of manuscript to be submitted: 2

Illustrations: Average of one per 500 words;
action photos where possible;
simple machine sketches; few
graphs; no tables

Style: Much anecdote; some personality stuff
on inventors, usually only near end of
long article; not much history; some
humor; slang O.K.; short paragraphs

Nevertheless they may give the student and the young engineer certain nontangible returns of considerable value.

Keeping a Market Record. If your survey is to be really thorough you should keep a card file of data on all publications that you think you may want to "hit." A typical card is shown on page 316.

As you get better acquainted with a publication you can add data on rates of payment, on preferences concerning form of manuscript, on the interval between submittal of a manuscript and its rejection or acceptance, and above all on the publication's "deadline." This last is very important. Hundreds of editorial assistants have to waste much time each year sending back Christmas stories that reach the desk during November. Don't throw such a needless burden on a magazine office; don't brand yourself as an amateur; do show some knowledge of editorial, printing, and distribution schedules. You may be unhappy that, at least as regards nonstaff prepared material, most magazines take four to eight months between receipt of a manuscript and its publication; but you will have to bow to their needs.

27. Writing the Article

GETTING SPECIFIC SUBJECTS

You may be one of those fortunate people whose minds teem with ideas for articles or whose job affords them more material than they have time to write up. Even so, if your plans include the marketing of non-technical as well as more highly professional articles you will probably wish to develop the ability to “nose out” salable topics. Here are some suggestions.

First, don’t try to handle too big a subject. Experienced writers can give in a few hundred words a good bird’s-eye view of a large corporation or even an industrial empire; but the average novice can neither get enough information nor select it so sharply that each detail implies a dozen more.

Second, remember what has already been said (see page 220) about “the simplicity to wonder.” Cultivate that simplicity all the time. For example, ask yourself many questions about your own job—What do I and my fellow workers do that other people wonder about? Why do we do our job in just the way we do? How could it be done better? Your answers may yield topics for half a dozen articles.

Go further. Take into account the distance which a chain reaction travels in our society. For example, certain new and certain possible alloys are of concern to trades that might not at first occur to you—the printing trade, for one. Shoe manufacturers may be able to adapt to their needs some time-saving procedure or some principle of plant layout that is used in your branch of the steel industry. Florists have a dollars-and-cents concern with virtually any developments that speed up transportation. Doctors and dentists might get from your engineering experience or observation some tips on improving their books or channeling patients more expeditiously. And housewives may be able to save steps or money, “dress up” the living room, clothe Jane at less cost, or suggest how to better the lighting and ventilation of Bill’s schoolroom, as a result of innovations in your own field of engineering.

When you thus analyze your own and related jobs for their publication possibilities, do as you should when you make a technical inspection—Go beyond “the brass.” Talk to men at the bench or on the business end of a shovel. Some of these men have knacks and tricks of the trade that apply, or could be applied, in other lines of work.

Or such people may have hobbies in which a house organ or even a professional journal might be interested. To generalize, don’t neglect “human-interest stuff.” If you like people and can draw them out, you can get salable material on both their avocations and their vocations. One suggestion. Don’t limit yourself to men and women doing jobs that are obviously hazardous or picturesque or dramatic. Test pilots, loggers, linemen, firemen, cops—these have all been pretty thoroughly written up. They still yield copy; but you may have better luck if you seek “the romance of the commonplace.” For example, find out how the stevedore’s job affects the stevedore himself and the corner grocer and Mrs. Jones, the grocer’s prize customer. Find out how the skills a grinder uses may mean safer cars or better toys.

There are scores of other ways to get ideas for articles—talks with salespeople, tradesmen, customers of a variety of businesses; newspaper stories of accidents whose cause and prevention will interest travelers or homeowners or entrepreneurs; the want ads, with their clues to significant trends in sales, employment, real estate, and even social habits; statistical tables and charts that raise such questions as Why has the price of flashlights or copper or hot dogs or whatnot recently gone up or down? What other changes will this one drag with it? Are any substitute products or industries springing up, gaining ground, or losing out because of the initial or subsequent changes? How does all this affect readers of Magazine A or House Organ B?

Lack of space prevents the describing of still further possibilities—the anniversaries of products, organizations, famous men and women, technological events; a visit to your plant or city by some technical leader whom you can interview for publication; what several writers call “Sure You Can Get the Idea” stories that explain in simple terms a process or machine or theory which many people (women, for instance) think they can’t understand; and controversies in which the rank and file has been so neglected that there is room for articles on “What Does the Man at the Bench Think?” “How Do Engineering Undergraduates React to Shop Courses?” and “The Apprentices Say No.”

“WORKING UP” YOUR MATERIAL

Once you have got and narrowed your idea for an article you can proceed just as you do when making a report. That is, you can follow whatever work schedule is dictated by your temperament and habits.

Especially is this true of gathering your data. Since all the sources of information you ordinarily use in preparing an article have been discussed earlier, little more is said here. But you do need one suggestion: Expect that interviews with members of the general public will differ from one another more than interviews with technical men. Though many laymen are as brief and businesslike as the average engineer, some will at first drive you crazy by their slowness, prejudice, or egocentricity. Don't get impatient. Gradually you will learn how to obtain information from them. You may even come to enjoy their flavor and idiosyncrasies, and perhaps indeed to try your hand at a "local-color" character sketch or dialogue.

"Slanting" the Article. Having obtained all the information you need for an article, start slanting.

Aim at one specific publication. As you gain experience you may be able to write in such a style that your manuscript will suit Magazine B if it is turned down by Magazine A. But while you are a novice you had better try only to "place" in Magazine A without rewrite.

The next step ordinarily is to phrase a subject sentence. If this can be either the first or the last sentence of your article, so much the better; in any event it should sum up the big fact or idea that you want your readers to carry away with them. Once in a while your choice of markets will be determined by the nature of a subject sentence that springs unsought into your mind. You say to yourself, "That's the kind of 'lead' that *Mining and Contracting* likes." Nine-tenths of the time, though, you should select the magazine first and then frame the sentence accordingly.

Regardless of what market you select, you ought to arouse interest with your title and your first few words. You know without being told that this may be easier when you write for engineers than for businessmen or some part of the general public. But never should you neglect the job. If you aim at a definitely technical magazine, the title of your article can at least be clear, accurate, and fairly brief. For a different audience you must make the title challenging as well, and the lead perhaps equally so.

In case you're no good at formulating titles that will command attention, the editor of a semitechnical or nontechnical magazine may do this for you. But he probably will not rewrite your introduction; it's your job and yours alone to lead off interestingly. Therefore, part of the task of slanting includes the framing of a good title and a good introduction.

Slanting also entails determining in advance:

1. The scale of treatment you will adopt for:
 - a. Text as compared with illustrations.
 - b. Generalizations vs. details.
 - c. Present-tense vs. past-tense and future-tense material.
 - d. Introduction, body, and ending.

2. The tone of your write-up—and any shifts in tone, as from factual to hortatory or “from grave to gay.”
3. The level of phrasing.
4. The order of topics.

In deciding on these matters, keep in mind that nine weaknesses common in “class” magazines are the writer’s fault.

1. Lack of clearly visible pattern.
2. Misleading or long-winded introduction.
3. Undue repetition.
4. Obvious wordiness.
5. Excessive detail.
6. Too much past-tense material.
7. Patronizing tone—easy to fall into when you write controversial articles or “Sure You Can Get the Idea” stories.
8. In long articles, failure to give your reader the internal and final summaries he needs.
9. In nontechnical and many semitechnical articles, too much stress on abstractions and too little stress on people.

To these should perhaps be added another weakness:

10. Failure to accommodate the number, nature, and placing of your illustrations to the typographical requirements of the magazine and to the interests and needs of its readers.

The Actual Writing. The foregoing list of common weaknesses, together with the recommendations in earlier parts of this book, makes unnecessary an extended discussion. You already know that if the readers of the magazine are fairly homogeneous, you can try to picture an average or typical reader and aim at him. You know that if the group is mixed you can aim at some unified subgroup. You likewise know the major principles of content selection, organization, and phrasing that apply to all communications. A magazine’s style sheet will tell you much that you may need to know in addition.

However, a few pieces of advice can be given. These will be of most use to you if classified according to the nature of the various publications for which you may write—with the warning, however, that the line between a technical and a semitechnical article may be thin and wavering and so may be the line between a semitechnical and a nontechnical production.¹

Technical Articles. Many articles dealing with research, and a number that fall into other functional categories, differ little from reports. However, in an article you may have to put a greater burden on words and a

¹ Differences rather than likenesses stand out in P. W. Swain’s “Research in the Engineering Press,” *Telling the Story of Engineering Research* (Iowa City, Iowa, 1949), pp. 37-43.

smaller burden on subheadings, tables, and illustrations. There are two reasons for this: (1) publication costs may force an editor to use few tables, photographs, and curves; and (2) the fact that most magazine editors prefer subheads of only the first and second levels may require you to state your plan and pattern more fully than in a report, and may demand more transitional words, sentences, and paragraphs.

One way to avoid the second disadvantage in part is to make your article virtually a "triple report":

Summary of Test Results

Specimens

Scope of the Test

Results on Tensile-Test Specimens

Creep of Tubular Test Specimens

Comparison of Test Results with Theory

Calculation of Tubular Rates from Tension Creep Rates

Comparison of Measured and Calculated Creep Rates

Approximation Involved for Large Wall Thickness

Appendixes describing Materials and Procedure, commenting on the microphotographs, and giving detailed mathematical results²

Do not be surprised if the editor asks permission to make considerable changes in your text and in the number and placing of your illustrations. He may even make the changes without asking you, though he is not so likely to do this as is the editor of a semitechnical or nontechnical publication.

Semitechnical and Nontechnical Articles. In most articles in these categories, your readers expect an answer to one or more highly practical questions: "Of what specific use is this machine or process?" "What future applications can we see?" "What's this plane got that others haven't got?" "If I (the reader) am being told how to make or test or repair or use something, what special skills do I need, what materials and equipment must I procure, how much time and money will the job take, what cautions and safeguards must I know about?"

Where your answer to these questions will be placed in the article depends on what kind of pattern you believe you should follow or what kind the publication requires or prefers. You have at your disposal all the patterns thus far spoken of—the deductive, the semi-inductive, and the purely inductive. As with news stories and technical reports, so with articles: the deductive is the commonest of the arrangements.

But if you use it, don't adhere mechanically to one set form of it. Don't feel, for example, that the inverted-pyramid form is necessarily the best kind of deductive arrangement; remember that it's likely to give you an anticlimax ending. The full-circle pattern may be better, if your editor

² F. H. Norton and C. R. Soderberg, "Report on Tubular Creep Tests," *Transactions of the A.S.M.E.* 64:769-777, November, 1942.

can spare you the space. When he can, better see that your concluding restatement differs somewhat from your lead. If the lead is literal, make the restatement figurative; and vice versa. If the lead is phrased negatively, make the ending positive. Still other varieties of deductive arrangement are easy to work out. You may get useful tips from Dr. V. K. Zworykin's "The Scanning Electron Microscope," *Scientific American*, 167:111-113, September, 1942. This article adapts the order of its topics to both a complex subject matter and the needs of a specialized reader-group.

Among the several kinds of leads commonly used when a deductive arrangement is followed, two or three should be employed with care in semitechnical and nontechnical articles. Specifically, the straight news-story lead, with its emphasis on the immediacy of the events it covers, can seldom be employed without change, except in some magazines that publish once or twice a week. Again, a formal definition is generally too heavy as a starter. If you feel your article must begin with a definition, do the job informally:

Something new has been added to the vocabulary people use when they talk about building a home. It's *modular*. And it means . . .

If you want a broad statement as your "challenger," followed by your findings or conclusions, make the statement short, get quickly to the findings or conclusions, and phrase these in plain, simple terms. An example will show what is meant.

Lightning has always symbolized the unpredictable. For three years I have personally known just why. For three years I've tried to snare a thunderbolt. Only three bolts came near the tall steel masts put up as lures, and only one bolt actually struck. But the bolts did leave their mark on registering devices. And as time goes on, the knowledge gained will be valuable in the design of the buried cable plant.³

You may think that the partly negative advice given above will hamstring you. Not at all. That many varieties of deductive leads are still open to you is shown by the examples which follow.

"Like the Colt revolver of frontier days, which made the small man the equal of the big, compressed air motors, tools and appliances provide equal manufacturing economies for small as well as large manufacturing plants. The truth of this statement is established in the case of the 100 x 50-foot shop of the Accurate Tool and Engineering Company, San Diego, Cal., which through the proper application of compressed air to manufacturing processes, finds itself in no wise handicapped when competing with larger plants."⁴

³ Adapted from J. J. Mahoney, Jr., "Waiting for Lightning," *Bell Laboratories Record*, 21:86, December, 1942.

⁴ Vaners Borg, "Compressed Air—the Great Equalizer," *Tool Engineer*, 19:43, January, 1948.

"A big welding year has just closed. When compared with some of the war years, it was not big from a sales standpoint; neither was it big because of new developments in the industry. Its bigness was due largely to a change in public thinking."⁵

"An expansion of plant capacity, a more efficient rearrangement of rod and wire mill equipment and complete mechanization of nearly all material handling operations is expected to permit production of 1000 tons of tool, stainless and specialty steel coil products per month at . . ."⁶

"Dramatic design and action demonstrations helped United States Gypsum Company capture more than its share of attention and interest at the recent show . . . at Chicago.

"A blazing blow torch gave dramatic proof of gypsum's major selling point, resistance to fire, in one of four action displays. . . . Other working displays . . . demonstrated sound construction methods for control of vapor, heat, cold and noise in homes."⁷

Leads for semi-inductively arranged articles present just as many possibilities. And here again it is usually advisable to steer clear of bookish diction and syntax, as a *Washington Star* writer did in following his one-sentence big generalization with an indication of the three parts into which the body of his "story" was to fall:

"There's nothing unusual about the weather except the heat.

"The way it happened, the way it is hanging on and the way it eventually will leave us (we hope) are as old as weather itself.

"Broken down to breakfast table terms . . . , what has happened to us goes something like this."⁸

This far along in our discussion of technical communication you don't need much more than a brief listing of other semi-inductive and inductive leads. You know, or can infer, that you may begin your article with an anecdote, with a vivid reference to something that's in the news, with a question that will jolt your prospective reader awake, or with a frightening prediction such as is fairly common in write-ups on atomic warfare, cancer, and the waste of our natural resources. You may even start with a paradox, with a negative definition, with a negative statement of the purpose or scope of your article, and—in manuscripts that originally were talks or addresses—with a reference to the occasion which brought you and your audience together.

Writers for the nontechnical press have sometimes used successfully the trick of describing certain picturesque details of a machine or some

⁵ T. B. Jefferson, "1947 Found Welding Again Winning Rightful Place," *Welding Engineer*, 33:33, January, 1948.

⁶ John Anthony, "Crucible Modernizes Wire Mill," *Iron Age*, 161:70, January 29, 1948.

⁷ "USG Tells Sales Story in Fire, Sound," *Industrial Marketing*, 32:41, March, 1947.

⁸ "Story Behind Scorching Heat: Wind is Blowing Wrong Way," *Washington Sunday Star*, August 29, 1948, p. A-10.

unusual operation in a process before giving an overview of the machine or process as a whole: "The man swung a long forklike tool in an arc above his head. . . ."

Still another device is the analogy:

"The vacuum tubes used in the telephone plant are, on the average, very long-lived. However, with an individual vacuum tube as with a human being, the surest thing about life is that it will sometime end. Among a group of tubes which are made as nearly alike as possible and used under identical conditions, a few may die in infancy, many will live their normal span, and some will last to a ripe old age. Still, while the future of any individual tube may be unpredictable, there is a great deal more certainty about the probable average life of a large group of tubes.

"The statistics of human life are studied by the life insurance actuary so that, knowing the 'life expectancy' of people, he can determine the average annual cost of insuring their lives, and thus establish the proper insurance premiums. Similarly, statistics regarding vacuum tube life are studied by the engineer, so that, knowing the 'life expectancy' of the tubes, he can determine the average annual cost of replacing them when they fail. The engineer, however, has a broader interest than merely determining costs."⁹

Of course you should not overdo these techniques.

Question leads, for example, are shopworn. Moreover, they can easily be carried too far. You can pile query on query until you bewilder the reader instead of stimulating him. Four or five questions at the start are plenty. And they ought to do a double job. They should not only arouse the reader but also imply what plan you will follow in answering the questions and thus in organizing your material.

Apply similar cautions to such devices as the anecdote and the analogy. Keep introductory anecdotes and analogies short. Be sure they have point. Be sure they are truly relevant.

As for the *you* style, which is good when you are actually giving instructions, learn how strongly it may boomerang when used merely as a rhetorical device. Remember that many readers want to stay aloof from an author. They resent any trick of style which can be taken for a "palsywalsy" approach. Other readers may be in a cantankerous mood when they pick up your article; they will be angered by such a point-blank question as "Do you really know your costs?" or by so bland an assumption of omniscience as "Sure you get tangled in red tape."

Most engineers dislike attempts to scare them, and are not much happier when presented with paradoxes.

Negative definitions should be brief. They should also be tactful; refrain from implying that your reader is a dummy because he may take *engine* or *sewage* as meaning something other than the signification that your

⁹ D. K. Gannett, "Determination of the Average Life of Vacuum Tubes," *Bell Laboratories Record*, 18:378, August, 1940.

article assigns to it. Similar cautions apply to starting with a statement regarding the purpose you are *not* trying to fulfill or topics you are *not* going to cover.

Endings demand as much care as introductions. Make sure that your article doesn't peter out into trivialities. But do not feel that a short article must have a formal conclusion. Merely see to it that the article ends instead of just stopping.

REVISING YOUR MANUSCRIPT

As you check what you have written, watch for any passage in which your logic falters. Rethink your way through the passage. Take pains to make the revised version of it "hook on" closely with the passages before and after it. Correct all instances of unclear arrangement. Insert all necessary transitions.

These counsels are not new to you. They have been stressed in every part of this book. Why repeat? For this reason: The informality of style which you will employ in many of your semitechnical and nontechnical writings may lull you into the false belief that logic and accurate organization matter less than in a technical document. Far from it. Your proper aim is to combine clear thinking with clear though somewhat informal presentation.

Watch especially for dull spots. These may occur about a third of the way through the body of your article. If you find any, see whether you will gain vividness by adding a brief anecdote, a little humor, a direct quotation; by changing one or two statements into questions; by deleting every *the*, *that*, and *which* that can be sacrificed; by cutting out some adjectives and adverbs; correlatively, by replacing colorless verbs and nouns with picture-making terms ("swath slashed" for "road made"); by inserting one or two bullet sentences; perhaps by substituting a photograph, sketch, or cartoon for two or three paragraphs of text.

People who read widely will also find dull a style containing stereotyped expressions (worn-out or trite expressions, also known as clichés). By no means every expression that we use frequently should be called a cliché. Many words and phrases must recur and re-recur in our speech and writing—"on the other hand," "in brief," "we agree," "I hardly think so," "it will pay," "off the record," and many more. A cliché is not just an expression that occurs often. It is an expression which was once a fresh way of saying something but which has been used so much by drab people that its life is gone. Common examples are "last but not least, out of this world, the fair sex, rank amateur, the old apple," and hundreds of others. In technical reports you are seldom tempted to use them; in writings that aim at literary excellence you should shun them; in articles for laymen you can employ them if your readers have little general education, but

you ought, even so, to avoid them in order to keep your own outlook and powers of observation unclouded.

Don't violate your editor's preferences regarding diction and syntax and typographical devices. You may even have to cater to what you regard as his prejudices. For example, he may blue-pencil all words of four syllables or more. He may want lead sentences to be deliberately fragmentary ("Two thousand miles an hour"; "Calling all foundrymen"; "Time study and motion study and layout studies"). He may favor, or may dislike, frequent *I*'s. He may eschew hyphens and semicolons. Perhaps he is not even consistent: he may use *lots of* and yet shy away from *in the bag*. Since he knows his readers better than you do, go along with him unless your sense of style will be outraged—in which event you should send your manuscripts elsewhere.

Don't be stubborn about practices that are general among magazine editors or that should be matters of indifference to you. For example, it has become common in recent years to throw what is logically the topic paragraph of a section in with the first developmental paragraph of the body of that section:

"There are as many different impressions of the Alaska Highway as there are travelers over it. To some, it is a rough, tortuous, dusty, mosquito-infested road from nowhere to nowhere. The scenery is monotonous; the food and quarters obtainable en route lack refinement; gasoline becomes more costly with every mile. In short, the Highway is remarkable only for its length.

"To others, the road is a miracle of engineering and the scenery breathtaking. The 26-foot swath slashed through a wilderness becomes a road of romance. . . ." ¹⁰

The slight departure from pure logic is justified by the resulting avoidance of many short paragraphs in a row. For that reason the practice has been used fairly often throughout this book.

¹⁰ Harry Ransdell, "Alaska Is Land of Adventure to Washington Couple," *Washington Sunday Star Pictorial Magazine*, August 29, 1948, p. 8.

28. Final Chores, Mailing, and Marketing

Before you mail your manuscript, do half a dozen jobs.

1. Make sure you have received the go-ahead from every informant who has been told that he may check any of your statistics, statements, and direct quotations.

2. Make sure you have all legally or morally necessary permissions to quote directly.

3. Make sure that no passage contains a libel or invades the legal right of privacy.

4. In typing your manuscript, follow these common practices: (a) leave blank the top half of the first page, and then put the title of the article and the name under which you wish it published; (b) type only one or two paragraphs on the rest of that page; (c) throughout the typescript, avoid carrying a paragraph over from one page to another; (d) use the guide lines and the other ways of making the manuscript easy to read, channel, and file which are recommended on page 165; (e) copyread the text in conjunction with the tables and the illustrations; (f) retype every page that then requires more than three visible corrections or insertions.

5. In preparing your illustrations, follow these practices: (a) caption each illustration accurately and clearly; (b) do not caption a photograph on the back but, instead, type the caption on copy paper and paste the blank top part of this to the reverse of the positive print, with the caption clearly visible below the print; (c) for all illustrations that are to bear official numbers such as Fig. 1, type the number above or before the caption; (d) in addition, type on an 8½ by 11 sheet the captions of all illustrations, in proper sequence and double-spaced; and (e) show where you prefer your illustrations—and also your tables—to be placed. The usual practice is to place a figure or table at the point where reference is first made to it in the discussion. If for any reason the illustration or table should be placed elsewhere, pencil instructions in the margin. Make them brief but clear.

6. Double-check your guide-lining and pagination. All page numbers

should be consecutive. If for reasons beyond your control you must cancel or insert material after you have typed your page numbers, proceed as follows. At the bottom of any page preceding either one or more inserts or one or more cancels, give the editor some such parenthesized directions as "Go to page 12," "Go to page 17a," "Page 12 follows," "Page 17a follows." Some editors wish to have you indicate the pagination twice. On the page after any cancel or insert they wish you to put in parentheses "Page 10 precedes" or "Preceded by pp. 7a and 7b."

Before mailing the article (in whatever number of copies is demanded by the publication to which you are submitting it), make a cover sheet. This should be of the same grade and weight of paper as that on which the text is typed. In the upper left-hand corner of the sheet, 1½ or 2-inches from the top, type whichever of the following expressions suits the circumstances: "Submitted for publication in accordance with your usual policy," "Submitted at the usual rates," "To be paid for at the usual rates or returned in the enclosed stamped envelope." Two spaces below, type your name and address. The corresponding items on the right-hand side of the cover sheet are "For ATOMIC ERA" and "Approximately 1200 words."

About 1 inch down, type a list of your illustrations.

About 3 or 4 inches farther down, type the following data:

1. The title of the article, centered, in capitals.
2. A subtitle that will attract the editor of a semitechnical or non-technical magazine. An example is: "Here's How New Carload Bracing Saved Dollars, Cut Complaints, on the X. Y. & Z. Road."
3. The by-line ("By John F. Sumner").

Some writers follow these three items with a parenthesized note telling the editor briefly what particular reader-group will find the article interesting or profitable, and why. Of course, if you have queried him before submitting the article and are therefore sure he knows who you are aiming at, this note is superfluous.

All the typed material should be arranged symmetrically so that it will be pleasing to the eye.

Now for the actual packaging and mailing.

Do not staple the pages. If there are more than ten, mail them flat rather than folded.

You may find it advisable to put your illustrations within a smaller envelope inside the manuscript envelope. At any rate, you *must* use some effective means of protecting illustrations from dirt, smearing, and crumpling or bending.

As has already been implied, you should enclose a stamped and self-addressed envelope that is large enough to contain the rejected text and illustrations.

When you send out a rejected story again, retype the cover sheet, and also any pages that are dog-eared or dirty. And retype any pages that you have had to revise in order to meet the requirements of the new market.

If you want to go in seriously for nontechnical writing, keep a record of your manuscripts. Here is a record card that is widely used.

Title:				Length:		
Date Written:				Illustrations:		
Publication	Mailed	Returned	Taken	Costs		Pay
				Ills.	Other	

One last suggestion. Many articles on technical subjects should be accompanied by one or more approval sheets. On these, above their signatures, your informants say that the material is factually correct and is releasable. Your reslanting of a “story” after it has been turned down may make a revision of some approval sheets necessary.

Appendix: Instructions Manuals

Even as a young employee you may be asked to help prepare an instructions manual. Your training in the presentation of descriptive reports will aid you. Though most instructions manuals use mainly a “you, do, and don’t” style instead of a third-person declarative one, the likenesses between them and descriptive reports are more noticeable than this difference.

Both demand that you observe accurately, factor operations into their components, and study performance and safety records thoroughly. Both make much use of pictures, maps, flowsheets, graphs. In many manuals these are deliberately simplified, and are also colored for eye appeal and clarity. Again, both are usually arranged on a deductive plan throughout. Like most descriptive reports, the manual first gives an overview; and in dealing with each department, process, or machine it likewise offers generalizations ahead of details.

New or intensified problems that face you when you work on an instructions manual include the following.

What is the best format? Certainly, one that employs facing pages. You want every page to be read; and experimental evidence indicates that people who go through an item on one page will read at least some of the opposite page. If you can take a step beyond this and use a format like that of a railroad timetable, you will increase the readability still more.

Where shall you place vital illustrations and vital parts of the text? The answer is fourfold. For one thing, tie the text and the illustrations as closely together as possible. For another, get essential information in the upper right-hand corner of a page, especially a right-hand page, whenever you can. In the next place, guard against letting any page “fall downhill”; see to it that material in the bottom half of the page will get and hold attention. Finally, try to keep the reader turning the pages; so phrase and space your material that interesting paragraphs and sentences “break over” from one page to the next. To do this, you may have to revise a

good many passages several times. If the manual is to be printed, the revisions will be expensive. They are nevertheless worth the cost if they help hold the reader's attention.

Make your basic arrangement of material crystal-clear. Sometimes you can do this by using as main labels the Six P's—(the company's) Product, Purpose, Policies, Plant, Personnel, and Procedures.

Begin the account of each operation or process with a brief overview, number every step that your reader should perform, and paragraph each step separately.

Use typographical devices to set off your instructions from explanations and from warnings. For instance, explanations may be in ordinary type, instructions in blackface, warnings in red.

Keep your sentences fairly short. This may be hard to do in three parts of the manual. One is the statement of the company's or department's policies. Your superiors may want to employ rather heavy and abstract phrasing; try to get their permission to set forth the policies in a way that the average user of the manual will grasp and like. Long sentences may also be hard to avoid in your statement of the working principle of a complex machine. When such a statement is needed, see whether you can start with a simple, briefly phrased analogy. Shift to your main line with some such expression as "It's the same with this pump" or "This pump works the same way." To avoid long sentences in the actual description of a machine or process, employ *you*, and don't be afraid of *first*, *next*, *after this*. These suggestions plus the use of clear, large, perhaps simplified sketches and diagrams should enable you to keep most sentences short.

The last major problem is: How shall you handle Don'ts? Where shall you put them, how shall you phrase them, how many shall you include? The basic principles are of course twofold: Give no reader an opportunity to risk life, limb, material, or machine; and yet don't antagonize him if you can help it. So include all cautions (and positive suggestions) essential for safety and efficiency, put them where he will come across them before he can make a serious error, set them forth in a way to gain his willing coöperation rather than his grudging obedience.

You may find it possible to put warnings in the third person rather than as commands. If in doubt, be direct and give orders; considerations of safety and efficiency override considerations of tact. But you can generally be at once tactful and impressive, particularly if you give from the reader's point of view the reasons why he should and shouldn't do certain things.

Often you can remove the curse from an otherwise brusque command if you resort to a cartoon or a comic strip. Get suggestions from sales and safety departments, and if necessary from commercial public-relations

firms, on how to use and how not to use these devices. Humor must be good-natured, not savage; and it must be a means, not an end in itself.

These suggestions apply to manuals for both employees and customers. The customer manual, however, demands a few additional remarks.

In particular, you may be tempted to include either too much or too little detail. When determining how precise and specific to be, work closely with your service department. Find out what instructions your customers need in order to keep your product in good working order. If it is a multipurpose material or piece of equipment, tell them clearly the many ways in which it can be used, and with what safeguards or what precautions.

To increase the usefulness of a customer manual, separate the chapters (or sections) dealing with installation, operation, maintenance, and repair. Include clear directions on trouble-shooting and overhaul, and list the chief renewal parts of a machine or piece of apparatus.¹

Look on the customer manual as an opportunity for salesmanship. But do not obtrude that motive. Don't backslap either your customer or your company. Don't toss around a lot of emotional phrases. Remember that the publication is to be essentially factual, temperate, and useful. If kept that way it cannot help being a promoter of good will and of sales.

¹ See George Cushing, "A Working Formula for Technical Manuals," *Industrial Marketing*, 31:44 ff., September, 1946. Also pertinent, though the title doesn't indicate it, is E. H. Cameron's series of articles called "Mental Cramps of the Engineer Writer," *Industrial Arts and Vocational Education*, Vol. 37 (1948).

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