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OUR COUNTRY'S INDUSTRIAL HISTORY

To Tubal Cain came many a one, as he wrought by his roaring fire,
And each one prayed for a strong steel blade as the crown of his desire;
And he made them weapons sharp and strong, till they shouted loud for glee,
And gave him gifts of pearl and gold and spoils of the forest free.

And for many a day old Tubal Cain sat brooding o'er his woe;
And his hands forbore to smite the ore, and his furnace smouldered low.
But he rose at last with a cheerful face, and a bright courageous eye,
And bared his strong right arm for work, while the quick flames mounted high,
And he sang "Hurrah for my handiwork!" and the red sparks lit the air;
"Not alone for the blade was the bright steel made," and he fashioned the first ploughshare!

CHARLES MACKAY



PHŒNICIANS BARTERING WITH ANCIENT BRITONS

From the wall-painting in the Royal Exchange by Lord Leighton, P.R.A.

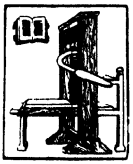
OUR COUNTRY'S INDUSTRIAL HISTORY

BY

WILLIAM J. CLAXTON

AUTHOR OF
'JOURNEYS IN INDUSTRIAL ENGLAND' 'RAMBLES IN RURAL ENGLAND
'LONDON PAST AND PRESENT' 'WORKERS IN NATURE'S WORKSHOP
'LESSONS FROM NATURE'S WORKSHOP'
ETC.

WITH OVER ONE HUNDRED ILLUSTRATIONS



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PREFACE

In this book I have endeavoured to give a simple and logical outline of the industrial history of this country, from the days before the Roman occupation up to the present day, which has seen the development of such inventions as wireless telegraphy and the aeroplane.

It is fitting that the young generation of a great industrial people should have some knowledge of the history of the chief handicrafts with which their own fathers are concerned, and that they should have some realization of the enormous debt which these same handicrafts owe to all who worked and won before us through the centuries that have made England what she now is.

But it is even more fitting that they should be impressed with the special debt we owe to certain of our forefathers who have left their own individual mark on our great industries.

I have therefore included biographical sketches of some of our greatest inventors, in the lives of whom are not a few strange and even romantic incidents. Those lives might be worth recording for these alone, but their real claim to record is that nothing that they have done is a loss, however slight a part it may seem to play in the industrial history they helped to make. Even though they may be, one by one, overshadowed

and almost forgotten as more and more wonderful inventions come to light, yet it is our duty to realize and to remember what we owe to a Hargreaves, a Symington, a Neilson, even as we realize our debt to a Stephenson or a Marconi.

The lesser and the greater, the old and the new, each and all are worthy of their place; and in our wonder at the mighty doings of the latter we have no right to ignore the attempts—no less mighty for their day—of the former. The latter have perhaps, to speak figuratively, changed the face of the world. But the former did so much to make that world that without them it might never have been what it now is.

My book is intended mainly for use in the senior classes of day schools and for evening institutes. It is my hope that the intelligent student will have his interest aroused by the perusal of the progress of scientific discovery, and by the romance of the lives of those to whom this progress has been due; and I trust that he may thereby gain an incentive to the further study of the whole subject. And, for this, I would commend to his notice the works which I name below, as well as those from which I quote throughout my book, as he will gain therefrom a fuller and more detailed knowledge than that which I can offer him in these pages.

I have thought it advisable in three or four cases to include extracts from various old charters and books describing the manners and customs of the people and the industries in which they were engaged some centuries

ago. Among these extracts—some of them are quaint in their old phrasing—is a passage from the "Charter of the Sheriffs of London," showing the importance of the wool trade in the Middle Ages; there is also the description of our early fairs and markets taken from Defoe's *Tours*.

In compiling this history I have consulted over twenty standard works; but I must acknowledge my especial indebtedness to Toynbee's *Industrial Revolution*, Cunningham's *Growth of Industry*, Adam Smith's *Wealth of Nations*, Yeats's *Technical History of Commerce*, and Gibbin's *Industrial History of England*

W. J. C.

CONTENTS

CHAPTER		PAGE
I.	THE SCIENCE OF ARCHÆOLOGY	13
II.	THE STONE AGES	17
III.	THE DISCOVERY AND TAMING OF FIRE	24
IV.	THE BRONZE AND IRON AGES	28
V.	THE ROMAN OCCUPATION OF BRITAIN	34
VI.	INDUSTRIAL DARKNESS	39
VII.	THE MANORS	48
VIII.	HOW THE CRUSADES RESULTED IN THE DEVELOPMENT OF TOWNS	55
IX.	THE TOWNS	60
X.	MEDIÆVAL MARKETS	65
XI.	THE FAIRS	74
XII.	THE MERCHANT GUILDS AND CRAFT GUILDS	80
XIII.	SHEEP-FARMING AND WOOL	85
XIV.	THE INFLUENCE OF THE FLEMINGS	93
XV.	THE INFLUENCE OF THE MONKS ON INDUSTRY IN THE MIDDLE AGES	97
XVI.	THE EARLY HISTORY OF THE WOOLLEN INDUSTRY	104
XVII.	THE BLACK DEATH AND ITS INFLUENCE ON INDUSTRY	110
XVIII.	THE RISE OF OUR GREAT INTERNATIONAL TRADE	116

CHAPTER PAGE

XIX. The Coming of the Huguenots . . . 121

XX. A Revolution in Industry 124

XXI. The Factory System and its Evils . . 131

XXII. The Three Great Inventors of Textile Machinery 140

XXIII. The Development of the Coal-mining Industry 154

XXIV. The Progress of Steam Navigation . . 160

XXV. The Development of the Iron-smelting Industry 164

XXVI. Means of Transit and their Development . 170

XXVII. The Introduction of Printing and its Effect on the Paper-making Industry . . 181

XXVIII. The Development of the Leather-worker's Craft 190

XXIX. The Development of the Potter's Art 195

XXX. Machines and their Effect on Industry, with a Note on the Sewing Machine . . 204

XXXI. Great Discoveries which have been made by Chance 209

XXXII. Electricity and its Influence on Commerce 212

XXXIII. The Conquest of the Air 221

XXXIV. Free Trade and Protection . . . 229

XXXV. The Age of Invention 233

Index 247

OUR COUNTRY'S INDUSTRIAL HISTORY

CHAPTER I

THE SCIENCE OF ARCHÆOLOGY

HAVE you ever asked yourselves how our great historians obtained all their knowledge of the life and habits of mankind in its earliest stages—its prehistoric age?

We all know that there are no written records of British history previous to that found in the *Commentaries* of Julius Cæsar, written hardly fifty years before the beginning of the Christian era; these give us the first written, reliable, and clear account of Britain as Cæsar found it.

Yet people talk often enough, and in quite familiar terms, of the different 'Ages'—Iron, Bronze, Stone—centuries before Cæsar was born; they discuss the manners and customs and lives and surroundings of cave-men, tree-men, lake-men; they inspect, knowingly, the crude tools and weapons of those remote ages, until we have almost the impression that, after all, these early folk did not live so very long ago. We may even imagine that they do live somewhere rather far away—something like the savages of Africa. Where do they get all this knowledge?

They owe it all to the archæologist. Archæology (the word is derived from *archaios*, old, of the begin-

ning, and *logos*, word, discourse) is the science of ancient things. The archæologist searches for and examines and compares the relics of bygone ages, and from these he pieces together the history and the picture of the days when those relics were—well, let us say modern articles of daily use. Archæology is deservedly called a science, for it involves the systematic and scientific investigation and use of its subject-matter. It has its two sides—the historic, as confirming (or upsetting) written history, and the prehistoric, as discovering and arranging the material from which can be compiled the history that has not yet been written, because it describes a period when nobody could write it. And it is this prehistoric side that concerns us, as it gives us the records of Britain in the days when no written records were possible.

There are ignorant and narrow-minded people who ridicule the archæologist and his labours. They read of his digging into buried cities, cairns, caves, dry river-beds, sites of ancient lake dwellings; unearthing and deciphering dirt-encrusted coins, broken pots, ornaments, lamps, rusted weapons of war or the chase; reading the marks on Cleopatra's Needle or on Assyrian bricks; and they set him down as a 'crank,' 'not quite right in his head.' Business men call it a misuse of money that might otherwise be really well employed when they read of exploration funds; others—detectives, perhaps—will say that it is a waste of brains and faculties that could find many better fields of occupation. At best the general public looks on archæology as a harmless hobby, but of little practical use to mankind.

But ask the geologist, the philologist, the historian, the ethnologist, what they think of archæology. To

the first of these it means the study of rock-formations and strata and the fossilized remains found therein; for the second, it is light thrown on the origin of languages and dialects; for the third, those crumbling and age-eaten relics are the facts of the ages he is studying; for the last, it is the revelation of the customs and institutions and characteristics of early mankind.

The nation has deservedly paid honour to the memory and the work of Captain Scott, who lost his life on his way back from the South Pole. That brave explorer and his gallant little band of followers gave up their lives in the cause of scientific discovery, and the country, very rightly, paid them their due tribute. But those very people who speak so scornfully and sarcastically of the work of the archæologist very probably spoke in similar terms of Scott's work before the news of his death reached England. "What useful purpose could be served by tapping about the rocks buried beneath the Antarctic snows?" they asked; "what is the practical value of the relics found in that lonely tent? No one can possibly live near the South Pole, then why risk one's life in trying to discover it?"

Some people delight in calling themselves practical. But they forget that many of the very industries in which they themselves are engaged owe their very origin to scientific investigation and invention, and that these things are not, as a rule, the result of accident. It is rather a similar attitude to that of people who wonder why certain individuals pay hundreds of pounds for masterpieces of painting, or why collectors of china go into raptures over 'priceless' specimens of pottery; why the signature of the painter should be worth so much more than a reproduction; why such care is

taken of that piece of Sèvres when a sixpenny cup will hold the tea quite as well. It is not quite the same thing; inventions are a necessity, whereas art is in most cases a luxury. But the instance serves to show that we must not always think that this or that is valueless because we cannot see any immediate and tangible result from it.

But perhaps you will ask what immediate connection there is between archæology and industrial history. It is simply this, that archæology reveals and explains, as does nothing else, the primitive industries of prehistoric races, and that we must study these primitive industries if we are to know the origin of our modern industries. In the chapters that follow we shall speak of the various stages of primeval man; and when we discuss the origin of his rude weapons and domestic implements, when we discover the beginnings of his simple handicrafts that are the foundations of all the complex modern industries for which our nation is today famed throughout the world, then you will realize what a debt of information we owe to the patient and painstaking archæologist.

CHAPTER II

THE STONE AGES

ARCHÆOLOGISTS divide the primeval history of this island into three periods, or 'Ages,' and these are known as the Stone Age, the Bronze Age, and the Iron Age. By 'Age' we mean the stage at which a people has arrived, and the descriptive words 'Stone,' 'Bronze,' and 'Iron' are used on account of the materials employed in the construction of weapons and domestic implements during these particular periods.

Lord Avebury, one of our distinguished authorities on archæology, has divided the Stone Age into two parts. These are the *Palæolithic*, or Old Stone Age; and the *Neolithic*, or New Stone Age. In the former period the stone tools were not polished or fashioned so skilfully as in the latter Age.

Let us take a peep at some of the dwellers in this country during this remote Stone Age. So far as we know, most of them appear to have been cave-dwellers or *troglodytes*. Theirs was a very low state of civilization, and no traces of metal are visible in any of their tools or weapons. A descriptive writer tells us that "before the coming of the Celts into Britain this island was thinly inhabited by a race of stunted savages whose tools and weapons were of flint, wood, or bone; who dressed in skins, painted their bodies with red ochre and blue woad juice, and who lived by hunting." This

was in the time when—as now in Labrador—glaciers filled the upper parts of the river-valleys, and in the plains and over the moors roamed elks, wild oxen, wild horses, cave-lions, cave-bears, hyenas, while the low-land swamps harboured river-horses, elephants, and rhinoceroses.

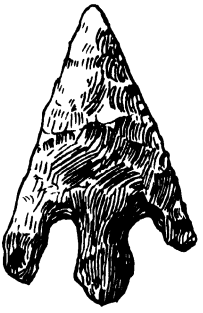
There is no doubt that the climate of this country in those early times was very different from our climate of to-day. This is proved by the remains of animals discovered in Somerset, Yorkshire, Kent, and other districts. At the famous Wookey Hole in the Mendip Hills (first investigated in 1852) were discovered 467 specimens of the hyena, 15 of the cave lion, 27 of the cave bear, 11 of the grizzly bear, 11 of the brown bear, 7 of the wolf, 30 of the mammoth, 233 of the rhinoceros, 401 of the horse, 30 of the bison, 35 of the great elk, 30 of the reindeer, as well as remains of several smaller animals, all embedded together and intermingled, thus showing that all these creatures were living at about the same period.



A Man of Primitive Times

Another writer says of these prehistoric caves: "The hyenas were the normal occupants of the cave, and thither they brought their prey. We can realize these animals pursuing elephants and rhinoceroses along the slopes of the Mendips till they scared them into the precipitous ravine, or watching until the strength

of a disabled bear or lion ebbed away sufficiently to allow of its being overcome by their cowardly strength. Man appeared from time to time on the scene—a miserable savage, armed with bow and spear, unacquainted with metals, but defended from the cold by coats of skin. Sometimes he took possession of the den, and drove out the hyenas—for it is impossible for both to have lived in the same cave at the same time. He kindled his fires at the entrance to cook his food, and to keep away the wild animals; then he went away, and the hyenas came back to their old abode."

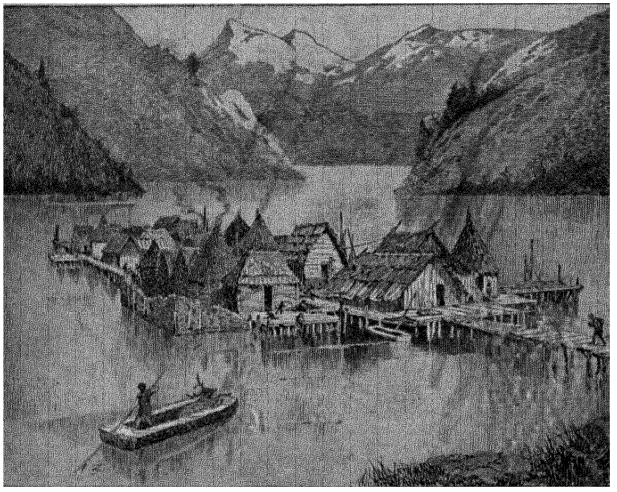


STONE ARROW-HEAD

Now we know that hyenas, lions, and elephants cannot live under the climatic conditions of modern England, and so the evidence obtained from the presence of animals that we now find in tropical countries, proves that the climate of this island was considerably hotter than it now is.

In all parts of Europe cave-dwelling preceded house-building. The earliest form of 'house' is thought to have been the lake dwellings, which were curious habitations supported by piles sunk near the shores of lakes. Lacustrine remains have been discovered in England at Glastonbury, and in Ireland, as well as in many parts of Europe and Oceania. Herodotus, who was practically the earliest reliable Greek historian, described lake dwellings as being approached by a narrow bridge, each habitation having a trap-door in the floor, giving access to the water beneath, through which fish were

caught. It is generally agreed that large populations inhabited these lacustrine villages over a long period of time, and this period is said to belong to the Stone and Bronze Ages. At an earlier period man appears to have lived among the boughs of trees, after the manner of



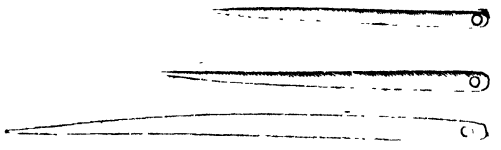
RECONSTRUCTED VILLAGE OF LAKE-DWELLERS
From "Cave, Mound, and Lake Dwellers," by Florence Holbrook

monkeys, his 'house' consisting of interwoven branches and twigs formed into the shape of a hammock, and lined with some soft materials.

The caves were large openings in the rocks, or in cliffs —usually found in limestone formations; probably they were the result of the action of water on the limestone. There are several natural caves to be seen in England to-day; the chief of these are the Tilly Whim caves at Swanage, and the Cheddar caves in Somerset.

All the fossilized remains unearthed from prehistoric caves have been found to be embedded in sand, clay, and gravel, and pressed into the solid rock.

Fossils are of two kinds—one, a *cast* in stone of the bones or the imprint of men or animals or other creatures (there are, of course, such fossils of plants or trees); the other the *actual* bones or substance, buried and preserved in the material in which they are found. These various fossils have their importance in that they show us the appearance, size, shape, and structure of the



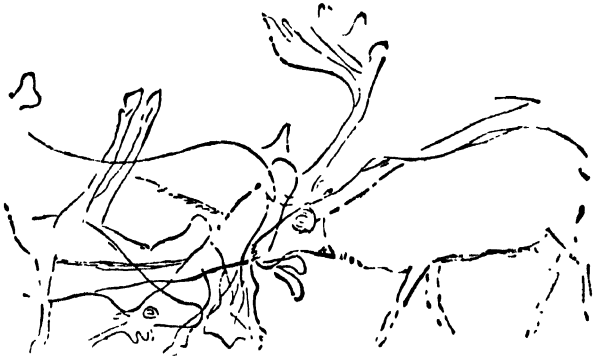
BONE NEEDLES

men or animals, etc., etc., which they have preserved for us. To show what curious details come to light, illustrating even small aspects of prehistoric life, there are even instances of discoveries of the bones of animals long extinct—which bones have been found to be *split up lengthwise*, evidently suggesting that the cave men had split them up to get at and eat the marrow!

In the Palæolithic Age, the cave men were a timorous race, for ever hiding and fleeing from the savage beasts that roamed the forests and prowled about the river-valleys. The very fact of their choosing caves shows the need they had of a relatively safe refuge. Their tools were bone and stone awls, bone spear-heads, stone hammers, flint flakes, bone needles, and reindeer antlers. They were clad in skins sewn together with the intes-

tines or sinews of some animal. Their food consisted mainly of the flesh of the reindeer, then in a wild state; for that matter, no animals appear to have been domesticated at that time. They were wholly ignorant of the arts of spinning and weaving, nor was any sort of pottery known to them.

A modern race of people corresponding most closely



PICTURE OF REINDEER, SCRATCHED ON SLATE, FOUND IN A CAVE IN FRANCE

to that of the prehistoric cave men is the Eskimo race. Their weapons and tools are of similar make, and their methods of sustaining life are much the same as those of the Troglodytes There is this difference, that they have, instead of the hyena, elephant, or cave-lion, the seal, the walrus, and the whale. But they, like the cave men, have the reindeer which, however, they have tamed.

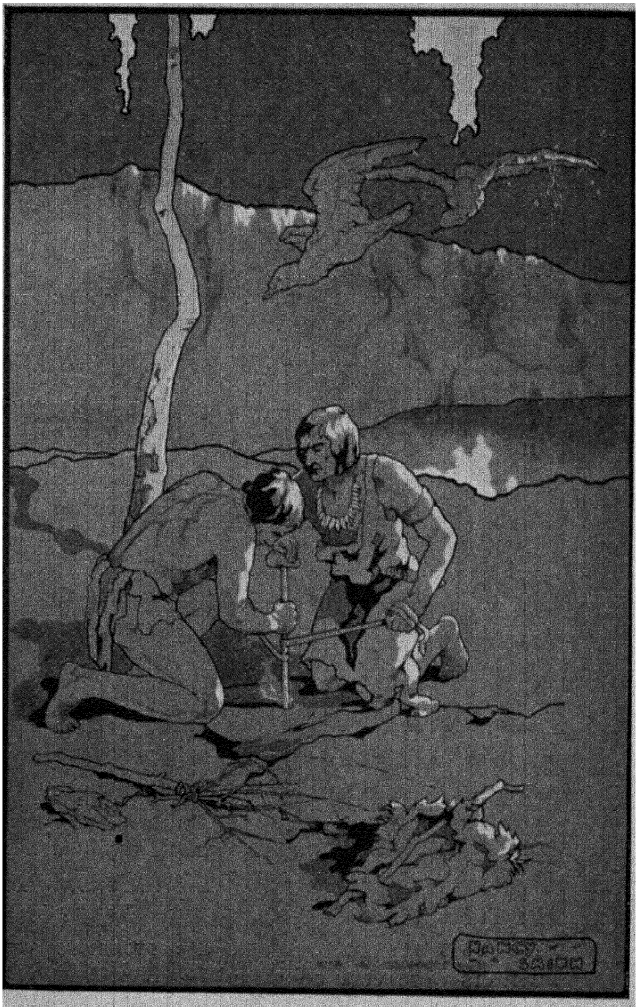
In summer the Eskimo lives in a tent covered with skins and in winter he burrows into a snow hut.

CHAPTER III

THE DISCOVERY AND TAMING OF FIRE

We have spoken of the cave men and have tried to indicate how almost defenceless was their life, how entirely comfortless. We now come to the great change that spread over the land at the discovery and taming of Fire—that most terrible master but steadfast and useful servant, through whose agency man was destined to take his proper place as the Lord of Creation. It has been said that human culture began with fire. And indeed it produced, for our primeval forefathers, the first real advance in their manner of living, even as it was (if we go right down to the facts) the starting-point of the great inventions of the world.

How fire was discovered we cannot say. There is no doubt that the ancients had seen the effects of fire in many forms. There was the volcano, lighting up the darkness of the night for miles around, and vomiting its burning dust, ashes, and lava. There was the lightning, which struck and charred mighty forest trees; even the rays of the summer sun may have set light to dry herbage. It is not impossible or unlikely that the Ancients, seeing what a terrible weapon fire was in *Nature's* hands, gave much anxious thought to the possibility of producing it for *their* use. They knew some of its dangers, and they could foresee many



MAKING FIRE IN THE STONE AGE

Reduced from the wall-picture in colours, by Nancy Smith

of its uses, if they could only find some means of making and controlling it.

Lord Avebury, to whom we have referred previously, says that the making of stone into tools must have been soon followed by the discovery and use of fire, from the sight of the sparks produced by knocking together the dry flint flakes. The toolmaker would find that rapid and sustained friction produced a series of sparks, and that the stone soon became warm. Perhaps one day a spark caught and kindled dry grass or tinder that happened to be within reach; perhaps even some one *placed* such tinder near with the idea of firing it.

It is strange that the very tools used by these primitive fire-raisers have been used for thousands of years, by Britons and then by English. Indeed, the flint knapping industry is still carried on at Brandon, in Suffolk. For centuries our guns were fired by sparks from flint flakes placed in shallow pans underneath the triggers.

With the conquest of fire much of primeval man's fear of the lower animals vanished; he was now able to show his superiority over them, and they, in turn, fled from him in terror. Fire constitutes one great distinction between man and the lower order of creation, for the latter have never been able to make or use it, and they are invariably frightened at it.

At first fire was used only to drive away and keep off man's natural foes, but, as time went on, he found many other uses for it. Though the summers were hot, the winters were very cold, and he soon introduced fire into his cave to afford him protection from the cold. In course of time he constructed many mechanical

appliances by the aid of fire, he felled trees and built boats by the use of fire; and in many ways, in short, his industrial life commenced with fire.

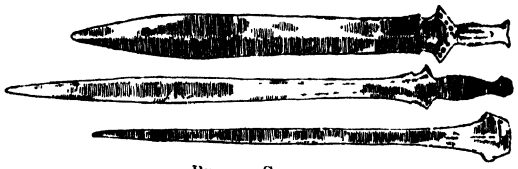
A writer pays the following tribute to fire: "The first step man takes toward remedying his nakedness and helplessness is in a direction where no other creature has led the way, and none has followed his example. He lays hold of that most powerful of all weapons of peace or war, *Fire*, from which every other animal, unless when fortified by his presence, flies in terror, and with it alone not only clothes himself, but lays the foundation of a hundred arts. Once provided with his kindled brand, the savage soon proves what a sceptre of power he holds in his hand He tills with it; by a single touch burning up the withered grass of a past season, and scattering its ashes to fertilize the plains, which will quickly be green again. It serves him as an axe to fell the tallest trees with, and hollows out for him the canoe in which he adventures upon strange seas. It is an all-sufficient defence against the wild beasts; and it reduces for him the iron ore of the rocks, and forges it into a weapon of war. I might say, indeed, with truth, that his kindled brand makes the ten-fingered savage, without further help, a farmer, a baker, a cook, a carpenter, a smith, a potter, a brick-maker, a lime-burner, and a builder, and, besides much else, a soldier and a sailor. . . . The great conquering peoples of the world have been those who knew best how to deal with fire. The most wealthy of the active nations are those who dwell in countries richly provided with fuel. No inventions have changed the entire world more than steam and gunpowder. We are what we are, largely because we are the ministers and masters of *Fire*."

CHAPTER IV

THE BRONZE AND IRON AGES

ALL archæologists are agreed that the Stone Age was succeeded by the Bronze Period, when domestic tools and weapons of war were fashioned out of a mixed metal consisting chiefly of copper and tin.

In the British Museum there are many examples of very early bronze implements which have been found in different parts of Britain. In shape they are not greatly

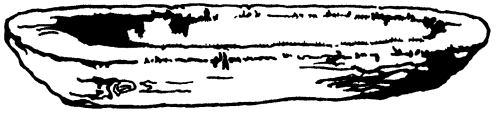


BRONZE SWORDS

superior to those made of stone, and it seems fairly certain that the earliest bronze tools were not cast by melting the metals in fire, but were simply hammered into shape.

Who were the first people to discover the existence and use of those valuable metals, tin and copper, history does not tell us, but it is highly probable that it was some Eastern race. As we read farther on in this book we shall see that during these very remote ages the East was far ahead of the West in many of the arts, sciences, and industries. Civilization had begun and had

advanced greatly among ancient eastern nations (the chief of whom were the Chinese) before ever it had dawned among the peoples of Europe ; and the Egyptians, in the Near East, with whose successors we are so closely connected to-day, taught our early forefathers much of what they knew in industry and science. That is to say, indirectly ; the Greeks learnt from the Egyptians ; and the rest of Europe may be said to have learnt from, or through, the Greeks. What time the inhabitants of our island home were content to live like wild beasts, to think only of eating, drinking, fighting,



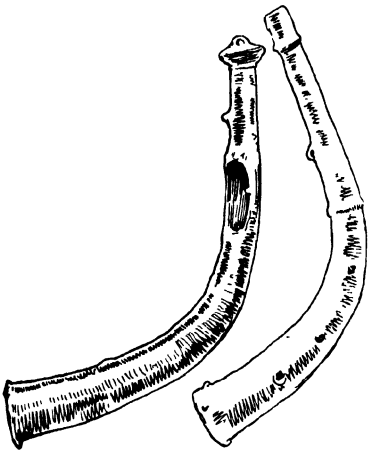
A HOLLOWED-OUT CANOE

and sleeping, the Egyptians were highly skilled in many of the mechanical arts, such as those of pottery, leather-making, boat-building, glass-blowing, and carpentry.

" But," you remark, " if Eastern races knew so much of these arts and sciences ; if, as we see by representations on ancient Egyptian monuments, they knew how to blast metals, how to fashion clay on the potter's wheel, how to glaze bricks and earthenware, how to manufacture linen from flax, and weave it on the loom—why did not this knowledge spread to Britain ? "

There was one very great reason for that, and it was that our primeval ancestors in their island home were effectually cut off from any other country. For many centuries they had no boats in which to venture on the sea, and, at first, their only means of crossing small lakes were clumsy rafts. And you would smile if you saw a man

to-day fashioning a canoe after the manner of the people who dwelt in the Bronze and Iron Periods. He would first select a suitable tree, and burn all round the bottom of the trunk. With his flint axe, or stone hammer, he would knock off the pieces of charcoal, and after many hours' work the tree would be burnt through, and felled. Then he would have to hollow out the middle of the trunk, partly by the aid of fire, and partly by his clumsy tools. Fancy launching a boat of this kind on the rough sea! And what a contrast to the busy ship-building yards of to-day!



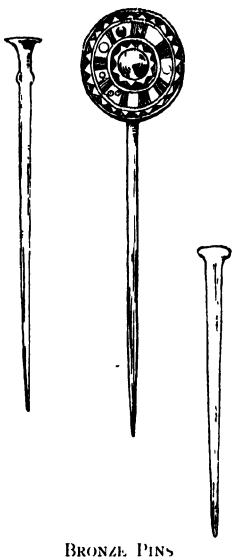
BRONZE TRUMPETS FOUND IN IRELAND

Nowadays we think little of a trip to Egypt. Many people spend the winter there, and thousands of English tourists make the short voyage in order to see the wonderful Pyramids. But in those years which we denote as 'B.C.,' little or nothing was known of Egypt by the peoples of this land, and the Egyptians knew little or nothing of us.

The most adventurous people at this period of the world's history seem to have been the Phœnicians. You may have seen Lord Leighton's famous painting of these dark-skinned sailors. It hangs in the Royal Exchange, London, and it shows the Phœnicians displaying rich

cloths, and costly robes before the half-naked dwellers of what we now call Cornwall and Devon.

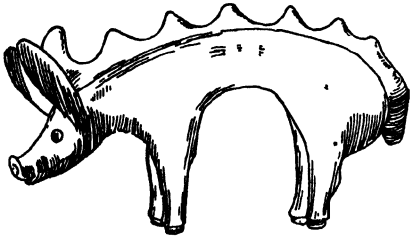
It seems highly probable that the Phœnician sailors came to this country in search of tin. At some time, and somehow or other, the knowledge of the presence of this metal in Cornwall had spread even as far as to the ports of Tyre and Sidon, and from that time, to eastern nations, our Islands were known as the Cassiterides, or 'tin islands.' Tin was considered a very valuable metal, for, when mixed with copper, it made the most serviceable bronze. Pure copper is in itself too soft for hard wear, and it does not take a good cutting edge.



BRONZE PINS

Most historians think that the Phœnicians taught the inhabitants of this country how to work and alloy copper and tin, for it is certain that this art was known in the East long before our Eastern visitors came to Britain. The fame of Cornish tin spread quickly through all the civilized world. Grecian spears and shields were fashioned from bronze, the tin of which had probably been brought from Britain, and there is an opinion that much of the so-called 'brass'-work in Solomon's temple was really Cornish tin alloyed with copper, for, wherever 'brass' is mentioned in very ancient history, it does not mean our modern brass—which is an alloy of copper and zinc—but bronze.

We learn from records in the British Museum and elsewhere that the art of casting bronze was probably known before 2000 B.C., and that bronze implements, ornaments, and weapons, were in use for quite a thousand years. If you wish to see a good collection of bronze tools and weapons you should look at the Greenwell collection in the British Museum, which was presented to this nation by the late Mr J. Pierpont Morgan. It includes bronze brooches, daggers, spear-heads, shields, and celts, and it is one of the most valuable collections in the country.



BRONZE FIGURE OF A BOAR

The discovery and use of Iron marked a great advance in industry, because a crude knowledge of smelting must have been obtained. Copper is found in some parts of the earth in an almost pure state, but iron is always mixed with earthy materials, in the form of ore. No one could hammer iron ore satisfactorily into a serviceable tool; the metal must be separated from the dross.



A COOKING-POT

Ancient history tells us that iron was accidentally discovered through a fire breaking out on the slopes of a Trojan mountain. The rocky surface of the mountain was

melted, and the molten rock, which consisted chiefly of iron ore, revealed to the onlookers, when it became cool, a new metal. Whether this romantic story be true or not it is certain that the discovery of iron resulted in an enormous advance in civilization, and it is here that our industrial history may be said to begin. One famous historian says : " The introduction of metal tools revolutionized the farmer's life. Henceforward the axe became more efficient, the spade and the plough became possible ; forests could be felled, fens could be drained, wastes could be cultivated, and the age when nature, which was formerly the tyrant, became the handmaid of man, may fairly be said to have begun."

CHAPTER V

THE ROMAN OCCUPATION OF BRITAIN

WITH the coming of the Romans our island may be said to have emerged from the prehistoric night and to have entered into the dawn of its history.

It is not the purpose of this book to give an account of wars, conquests, defeats, and changes in dynasties; our work is concerned mainly with the gradual advance of industrial art, and with the discovery of the way in which the successive historical periods influenced industry for good or for evil.

The Roman invasion is generally considered to be the starting-point of English history. Before that time our knowledge of the country, and of the various races who inhabited it, was obtained by inference, that is to say we see certain relics of these people, and from these relics we judge or *infer* that certain events or conditions happened or existed.

But the advent of the Romans gives us, as we have said in a previous chapter, our first written record of our country. We have spoken of Julius Cæsar, who subjugated Gaul and Spain and who twice invaded Britain, defeating the gallant Britons and compelling them to give him hostages; and we have mentioned his *Commentaries* or accounts of the various countries which he conquered. Among the many great writers of his day he was by no means the least; and good judges of literature are agreed

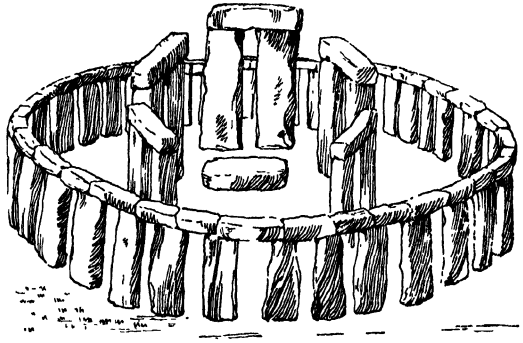
as to the excellence of his style, which is so lucid and clearly phrased that everyone who reads his work can see the pictures which he presents as clearly as did he himself.

In one part of his *Commentaries* Cæsar says: "About 60 B.C. there were in the island two kinds of Britons. One—the native—was a half-naked savage, wearing skins of wild beasts on his shoulders, his body painted blue to frighten his enemies, using stone hatchets and arrow-heads of flint, growing no corn, living on milk and flesh, and leading a miserable life in the heart of dense forests and dreary marshes. The other kind, who had come from the neighbouring countries of Gaul and Belgium, inhabited chiefly the country along the southern coast, and were hard-working farmers and traders. They had orderly governments; they lived in comfortable circular houses; they wore garments of good black broadcloth reaching to their feet; and the richer class walked about with gold-headed staves in their hands. Both these kinds of Britons were of the same race—the Celtic—and both had the same religion."

If this description be true—and there is not the slightest reason to doubt what the Roman historian says—what an enormous contrast there was between the peoples of the south and those of the north! Civilization in a high form in one part, and utter darkness in the other! The contrast would be remarkable if seen at two different ends of a continent—how much greater was it, therefore, when the tribes were existing practically side by side in one small island!

The new-comers who had taken the place of Palæolithic and Neolithic man were the Celts, and they belonged to that group of nations known as the Aryan family. Just

when the Celts came to Britain it is impossible to tell, and the exact locality whence they came is also open to conjecture. But this much we know, that they were firmly established in this country long before the Roman invasions. They had fought and conquered the Ivernians —as those races were called who lived in the later Stone Age—and had driven them from Gaul and the southern part of this country.

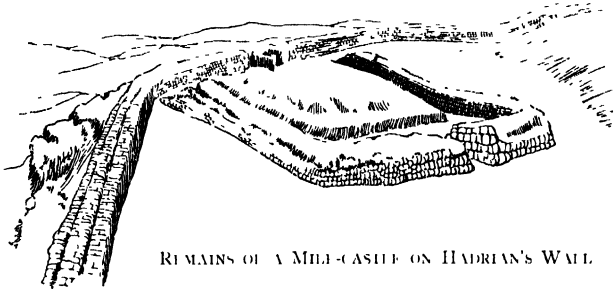


RECONSTRUCTION OF STONEHENGE

In course of time a more civilized race of Celts appear to have swept westward from Central Europe, and to have driven the original Celts to the shores of Wales, and over the sea to Ireland. The Ivernians, who had previously been living in the middle of the island, were driven into Scotland.

Most historians call the original Celts 'Goidals,' and the later and more civilized race the 'Brythons,' from which the word 'Briton' is derived. During the Roman invasions of Gaul yet another tribe of Celts appears to have invaded the south-east of Britain, and these were known as the Belgæ.

There is no doubt that the Brythons and Belgæ knew a great deal more of industries and agriculture than the Ivernians whom they displaced. Cæsar describes the orderly farms, the large herds of cattle, and the corn-fields which he saw in that part of the island now called Kent and Sussex. "Tin," he says, "was common, but iron scarce, and bronze had to be imported." This leads us to infer that the Brythons knew nothing of making bronze



REMAINS OF A MILE-CASTLE ON HADRIAN'S WALL

by alloying copper and tin, or, if they were acquainted with this art, then it is evident that copper was not mined in Britain at that time. The Belgæ of Kent were the most civilized race.

In describing the Druids Cæsar says: "They taught the doctrine of the immortality of the soul, which, they believed, had a tendency to inspire men with courage by making them indifferent to death. They also devoted much thought to astronomy, to the magnitude of the universe and of the earth, to the nature of things, to the power and prerogatives of the immortal gods; and their learning they taught to the young men."

During the century which followed the invasions of Julius Cæsar, the Britons made great progress in commerce

and in some of the industrial crafts. An important trade was opened up with Gaul, and we are told that "ships laden with merchandise frequently came to and from the Roman station of Londinium"; this, of course, was afterward our modern London.



DECORATED SHEATH OF THE SWORD OF TIBERIUS

But it was to the real Roman conquerors, Suetonius Paulinus and Agricola, and to the visit to Britain of the Emperor Hadrian, that the Britons were chiefly indebted for the remarkable progress they made in civilization. The straggling British settlements were in many cases replaced by walled towns which had strongly fortified gates; good roads were made,[1] and this last alone gave a great impetus to trade and the gradual development of industry. A great historian says of the Roman occupation of Britain: "Besides building towns, bridges, and roads, the Romans did much to develop the natural resources of the country. Traces of their manufactories of glass and pottery are abundant. Iron, tin, and lead were worked by them upon an extensive scale, and the corn-producing powers of the island were so far developed that Britain became the granary for the legions on the Rhine."

You probably know of the recall of the Romans by the Emperor Honorius, and the disasters that befell this country during the next two or three centuries after the Britons had lost their splendid rulers and teachers.

[1] See map, page 171.

CHAPTER VI

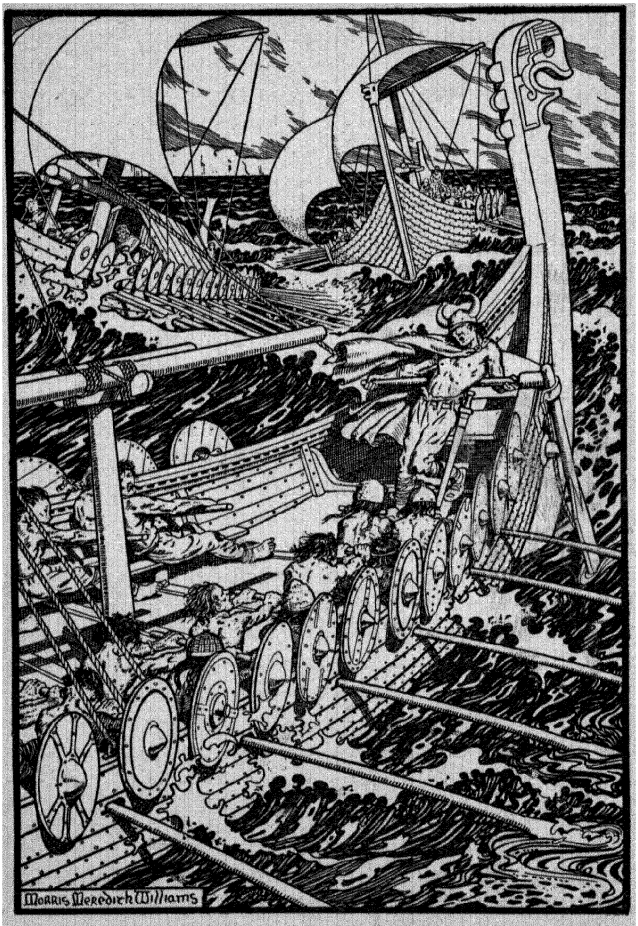
INDUSTRIAL DARKNESS

It had been the settled policy of all the later Roman governors to draft the best British manhood from their own country into other Roman dominions, and especially into the provinces on the Rhine. As soon as a Briton became skilled in the arts of war, or in any branch of industry, he seems to have been withdrawn from Britain.

It may therefore be imagined that Britain was in a pitiable state when the Roman legions were called home to fight the Goths and other foes who were pressing to the very heart of the Roman Empire. What really happened in Britain during the century following is not accurately known, for much of the history of that period is the record simply of the historian's imagination.

It appears tolerably certain, however, that the northern part of the country was incessantly attacked by the Picts and Scots, the descendants of the original Ivernians of whom we have already spoken. At this time, too, the raids of the Saxon sea-rovers along the eastern and south-eastern shores were more frequent. For centuries these terrible 'knife-men' from the shores of Jutland and the northern part of Germany had been a thorn in the sides of the Romans, who describe them as being "fierce beyond all foes, and cunning as they were fierce, with the storm as their friend, and the sea as their school of war."

With the actual *doings* of the period which was taken

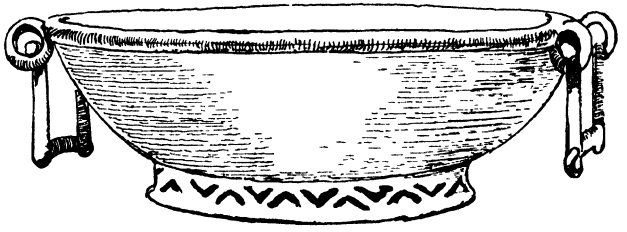


THE COMING OF THE NORTHMEN

From "The Northmen in Britain," by Eleanor Hull

up by the invasions of the Jutes, Angles, and Saxons, and the establishment of the Saxon Heptarchy, we have no concern in this book—our main object is to discover what was the effect of the Saxon occupation of Britain on our industrial, social, and commercial progress.

The following quotation from one of our historians will give us a faint idea of the change which came about: "In the wars which followed the withdrawal of the Romans, their laws, institutions, manners, customs, and



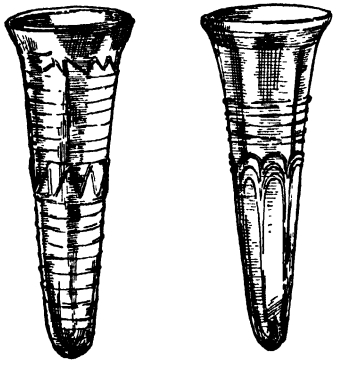
BRONZE BOWL (FAVERSHAM)

even their language, perished, and nothing was left to show that the Romans had even been in this island except the ruins of some of their towns, the coins, urns, and tablets now and then dug up and a few words which have kept their place in the English language we speak to-day."

The Saxons were lovers of the country; they detested town life, as do many of their fair-haired descendants in rural England of to-day. They were not particularly devoted to industry. Their chief occupations were farming, fishing, and hunting, and they had a slight knowledge of weaving, dyeing, and metal-work. They appear to have known of the existence, and of some of the uses of coal, and probably this

knowledge came to them through finding the huge cinder-heaps which the Romans had left behind them.

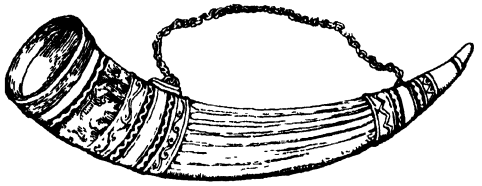
Though most of the Roman towns had been burnt or were in a state of sore neglect, village life was planned on clearly defined lines. Grant Allen says with reference to this: "Each little village of the old English community possessed a general independence of its own, and lay apart from all the others, often surrounded by a broad belt or mark of virgin forest. It consisted of a clearing like those of the American backwoods, where a single family or kindred had made its home, and preserved its separate independence intact. Each of these families was known by the name of its real or supposed ancestor. The mark or border of woodland, heath, or fen was jealously guarded as a frontier and natural defence for the little predatory and agricultural community. Whoever crossed it was bound to give notice of his coming by blowing a horn, else he was cut down at once as a stealthy enemy. The marksman wished to remain separate from all others, and only to mix with those of his own kin."



ANGLO-SAXON DRINKING-GLASSES

During the early years of the Saxon occupation of this country industry was under a dark cloud, which was lightened only by the wise rule of Alfred the Great. Each village was generally the property of the overlord and the

inhabitants were bound to him in a number of ways. A certain section of the community—the serfs or slaves—could be bought or sold in open market, and the class between the serfs and the overlord was known as *villeins*. As a rule the villeins did not pay their rent in money; they held the land on condition that they rendered the lord certain stated services. They were allowed to have property of their own, and if a villein was very successful in amassing riches, or if he undertook three very long voyages, he could become an earl or ealdorman.



HORN OF ULPHUS THE SAXON

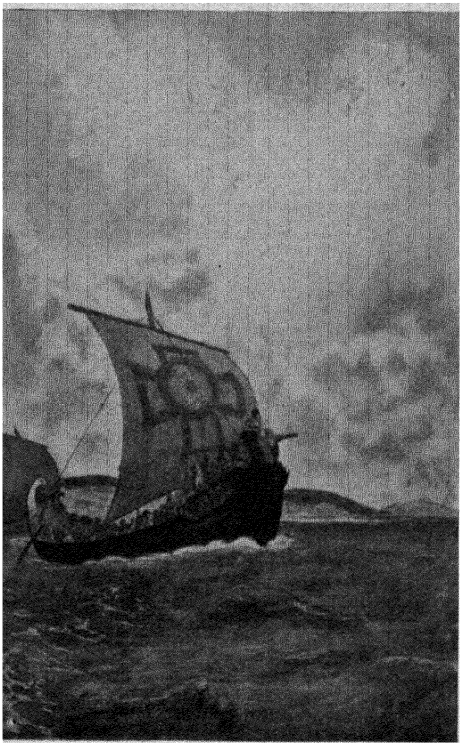
Saxon houses were usually one storey high and built of wood, but the lord's castle was built of stone, as were most of the churches. Many of the houses of the poorest class were simply mud-huts, with holes in the roofs to let out the smoke, and holes in the walls to admit the light. We are told: "The towns were small, mining was rare, and there was only domestic manufacture. Salt, however, was made either from brine or the water of the sea; and by the river there were fisheries, the weirs for which had to be kept in order by the villein tenants. What commerce there was was carried on by chapmen; and as the lords under such a system, were very wealthy, the chapmen were often men who possessed a considerable stock of goods and travelled about the country with a large

retinue of armed followers—a precaution rendered necessary by the number of robbers and outlaws who swarmed in the extensive forests."

In many ways Alfred the Great was an ideal king. Necessity first made him turn his attention to the defences of the country, for the warlike Danes gave him little peace during the early years of his reign Some historians speak of Alfred as the founder of the English navy. Certainly he built a fleet of large boats, and he saw to it that each part of his kingdom should pay its share of the cost and upkeep of the fleet, but Alfred's navy was for purposes of defence only. He reconstructed his army and put it on a thoroughly sound footing, and prepared to resist any attacks which might be made on the country. The Roman forts which had so long been neglected were, in several cases, restored, and London became the chief stronghold of the South.

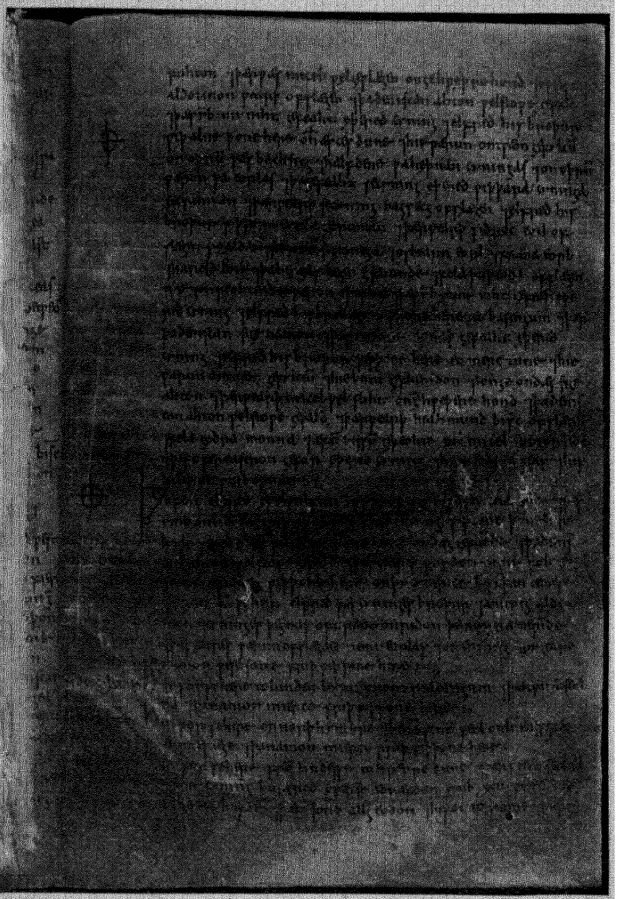
For the first time in English history, education was encouraged, for, as Alfred said · "Let the youths of England be grounded in letters, for they cannot profit in any pursuit until they are well able to read English." The advancement of education always brings about the advancement of industry; the one is inseparably connected with the other. Alfred superintended a college where the young nobles of his court were trained, not only in the arts of war, but in the arts of peace, and as the king encouraged his bishops to translate various books into the Saxon language, a knowledge of reading became fairly common among the nobility. Scholars from abroad came to England to teach in his colleges, and, in his spare time, he also had tuition from these foreign teachers. He is said to have commenced writing the famous *Anglo-Saxon Chronicle*, which was continued until the reign of

King Stephen; there it ends abruptly, in the middle of a sentence, in the year 1154! This manuscript was the



A SHIP OF ALFRED'S FLEET
From "The Story of Alfred," by A. E. McKilliam

earliest true record of events in this country—if we except the *Commentaries* of Cæsar, which, after all, were devoted mainly to the Roman occupation of Gaul—and



A PAGE FROM THE MS. OF THE "ANGLO-SAXON CHRONICLE"
Containing the account of the Battle of Ashdown
Corpus Christi College, Cambridge

it has been truly described as "the oldest history in its own tongue possessed by any European nation." Year by year the chief events of the country, whether of war or of peace, were chronicled in this book. There are several versions of the *Chronicle*, which were compiled originally by the different monastic orders. One version may be seen in the British Museum. It is a bulky volume and lies open at a page about half-way through. It has been partly destroyed by fire. The reference note states that the first events which it chronicles took place in 54 B.C., and that nearly all the history of the Roman and Saxon occupation was written by Alfred the Great.

CHAPTER VII

THE MANORS

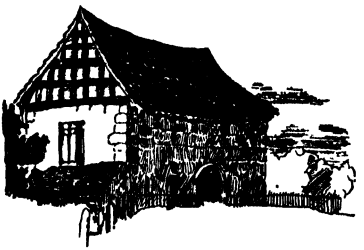
WITH the details of the Norman Conquest we are not concerned in this book, except in so far as they bear on the social life and industry of the country, and it is of these that we are now going to speak.

In Saxon times there were a large number of villages dotted about the country, each of which was chiefly the property of the lord. These villages were known as townships, but they were quite unlike our modern towns As a rule one township was quite independent of any other township; it grew its own corn, fruit and vegetables, it raised its own cattle and sheep, and from the wool and hides it made its own clothing; it provided its own building materials, which in most of the houses consisted of timber, clay and reeds; it bred its own fish in the large central fish-pond; and it made its own tools and weapons. The inhabitants of each township appear to have been very suspicious and jealous of those who lived in neighbouring townships, and frequently bitter quarrels arose.

You probably know that William the Conqueror distributed much land among his faithful followers in proportion to the services they had rendered him, and so Saxon townships passed into the hands of Norman lords. The independent life of each township was well maintained under the new owner, but henceforth the township was

called a *manor*, and the overlord was known as the *Lord of the Manor*, a title which still survives in many parts of the country. It was not the policy of the Conqueror to make any one lord too powerful, by giving him a number of manors lying close together; if he owned three or four they were usually several miles apart, and he would live in the largest of them.

About this time there were over nine thousand manors in the country, and they varied considerably in size, some of them consisting of only five or six hundred acres, and others being ten times as large. The King himself held a number of manors which were managed by stewards or bailiffs. Sometimes, too, it happened that the noble sub-let one or more of his manors, and in that case the tenant would become the lord of the manor.



A Manor House

In those times the payment of rent was effected in a manner very different from that of to-day. As a rule rent was paid in service and in kind and not in money, although in some cases arrangements were made whereby the tenant should pay his lord a small sum of money. The tenant sub-let his land to the villeins, who held plots in various parts of the manor; and below the villeins were the cottars, who also held land, but in smaller plots than the villeins. In the lowest class were the serfs, but in course of time these were gradually merged into the cottars. According to *Domesday Book*, about 38 per

cent. of the whole population were villeins, 32 per cent. cottars, and 9 per cent. serfs.

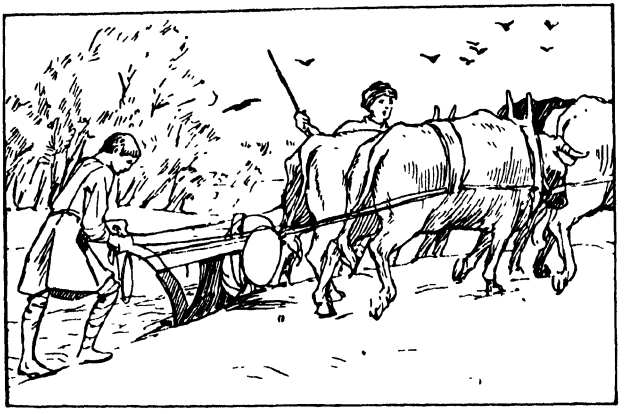
From descriptions of these ancient manors we get a good idea of the various social classes, and we also see how payment for land was made. Thus on one manor we find a villein paying his lord one bushel of wheat, three bushels of oats, and six bushels of seed-wheat every Michaelmas, two cocks and ten hens every Christmas and a halfpenny whenever he brews. His payment in *service* was to work for one week at harvest-time and seed-time, to plough half an acre of the lord's land, and to do such work as the lord, or his bailiff, should call upon him to do. In return for these various services and payments the villein was entitled to a twenty-acre plot of land, on which he was free to work when he had finished the stipulated service for his lord.

By far the most important buildings in the manor were the manor house and the church. The former was the residence of the lord of the manor; at first it was strongly fortified, and was more in the form of a castle than a house. It usually occupied a commanding position, and close to it was the church, built as a rule on land under the immediate control of the lord and not sub-let to a villein. This land was known as the *demesne*, a word which is still in use.

The priest was generally appointed by the lord of the manor, and his stipend was drawn either from the rent of the glebe land, which was the property of the church, or from tithes, which were paid voluntarily by the villeins. In time it was made compulsory for the occupiers of land to pay tithes to the church, for the rent of the glebe was insufficient to maintain the priest, and some of the villeins would not offer their tithes. Sometimes

the lord of the manor handed over the tithes to a neighbouring monastery on condition that the monastery maintained the priest.

At this time the plough seems to have been the most useful agricultural implement, and frequently a dozen ploughs had to do duty for twice that number of farmers. In some manors there was but one plough in use on the



PLOUGHING ON AN ENGLISH MANOR

whole of the land. We know that the plough was considered of very great importance, for in *Domesday Book* the survey of the manors tells us the number of ploughs in use on each. Thus we read of a certain manor. "The arable employs 22 ploughs; in the demesne there are employed 8 ploughs. There are 45 villeins, with a priest, 15 cottars, and 3 bondsmen. They have 20 ploughs."

Once a year the *court-baron* sat in the court-house, which formed part of the manor-house, to settle disputes

and administer the law. The court-baron was a kind of jury made up of the chief men of the township, who were freeholders of the land, and it was presided over by the lord of the manor, or his deputy. Its chief duty was to carry out the Civil Law, such as the trial of debtors, and so on. Criminal offences were tried by the *court-leet*, which was composed of representatives of all classes in the township, whether freemen or bondmen.

Thus we see that even in its government the early manor was self-centred. There was no national government such as we have nowadays; each manor governed itself. Similarly there were no national industries; commerce, industry and agriculture were purely local.

Could we have peeped inside a Norman church eight centuries ago we should have witnessed a scene in striking contrast to what we see nowadays. In modern times the visitor to a church steps cautiously and softly; the gloom of the sacred edifice produces within him a kind of mysterious awe. However noisy he may be outside, however raucous his voice and rough his manner, there is one place in which he invariably behaves himself in a spirit of reverence and decorum, and that is the church. But in olden times the nave of the church was the resort of hagglers and money-lenders. Often it was used as a town-hall for meetings, and frequently markets were held there. For centuries the church, being the most commodious building in the manor, was a refuge for idlers and loungers; people took their meals there; and gossips gathered together and related the scandals of the village. In later years, when the Bible had been translated into English, a chained copy was placed in certain churches, and lay readers daily read portions of the Scriptures to

those sitting and standing around. Perhaps you may have seen pictures showing such scenes.

All things considered, the villagers were fairly happy under the manorial system, and quite as comfortably off as are their descendants in the villages of to-day. They might be described as a 'help-one another' society, each man being dependent on his neighbours for something or other in connection with his little plot of land. Perhaps one farmer kept five or six oxen and a waggon, while another one had only a plough. The two would interchange, and perhaps help each other at seed-time and during harvest. Many of the farmers who owned sheep or swine put all their animals together under the care of one shepherd or swineherd, who knew to whom the different sheep and pigs belonged by the distinctive mark which each animal bore. (A similar plan is followed in the winter-time by many Canadian settlers who leave their cattle in charge of one man while they work many miles away in the lumber-camp during the winter months.)



LADY AT LOOM IN THE MIDDLE AGES

In most of the larger houses there was a loom where the wool fibre was woven into cloth. Both men and women did the work of weaving, but, as a rule, spinning the shorn wool into fibre was a woman's occupation. A

man-weaver was called a 'webbe,' and a woman weaver a 'webster'—these names are fairly common to-day. A woman who spun was known as a 'spinster.' Usually she was one of the young unmarried daughters of the family, and in this latter sense the word is still used to-day.

CHAPTER VIII

HOW THE CRUSADES RESULTED IN THE DEVELOPMENT OF TOWNS

To raise the enormous armies required for the various wars of the Cross in the Holy Land, to maintain these, and to transport them across the sea, a vast amount of money was needed. The King obtained much of this money by granting charters to cities, which conferred upon those cities many important privileges, in exchange for sums in proportion to the benefits derived by them.

Probably Richard I granted more charters than any other monarch, and it has been remarked that, "The ready granting of charters, moreover, had an immense effect on the development of towns, in the history of which almost an epoch is caused by the charters of Richard." To show the sums paid, we may quote the historian Ransome, who says. "The citizens of London paid 100 marks to have sheriffs of their own choosing. The burghers of Cambridge paid 300 marks of silver and one mark of gold to have their town at a fixed rent, and to be free from the meddling of the sheriff of the shire. Shrewsbury did the like. The weavers of Oxford paid two marks to have a guild of their own. Thomas of York gave a coursing dog to be alderman of the guild of merchants."

But even more important was the fact that several of the turbulent barons also gave up, by charters, many of

their rights to the commercial classes in exchange for gold. As these charters conferred by both the King and his barons gave the right of free trade between one town and another, and also empowered the freemen of the town to levy local dues (somewhat after the manner in which rates are levied in modern times), they did much to make the merchant class rise in wealth and importance.

Perhaps some of you live in towns where you hear certain people spoken of as freemen of the town; and, at various times, we read of a person being honoured by having bestowed upon him the 'freedom of the city.' It is impossible to give a list of the precise privileges which freemen enjoy, for different cities, boroughs and towns confer different benefits upon their freemen. In some towns the freemen take all the rent for the grazing of sheep and cattle on the common land belonging to the town; in other towns the freemen have special advantages in the education of their children.

Richard appears not to have cared how many charters were granted, nor how many 'freemen of cities' were made so long as he received ample funds to carry on his wars. It is said that "he would have sold London if he could have found a buyer." But the result was that the leading townsmen became of almost equal importance to the nobles, and a tradesman was no longer looked upon as an inferior kind of person. Hitherto most of the Norman barons had been immensely rich, but they spent such an enormous amount of money in equipping their retainers as soldiers that they became much poorer in pocket; this tended toward the levelling of the different classes of people.

But the Crusades had other very important and far-reaching effects upon the commerce and industry of our

country. We have already seen that the East was far in advance of the West in many of the crafts, sciences and industries. The only craft which Englishmen knew really well was that of metal-work. This was practised in order that the rich and costly vessels required by the monks in the services of the monasteries could be made. It is said that: "The use of silk stuffs, spices, and perfumes became general. Syrian glass, vessels of enamelled metal, and other products of art and skill were introduced into England."



CANDLESTICK

For centuries the chief commercial mart of the world had been held at Jerusalem at Easter; and traders from all civilized countries, even as far away as China, displayed their wares and interchanged their commodities there. It was well for England that she was brought into contact with such a mart; that she should see the costly Arabian spices; that she should know how to make and use some of the delicate fabrics for which the East has always been renowned. England soon acquired a taste for Eastern luxuries, and various fruits and spices grown in those lands were imported in large quantities.

You probably know that the armies which fought side by side in the Crusades represented three or four different countries; this brought about close contact between the peoples of these countries, who thus came to know each other better; and thereby new markets for trade were opened up. Do not think that England had nothing to give in return for the costly furs, silks, spices, wines, and precious stones which she imported. At that time she had wool, leather, tin, lead, and corn; and, as merchants

often preferred exchanges of their respective wares to cash payments, commerce was conducted largely upon this principle, and, in consequence, our exports and imports increased rapidly. Among the industrial facilities with which the Crusaders became acquainted in the Holy Land was that of grinding corn by wind power. Hitherto the only mills in use in England had been those driven by water, but as watermills are entirely dependent



Old Windmill

on a good stream of water, the mills were idle in times of drought. But in the twelfth and thirteenth centuries the summits of many village hills began to be occupied by the windmills we know so well, and as corn could be ground at a cheaper rate, more of it was grown, and an impetus was given to agriculture.

About this time, too, the famous Arab horses were introduced into Britain, and these were, and still are, among the most excellent in the world. (It is for interbreeding that Arab horses have such value for us, and it is their qualities, mixed with those of our own horses, that make them important.)

Professor Yeats in writing on the influence of the

Crusades says: "The absence of the feudal chief relaxed the grasp of tyranny, and left the serfs unfettered on the soil; whilst every crusader was an eye-witness of the advantages derived by the possessors of the Holy Land from the progress they had made in agriculture. Each survivor, on his return, would probably strive to apply the knowledge thus gained to the improvement of his estates, and thus add to the variety of native produce. About this time Europe received the roses of Jericho and Damascus, and the Turkish plum. It was during the Crusades that many of the modern cities of Europe arose, and that trade and commerce began to revive. The enthusiasm for the Holy Land laid hold on all classes. The great barons sailed proudly forth with their retainers; but on their return, humiliated and impoverished by defeat, they were reduced to seek help from their inferiors. Estates were then sold to the city merchants who had profited by quietude at home, and had acquired wealth, and soon, also, many of the most skilful of the operative class were, by their savings, enabled to free themselves from a state of vassalage."

CHAPTER IX

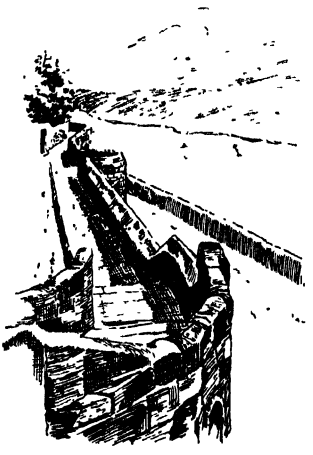
THE TOWNS

WE have seen that the Saxon townships and the Norman manors were quite unlike our modern towns, and that they were, in effect, self-contained and independent villages. But we have now to see how towns came into existence, and how they became established in certain definite places.

The chief distinction between a town and a manor was that the former had a larger population, and was, as one historian says, "a district where men lived closer together than elsewhere." It was also more strongly fortified; in place of the wooden fence which surrounded the manorial village, there would perhaps be huge earthworks, flanking a wide moat which ran all round the town. In many cases the town included several manors, and it was in the special charge of some noble; it had many privileges, one of which was that it paid an annual fixed sum of money to the Crown, instead of the various taxes and bodily services demanded of the inhabitants of the manors. We have already seen how it was that certain towns obtained royal charters which conferred special privileges upon them.

The first towns were made by the Romans; these were large fortified camps, but they had long since been sacked and deserted. We know that the Saxons detested town-life, and up to the time of the Norman Conquest there

were very few towns in the country. But as trade increased the various traders found it more convenient to live together, thus establishing a great centre where the farmers and weavers and spinners who lived in the surrounding district could send their produce in exchange for other goods. It was natural that these early townsmen should select such sites as were most convenient of access for all the outlying districts, and so we find that many of the original towns were established on river-banks at those points where the river was shallow and could be forded, or where bridges afterward spanned it. We can trace such towns by their names; thus we have Oxford, or oxen-ford; Stratford, Chelmsford, Romford, Cambridge, Stourbridge, and so on. Many towns, too, grew up on the estuaries of rivers, and in time became important ports, and on some large rivers (such as the Thames) the site chosen for the town was that particular ford or bridge (or fordable or bridgeable point) which happened to be the nearest to the sea. The reason for this was that ships could sail as far as possible into the country, and docks could more conveniently be made on the banks of a river than on the sea-coast. Good examples of such towns as these are London and Bristol.

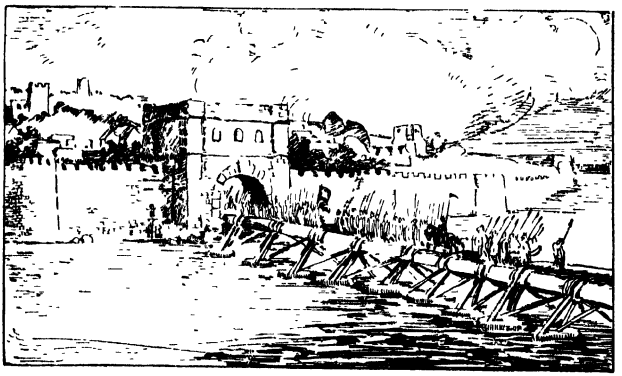


PART OF THE CITY WALL, CHESTER

Great Britain has always been noted for its fishing

industry, and many of the first towns sprang up on the coast, where they served the double function of commercial ports and havens for deep-sea fishermen. Two such towns are Brixham and Grimsby.

In the Middle Ages London was by far the largest town and the most important port in the kingdom. Norwich was one of the largest towns in the eastern



LONDON BRIDGE IN THE NORMAN PERIOD

counties. It carried on a great trade in wool with the Netherlands. Other ports trading with the Baltic seaboards were Grimsby, Lynn, Harwich, Yarmouth, and Hull. In medieval times the North of England had not taken that pre-eminent position in industry and commerce which it holds to-day, and its ports were insignificant. Southampton, Plymouth, and Bristol were the chief southern harbours, and the Cinque Ports had a large trade with the Continent.

In the thirteenth and fourteenth centuries special towns were selected for the sale of certain commodities

belonging to the districts of which they were the centres. These were known as *staple towns*. A staple town was granted the privilege of selling the staple product of the district, and only that town (or those towns that were in that staple district) could sell that article. The institution of the staple was held to have two great advantages—the first, that the customs could be collected much more conveniently when the wholesale business was kept within a definite area; the second, that a staple town, as having a species of monopoly in a certain commodity, afforded a privileged market for that special commodity.

Not only were there staple towns in England for various goods, but there were towns established on the Continent, specially for the sale of English goods. Antwerp, Calais, and Bruges were in turn constituted as staple towns for British goods. The staple for wool was invariably placed in Flanders, because, as we have seen, most of our woollen trade was carried on with that country.

Edward I is said to have begun this 'staple' system, though the 'Merchants of the Staple' claimed that their association originated in the reign of Henry III, and it was established more firmly in the two succeeding reigns. Edward III in 1328 tried the experiment of abolishing 'all staples beyond the sea and on this side,' but it was not a success. A statute was then enacted which set forth numerous rules for the government of the staple, and also a list was made of all the staple towns in England. From this statute we learn that inland staple towns had a special port for their export trade, and such trade could be carried on through no other port. Thus all York goods in the York staple were exported and imported through Hull; Southampton was

the staple port for Winchester, and Yarmouth for Norwich.

Much may be learnt of the origin of certain towns by a study of their names. The towns of Roman origin can be traced by the few words, *castra*, *strata*, *portus*, and *colonia*. Castra denoted a camp, and variations of this word are *chester* and *cester*. It is not difficult to find names of important English towns derived from these words. *Strata* denoted a causeway, and the word is seen in *streat*, and *stret*. *Colonia* denoted a colony; thus we have Lincoln, a famous Roman settlement. *Portus*, or port, is traced in Bridport.

Towns of Saxon origin may be traced by the affixes *stoke*, *fold*, *ham*, *ton*, *worth*, and *burgh*. All these words refer to land which was brought under cultivation and enclosed in some way or other. A *ham* denoted a home, and a *hamlet* was a 'little home.' These 'little homes' afterwards developed into such important towns as Nottingham, Birmingham and so on. A *stoke* was a stockade, a *ton* denoted a place hedged in by trees, a *worth* was a protected place, and a *fold* another form of enclosure.

CHAPTER X

MEDIÆVAL MARKETS

WE have remarked that many of our first towns were built at suitable havens round the coast or on the banks of navigable rivers For, as the population increased, people produced more than sufficed for their own needs, and so exchanges took place, whereas, in prehistoric times, the sole aim of the cave-man was to produce just sufficient for himself and those immediately dependent on him ; he rarely bartered, and he seldom procured more fish, hides, fruit, etc., than he needed.

We find, however, that, as civilization advanced, farmers grew more corn than was required for their personal wants ; they acquired large flocks of sheep and were able to spare plenty of wool and mutton ; similarly, miners of lead, tin, and iron could exchange these minerals for other materials which they needed ; spinsters and webbes disposed of spun yarn and woven cloth to their customers ; fish merchants supplied the townspeople with fish, and so on.

Now in this system of exchange, or barter, it was necessary for the farmers and dealers and traders to meet together so as to show each other samples of their wares, and to talk over the terms of exchange. This led to the establishment of markets. Those of you who live in provincial towns probably see dozens of carriers' carts bringing people to town on market-day from the out-

lying villages. Some towns have a weekly market; others two, and perhaps three, markets in a week. The tradesmen in the town look upon market-day as the chief day of the week for doing good trade, for while the farmers are buying sheep, cattle and pigs in the cattle-market, their wives and daughters are busy shopping, and the streets of the town are thronged with people from the country-side. Generally in the centre of the town there is a wide open space called the market-hill or market-square, and there we see rows of stalls where fruit, confectionery, trinkets, fish, and other commodities are sold. In some large towns there is a separate market for corn, which is generally known as the Corn Exchange; another for dairy produce, known as the Butter Market; another for fish; and another for meat. Thus London has its meat market at Smithfield; its fruit and vegetable market at Covent Garden; its fish market at Billingsgate; and its corn market at Mark Lane.

As a rule the provincial town never varies its market-day, and some towns have had the same market-day for five or six centuries. Towns in the same district invariably hold their markets on different days of the week so that they do not interfere with each other's trade. Each stall-owner has to pay a toll, or rent, for the ground which his stall occupies. Originally the lord of the manor claimed the tolls, but in time they came to be taken by the corporations and councils of the boroughs and towns.

The rules and regulations which controlled the market were at first made by the lord of the manor, and afterward by the merchant guilds or the mayor of the borough. By-laws, or *town* laws, were drawn up for each market-town and these had to be strictly adhered to. It was

natural that the townsmen should wish to protect themselves as far as possible, and the toll which they paid was considerably less than that paid by visitors. Merchants and traders who lived away from the town were at first only allowed to transact wholesale business; that is, they



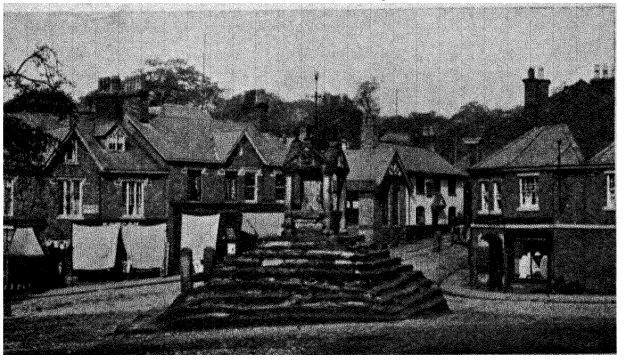
THE MARKET-PLACE, LEICESTER

could sell to one man only. For example, if a fish merchant at Yarmouth had a large supply of fish which he wished to sell to the townsmen of Cambridge he would not be allowed to have a stall in the market-place at Cambridge and do a retail trade; he would have to find a customer at Cambridge who would buy all his fish, and this customer would have the privilege of re-selling the fish as he liked. Neither were strangers from different

towns allowed to buy from and sell to one another in the market of a third town. A Yarmouth man could not buy from a Lynn man in the Norwich market; if these two men wanted to do business in Norwich they would have to find a townsman of the latter place who would act as a go-between, or, as we say, a middleman. Of course the middleman would want a share of the profit, and there were several tradesmen who made a good living in this way.

Another very useful regulation was made which prevented merchants from obtaining a monopoly of any article, or 'cornering' it, as we say nowadays. You may have read of a merchant buying up all the possible supply of certain goods, and being then enabled to sell these at a very high rate. For example, let us suppose it possible for one man to buy up all the corn grown in this country, or imported into it. As corn in one form or other, is a daily necessity of life, it follows that we should have to pay practically what that merchant likes to charge and we may be sure that he would charge much more for his corn than if there were rival merchants to compete with him. Of late years we have heard a great deal of the American Trusts, which seek to prevent firms outside the Trust selling or making that particular article or commodity in which the Trust trades. For example, they work in with railway or shipping companies, with municipalities and other administrative or legislative bodies so as to make production, etc., so difficult for their rivals that the latter (though these *can* procure or produce the article) find conditions so ruinous or difficult that they must either go bankrupt or amalgamate with the Trust. We can understand that it would be comparatively easy for the merchants of mediæval

times to 'corner' a particular commodity, or even establish a kind of Trust, for there was not an unlimited supply to buy up, and also the carriage of goods was so costly and slow in those days that if the merchant bought in all supplies from his own district he would practically have his corner established and successful before the goods that might spoil it could arrive at



THE MARKET CROSS AT LYNN
Photo Frith & Co., Ltd.

the required market. The town authorities wisely looked after the interests of their fellow-townsmen by prohibiting any one man from holding back supplies of any commodity for the purpose of making a 'corner' in that commodity.

A still further privilege which the tradesmen of a market-town had was that they had the use of the King's beam free of charge, whereas strangers had to pay for using this. (The King's beam was an official balance set up in a building known as the King's weigh-house, and from time to time it was tested by Government inspectors to ensure its accuracy.)

The market-cross was a prominent feature of the market-place, and several old market-towns still have a cross. That of Banbury in Oxfordshire is immortalized in nursery rhyme, and the crosses at Cambridge and Salisbury are interesting relics of the past.

A good description of one of the early markets is given by Daniel Defoe in his account of the Leeds cloth-market in 1725. (I would strongly recommend those of my readers who are interested in the industrial conditions of this country, prior to the institution of the Factory System, to read Defoe's *Tour through the Eastern Counties of England*, and *Tour through Great Britain*.)

" Leeds is a large, wealthy and populous Town, standing on the North side of the River Aire, with great Suburbs on the South side, and both joined by a stately, strong, Stone Bridge, so large, and so wide, that formerly the cloth-market was kept upon it; and therefore the refreshment given the Clothiers by the Inn-keepers (being a Pot of Ale, a Noggin of Pottage, and a Trencher of boil'd or roast Beef, for Two-pence) is called the Brigg-shot to this day.

" The increase of the Manufactures, and of the Trade, soon made the Market too great to be confined to the Brigg; so that it is now kept in the High-street, beginning from the Bridge, and running up North almost to the Market-House, where the ordinary Market for Provisions begins; which also is the greatest of its kind in all the North of England. You may judge of the Plenty of it, when five hundred load of Apples have been numbered by the Mayor's officers in a Day.

" But the Cloth-market is chiefly to be admired, as a Prodigy of its kind, and perhaps not to be equalled in the world. The Market for Serges at Exeter is indeed

a wonderful Thing, and the money returned very great; but it is there only once a week, whereas here it is every Tuesday and Saturday.

"Early in the Morning, Tressels are placed in two Rows in the Street, sometimes two Rows on a Side, cross which Boards are laid, which make a kind of temporary Counter on either Side, from one End of the Street to the other. The Clothiers come early in the Morning with their Cloth; and, as few bring more than one piece, the Market days being so frequent, they go into the Inns and Public-houses with it, and there set it down.

"At about Six o'Clock in the Summer, and about Seven in the Winter, the Clothiers being all come by that Time, the Market Bell at the Old Chapel by the Bridge rings; upon which it would surprise a Stranger, to see in how few minutes, without Hurry, Noise, or in the least Disorder, the whole Market is filled, and all the Boards upon the Tressels covered with Cloth, as close to one another as the Pieces can lie longways, each Proprietor standing behind his own Piece, who form a Mercantile Regiment, as it were, drawn up in a double Line, in as great Order as a Military One.

"As soon as the Bell has ceased ringing, the Factors and Buyers of all Sorts enter the Market, and walk up and down between the Rows, as their Occasions direct. Some of them have their foreign Letters of Orders, with patterns sealed on them, in their Hands; the Colours of which they match, by holding them to the Cloths they think they agree to. When they have pitched upon their Cloth, they lean over to the Clothier, and, by a whisper, in the fewest words imaginable, the Price is stated; one asks, the other bids; and they agree or disagree in a moment. The Reason of this prudent Silence is owing

to the Clothiers standing so near to one another; for it is not reasonable that one Trader should know another's Traffick.

"If a merchant has bidden a Clothier a Price, and he will not take it, he may go after him to his house, and tell him he has considered of it, and is willing to let him have it; but they are not to make any new Agreement for it, so as to remove the Market from the Street to the Merchant's House.

"The Buyers generally walk up and down twice on each Side of the Rows, and in a little more than an Hour all the Business is done. In less than half an Hour you will perceive the Cloth begin to move off, the Clothier taking it up upon his Shoulder to carry it to the Merchant's House. At about half an Hour after Eight the Market Bell rings again, upon which the Buyers immediately disappear, the Cloth is all sold; or if any remains, it is carried back into the Inn. By Nine o'Clock the Boards and Tressels are removed, and the Street left at Liberty for the Market-people of other Professions, the Linen-drapers, Shoemakers, Hand-waremen and the like.

"Thus you see ten or twenty thousand pounds' worth of Cloth, and sometimes much more, bought and sold in little more than an hour, the Laws of the Market being the most strictly observed that I ever saw in any Market in England.

"If it be asked, How all these Goods at this Place, at Wakefield, and at Halifax, are vended and disposed of? I would observe,

"First, that there is an Home-consumption, to supply which, several considerable Traders in Leeds go with Droves of Pack-horses, laden with these Goods, to all the Fairs and Market-towns almost over the whole

Island, not to sell by Retail, but to the Shops by Wholesale; giving large Credit. 'Tis ordinary for one of these men to carry a thousand Pounds worth of Cloth with him at a time; and having sold that, to send his Horses back for as much more; and this very often in a Summer; for they travel chiefly at that Season, because of the Baldness of the Roads.

"There are others, who have Commissions from London to buy, or who give Commissions to Factors and Warehouse Keepers in London to sell for them, who not only supply all the Shop-Keepers and Wholesale Men in London, but sell also very great Quantities to the Merchants as well, for Exportation to the English Colonies in America, which take off great Quantities of the coarse Goods, especially New England, New York, Virginia, etc., as also to the Russia Merchants, who send exceeding great Quantities to Petersburg, Riga, Dantzick, Narva, Sweden, and Pomerania; tho' of late the Manufactures of this kind set up in Prussia, and other Northern Parts of Germany, interfere a little with them.

"The third sorts are such as receive Commissions from abroad to buy Cloth for the Merchants chiefly in Hamburg, and in Holland, etc. These are not only many in Number, but some of them vary considerably in their Dealings, and correspond with the farthest Provinces in Germany."

CHAPTER XI

THE FAIRS

WE have seen that the regulations governing a market were very strict, and that under those regulations business was limited to a great extent to the citizens of the town where the market was held.

As a rule, each ordinary trader of the Middle Ages dealt in one particular commodity; the fishmonger's business was restricted to fish, and he was not allowed to sell poultry and game as he does nowadays; the grocer could not sell ham, pork, and beef as does his descendant of modern times—that was the butcher's business. One tradesman was not allowed to encroach on another's preserves. "General Stores" were unknown, and the inhabitants of the villages, even when they came into the town on market-day, needed a far greater variety of goods than the shops and stalls could supply. In time the people tired of the strict rules which controlled the market; they needed a wider market for their goods, and they wanted to be brought into touch with the produce of other parts of England, and even that of foreign countries. Thus it came about that periodical meetings of traders from different parts of the country took place at certain times, and goods were bought and sold in open market.

As these meetings generally took place on one or other of the numerous festivals of the Church, when many pilgrims would be gathered together at the shrine of some

saint or martyr, they were called *fairs*, a word which is derived from the Latin *feria*, a holy day. Pilgrimages were quite common five or six centuries ago, and as the religious devotee had an eye to business as well as to his devotional exercises he frequently paid the expenses of his pilgrimage by the trade which he transacted among his numerous fellow-pilgrims who had gathered together

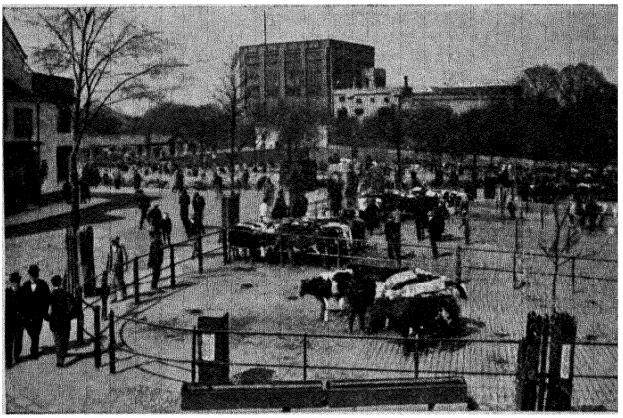


A Fair in the Fourteenth Century

for the saint's day. In time these fairs were visited by others than pilgrims, and they came thus to be established as the chief markets of the year, when all classes of the community, from noble to serf, assembled in the town and bought and sold goods freely in open market. Often the fairs lasted two or three weeks, and so important did they grow that they became the objects of special privileges and charters conferred by princes and magistrates; in the case of some of the most important fairs, public proclamation was made of their commencement and duration.

It is said that the gradual abolition of the fair during

the last century is due to modern means of travelling, and that the railway has effectually killed the fair. Nowadays goods can be transported so quickly that fairs are no longer a necessity, and it is chiefly in the agricultural districts that they are of importance. Dwellers in North London are quite familiar with Barnet Fair, where cattle



CATTLE FAIR AT NORWICH
By permission of the Great Eastern Railway Company

and horses are sold during two or three days at the annual fair in September. Many of the old fair-days are still kept up, but they are now merely an assemblage of roundabouts, swings, cocoanut-shies, shooting-alleys, and similar amusements. The modern fairs which correspond most closely to the old English fairs are those held at Nijni-Novgorod in Russia, Lyons in France, and Leipzig in Germany.

One of the most famous fairs was Bartholomew Fair, or Bartelmy Fair, which was held in London, in West

Smithfield, on St Bartholomew's Day, August 24th. This fair was established in the reign of Henry I (for a good description of Bartholomew Fair read Ben Jonson's play, *Bartholomew Fair*.) Other important fairs were held at Greenwich, Glasgow, Winchester, Boston and Peterborough.

Probably the largest fair in England was that of Stourbridge, a village near Cambridge. People from all parts



OLD SMITHFIELD AND ST BARTHOLOMEW'S CHURCH

of England, together with merchants from most of the European countries, visited this fair, which commenced in the last week of August and lasted until Michaelmas Day. Gibbins, the historian, says of Stourbridge Fair: "Hither came the Venetian and Genoese merchants, with stores of Eastern produce—silks and velvets, cotton, and precious stones. The Flemish merchants brought the fine linens and cloths of Bruges, Liège, and Ghent, and other manufacturing towns.

"Frenchmen and Spaniards were present with their wines; Norwegian sailors with tar and pitch; and the mighty traders of the Hanse towns exposed for sale, furs

and amber for the rich, iron and copper for the farmers, flax for the wives; while homely fustian, buckram, wax, herrings, and canvas mingled incongruously in their booths with strange, far-off Eastern spices and ornaments. And in return, the English farmers—or traders on their behalf, carried to the fair hundreds of huge wool-sacks, wherewith to clothe the nations of Europe; or barley for the Flemish breweries, with corn and horses and cattle also. Lead was brought from the mines of Derbyshire, and tin from Cornwall; even some iron from Sussex, but this was accounted inferior to the imported metal. All these wares were, as at Winchester, exposed in stalls and tents in long streets, some named after the various nations that congregated there, and others after the kind of goods on sale."

One of the great advantages of the fair of the Middle Ages was that it broke down that spirit of isolation in the towns and villages of which we have previously spoken. By intermingling with other people the minds of the villagers became broadened, and new ideas of commerce and industry were obtained. Agriculture was by far the most important industry, and, as one historian remarks: "Such manufactures as England possessed were entirely for consumption within the land, and for goods of the finer qualities it was dependent on importation from abroad. The only articles of export were the raw products of the country, and of these by far the most important was the agricultural product, wool."

Professor Knight gives us a good pen-picture of home life in mediæval times: "The farmer of the sixteenth century pursued many trades in his little homestead. He had eels in his stew (pond), and bees in his garden. He grew his own hops and made his own malt. He

raised his own hemp, and twisted his own cart-ropes. His flax was cleaned and spun at home. Some of his wool he sold to the webster, and some kept the spindles moving on his kitchen floor. He sawed out his own timber. He made his own mud-walls round his cattle-yard. He was his own farrier. He killed his sheep or his calf without the aid of the butcher. He made his own candles and his own charcoal. He cultivated herbs for physic, which his wife dried or distilled. His cheese was manufactured in his own press."

In the middle of the fourteenth century the total value of our exports was just over £200,000, and they consisted almost entirely of wool, cloth, worsted, and hides. The imports, which were mainly Flemish cloth, linen, and foreign fruits and wines, only came to about £20,000 in value. Nowadays our exports and imports represent an amount of many millions of pounds in a year, but in making any comparison between modern and mediæval times it must always be taken into account that the purchasing power of money in the Middle Ages was about fifteen times as great as it is to-day.

CHAPTER XII

THE MERCHANT GUILDS AND CRAFT GUILDS

If the histories of many of our manufactures and industries be traced to their very beginnings we shall find that the first stages were those during which the work was invariably done in the home. We have seen that man first of all produced only what he required for his own personal needs and the needs of those dependent upon him.

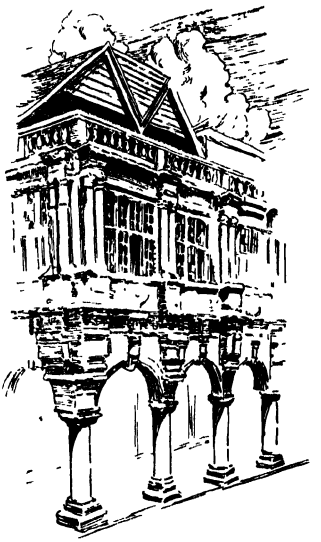
There are four clearly defined stages in the history of almost all manufactures; first, the home or family stage; secondly, the association of bodies of tradesmen or craftsmen, all of whom worked at the same trade or craft; thirdly, the domestic system; and fourthly, the factory system, which is in use to-day.

The second stage is known as the *guild* stage. There were four or five kinds of guilds, such as the *religious* guilds, which were founded by the Saxons for the strict observance of certain religious feasts and customs; the *frith* guilds, also founded in Saxon times as a protection in legal affairs; the *merchant* guilds, founded by bodies of merchants for exclusive trading rights; and the *craft* guilds, where bodies of tradesmen formed themselves into a kind of club which looked after their interests.

The most important guild in the Middle Ages was the merchant guild. All those merchants who belonged to the guild were granted the sole right of carrying on the

local trade of the town, as well as certain privileges concerning the payment of tolls and other imports.

From the following extract from a curiously phrased old charter we obtain some idea of the power conferred upon a merchant guild: "We grant a Gild Merchant with a house and other customs belonging to the Gild so that no one who is not of the Gild may merchandise in the said town, except with the consent of the burgesses."



GUILDHALL, EXETER

At first the guilds treated outsiders very severely; a stranger had to pay heavy tolls for trading in the town, and his trade was carried on under great restrictions. He could only remain in the town for a limited period, and any retail trade which he did, had to be transacted in a public place where the officials of the guild could supervise it strictly. Indeed, the poor tradesman who was not a member of the guild, found it very difficult to carry on business at a profit, and in certain trades the guildsmen practically enjoyed a monopoly.

But though the guilds would allow no intrusion by non-guildsmen in their business affairs, and though many of their rules and regulations were harsh and arbitrary, within their own ranks they were far more generous.

In this respect they were somewhat similar to our modern friendly societies or Freemasons' Lodges; if one of their members fell sick he was visited by fellow-members; if he were imprisoned, the members strove to obtain his release, and they granted him legal aid should he require it; if poor, he had a weekly allowance; and, should he die in indigent circumstances, it was seen that he had decent burial. Neither did guildsmen look with favour upon 'tricks of the trade'; if a guildsman was known consistently to give short weight, or to supply goods the quality of which was inferior to what he stated it to be, he was called before the officials of the guild and if he could not answer the charges satisfactorily he was either expelled from the guild, or else severely reprimanded.

The *craft guilds* came into existence about a century later than the merchant guilds. As various industries became firmly established the industrial workers followed the example of the merchants and formed themselves into similar associations for the purpose of looking after their business, and also of combining against any form of oppression or tyranny from their employers. In many respects the craft guilds were analogous to the trade unions of to-day.

At first the craft guilds were not so powerful as the merchant guilds. In making their rules they were under the guidance of the governors of the town, and for many years did not receive public recognition by charters. Nearly every town which was a trading centre had its craft guild, thus there was the Weavers' Guild, the Goldsmiths' Guild, the Fishmongers' Guild, and even the Parish Clerks' Guild. The guilds were not national as trade unions are now; each large town had its own guilds,

and the Weavers' Guild at Norwich was quite independent of the weavers' guilds in London or elsewhere.

Like the merchant-guildsmen the members of the original craft guilds made some very wise regulations; they looked with disfavour on bad work, and they maintained that a man was in duty and honour bound to serve his master to the best of his ability. They attempted to keep their particular industry within their own guild, and they tried to ensure that no non-guildsman produced their wares. The 'prentice system,' which became so popular in Elizabethan times, was started by the guilds. All true guildsmen were jealous of their craft, and they also tried to make their members maintain a good moral and social character. Work at night, even though it was paid for at a higher rate, was banned by the craft guilds, and the working hours for apprentices were regulated.

Had you been the son of a crafts-guildsman in the Middle Ages it is highly probable that you would have been apprenticed to some one of the same trade as that at which your father worked, for a period of seven years. Conditions of service would be drawn up and written out on a large sheet of parchment; these conditions stated the number of years for which you would be bound to your master, the number of hours a day you would have to be employed at your trade, the amount of premium your father agreed to pay the tradesman for teaching you the trade, and the various undertakings and liabilities for which your master was responsible. After the agreement had been duly signed and witnessed, the sheet would be torn in *two parts*, each with a jagged edge; one part would be given to your father to keep, and the other part would remain in the possession of your master. From this jagged or indented edge the agreement was called an

indenture. By tearing the paper in this way each party to the contract could produce his portion of the indenture in case of dispute, and prove that it was a part of the original agreement by showing that the two portions fitted closely together. The word 'indenture' is still applied to this form and to other forms of agreement, but the old custom of tearing the contract has been abolished.

When the apprentice had served his time there was a wise custom among some of the guilds by which he was given a 'wander-year.' For a whole year he wandered from one master to another, before settling to his trade; and by this means he obtained a deeper insight into his craft, and a broader knowledge. After this he was generally admitted as a freeman of the city where he could freely carry on the trade to which he had been apprenticed. The modern custom followed in some trades of serving a year or more as a 'journeyman' at the completion of apprenticeship approximates most closely to the system of the 'wander-year.' The word 'journeyman' is probably derived from the French *journée*, a day, and originally meant a workman who was hired by the day.

CHAPTER XIII

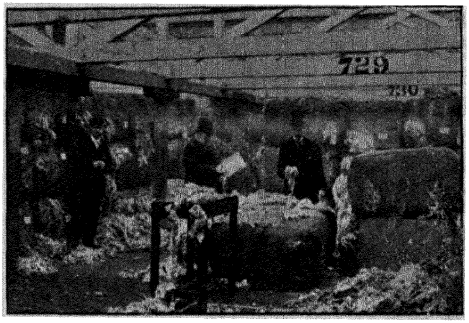
SHEEP-FARMING AND WOOL

In the early days of its industrial history, England was the chief wool-producing country in the world. During the thirteenth and fourteenth centuries Britain supplied Flanders, the great woollen manufacturing country of the Middle Ages, with much of her raw material, and with regard to wool, we stood in relation to the Flemings much as the colonists in New Zealand, South Africa, and Australia now stand to us.

The sheep has been for centuries one of our most useful domestic animals; its wool has provided our clothing, its skin has furnished some of our leather; its flesh has formed part of our food; its milk has, on certain occasions, been used to make our butter and cheese. In modern times the varieties of domestic sheep are numerous, but originally flocks of wild sheep roamed at will throughout these islands. We know that sheep existed in Britain prior to the Roman invasion, and that they were of the greatest importance to the Celtic races who inhabited the south of Britain. It is thought that the first sheep to be domesticated were those descended from the wild species known as the *moufflon*; these had crescent-shaped horns which were a useful protection against the wild animals of pre-historic times.

The best known of our modern sheep are the Leicesters, the Cotswolds, the Southdowns, the Cheviots, and the

various black-faced breeds. The Leicesters and Cotswolds provide the longest wool — an average fleece weighing from seven to eight pounds—while the Southdowns, Cheviots, and black-faced sheep are more especially noted for their excellent mutton. The Downs of the southern counties, and the wolds and hilly slopes of the north afford suitable pasturage, and sheep thrive as well in England as in any part of the world.



A London Wool Warehouse

The monks of the early Middle Ages turned their attention to sheep-rearing, and, as they found a ready market in Flanders for the wool, sheep-farming arose all over the country. But it was not until after the Black Death in 1348 that the farms were turned mainly into large permanent pastures. One shepherd was able to look after the sheep which grazed on land which had formerly required forty or fifty labourers to till it, and as Edward III promoted the woollen manufacture by statute and example, wool-producing was carried on at considerable profit. At the commencement of the fifteenth century the export trade in wool was so important that three-fourths of our

revenue from customs and taxes were derived from it, for our only serious rivals were the Spaniards who reared the famous long-haired merino sheep.

English visitors touring through France generally remark on the absence of the small fields bounded by high hedges which are so prominent a feature of the English countryside. In France there are wide stretches of arable land and miles of rolling pastures unbroken by any visible boundary marks, but in England we see a number of holdings (many of which are not more than 200 acres in area) divided up into small plots of land by hedges, with here and there a few trees interspersed. This system of enclosures was established principally by the sheep farmers of the sixteenth century for the purpose of keeping their flocks within limited spaces so that they could not stray.

The poor greatly resented the large number of sheepwalks formed, for many of the agricultural labourers had thereby no work to do. Parliament tried to prohibit the sixteenth century farmer from enclosing such large stretches of land for sheepwalks, and in 1535 an Act was passed forbidding any single farmer from keeping more than two thousand sheep. It was high time to take some such action, for risings were taking place all over the country in consequence of the depression in the labour market; peasants armed themselves and had to be dispersed by the royal troops; their leaders were executed, and insurgent monks and priests were hanged from church steeples. Robert Ket, a Norfolk farmer and tanner, headed a rebellion in 1549 against the system of sheep enclosures, and consequent lack of employment in Norfolk, but the rebels were dispersed by the Earl of Warwick, and Ket, with nine other ringleaders, was hanged.

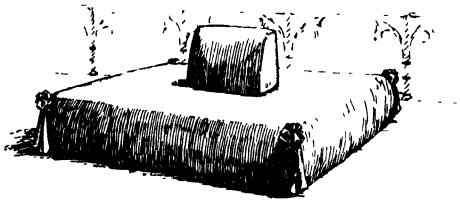
The historian Knight says of the Norfolk rising: "At Norwich it was a time of feasting and holiday for the thoughtless multitude, who revelled in the spoils of the neighbouring deer parks; and brought in the fat sheep by thousands from the enclosures which they had broken down."

The great trouble, of course, was that the landlords had gone to the extreme limit in the production of wool, but in course of time matters were adjusted more evenly, and a greater proportion of arable land was put into cultivation. We learn something of the discontent among the labouring classes from the following quotation from Sir Thomas More: "Your sheep that were wont to be so meek and tame, and so small eaters, now, as I say, become so great devourers, and so wild, that they eat up and swallow down the very men themselves. They consume, destroy, and devour whole fields, houses, and cities."

An interesting relic indicating the importance of wool in mediæval times is the *Woolsack* in the House of Lords. The Woolsack is a large square seat or lounge stuffed with wool, without back or arms, covered with red material; it forms the seat of the Lord Chancellor who presides over the House of Lords. It was first placed in the House of Lords by Edward III as an indication that wool was England's chief source of wealth; or, as it was once described, "the sovereign treasure of the kingdom." For centuries the ancient and historic Woolsack, standing immediately before the throne, has been a memento of the days when wool was connected closely with our commercial and industrial life. Nowadays, though wool is still of great value to us and the production of it of commercial advantage to our farmers, it is no longer our *chief* industrial product.

If the present king wished for a *modern* symbol of British Industries, it would have to take the form of a coal-and-iron sack!

Something of the value of the wool trade in the thirteenth and fourteenth centuries appears from a passage in the *Chronicles of the Sheriffs of London* which recounts a dispute between Prince Edward, afterward Edward I, and the Countess of Flanders: "The Countess of Flanders seized all chattels found in Flanders, belonging to merchants of England, Wales, and Ireland, and even Gascony.



THE WOOLSACK

"This she did by reason of a certain yearly rent that she demanded of his lordship, the King of England, which rent she declared was many years in arrears. She also forthwith sold the said chattels, and took to her own use the money obtained for the same, turning out of her land all the merchants aforesaid. Wherefore Sir Edward, who was still in the South of France, on his way to the Holy Land, as soon as he heard of such unjust and cruel conduct on the part of the Countess, upon the men of his father and himself, wrote to his lordship, the King his father, and to the Queen, and to his lordship, the King of Germany. To all these, and to the council of the realm, he wrote that they should harass the Countess and her people in every way they could, so that all the goods

that had been taken from the said merchants might be restored to them in full. Thereupon, after council had been held, by order of his lordship the King, all chattels belonging to the merchants of Flanders were taken and seized. They were, however, but few in number, because the Flemish merchants, being warned by the Countess, had sent nearly all their goods out of the kingdom.

"At the same time, also, it was forbidden that any person, whether native or foreign, should take away any wool out of the realm, to the parts beyond sea.

"And so it was accordingly done, until Parliament, which was held at Westminster on October 13th, gave orders that all merchants, except those of Flanders, might carry wool out of the kingdom, wherever they might think proper.

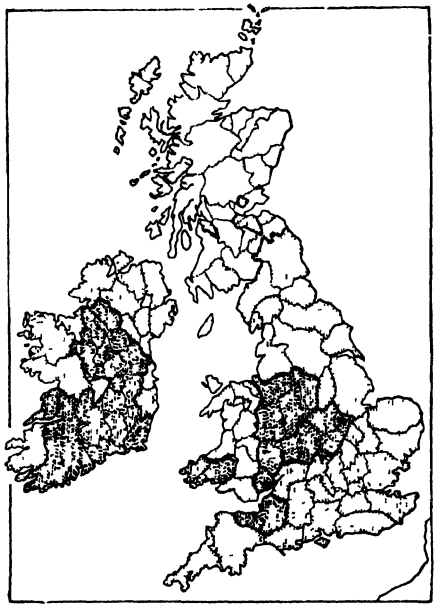
"Then, by the King's orders, all the merchants who were in London appeared before the council at Westminster, and there made oath that they would carry no wool to Flanders, nor would have any dealings with the Flemings, nor sell them any wool. And if anyone should go against this, all his chattels coming into England were to be given up to the King, and himself be cast into prison. But if such person should not himself come into England, then the man who had come into England in his stead should suffer the punishment.

"It should also be known that the chattels, which the Countess of Flanders had seized, were worth the sum of 40,000 marks sterling.

"Then his lordship, the King, sent unto the Mayor and Sheriffs of London, saying:

"You are to make it known that all workers of woollen cloths, male and female, as well of Flanders as of other lands, may safely come into our realm, there to make cloths;

upon the understanding that those who shall so come and make such cloths shall be free of payment of customs for their work, until the end of five years from this time.'



THE EXTENT TO WHICH THE LAND OF GREAT BRITAIN IS USED FOR PASTURAGE

Lightest shading	. .	under 20 per cent.
Medium	,, .	20–50 ,,
Darkest	,, .	over 50 ,,

From "The Home of Man," by W. C. Brown and P. H. Johnson

This letter from his lordship the King was made known throughout the City.

"Soon afterward envoys of the Countess came to London, hoping by bribes to win over the council, and asking that the matter might be put off till the feast of

St Michael (Michaelmas Day, September 29th). In the meantime, the Countess wished that the merchants of England might trade to Flanders, and the Flemings to the kingdom of England, as they had been wont.

"This, however, was a foolish thing to ask, and one against all reason. By this means they would be able to remove all their goods and chattels out of the kingdom of England, and buy wool and carry it to their own country, enough for all their needs for the next two or three years.

"After the envoy had stayed in London three weeks, they were clearly told by the King and his council that they must leave the kingdom.

"After Easter in the year 1271 there came envoys who had been sent by the Countess of Flanders unto his lordship, the King, saying it was her wish to make good, to all the merchants of his realm, the goods and chattels which had been taken in her land, as aforesaid. This, however, was only if the King would bind himself to pay, within the next three years, the rent which she demanded, as also, all the debts which he and his Queen owed to the Flemings. If he would not do so, she might lawfully seize all persons coming into Flanders from the realm of England, till she was paid what was due to her.

"Upon hearing this message the King and his council were very angry, and sent away the said envoys, ordering them, on peril to life and limb, to leave England within three days, and forbidding anyone from Flanders, upon the like peril, to come into England. Still it was allowed that wool should be taken out of the country, but every sack of wool so taken away was to be sealed with the mark of his lordship the King. For this mark the merchant was to give one halfpenny for each sack."

CHAPTER XIV

THE INFLUENCE OF THE FLEMINGS

QUITE in the forefront of British manufactures is the textile industry, which embraces the allied arts of spinning and weaving, and employs hundreds of thousands of our workers in the North.

The founders of this industry are generally acknowledged to be the Flemings who originally came to this country during the reign of William the Conqueror. Flanders in those early days held the position among the European nations in the world of industry that Britain holds to-day. The historian Gardiner, says: "In the cities of Flanders had arisen manufacturing populations which supplied the countries around with the products of the loom. To the Ghent and Bruges of the Middle Ages, England stood in the same relation as that which the Australian Colonies hold to the Leeds and Bradford of our own day. The sheep which grazed over the wide unenclosed pasture-lands of our island formed a great part of the wealth of England; and that wealth depended entirely on the flourishing trade with the Flemish towns in which English wool was converted into cloth."

It seems strange, does it not, in these days when almost every country in the world is laid under tribute by our woollen manufacturers, and when millions of bales arrive yearly in this country from distant Australia, New Zealand, and South Africa, that in early times raw wool

was our staple export? In the early Middle Ages the various monastic orders, especially the Cistercian order of monks, had laid many thousands of acres under pasturage, much as our kin in our over-seas dominions are doing in our time.

Historians differ as to the true reason of the Flemings' migration to England during the Conqueror's reign. Some authorities say that William, having a keen eye to business, invited them here, and settled their colony at Carlisle, hoping that they would impart their knowledge and some of their skill in weaving to his subjects. The more general opinion, however, is that a series of disastrous floods swept over the Netherlands during the eleventh century, and that this was the real cause which drove the Flemings from their home, and made them seek refuge on our shores.

But, whatever may have been the cause of their appearance in England, we know that these skilful weavers followed William thither the year after his accession, and that a Weavers' Guild to protect their interests was formed in this country in 1080. The inhabitants of Carlisle appear to have disliked the presence of these foreigners in their town, and so the little colony removed to Ross, in Herefordshire, while another colony settled near Norwich in the reign of Henry I.

The woollen industry during the following two or three centuries made very rapid progress. We are told that Edward III, sometimes described as the 'father of English commerce' invited a further batch of seventy families of Walloons to England in 1331, and enacted, for their protection, several statutes, and banned the use of foreign cloth. Previous to this, in 1258, a law had been made forbidding the export of wool from England. When we

consider that the revenue gained by the Government from the export of raw wool was far in excess of that obtained from any other material, we see something of the power and importance of the woollen manufacturers in those early days.

In his wish to get into closer contact with the Flemings, Edward III removed his Court to Flanders, in 1338, and he made a league with that country, and several of the small German states, though this league was really more for purposes of war than for commerce. One of his sons, the famous John of Gaunt, was born while the English court was in residence in Flanders.

In 1348 the worsted trade commenced near Norwich, and two years later an Act was passed by the English Parliament specifying the kinds and qualities of woollen cloths to be made. Our English weavers could not yet make the delicate fabrics and fine cloths that the Flemish weavers produced, and for this reason, most of our English ladies had hitherto obtained their dress material from Flanders; but Edward III compelled them to wear cloth which had been made in England only.

A writer on the textile industries says: "About the middle of the thirteenth century woollen manufacture attained the position of being a leading industry. Beverley, in the north, gained renown for russets and blues; Lincoln was the seat of scarlet fabrics; Totnes became a great centre of cloth manufacture. . . . Fulled woollen cloth soon became an article of English export; at the commencement of the fifteenth century these goods formed a great part of our exports, and were largely used in Spain and Italy."

Fuller in his *Church History*, gives a more detailed description of the localities which specialized in the

woollen industry. It had been the settled policy of Edward III to scatter about the country the various families of foreign weavers, in order that as many English artisans as possible should have the chance of learning the new industry, and also that the foreigners in any one district should not become too powerful and combine their interests to the detriment of the natives. Thus Fuller says: "Woollen fustians were made at Norwich, baizes at Sudbury, broadcloths in Kent, kerseys in Devon, friezes in Wales, fine cloths in Worcestershire, Gloucestershire, Hampshire, Sussex, and Berks, coarse cloths in the West Riding of Yorkshire, and serges at Colchester and Taunton."

CHAPTER XV

THE INFLUENCE OF THE MONKS ON INDUSTRY IN THE MIDDLE AGES

In various parts of England there are magnificent ruins of the mediæval abbeys and monasteries about whose extensive cloisters and well-kept grounds the silent meditative monks were wont to roam in bygone times. Among the most famous of these ruins are the Benedictine monastery of Reading, Tintern Abbey in Monmouthshire, Fountains Abbey in Yorkshire, Furness Abbey in Lancashire, Battle Abbey in Sussex, and Whitby Abbey in Yorkshire. Of these once majestic buildings it has been said

> Pillar and roof and pavement, all are gone,
> The light extinguished and the prayers long done;
> But faith and awe, as stars eternal shine,
> The human heart is their enduring shrine.

From time to time various orders of monks arose, but one of the earliest and most famous orders was that founded by St Benedict in the sixth century, which was generally known as the Benedictine Order. In this country their more usual name was the Black Friars because of the colour of their dress, which consisted of a loose black gown with large wide sleeves, and a black cowl over the head. Most of the early mediæval abbeys in Britain belonged to the Benedictines who, it is said, originally

came to this country under the leadership of St Augustine about the close of the sixth century.

The rules which the Benedictines had to obey were very harsh. On joining the order the monk had to give up to the monastery all his personal property, and renounce the world for ever. He was publicly chastised for the most trivial offences, and his food was coarse and scanty. In addition to the religious services which he attended at least seven times daily, he was employed in some form of manual labour, or in the copying of manuscripts (this has preserved to us many literary remains of antiquity, such as the various versions of the *Anglo-Saxon Chronicle*) or in the instruction of the young. In the early Middle Ages the monks were almost the only scholarly and cultured men in the country; they were the historians of their time, and to them we are indebted for much of our knowledge of the lives, manners, and customs of the English of those days; they studied many of the fine arts, such as drawing and painting, or music; they were acquainted with the practice of surgery and medicine such as it was in their day, and in many districts they were the only doctors available; they were also large employers of labour, and on the monastery lands there were farm labourers, woodmen, millers, and carpenters all at work. All manner of trades were represented in the monastery, and some of



ABBEY GATEWAY, READING

the monks specialized in carpentry, others in building, others in smith's work, and so on. The utmost care was lavished in making the costly vessels used in the service of the church, and some of the smiths were highly skilled designers and engravers.



BENEDICTINE MONK

The Black Friars were succeeded by the Cistercian Order, which became established in England during the twelfth century. During the previous century the Black Friars had grown lax in the strict observance of their rules, and had begun to lead idle and luxurious lives. A reformed branch of the Benedictine order appeared in 1098 in Eastern France, and the original convent was Citeaux (Cistercium), hence the name 'Cistercian.' In time the Cistercians spread to England; and at the dissolution of the monasteries in the reign of Henry VIII it is estimated that there were a hundred Cistercian houses in this country. One of the best-known houses founded by this order is Tintern Abbey, now in ruins.

The Cistercians were the chief wool-growers in England during the thirteenth and fourteenth centuries, and as wool was the foremost commodity of the Middle Ages it will be seen that these monks had a large share in the country's industry. Their sheep-walks extended for miles over the Yorkshire moors and the pastures in the Midlands and the West, and the merchants of Bruges and Ghent

made several contracts with them as their sole suppliers of wool. In time the monks amassed great riches, and even the ascetic contemplative Cistercians began to lead lives of idle luxury, and abused the powers committed to them. The poor, whom they had hitherto befriended, were neglected; beggars were driven away from the monastery unrelieved, and the rich old abbot thought more of hoarding up money than of enforcing the rules established by St Benedict.



A Monk at Work upon a Manuscript

And now appeared the Franciscans or 'begging' friars, with a new mission in life. This order was founded by St Francis of Assisi, early in the thirteenth century, and in nearly every way they were a great contrast to the Benedictines. We have seen how the latter became very wealthy through their various industrial occupations; they lived in country districts, and invariably selected especially beautiful sites on which to build their monasteries. But the 'begging' friars were the ministers of poverty, and their aim was to serve God not by amassing wealth, or by manual labour, but by preaching, and healing the sick. Their houses were built in the 'slums' of the great cities and in every way they obeyed the Divine injunction.

One terrible feature of the Middle Ages was the pre-

valence of leprosy which was everywhere rife in the city hovels by reason of the insanitary conditions of the streets and houses and the impurity of the water.

An interesting reminder of the days when leprosy was common is provided by the ' Lazar squint ' still to be seen in the walls of a number of very old country churches. This was a narrow aperture through which the leper peered into the chancel and by means of which he was able to take part in the Mass. The sacred wafer was handed to him upon a special spoon. The sufferer was, of course, compelled to keep apart and he wore a hood and carried a bell that others might be warned of his approach.



CISTERCIAN MONK

The Franciscans used to go, day by day, into the most squalid dwellings, on their errand of healing, cleansing the lepers, and ministering to the spiritual needs of the sufferers as well.

The original Franciscans were unlettered men, but in course of time, they numbered within their ranks clever men of science (such as Roger Bacon) also some of the greatest and most learned preachers and teachers of the age. Unfortunately the later Franciscans became engaged in many political intrigues, and they had an evil repute as spies in the royal courts, and the houses of the nobility. (For a full description of the plots and subterfuges of the Franciscans and Jacobites you should read Eugène Sue's remarkable book *The Wandering Jew.*)

Nearly a thousand religious houses were suppressed in the reign of Henry VIII, chiefly on the advice of Thomas Cromwell, Earl of Essex. In 1536 Parliament passed an Act suppressing or dissolving all the smaller monasteries and nunneries, and three years later most of the larger monasteries were also dissolved, and their income was granted to the Crown. With some of this money a few grammar-schools were established, but by far the greater part of it went to pay for the luxuries of the Court, and the extravagance of the King.



A FRANCISCAN FRIAR

The people of the North greatly resented the dispersal and expulsion of the monks and, headed by a lawyer named Aske, they rose in rebellion, taking as their badge the 'Five wounds of Christ.' The movement, which was also a protest against the misrule of Cromwell, and the execution of Sir Thomas More, was known as the 'Pilgrimage of Grace.' The rebellion was put down, and Aske and some other ringleaders were executed.

The whole of the land held by the monasteries, estimated at one-quarter of the total arable and pasture land in the kingdom, was transferred to the nobles. The tenants who had previously held their lands under quite fair conditions, had to pay there and then a higher rent, and many of them were reduced to pauperism. In those days there was no Poor Law; for centuries the monks had done for

the poor what the workhouses and the hospitals attempt to do to-day, and it was this dissolution of the monasteries and the subsequent rapid increase of pauperism that led to the first attempts at relief by Act of Parliament. Agriculture was discouraged and most of the arable land that had been previously laid down by the monks was again turned into pasturage, so that laws had to be passed which limited the number of sheep kept on a single farm. It has been supposed that the ejected monks were quite penniless; this was not the case, as the King granted them pensions in accordance with their position in the Order. Thus the abbots and the superiors had annual pensions ranging from about £100 to £3,000 of our money, and the ordinary monks and



LEPER
TWELFTH CENTURY



BERMONDSEY ABBEY

nuns received annual grants of about £60 and £50 respectively. It was with money received from the dissolution of the monasteries that the sees of Peterborough, Chester, Gloucester, Westminster, Bristol, and Oxford were established.

CHAPTER XVI

THE EARLY HISTORY OF THE WOOLLEN INDUSTRY

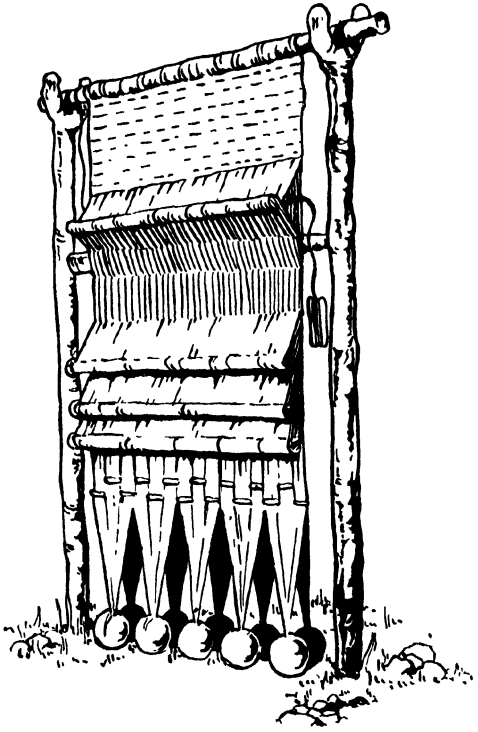
It will be noticed that Britain's early industrial history is concerned mainly with wool, and we have seen that in mediæval times the staple industry was sheep-farming and the production and export of enormous quantities of wool, for which were imported fine manufactured cloths in exchange.

In these days of great industrial activity in the North and Midlands it is hard to realize that there was only one important industry five centuries ago; we certainly look upon wool even to-day as one of our chief industries, but as only one among many, and in speaking of industry we think more naturally of the mighty blast-furnaces of Cleveland and Furness, to the clanging shipyards of the Clyde and Tyne, and to the enormous mills of Lancashire and the West Riding. Nowadays our country's prosperity depends to a large extent upon the busy hives of industry in the North, but in the Middle Ages the history of the northern counties was one long chapter of Border warfare with its consequent raids and pillage, nor had this part of the country even then recovered from the merciless raids and ravages of William the Conqueror, who laid waste all the land from York to Durham, so that not an inhabited village was left.

In this chapter we will trace briefly the rise of the woollen industry through the *family*, *guild*, and

domestic stages, leaving the modern *factory* stage to a later chapter.

The textile manufacture, which now employs millions



The Primitive Loom

of workers, who have at their command vast masses of intricate machinery, is based upon the simple arts of *spinning, felting, and weaving.* All of these arts have been long established, for we have the evidence of actual

threads and woven fabrics discovered on the floors of Neolithic caves, to show that even prehistoric man had a fair knowledge of the processes needed for such work.

Spinning was certainly known to our remote ancestors, long before they learnt how to weave the spun yarn into a fabric. The savage, in his forest home, had acquired the art of drawing out and twisting a number of fibres into one long fine thread—very much as do the Polynesian savages of to-day. It was at a much later day that he learnt how to combine his threads into some kind of fabric.

Still, the gradations between the most primitive forms of weaving and even those of to-day are slight. From the *home* or *family* stage of the textile industry (where no machinery existed and all the work was done by hand) to the guild stage (here there were very few, if any—and those, very primitive—machines) is but a step.

W. G. Murphy in his book *The Textile Industries*, when making a comparison between the rudimentary stages of spinning and weaving and the modern spinning-machines and looms, says: "It is possible to illustrate every stage of weaving, from the lowest to the highest, by collecting fabrics woven at the present hour in various parts of the world. From the open-textured hammocks of Polynesia, the plaited loin-cloths of many savage races, the rude cotton fabrics of Brazilian aborigines, the rough and loose canvases of Hindu jute weavers, the irregular woollens of the weavers of Harris, up to the most gorgeous of silk brocades and the finest of broadcloths, the gradations are slight and readily traced."

Though Great Britain holds such a pre-eminent position among the world's industrial countries of to-day, that pre-eminence is not very ancient at the time

when the ancient Greeks, Egyptians, and Chinese were making delicate and costly fabrics the people of our island home had a very, very slight acquaintance with the textile arts. One of the first weaving-sheds set up in England was that established at Winchester by the Romans in the year 80 A.D. Later on a Wessex king ordered that a sheep and its lamb be valued at a shilling, and that the fleece be sold at two pennies.

We have referred to the Flemish weavers who followed William the Conqueror into England in 1068, and we have seen something of their influence on the textile manufacture. The first weavers' guild was formed in this country in 1080. No class of people were so jealous as the weavers of their rights, and they contained within their ranks some of the wealthiest citizens of the kingdom. In many cases they underwent military training, for in those days of warfare it was necessary for them at times to defend hearth and home. They looked upon the Flemish settlers as aliens, and so bitterly did they attack these foreigners that the Government had to afford military protection to the latter.

Various laws were passed from time to time by the parliaments of the Plantagenet line of sovereigns for the special benefit of the woollen industry, but the monarch who did most to encourage the manufacture of wool in this country was Edward III. We have already seen that, not only did he bring the woollen weavers into England, but he ordered that the exportation of wool should cease, and that the importation of fine cloths from Flanders should be prohibited. His object was to encourage the weavers of this country to improve the qualities and designs of the various cloths they wove; hitherto only coarse cloths had been

made, such as hempen sacking, windmill sails, and woollen coverings.

This Act, however, had one serious drawback; for as soon as the export of wool stopped, the English market was flooded, and the manufacturers, with their limited skill, were unable to deal with all the raw material supplied. In addition, a considerable source of revenue was lost to the Crown from export duty on wool, but this was in part made up by a heavy tax on exported cloth. The Commons advised the King to remove this tax in order that foreign merchants should buy our cloth more freely, but he, with the Lords, declined to do this, and so the tax remained.

With the gradual development of the woollen manufacture arose the *clothier*. Hitherto the craftsman had bought the raw material and turned it into cloth, which he sold to the *draper*, who in turn sold it in the markets and fairs. So important did the drapers become that they obtained a Royal Charter which, among other things, forbade any but those who belonged to their Company to sell cloth in London, and they exercised the right to examine and test all cloth sold at the annual Cloth Fair at Smithfield. But the *clothier*, as one writer says, "bought the wool; caused it to be spun, woven, fulled, and dyed; paid the artisan for each stage of the manufacture; and sold the finished commodity to the drapers." Thus the clothier acted as a kind of middleman between the craftsman and the wholesale merchant, and this led to the gradual abolition of the guild system, and the institution of the domestic system, where the craftsman, with his family, worked at home, and manufactured the raw material supplied to him by the clothier.

The allied arts of dyeing and fulling were encouraged

by various sovereigns in the fifteenth and sixteenth centuries, though until the seventeenth century these industries were carried on chiefly in the Netherlands. This was due to the knowledge possessed by the Dutch in the cultivation of the madder, which at that time was the principal dyeing agent—of course, our modern coal-tar dyes were then unknown. The Parliament of Henry VII passed an Act forbidding the export of undressed cloths, and early in the seventeenth century the practice of dyeing wool before it was spun began in this country. Probably one of the most curious Acts relating to wool was that passed in 1666, which ordained that all persons, of whatever rank, should be buried in woollens.

CHAPTER XVII

THE BLACK DEATH AND ITS INFLUENCE ON INDUSTRY

In 1348 England was visited by a terrible plague which is generally described as the Black Death. It is not our purpose to give a full description of the origin of this plague, nor of its symptoms, or the enormous fatalities among the inhabitants of the densely populated towns. It will be sufficient for us to remember that it spread so rapidly through the insanitary dwellings and streets of the cities that in about two years more than half of the total population of this country—estimated at about four millions—was swept away. The Black Death spread most rapidly in the towns, but the villages and hamlets suffered also, and there was no part of England left undevastated.

Our main purpose is to watch the influence of this plague on the lives of the workers and on the leading industries of the country. Then, as now, a large proportion of this island was devoted to agriculture and sheep-culture, and though the modern usage of the word industry does not rightly include the various branches of farming, sheep-rearing, and so on, yet we must look upon these occupations as the staple industries of the people in the Middle Ages.

We have previously referred to the manner in which land was held under the Manorial System. During the

century which preceded the Black Death, the conditions under which the labourer worked had been gradually improving, and in most cases there were happy relations between the farmer and his men. The bodily service which the villein in Norman times undertook to render to the lord of the manor or his bailiff had, in many cases, been dispensed with, and a money payment had been substituted as rent for his plot, thus establishing conditions somewhat similar to those which exist between landlord and tenant to-day. On many manors, too, the villein was paid wages for working on his lord's land, and he in turn paid the serf for helping him with the cultivation of his own plot. Indeed, the bondmen or serfs had practically disappeared by the time the Black Death broke out, and on the whole the villagers were happy and contented, as we have said.

But when most of the labourers were swept away by the awful Plague, and when, as one writer says: "The sheep and cattle strayed at will through the deserted fields, and there was none left to mind them," there was a great scarcity of labourers. The few who remained demanded higher wages than their masters thought fit to pay, and there was every danger of a general strike of labour, with a subsequent famine in the land. A deadlock existed between master and men: the men on their part refused to work unless they were adequately paid; the masters contended that the demands of the labourers were exorbitant, and, under the circumstances of the moment, most unreasonable.

At such times as these, when public interest is at stake, and public disaster is threatened, it is the duty of the Government to intervene in any dispute, and act as arbitrator between the various parties. Thus, when a



RICHARD II AND WAT TYLER AT SMITHFIELD

great railway strike, or a coal strike, is threatened, the Government does all in its power by persuasion, and, perhaps, legislation, to prevent it. And so we find the Parliament of Edward III trying to settle the question of the rate at which the labourers were to be paid, and the conditions under which they were to work, by passing the famous Statute of Labourers. Intervention would have been very commendable if the Government had been just to both parties, but most of those who made the laws were large landowners and employers of labour themselves, so, when they drew up the Statute, they looked after their own interest only, and were grossly unfair to the labourers.

If we examine closely the various provisions of the Statute, we shall see that there was great danger of a recurrence of the dark days which existed just after the Norman Conquest, when the peasant was in many respects no better off than a slave. Thus one part of the Statute says: "The Lord King, seeing the grievous inconveniences which may arise hence, especially through the want of agricultural labourers and workmen of this kind, has ordained that every man and woman, of whatever condition, free or bond, able in body, and under the age of threescore years, not living by merchandise, and not having any certain craft, and not having wealth of his own on which he may live, nor land of his own which he may till himself, and not serving any other, shall be bound to serve the employer who shall require him to do so, and shall take only the wages, pay, reward or salary, which were accustomed to be paid in the neighbourhood where he is bound to serve. . . . And if any such man or woman, being so required to serve, refuse to do so, and that be proved by two lawful men before the sheriff, or the bailiff, or the lord, or the constable of the township, he

shall forthwith be taken and committed to the nearest jail, there to remain in strict custody until he shall find surety to serve in the manner aforesaid."

This statute applied chiefly to the farm labourer, but many industries and trades came within its scope, and it included the sheep-shearers, shepherds, weavers, spinners, and other craftsmen, who were all forbidden to take higher wages than those paid before the Black Death.

Many amendments were made to the famous Statute of Labourers during the next three years, and, indeed, for a period of ten or fifteen years the labour trouble was frequently discussed in Parliament, and various other Acts referring to it were passed. Always, however, these Acts were one-sided; the employers cared more for their own interests than for interests of the State, and they sought, by legislation and other means, to bind the peasant to the soil in every possible way. One Act provided for the branding of a runaway with a hot iron drawn across his forehead, and should the runaway take refuge in a neighbouring county, the ruling authorities of that county were bound under a heavy penalty to deliver him up.

But all these Statutes and Acts were doomed to failure because of their injustice and one-sidedness. It is not in the nature of an Englishman to submit long to injustice; for a time he may appear to be crushed, but in the end matters are invariably righted. In this case, however, the struggle between employers and men was very long and arduous, and it culminated in the Rising of the Villeins about thirty years later. You are quite familiar with the story of the insurrection of the men of Essex and Kent under the respective leadership of Jack Straw and Wat Tyler. The peasants marched to London and

demanded of the King the abolition of serfdom, the abolition of all tolls and market dues, and a free pardon. The boy King, Richard II, promised them their free pardon if they would go peaceably to their homes; he also promised that charters should be drawn up in their favour; but his advisers over-ruled him and, after the rebels had dispersed, the charters were revoked, and an army of 40,000 men was sent through Kent and Essex; the ringleaders of the mob, and thousands of the labourers who had taken part in the rising were hanged in chains. At first sight it might appear that the peasants had made their case even worse than before, but the landlords could see that the men were in deadly earnest, and that it was absolutely necessary to treat them more fairly for the future. Accordingly the old system of money payments of rent for land was revived, and the villeins became free tenants and wage-earners once more. Later on men could go to work where and when they willed, and serfdom thus came gradually to an end.

CHAPTER XVIII

THE RISE OF OUR GREAT INTERNATIONAL TRADE

It is generally agreed that the most rapid growth of English trade took place in Elizabethan times, and this was due chiefly to the maritime enterprise of Drake, Raleigh, and the other famous sea-captains of this period. Wherever these daring sailors ventured new markets were opened up, and in most cases companies were formed for trading purposes.

Up to the close of the sixteenth century our trade had been carried on mainly with France, Spain, and the Netherlands. A large fleet of small trading-ships plied between Harwich, London, Yarmouth, and Grimsby, and the ports on the opposite side of the North Sea, the greatest of which was Antwerp. An Italian writer says of our trade with Antwerp: "To England, Antwerp sends jewels, precious stones, silver bullion, quicksilver, wrought silks, gold and silver cloth and thread, spices, drugs, sugar, cotton, linens (fine and coarse), serges, tapestry, madder, hops in great quantities, glass, salt, fish, metallic and other merceries of all sorts; arms of all kinds, ammunition for war, and household furniture. In return the English export to Antwerp vast quantities of coarse and fine draperies, fringes, and all other things of that kind to a great value; the finest wool; excellent saffron, but in small quantities; much lead and tin; sheep and rabbit skins without number, and various other sorts

of the fine skins and leather; beer, cheese, and other provisions in great quantities; also Malmsey wines, which the English import from Candia. It is marvellous to think of the vast quantity of drapery sent by the English into the Netherlands."

From this list we may obtain a good comparison between our staple commodities of three or four centuries ago, and those of to-day. It will be noticed that coal and iron do not appear, for at that time, these, the chief of Mother Earth's hidden treasures, had not been widely worked. True, the Sussex Iron Industry was then in its prime, but the smelting of iron by charcoal obtained from the Weald was so slow and laborious, and the means of conveyance of iron ore to the smelting furnaces were so primitive, that the iron trade was comparatively insignificant. It is also curious to note that we imported arms and ammunition for war.

Spain at this time held a very prominent position in the transaction of European commerce, and the gradual establishment of London as the chief commercial centre of the world. In 1576 Philip of Spain invaded the Netherlands and sacked Antwerp and several other Flemish towns; this ended the commercial greatness of Flanders. The old proverb "It's an ill wind that blows no one any good," was well illustrated by the fact that the greater part of Antwerp's commerce became transferred to London; and hundreds of Flemish artisans migrated into England. The complete destruction of the Spanish Armada in 1588 also served us well from a commercial point of view, for it was such a mortal blow to Spain that her trade was ruined, and much of that also was transferred to England.

Other new markets were opened up at this period for our

rapidly increasing trade,—with Turkey in 1583, with Russia in 1532, with India in 1600, and with the West Coast of Africa in 1562. In nearly every case royal charters were granted to companies of merchants for exclusive trade with these various countries. Probably the most famous of these companies, both commercially and politically, was the East India Company, which was first granted its charter in 1600. In the original charter the Company is described: "The Governor and Company of the Merchants of London trading with the East Indies." From time to time the charter was renewed, and it was found necessary for the Government to give the Company power to seize and confiscate the goods of smugglers, and to fit out ships for defensive, and even offensive purposes, for in the early days of the Company the war galleons of the Portuguese and Spanish frequently attacked the merchant fleet on its way to the Indies. During the reign of Charles I the Company was hard pressed for money; its trade fell off considerably, and its difficulties were increased still further by the King granting a trading licence to a rival Company; but Cromwell rescinded this licence and replaced the East India Company on its old footing. For two hundred and fifty years the Company was the subject of many political discussions in Parliament, and there were considerable variations in its fortunes, but, on the whole, its members managed to amass great wealth. It fell on very bad times in 1857, when the Indian Mutiny broke out, and in 1858 it practically ceased to exist. A great change in the administration of India took place after the Mutiny. Before the Mutiny it was almost wholly *commercial*, but after the Mutiny the Indian Civil Service was formed, and administration was far more of a political and governmental nature.

Another important company was that formed with Turkey in 1581, for purposes of trade with the Levant, and the Russian Company, formed about fifty years before, was doing considerable trade with the Baltic coast. It is rather sad to relate that our original trade established with West Africa by Sir John Hawkins, was concerned mainly with the buying and selling of slaves.



CABOT DEPARTING FROM BRISTOL FOR AMERICA, 1497

With the establishment of all these trading centres our manufactures and industries made good progress, and instead of exporting wool we required as much raw material as we could get for our own use. English cloths now commenced to earn that European reputation which they have ever since maintained so well. The Flemings who were driven from their country during the Spanish persecution were even more highly skilled in the industrial arts than their predecessors who had visited us in Plantagenet times, and they met with far less opposition from the English artisans. Indeed, some of the rich Flemish merchants who had settled in London provided Elizabeth with a considerable sum of money toward the cost of putting out a fleet to resist the Spanish Armada. Norwich was still one of our most densely populated towns and the centre of the woollen industry in the East. The wealth of London was the envy of all foreign traders; Bristol was becoming a very busy port owing to the dis-

covery of America, and the gradual development of trade with the New World; and Boston, Hull, Harwich, and Grimsby were growing in importance as trading centres for the lands on the Baltic sea-board. One very great drawback to successful trade was the prevalence of *monopolies*. These monopolies were patents conferred by the Crown (especially during Henry VII's reign: indeed it may be said that he originated the practice) on particular traders or towns, empowering them to carry on the exclusive trade in certain manufactures or industries. As competition was removed, the price of the articles on which a monopoly had been granted rapidly rose, and though a few traders who enjoyed this exclusive trading right rapidly became rich, the general public suffered severely, and the production of the monopolized article was considerably lessened. In time, monopolies became so unpopular, that in 1601 most of them were abolished. They were, however, renewed under the Stuarts, but in the struggle between Parliament and the Crown, which ultimately resulted in the victory of the former, they were finally revoked.

CHAPTER XIX

THE COMING OF THE HUGUENOTS

ONCE more we have to notice how our country received the political refugees of a foreign nation, who, driven from their homes by cruelty and persecution, settled in England, and exercised great influence on many of our industries and manufactures.

On April 30th, 1598, there was signed in the city of Nantes, an edict, generally known as the Edict of Nantes, which allowed the French Huguenots or members of the Protestant Church, the free exercise of their religion. The Huguenots contained within their ranks some of the most skilful manufacturers, inventors, and artisans in the French nation, and they had the reputation of being highly intelligent and industrious. For nearly a century after the passing of the Edict they went on their way unmolested, but on October 20th, 1685, Louis XIV, in an endeavour to exterminate the Protestant religion, revoked the Edict. The Huguenots then became subject to severe pains and penalties if they did not renounce their religious opinions, and a considerable section of them, numbering about 400,000, fled to Britain, the Netherlands, and other Protestant countries. It is estimated that about fifty thousand Huguenots settled in Britain alone.

Many of the immigrants made their home in Spitalfields, a district in the East of London. Here they

followed their trade as silk weavers, and it is entirely due to them that the Spitalfields silk industry, which has been famous all over the country, was established. Hitherto Lyons, Tours, and other great centres in the south of France had enjoyed a monopoly of the silk trade, both in the breeding of the silk-worm, and in the manufacture of the delicate and costly silk fabric. After the flight of the Huguenots many of the French silk-mills were forced to close down, but what was their loss was our gain, and for a time the British silk industry was in a very flourishing condition. Later on, however, when France recovered from her disastrous wars, and when the religious persecutions ceased, many of the Huguenots returned to their forefathers' native home, but a colony of Huguenots still remained at Spitalfields, and some of their descendants live in that part of London to-day.

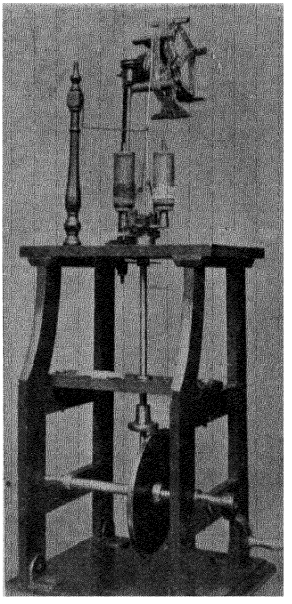


THE RELATIVE DENSITY OF POPULATION IN GREAT BRITAIN

From "How People Live," by W. C. Brown and P. H. Johnson

The French exiles were certainly received in this country with a warmer welcome than that accorded to the Flemings three or four centuries previously, but not-

withstanding, many of the British artisans looked with great suspicion on the 'aliens,' and they were intensely jealous of the workmanship of their visitors. Throughout the industrial history of our nation it has ever been thus; we have invariably given immigrants a very cold reception. The Dutch warmly welcomed the refugees, and the recovery and subsequent progress of their manufactures, which had received a deadly blow by the war with Spain, and which now once more revived, is directly traceable to the advent of the Huguenot exiles in Holland.



SILK-THROWING MACHINE
In the Victoria and Albert Museum
By permission of the Controller of H.M. Stationery Office

It would be well in speaking of the affairs of our nation, to remember that there are other nations in the world besides ourselves—nations who are quite as skilful, and quite as industrious and intelligent. We should not be at all lacking in patriotism if we took this view, for boasting and insular prejudice have no share in the true patriot's heart. We are indebted for many of our greatest industries to the pioneer work of foreigners, who have ever been before us in invention, and quite equal to us in handicrafts.

CHAPTER XX

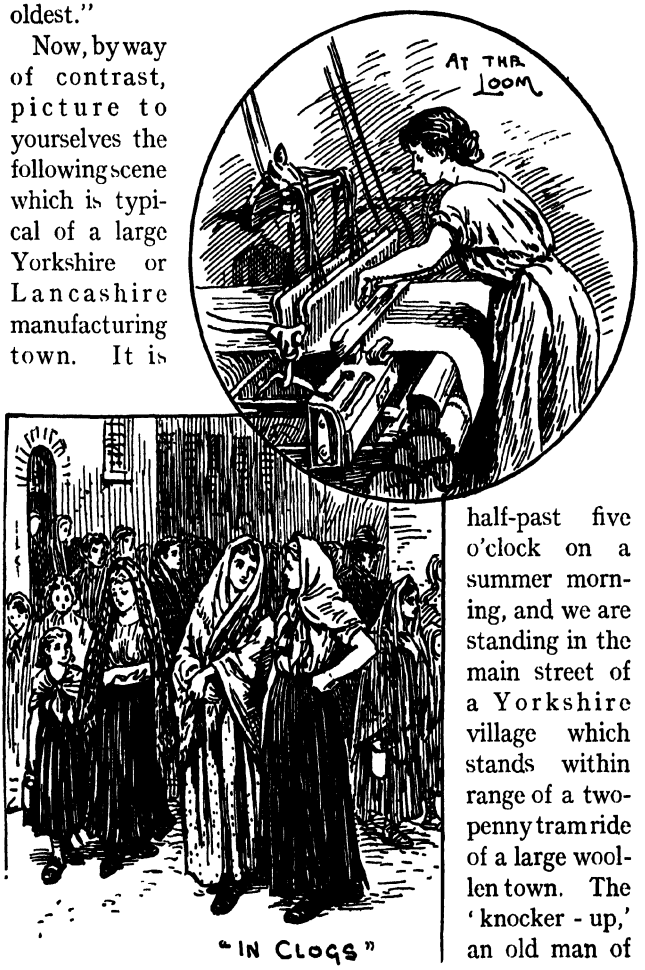
A REVOLUTION IN INDUSTRY

We have already said that there have been four clearly-defined stages in our industrial history:—(i) the family stage, (ii) the guild stage, (iii) the domestic stage; (iv) the factory stage. We have now reached the last of these stages, and it is customary to speak of the commencement of this period as an Industrial Revolution.

If we wish to understand something of industrial life in our villages and small towns during the eighteenth century, we cannot do better than read Daniel Defoe's *Tour through Great Britain.* Speaking generally of Yorkshire he remarks: "The land was divided into small enclosures from two acres to six or seven each, seldom more, every three or four pieces of land having a house belonging to them; hardly a house standing out of speaking distance from another. We could see at every house a tenter, and on almost every tenter a piece of cloth or kersie or shalloon. At every considerable house there was a manufactory. Every clothier keeps one horse at least to carry his manufactures to the market; and every one generally keeps a cow or two or more for his family. By this means the small pieces of enclosed land about each house are occupied, for they scarce sow corn enough to feed their poultry. The houses are full of lusty fellows, some at the dye-vat, some at the looms, others dressing the cloths; the women and children carding or spinning;

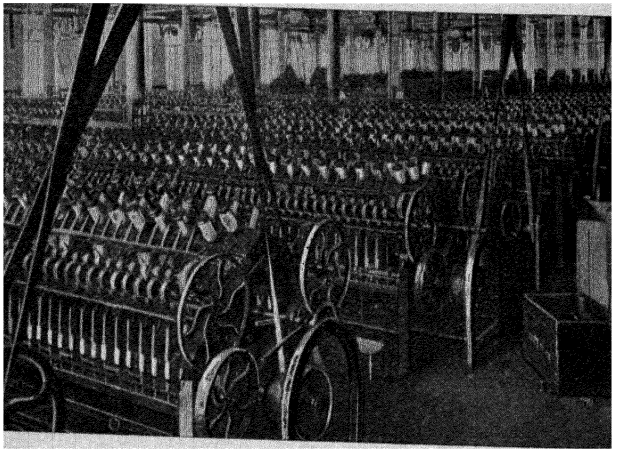
being all employed, from the youngest to the oldest."

Now, by way of contrast, picture to yourselves the following scene which is typical of a large Yorkshire or Lancashire manufacturing town. It is half-past five o'clock on a summer morning, and we are standing in the main street of a Yorkshire village which stands within range of a two-penny tram ride of a large woollen town. The 'knocker-up,' an old man of



THE COTTON DISTRICT

about seventy years of age is going his round, tapping on the bedroom windows of those who desire his services, and soon from out of the small brick-built houses come nearly every able-bodied woman, girl and boy, with a fair sprinkling of men. The women and children greatly outnumber the men, for



WORSTED SPINNING

From "Textiles," by W. H. Dooley

many of the latter are on the night-shift, but the Factory Act does not allow women to work at night. Tram after tram, each loaded to its utmost capacity both inside and out, bears its human load to the mighty city down in the valley, and in the distance there may be heard the screech of shrieking sirens or the howl of powerful steam-hooters, ever beckoning the pale-faced workers to another day's toil in the stuffy sheds. As one enters the narrow cobbled roadways in the industrial quarters

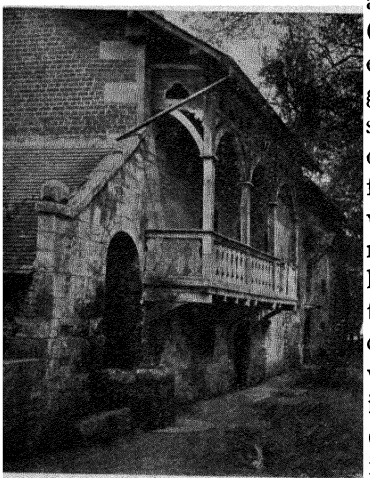
of the town the trams move slowly along, for traffic is very congested, and the human stream pressing ever onward to the mill-gates receives tribute from every street leading into it. At the yard-gates husband and wife, brother and sister, who work in the same mill, frequently meet; the men folk weary and worn after a night's toil, the women and children now leaving the sunshine of the moorland behind, to work for many hours in the stuffy atmosphere of the spinning or carding room. Inside the long narrow rooms there is the ceaseless roar of mighty machinery; and whizzing rows of spindles, tended by girls and bobbin-boys appear to stretch as far as the eye can see. The girls flit in and out among the machines, ever on the watch for a broken thread, which is at once mended by nimble fingers, and the boys keep a sharp eye on the bobbin frames, replacing the empty bobbins by full ones when necessary.

Similar sights are witnessed in the long weaving-sheds where scores of women are tending the looms. In some sheds one woman has charge of two looms, but in others, where the cloth is of firmer and more weighty texture, one loom is considered to be as much as she can manage. The whole day—with the exception of a short time off for meals—she is on her feet, with the roar of hundreds of looms in her ears, running here and there between the machinery, replacing the shuttles and mending any 'break' in the thread.

The din in the sheds is so deafening that the weavers communicate with each other by pantomimic signs, and long practice has made them so proficient at this method of talking that they are able to converse for quite a long time in this way.

And so the work goes on, day after day, week after

week, and year by year, until the toilers grow old before their time. "Use is second nature," however, and most of these northern lads and lassies come of hardy stock, so that they become inured to their hard toil, and appear not to notice it. Certain it is that they enjoy their leisure with greater zest than the southerners; you have only to see them at a football match or a whippet race on the moors or at any other kindred sport, to realize that they have entirely cast aside all thought of work or worry, they are intent on whole-hearted enjoyment, and they get it!

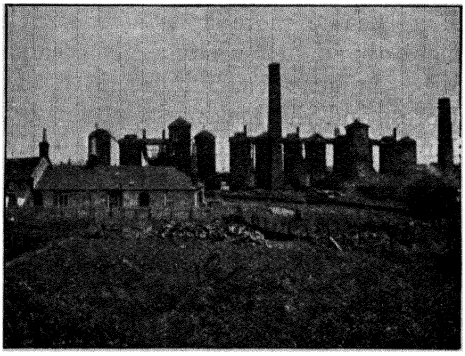


OLD WATER-MILL AT GUY'S CLIFF
Built in the eleventh century. The wheel is to be seen through the archway on the left.
Photo Frith & Co., Ltd.

But what a contrast between the old leisurely style of industry under the domestic system of two centuries ago, and that in vogue under the factory system! Then a man was more or less his own master, he could work as he pleased within certain limits. To-day he, with hundreds of his mates, is under the keen eye of an overseer, and should he be negligent or careless at his work he is soon dismissed. Truly the change was a revolution indeed!

But what brought about this great industrial revolution? There were many causes, but by far the most important

were the discovery and use of the power of the steam—which indirectly increased the output of coal to an enormous extent by creating a far greater use and demand for it—and the invention of textile machinery. It is rather strange that the great inventions, of which we shall speak a little later on, all appeared within the short space of about twenty years. As one machine could do the work of hundreds of men, the merchants found that it would



IRONWORKS, KILWINNING

be more convenient to have a number of machines working side by side, and so factories were built. At first these factories stood on the banks of rivers or streams, because water was the motive-power, but a few years later, when Watt had made his steam-engine, the merchants were quick to see the great advantage of steam- over water-power; their new factories, being now independent of streams, could be built on far more convenient and accessible sites. For a time the merchants seemed "as if they could not build factories fast enough"; peaceful hamlets became mighty towns, and gradually the centres of

population moved from the south to the north of the country Thousands of artisans migrated to the north from Norwich, Taunton, and other southern industrial towns, and places which had borne an honoured name in the country's industry for so many years soon became almost forgotten.

One industry, too, invariably influences another one, either for good or for evil. We have seen that with the rapid increase of machinery worked by steam-power the coal industry became more and more prominent. As coal was more abundantly produced it became cheaper, and this greatly influenced such industries as the smelting of mineral ores, and the making of pottery ware. The new machinery also extended to the other textile industries, such as cotton, silk, and linen, and, indeed, it is hard to think of a single industry which was not revolutionized by the steam-engine and machine-power.

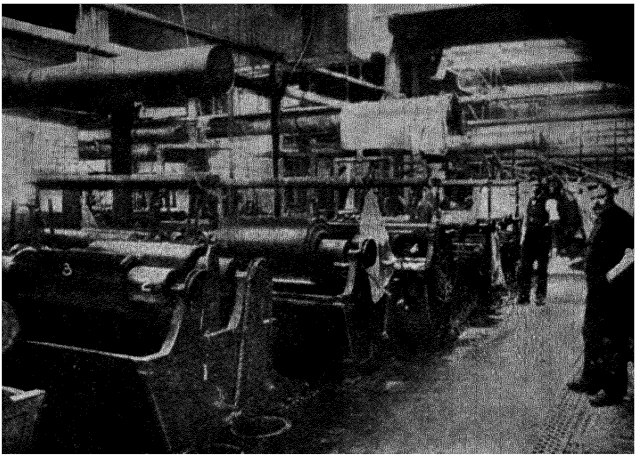
CHAPTER XXI

THE FACTORY SYSTEM AND ITS EVILS

THOUGH the factory system brought immense wealth to manufacturers and to the country as a whole, it also brought serious evils to the workers. There was a great contrast, as we have seen, between the conditions of service under which the workman laboured in the factory and those which prevailed under the domestic system. A factory 'hand' may be compared to the cog of the huge driving-wheel of a mighty machine; he has no individuality, so to speak; probably his master does not know his face. Just as the smooth running of a machine depends largely on the accuracy with which the separate cogs fit into each other, so does the welfare of a business, as a whole, depend to a great extent on the way in which each worker does his proper share of work.

We must bear in mind that this new order of things was very hard on the workers at first. Under the domestic system there was usually good fellowship between the master and his journeymen and apprentices. In a well-ordered house, where master and man were on terms of great intimacy, the master's interests became the man's interests too; in the factory the man has just his share of work to get through, and frequently he watches the clock so closely that every speck and scar on its face is known to him. There is, too, a dreary monotony about factory work as a rule. Thus, in most of our large

factories where the trade carried on involves several processes, the tendency is for each workman to specialize in one branch of the business, and he probably knows little or nothing of other branches of the manufacture. For example, if we visit a woollen-mill we shall find a number



DYE-ROOM

1. Tub or vat containing dye-stuffs.
2. Rolls or cylinders upon which cloth is wound.
3. Cloth leaving dye-tub.

From "Textiles," by W. H. Dooley

of people sorting the wool; in another yard there may be seen the dyers at work; in another, the spinners; in another, the weavers, and so on. Week after week, month after month, year after year, the weaver enters the great mill and goes to his loom, where the buzz and whirr of the mighty machinery becomes almost a part of himself. He is a weaver, pure and simple; probably he has no

knowledge whatever of the dyer's craft, nor of that of the spinner or the wool-sorter. His life's work consists in minding that loom, or perhaps a pair of looms. Under the old system he could turn his hand to spinning, weaving,



TAILORS' SWEATING-DEN

dyeing, fulling, and, in fact, all the processes of the manufacture.

Another evil was that the workshops were often most insanitary, and the air-space allowed for each worker was far below that which good health demands. It did not appear to matter how the workpeople were huddled together so long as there was room to do the work and amass large profits for the manufacturers. Women were everywhere displacing men, as the introduction of machinery

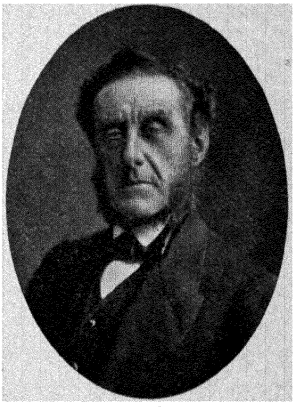
required less muscular strength on the part of the workers, and women did the work for lower wages than men, but long hours were required, and frequently the women were at work fourteen hours a day.

Great though these evils were, yet they were as nothing when compared with the evils of crowding children of tender age into the factories, and the harsh and brutal treatment which these children received. Child-labour was the very cheapest form of labour, and to obtain this labour the masters took children from the workhouses into the factories, nominally as apprentices, but in reality as slaves. It is true that proper indentures were drawn up and signed by the masters and the overseers of the parish from which the children came, and one might imagine when reading the terms of the agreement that the boys and girls were going to have a 'real good time' under their new masters, with only a little work to do, and good food and lodging provided for them. But how different were the actual conditions under which these little ones lived and worked! Their food was scanty and coarse, and a number of them were probably herded together at night in some damp shed or cellar. In nearly every mill they had to work twelve or fourteen hours, and, in some cases, sixteen hours, a day. The machinery was usually left quite naked, and there was no adequate protection against injury, so that there were frequent cases of child-workers being maimed or even killed.

Fortunately the attention of such philanthropists as Michael Sadler, Elizabeth Browning, and Lord Shaftesbury was awakened, and the country was shocked when the true state of things was made public. Mrs Browning's poem "The Cry of the Children," aroused as great a feeling for the children as did Tom Hood's "Song

of the Shirt" for the seamstresses, and the good work was continued in Parliament by Lord Shaftesbury. The chief speeches of this famous Earl are recorded, and one made in Parliament, describing the terrible hardships undergone by the children employed in coal-mines, is as follows:

"With respect to the age at which children are worked in mines and collieries in South Staffordshire, it is common to begin at *seven years old*; in Shropshire some begin as early as *six years of age*; in Warwickshire the same; in Leicestershire nearly the same; in Derbyshire many begin at *five*, many between five and six years, many at seven; in West Riding of Yorkshire it is not uncommon for *infants* even of five years old to be sent to the pit. About Halifax and the neighbourhood children are sometimes brought to the pits at the age of six years, and are taken out of their beds at four o'clock; Bradford and Leeds the same; in Lancashire and Cheshire from five to six. Near Oldham children are worked as low as four years old, and in the small collieries toward the hills some are so young they are brought to work in their bed-gowns. . . . All the underground work which, in the coal-mines of England, Scotland, and Wales, is done by young children, appears in Ireland to be done by young persons between the ages of thirteen and eighteen.



THE EARL OF SHAFTESBURY
Photo London Stereoscopic Co.

"Now, with respect to sex, no females are employed in underground work in South Staffordshire, nor in North Staffordshire. In Shropshire, Warwickshire, Leicestershire, and Derbyshire, the same. In the West Riding of Yorkshire the practice of employing females underground is unusual. About Halifax and the neighbourhood girls from five years old and upward regularly perform the same work as boys. At Bradford and Leeds, far from uncommon. In Lancashire and Cheshire it is the general custom for girls and women to be employed. In North Lancashire, throughout the whole of the district, girls and women are regularly employed underground.

"Some pits are dry and comfortable. . . . Many are so wet that the people have to work all day with their shoes in water, at the same time that the water is constantly dripping from the roof; in other pits, instead of dripping, it constantly rains, as they term it, so that in a short time after they commence the labour of the day their clothes are drenched, and in this state, their feet also in water, they work all day. The children especially (and in general the younger the age the more painfully this unfavourable state of the place of work is felt) complain bitterly of this! It must be borne in mind that it is in this district (Derbyshire) that the regular hours of a full day's labour are fourteen, and occasionally sixteen, and the children have to walk a mile or two at night without changing their clothes.

"In Oldham the mountain-seams are wrought in a very rude manner. There is very insufficient drainage. The ways are so low that only little boys can work in them, which they do naked, and often in mud and water, dragging sledge-tubs by the girdle and chain.

"In North Wales, in many of the mines, the roads are

low and narrow, the air foul, the places of work dusty, dark, and damp, and the ventilation most imperfect.

"The child, it appears, has a girdle bound round its waist, to which is attached a chain, which passes under the legs, and is attached to the cart. The child is obliged to pass on all fours, and the chain passes under what, therefore, in that posture, might be called hind legs; and thus they have to pass through avenues not so good as a common sewer, quite as wet, and oftentimes more contracted. This kind of labour they have to continue during several hours, in a temperature described as perfectly intolerable."

The value of this speech lies in the accuracy of the facts stated in it; it was not the result of a vivid imagination, but was based on the report of a Royal Commission appointed for the purpose of going fully into the question of child-labour in mines. Both in the country and in Parliament Lord Shaftesbury persistently seized every opportunity of urging the need of factory legislation, but it was extremely hard to move the House of Commons in the matter, as many of the members were mill-owners or employers of child-labour in other forms, and they thought far more of their own pockets than of the health and moral character of the nation. For years the noble Earl kept at his self-imposed task. Perhaps one of his finest and most pathetic speeches was that referring to the factory children of the West Riding of Yorkshire. An extract from it runs: "Well can I recollect in the early periods of the factory movement, waiting at the factory gates to see the children come out, and a set of sad, dejected, cadaverous creatures they were. In Bradford especially the proofs of long and cruel toil were most remarkable. The cripples and distorted forms

might be numbered by hundreds, perhaps by thousands. A friend of mine collected a vast number together for me; the sight was most piteous, the deformities incredible. They seemed to me, such were their crooked shapes, like a mass of crooked alphabets."

It must be borne in mind that these evils existed in our national workshops, not in remote ages, as might be imagined, but about a century ago. Indeed, it is highly probable that the grandfathers of many of the workers in the North and Midlands laboured under very similar conditions to those we have described. Charles Kingsley's *Water Babies* gives us a vivid description of the hardships endured by the little chimney-sweeps of that time, and it was due mainly to Lord Shaftesbury's efforts that a law was passed making it illegal to send boys up chimneys.

Hitherto the various Acts of Parliament relating to work in factories seem to have been ignored, and it was not until Lord Shaftesbury's campaign against factory evils that the conscience of the nation was really awakened. The first Factory Act had been introduced by Sir Robert Peel in 1802, and at various intervals other Acts were passed restricting the hours of day-work, prohibiting night-work, compelling the mill-owners to keep the sheds in a proper sanitary condition, and so on. In 1818 an Act prohibited the employment of children under nine years of age; in 1831 another Act fixed twelve hours a day and nine on Saturdays as the extreme limit for the employment of young people; in 1833 night-work by anyone under eighteen was forbidden; in 1844 six and a half hours a day was fixed as the limit for the employment of young children; in 1847 women and young persons were not to be employed more than ten hours a day. The Mines Act of 1842 forbade underground

work for women, and boys under ten. Inspectors were appointed to prevent evasions of the various Acts, and they had power to prosecute offenders. About this time the 'half-time system' of attendance at school was introduced, and it has continued down to the present day. (At the moment of writing, proposals are before Parliament to abolish the half-time system, which is doing so much to jeopardize the health and education of Britain's industrial population.)

Lord Shaftesbury lived to a ripe old age, and in addition to his work in Parliament he was president of the Bible Society, and of many other religious organizations. The institution of Ragged Schools, where the children of the poor could be taught free of charge, was chiefly due to him. In Piccadilly Circus, London, a fine memorial fountain has been erected to his memory, but he is honoured still more by the title of 'The Children's Friend.'

CHAPTER XXII

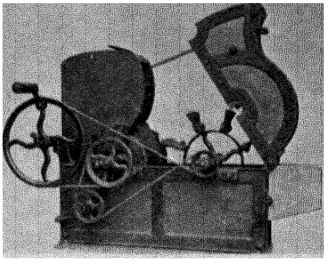
THE THREE GREAT INVENTORS OF TEXTILE MACHINERY

(*a*) JAMES HARGREAVES

IN the year 1761 appeared, on notice-boards in the Lancashire cotton-mills and in prominent places in the cotton and woollen towns, the following advertisement: "For the best invention of a machine that will spin six threads of wool, flax, hemp, or cotton, at one time, and that will require but one person to work and attend it (cheapness and simplicity in the construction will be considered part of its merits), for the best, fifty pounds; for the second best, twenty-five pounds."

This advertisement caused great excitement among the textile workers in the north, and many tried their hands, and exercised their wits, over the invention of a spinning-machine which should fulfil the requirements of the Society of Arts, who offered the reward. At this time the process of spinning by hand was very laborious, and it took up so much time that the spinners could not keep the weavers employed. Two centuries ago spinning and weaving were home industries. The clatter of clogs along the cobbled roadways in the Lancashire cotton-towns—so noticeable to-day outside the blank and dingy walls of a large cotton-mill when the teeming multitudes of spinners and weavers go to and from work—was not

nearly so much in evidence before the invention of spinning machinery. In those days the mills were concerned mainly with the business of warehousing the cloth and dispatching it to buyers. The workers from the villages around would go to the factory for their raw material, which they would take home and work up into cloth. Generally the women of the house did the spinning, while the men wove the spun yarn into cloth.

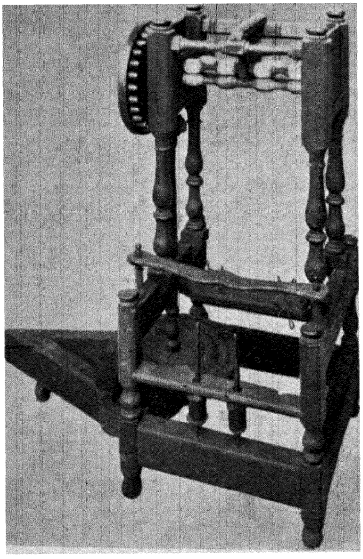


COTTON GIN FOR COTTAGE USE
From the Victoria and Albert Museum
By permission of the Controller of H M. Stationery Office

If we had peeped inside James Hargreaves' cottage at Stanhill, near Blackburn, about the year 1760, we should have seen a stout, broad man, sitting at a rudely-constructed loom which stood in one corner of the crowded kitchen, busily plying his shuttle, and weaving the yarn his wife had spun. Certainly he would not be working under anything like the favourable conditions of our modern up-to-date mills. There were two rooms only downstairs, and the kitchen served as dining-room and work-room, and as play-room for the younger members of his family. Hargreaves had a hard struggle to get a living. His wife, while most anxious to keep him well supplied with weft, had her household duties to attend to, and her children to bring up. If only he could invent the machine that had been so much talked about in almost every Lancashire home since the Society of Arts issued its advertisement!

Biographers of Hargreaves tell us that the poor weaver

passed many sleepless nights in thinking over the problem. We are informed that it was by a pure accident that he ultimately reaped the reward of his efforts, and the hitherto obscure Lancashire weaver soon became the most widely-known man in the country. The story of the invention of his famous spinning jenny is almost a romance. Two of his boys accidentally upset the spinning-wheel, and it overturned with a crash on the floor. We can imagine the father's wrath at the accident, for the wheel or the spindle might have been smashed, and the repair would have cost him much money. As Hargreaves sat gazing at the overturned wheel, he noticed that the spindle revolved very rapidly on a vertical axis. Cannot I, he thought, so fix a number of spindles in a frame, that they will all revolve in a similar manner? In a short time he succeeded in making a simple frame, which carried several spindles set vertically on a creel in one end of the frame. On another creel he set a second row of spindles, and at



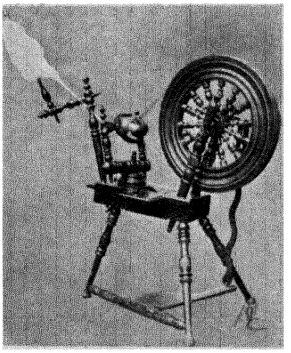
SPINNING-MACHINE MADE BY SIR RICHARD ARKWRIGHT IN 1769

In the Victoria and Albert Museum

By permission of the Controller of H.M. Stationery Office

the opposite end of the frame he fixed the old spinning-wheel. With this machine, which was driven by turning the big wheel, Hargreaves was able to spin several threads at one time, and far more rapidly than in the spinning-wheel.

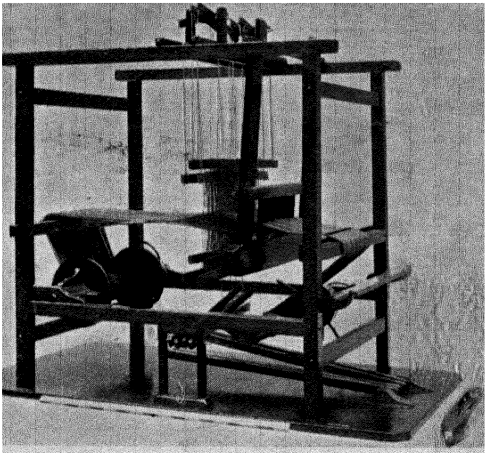
It was the intention of the inventor to keep his invention a profound secret, for he feared greatly the wrath of his fellow-workers if they discovered his machine. Perhaps this is hard for you to understand, for you would naturally think that they would be only too glad to possess machines which would do their work so much more easily and quickly. But these spinners and weavers were looking to the future, and to them it seemed that textile machinery would revolutionize their industry. Their first fear was that one machine would do the work of many men and thus throw them out of work, and perhaps some of them foresaw that, the trade increasing by leaps and bounds, the home industries of spinning and weaving, which had been the sole means of support for their families, would be taken away and transferred to the towns; no longer would they be able to work at home. Many of them did not care for factory life; others thought they would be too unskilled to work any machines which might be invented. In nearly all branches of industry we find that the workers resented the coming of machinery.



SPINNING-WHEEL.
In the Victoria and Albert Museum
By permission of the Controller of H.M. Stationery Office

Hargreaves appears to have kept his secret for two or three years, but apparently he made a great mistake in

selling such a large quantity of yarn to the manufacturers. People began to wonder how it was that one man, with only his wife and children to help him, could turn out as much yarn as twenty or thirty ordinary workers, and the manufacturers began to make inquiries too, for, unlike



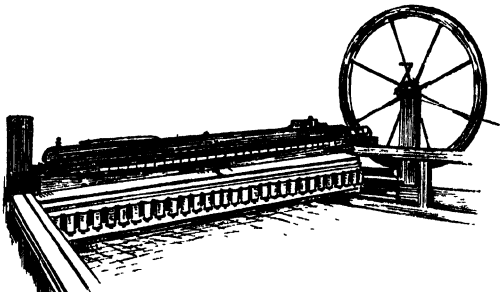
MODEL OF HAND LOOM IN USE PRIOR TO THE INVENTION OF THE FLY-SHUTTLE IN 1733

From the Victoria and Albert Museum

By permission of the Controller of H.M. Stationery Office

the workers, they were anxious for the coming of machinery and they suspected something was 'on the cards.' We are told that some of the hand-spinners kept watch on his house, and they soon found out the truth. The news quickly spread round the neighbouring villages, and one night a mob surrounded his house, beat down the door, and smashed his beloved jenny to fragments. The poor inventor was for some time in terror of his life. He was

quite ruined, for, though he had earned a good sum of money during the last three years, most of this had been spent over improvements to his machine. He obtained work, secretly, from some of the manufacturers to make other machines, but the suspicious hand-spinners hounded him out of the village, and he fled with his family to



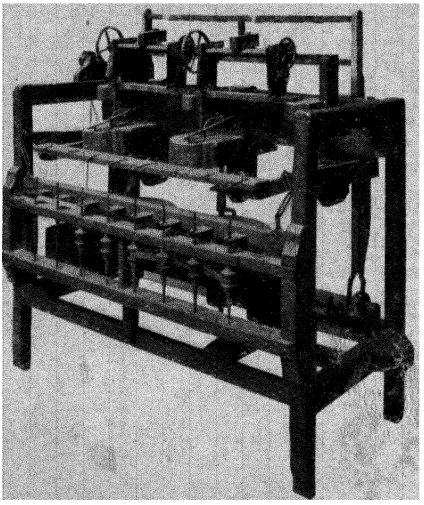
HARGREAVES' SPINNING-JENNY

Nottingham. Fortune was more favourable to him there, and he built up a good business before his death in 1778.

(*b*) RICHARD ARKWRIGHT

Once again we have an example of a poor man obtaining lasting honour through industry. It has been said of industry that it enables the poorest man to achieve honours, if not distinction, and that "A working instrument-maker gives us the steam-engine; a barber, the spinning-machine; a weaver, the mule; a pitman perfected the locomotive; and working men of all grades have, one after another, added to the triumphs of mechanical skill." (The writer is, however, careful to

explain that by the working man he does not mean merely the man who labours with his muscles and sinews, but that "The man who paints a picture, who writes



SPINNING-MACHINE MADE BY SIR RICHARD ARKWRIGHT ABOUT 1775

It is an improvement on the earlier invention (see page 142) in having an arrangement for guiding the yarn over the bobbins evenly, and in containing more spindles.

In the Victoria and Albert Museum

By permission of the Controller of H.M. Stationery Office

a book, who makes a law, who creates a poem, is a working man of the highest order—not so necessary to the physical maintenance of the community as the ploughman or the shepherd, but not less important as providing for society its highest intellectual nourishment.")

Richard Arkwright was born at Preston in 1732, and he was the youngest of thirteen children. His parents were very poor, and, as soon as he was old enough, he was apprenticed to a barber. For some years he continued to give his customers, as his sign said, "A clean shave for a penny," but he was of a restless and ambitious disposition, and his heart was never really in his trade.



WOMEN'S WIGS
EIGHTEENTH CENTURY

Two centuries ago it was the custom for the upper classes of society to wear enormous wigs, and there was such a great demand for hair in the making of these wigs that the supply was unequal to it, so that dealers in hair were able to make a very profitable living. You may have seen a picture of an eighteenth-century court 'Macaroni' with his enormous bunch of artificial hair behind. It is related that the head-dress was so extensive that the interior was stuffed with wool or tow; this was plastered over with pomatum, which, in hot weather, had a rather offensive odour.

Much of the hair used by wig-makers was obtained from the long tresses of peasant girls and women who met the hair dealers in the country fairs and markets, and, after a satisfactory bargain had been made, allowed their luxuriant growth of hair to be cut off. Arkwright's trade as a barber was of service here, and probably he would be better able to appraise the value of the hair than would dealers who had followed other trades. It is said, too, that Arkwright discovered a special process

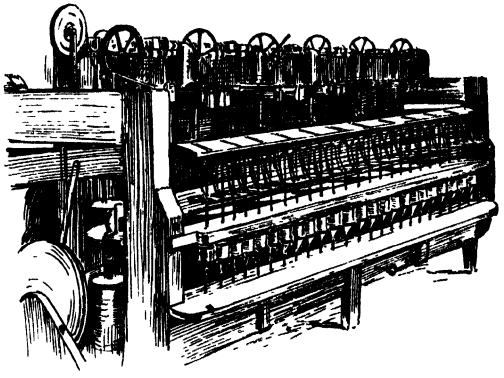
whereby he could dye the hair to any colour required, for at one period hair of a certain colour was in fashion, and, later on, quite another colour was the vogue. To show how colour of hair and fashion go together,—during the reign of Queen Elizabeth many of the ladies at court dyed their hair red because Elizabeth had red hair.

In travelling up and down the country Arkwright would have to make long journeys on carriers' carts, and he had many opportunities for gossip, especially in the village inns where he lodged. Much of the conversation in those days bore on the new inventions in the textile trade, and Hargreaves' 'jenny' was everywhere discussed. No doubt Arkwright picked up much valuable information which, in after years, was to bring him wealth and fame; at any rate the topical conversation among workmen at that time, especially in the North, was almost entirely devoted to recent inventions in textile machinery, and this gave the hair dealer his first thoughts of becoming an inventor.

Arkwright was at a great disadvantage in never having had any mechanical training, and we are told that he was rather clumsy with tools; consequently, though his superior intellect conceived all the different parts of his machine, he had to depend on various mechanics and tradesmen for the construction and putting together of the various parts.

We cannot here give a detailed technical description of his machine, or *spinning-frame* as it is usually called. In many respects it was an imitation of Hargreaves' jenny, but the thread spun by the latter was too fine and not of sufficient hardness for use in the warp threads on the loom. (The longitudinal, or vertical, threads on the loom are known as the *warp*, and those crossing them, and inter-

lacing them horizontally, are the *weft*. The warp forms the foundation of the fabric, and these threads are usually coarser and harder than the weft.) Arkwright's frame would spin a vast number of threads of any degree of fineness and hardness; all that the operator had to do was to feed the machine with cotton, and join threads that happened to break.



ARKWRIGHT'S SPINNING-FRAME.

The same lawless mob who had attacked Hargreaves also showed their hostility to Arkwright; hearing that Hargreaves had found a safe home at Nottingham, he also moved to that town in 1768. For a time he was much hampered in his operations for lack of capital, but a stocking-frame inventor advanced the money for the further improvement of the spinning-frame. The year after he settled at Nottingham he took out a patent for his invention, and erected a mill, which was driven by horse-power at Nottingham. Horse-power was, however, too expensive to permit of his carrying on the business

at a profit, and so a second and much larger factory was put up on a tributary of the Derwent at Cromford, in Derbyshire, the machinery of which was turned by a water-wheel. This mill was a great success, and Arkwright was able to undersell his Lancashire rivals and earn enormous profits. The inventor was not satisfied even with this machinery, and during succeeding years he completed a number of most intricate and ingenious machines, which brought him world-wide fame. His opponents in the cotton trade hated him intensely, and did all in their power to ruin him. Some of his most skilled workmen were bribed to leave the Cromford factory, and they imparted the secrets of his inventions to their new masters in Lancashire. Imitations of his machines were freely made, and so close did these imitations become that Arkwright was compelled to seek the aid of the law to prevent his rivals from infringing his patent. In addition to numerous legal actions, he had his property destroyed from time to time by mobs, but notwithstanding this and the animosity of his rivals, he amassed a large fortune, and this erstwhile Lancashire barber was knighted by George III in 1786.

(c) Samuel Crompton

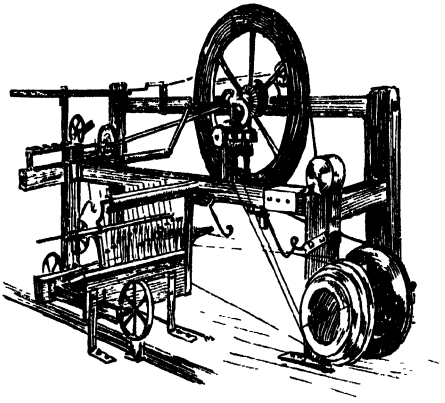
Another honoured name in the invention of textile machinery is that of Samuel Crompton, who was born near Bolton in 1753. His father was a small farmer, and, like most farmers of two centuries ago, he occupied his spare time in spinning yarn and weaving it into cloth. Early in Samuel's life misfortune overtook the family, for the father died, and the widow and children were left

almost unprovided for. All had to take their share in the round of domestic duties, and Samuel's special work was to weave the yarn which had been spun by the other members of the family. At the age of about sixteen years he was fortunate enough to procure one of Hargreaves' jennies, and he not only discovered the great advantages of the jenny in spinning, but also found out some of its defects. Unlike Arkwright, he had always displayed a love and a turn for mechanics, and for several years he devoted the whole of his spare time to making models of various spinning-machines. His great object was to invent a machine which would spin fine and strong threads, of superior quality to any which could be spun on the other machines. About this time he heard of Arkwright's water-frame, and he set to work to construct a machine which should be a combination of Hargreave's spinning-jenny, and Arkwright's roller-frame. After several attempts he produced a machine for spinning cotton, which was called a *mule*, for, just as the mule is supposed to combine the characteristics of the horse and the ass, so was Crompton's invention a combination of the principles of the jenny and the water-frame.

For a time the inventor was obliged to keep his invention a secret, but he was treated by the machine-wreckers with far less animosity than had been his predecessors. The sum of £5000 was voted him by Parliament in 1812, and this was practically his only reward for giving to the textile industry a machine which revolutionized the whole processes of spinning, and which has since been improved and has brought millions of pounds into the pockets of the manufacturers.

In speaking of these three great inventors we have referred to the machine-breakers, and we have seen how

they drove the inventors from their homes and smashed their machines. Early in the nineteenth century a secret society of these people, known as the *Luddites*, was formed for the special purpose of banding together to break the stocking-frames and lace-frames, as well as any other inventions in textile machinery. It is said that they took their name from Ned Ludd, a half-witted



CROMPTON'S SPINNING-MULE

lad who in 1811 had broken, in a fit of passion, two stocking-frames. For this offence he was sentenced to fourteen years' transportation, and, a little later, Parliament passed a Bill making *Luddism* punishable by death. Bands of Luddites roamed about Yorkshire, Lancashire, and Nottinghamshire, breaking into the factories and destroying anything that came to hand. Many of the rioters were armed and masked; and all manufacturing centres were in a state of perpetual disturbance. One writer says: "In Suffolk and other

agricultural districts, burning corn-stacks and farmyards sent a lurid blaze through the night; threshing machines were broken by day; in towns the operatives marched through the streets bearing banners inscribed with the legend, 'Bread or Blood?'" These riots lasted for about five years, but during that time several of the rioters were hanged or transported for life.

CHAPTER XXIII

THE DEVELOPMENT OF THE COAL-MINING INDUSTRY

Of all the factors which have tended to make us one of the leading industrial and manufacturing nations in the world the chief are the discovery and general use of coal and iron. For centuries these most useful minerals had lain 'bottled up' in the earth, for though it is known that coal had been discovered in this country as early as during the occupation of Britain by the Romans, yet our forefathers had such crude notions of coal-mining that it was not until the eighteenth century that the working of coal became general.

It is not our purpose to speak of the formation of coal, nor of the modern methods of mining it. Rather do we propose to give a brief outline of the development of the coal trade, and to see how the great factory districts of the North and Midlands have arisen invariably in the coal-field districts.

We have already referred to the discovery of huge cinder-heaps which were left behind by the Romans, thus proving that coal was worked in Britain nearly two thousand years ago. We know, too, that mining was much neglected by the Saxons, but that it was revived by our Norman conquerors, although, even then, the great value of coal does not seem to have been realized. In some ancient records, written early in the twelfth century, and relating to Durham, we read: "The smith

was to have twelve acres of land for doing the ironwork of the carts, and to raise his own coal."

Newcastle has the proud distinction of being the first English town to open up collieries. This took place in 1238, and the freemen of the town were granted a charter by Henry III empowering them to export coal. The value of coal as fuel seems to have become widely



ON THE TYNE

known, much to the prejudice of the charcoal dealers and burners, who, finding their trade ruined, persuaded the Government to prohibit the use of coal in London. But London's citizens had by now come to appreciate the great value of the famous 'Sea-coal' (as the Londoners called the coal which came by sea from the North), that the royal proclamations concerning it were openly disobeyed, and it was necessary to issue further prohibitions stating that all dealers or users of coal in London should be fined and their furnaces destroyed. Even this had

little effect, and the Government, finding its laws were so flagrantly broken, and seeing the great commercial value of the now widely-used mineral, withdrew the proclamations. Early in the fifteenth century a tax of twopence a chaldron (a chaldron was 12 cwts.), was imposed on all who used coal.



THE COAL-FIELDS OF GREAT BRITAIN
From "How People Live," by W. C. Brown and P. H. Johnson

In the sixteenth century coal-mining had become general in most British coal-fields. A great drawback to the trade was the granting of monopolies to various syndicates by Charles I, who authorized them to have the sole right of buying and selling coal. Thus Sir Thomas Temple and his company were granted a monopoly of the sale of Newcastle coal for twenty-one years. When the trade was in the hands of one company only, high prices could be charged, and the general rate for some years was 19s. a ton in winter, and 17s. a ton in summer. When we consider that the purchasing power of money in those days was many times

higher than it is nowadays, it will be seen that this was a very high price to pay, and only wealthy people could afford to use coal at all freely.

In the early days of coal-mining the seams lay close to the surface, but as these were worked out, and shafts had to be sunk very far down into the ground, great difficulties were encountered which, for a time, threatened to stop the industry altogether. Much water found its way into the mines; the methods of ventilation were very bad; no safety lamps were as yet in existence, and so the miners were in constant fear of gas explosions; also the machinery for raising and lowering the cage up and down the shaft was very crude; and the work of boring the shaft was very laborious and costly.

But one by one these difficulties were overcome. When draining the mine the water had originally been removed in buckets by hand, but as the shafts were sunk deeper and deeper this method became impracticable. Pumps worked by hand came into use, but these could not raise water from a depth of more than about thirty-five feet. For nearly two centuries, however, there were no better methods of pumping water from the mines, and it was not until 1698 that an engineer named Thomas Savery invented a steam pump. Seven years later Thomas Newcomen, a Dartmouth locksmith and a skilful engineer, improved on Savery's pump, and the Newcomen steam pump was installed in most collieries. Later on James Watt made a much more powerful engine, and the old drainage difficulty in the mines was entirely overcome.

To ventilate the mine, air was forced through the down-cast shaft into the workings, and the bad air was expelled by means of a huge lamp fixed in the upcast shaft. This heated the air and caused it to rise and make its way



A COLLIERY: THE PIT-MOUTH



SAFETY LAMP

out at the top. In course of time the lamp was superseded by a large furnace built at the bottom of the upcast. In some mines these furnaces were fifty feet in length, and ten feet in width. Modern and more scientific methods of ventilation include the use of rapidly revolving fans, which are fixed near the top of the upcast, and draw the impure air out of the mine. The fresh air which passes down the downcast is split by means of stoppings and doors, so that some goes one way and some another,

and in this way a proper supply of air is sent round the workings.

There are many kinds of safety lamps now in use in the mine, but one of the most widely-known is the Davy lamp, called after Sir Humphry Davy, the famous Cornish chemist who invented it. Modifications of the Davy lamp have been made by Clanny, Gray, and Mueseler.

Early in the eighteenth century coal was used for smelting iron. Hitherto wood had been used, and the chief seat of the iron industry had been the wealds of Sussex, Surrey, and Hampshire. For a time the iron-masters, especially those of the south, did not look with favour upon the new fuel for their furnaces, and they used wood so extensively that the Government, fearing a shortage of timber, passed a law to check them in this. But the old prejudice against coal soon died away, and enormous blast-furnaces were erected at Merthyr Tydvil in Wales, and at Carron, near Falkirk.

CHAPTER XXIV

THE PROGRESS OF STEAM NAVIGATION

As the industry and commerce of this country are so dependent upon the mercantile marine, we should, when studying the development of our industries, trace the gradual growth of steam-navigation. The employment of steam-power for propelling vessels on the water has had far-reaching effects on the commerce not only of Britain, but of the world. A century ago it took about two months for a sailing vessel to go from Glasgow to London; now the swift liners cross the Atlantic in just over four days.

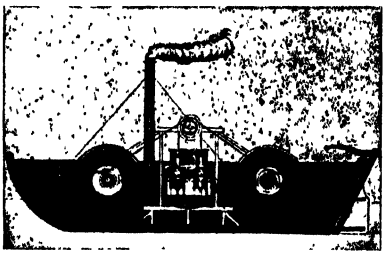
A Scotsman, named Henry Bell, can justly claim the honour of making the steamboat a practical success, although William Symington, a Scottish mechanic, constructed the *Charlotte Dundas*, which plied by steam-power on the Forth and Clyde Canal for some years previous to the appearance of Bell's *Comet* in 1812.

Henry Bell was born in Linlithgowshire in 1767, and after serving his apprenticeship as a millwright, he settled in Glasgow in 1790, and subsequently removed to Helensburgh on Clyde, twenty-four miles from Glasgow. Here he owned a bath-house and hotel, and it is said that, with a view to conveying visitors to and from his hotel, he determined to build, or to have built, a steamboat to ply between Glasgow and Greenock. After much hard work the *Comet*, a small vessel of thirty tons, propelled

by a three horse-power engine designed and constructed by Bell, appeared on the Clyde, in 1812, and continued to run until she was wrecked eight years afterward.

During the first few years after the launch of the *Comet* other steamboats were built so rapidly, that in 1837 nearly 100 steam vessels were calling at Greenock. The first Thames steamer which ran between London and Gravesend was the *Marjory*, which was launched in 1815.

At first the boats were employed only on tidal rivers, as it was thought impossible to construct a steamboat of sufficient strength to protect the paddle-box and engine from heavy seas. However, in 1818, David Napier, a famous Glasgow engineer, succeeded in constructing the *Rob Roy*, which ventured out on the open sea, and afterward plied between Greenock and Belfast. Other sea-going steamers soon followed, and a few years after the appearance of the *Rob Roy* there were inaugurated regular lines of steamers between Dover and Calais, between Glasgow and Liverpool, and between Liverpool and Ireland.

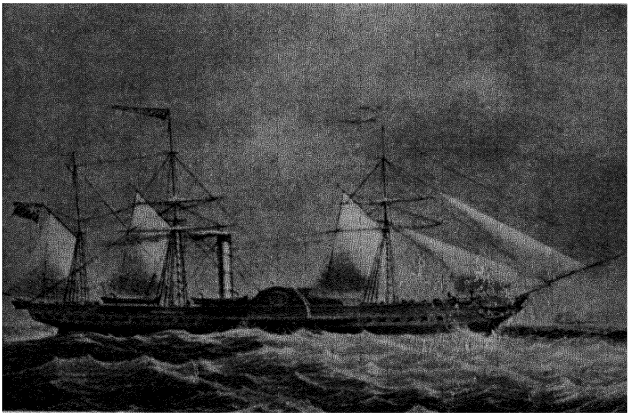


SECTION OF WM. SYMINGTON'S STEAMSHIP
By courtesy of the Carron Company

The first British steamer to cross the Atlantic was the *Sirius*, which made the passage from London to New York in seventeen days. This took place in 1838, but, previous to this, in 1819, the *Savannah*, an American boat, crossed from America to Liverpool partly under the

power of steam. Another famous passage was that of the *Enterprise*, which sailed under steam power, from Falmouth to Calcutta in 1825.

In 1840 the first of our great steamship lines was inaugurated. This was the Cunard line, named after the man who proposed it, Samuel Cunard of Halifax,



S.S. "CALEDONIA"

One of the first four steamships of the Cunard Company (1840)

Nova Scotia. Originally there were four steamers, the *Caledonia* and three sister ships, and they were employed principally as transatlantic mail-boats. So regularly were the journeys made when compared with the old sailing vessels which had to put into harbour under stress of weather, that orders for steamers were given to all the great shipbuilding yards, and the shipwrights of the Clyde, Tyne, Thames, and Wear could not possibly keep pace with them.

Hitherto all vessels propelled by steam-power had been paddle steamers, which were very similar to our modern pleasure boats that carry passengers from the piers of our chief seaside watering-places. But in 1827 a Dunbar engineer produced a screw-propeller which proved satisfactory, and in a few years, steamboats fitted with screws had practically superseded the old paddle-wheels for all sea-going vessels. The first screw-ship in Great Britain was the *Archimedes*, which was built on the Thames, and launched in 1839; four years later the *Dwarf*, also a screw steamer, was added to the commercial navy.

At about this time iron began to be used in shipbuilding. The Clyde has the honour of having constructed the first iron steamer in 1827, which was followed by Robert Napier's *Vanguard*—an iron-built vessel plying between Glasgow and Dublin—a few years later. The first iron screw steamer was the *Fire Queen*, built at Glasgow in 1845.

In recent years immense improvements have been made in the art of shipbuilding, and the allied trades of boilermaking and engine construction. The modern liners are built mostly of steel plates, and fitted with bulkheads and watertight compartments. Almost every year improvements are made in marine engines, and our largest liners (which, with their rich interior decorations, resemble first-class floating hotels rather than boats), can make the journey from Liverpool to New York in well under a week.

CHAPTER XXV

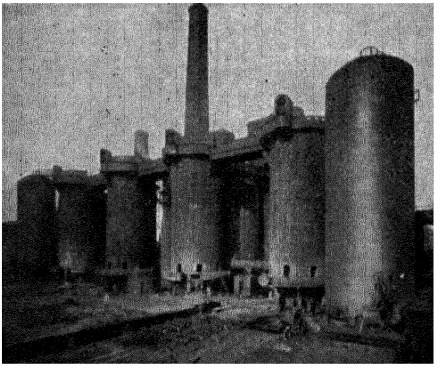
THE DEVELOPMENT OF THE IRON-SMELTING INDUSTRY

THE manufacture of iron and steel takes a foremost place in the industry of this country, and, undoubtedly it has done much to give Britain that commanding position in the world of trade which she holds to-day And yet, strange to say, this industry is comparatively modern, for the enormous iron trade carried on by this country has come into existence almost entirely during the last century.

We have already referred to the process of smelting iron by the use of charcoal, and we noted how the iron trade declined in the South when ironmasters found that coal was of far greater service than wood in the smelting of ores. There are still in existence several relics of the old Sussex and Kent foundries, notably those in the London Museum at Stafford House. Among the last products of the southern ironworks were the iron railings encircling St Paul's Cathedral. The last furnace in the Weald of Sussex was that at Ashburnham, which was closed down in 1829.

It is said that early in the seventeenth century pig- and wrought-iron had been smelted with coal, but the charcoal masters were at that time a very important body of men, numbering within their ranks many members of Parliament, and they showed great opposition to the

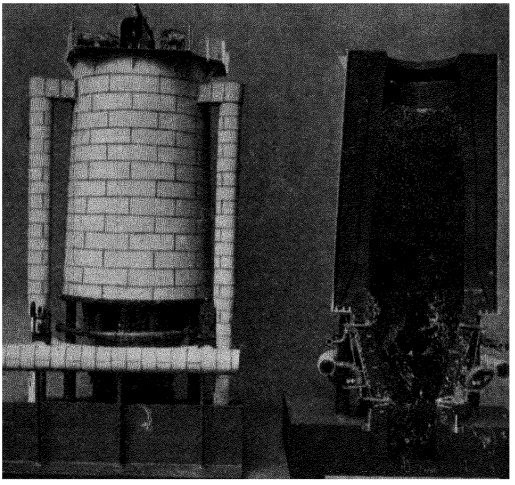
scheme, and succeeded in stopping it. It was not until 1735 that the use of coal was successfully introduced, and fifty years later the process of smelting by charcoal was almost entirely abandoned. The first ironworks for the smelting of iron ore with coal were the famous Carron Works in Stirlingshire. This Scottish village, standing on the river Carron, about two miles from Falkirk, has ever since been famous for its extensive ironworks, and for the high quality of its output.



COMPANY AT FALKIRK
BLAST-FURNACES OF THE FAMOUS CARRON

The establishment of the Carron Works, and the general substitution of coal for charcoal, effected quite a revolution in the iron industry. Under the new process of smelting the cost was considerably lower, for the blast-furnaces stood in the great coalfields, and coal needed no preparation before use, as did charcoal. Iron of higher quality could also be produced. At first coke was employed as the smelting agent, and this discovery is said to have been due to Dr Roebuck of Birmingham who was employed as manager of the Carron Works. But Abraham Darby, of Colebrook Dale, appears to have forestalled Roebuck in the use of coke in the blast-furnace. Later on pit-coal was substituted for coke with still better results.

Now, in order to work a coke-fed blast-furnace successfully, there is need of a very powerful blast; and Roebuck found that the blowing-engines hitherto in use in the Carron furnaces, while quite serviceable for charcoal and



MODEL OF A BLAST-FURNACE

From the Victoria and Albert Museum

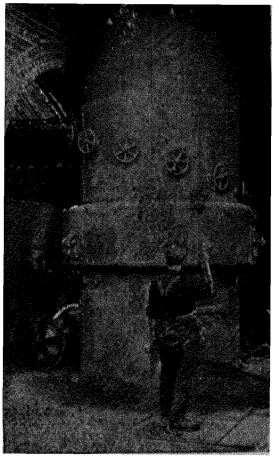
By permission of the Controller of H.M. Stationery Office

wood, proved to be not nearly powerful enough when coke was used. For a time he could find no one of sufficient skill to make a blowing-engine of the power required, but at length Smeaton, the Yorkshire engineer (who is perhaps better known from his having rebuilt the Eddystone Lighthouse) was consulted, and in a short time he succeeded in making a blowing-engine of sufficient power for Roebuck's needs. Soon the "Smeaton" engine was

employed in other iron-works, and this invention may be said to have been the starting-point of the rapid progress of the iron industry.

Another great invention which almost revolutionized the iron trade was the supplying of hot instead of cold air to the blast-furnaces. The credit of this discovery belongs to a Scotchman, James Neilson.

Neilson's father was an engine-wright, and, at the age of fourteen, James was apprenticed to his father's trade. At the completion of his apprenticeship, he was employed as an engineman in a colliery, and he eventually became foreman, and afterward general manager, of the Glasgow gas-works.



THE CUPOLA AT THE CARRON COMPANY'S WORKS

This is used for re-melting pig-iron, from which castings are made. It is charged with a mixture of coke and iron, the necessary heat being obtained by air forced in. In the illustration the molten metal is shown running into 'bogies,' which, when charged, are wheeled into the moulding shop, where the metal is poured into the mould for casting purposes.

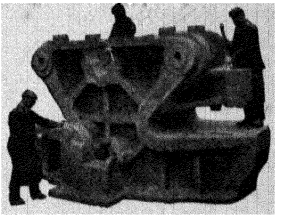
For some time Neilson, taking great interest in the processes of smelting then in vogue, had an idea that a *hot* air blast would be more economical, as increasing the output of the furnace, and, at the same time, decreasing the amount of fuel required. He proved his theory by several little experiments with gas-jets and currents of air at different temperatures. But though *he* was convinced that a hot blast was in every way desirable, it was a very difficult matter to bring the ironmasters round to his point

of view. Their great object had been to cool the blast, rather than to heat it, for they thought that the colder the air used in the blast the higher was the quality of the iron produced. Thus, in many furnaces, the pipes through which the air was driven by the blowing-engines were packed with ice, or else a stream of cold water was kept playing on them, so as to neutralize the heat given to the air by the engine.

Neilson had to wait several years before he could persuade any ironmaster to allow him to conduct experiments in a foundry furnace with a heated blast; but ultimately he was allowed to try his method in the Clyde Ironworks. The result of the experiment proved that the use of the hot blast in place of the cold blast produced nearly half as much more iron, and that the iron had not suffered the least depreciation in quality. The ironmasters were astounded at the results, and before long nearly every furnace in the kingdom was worked with the hot blast. Another great advantage was that coal could be used as fuel; under the old system of the cold blast, it had been necessary first to turn the coal into coke, a process which had entailed enormous waste.

Visitors to the Cleveland and South Wales ironworks a few years ago could have seen the enormous blast-furnaces sending out of their chimneys volumes of smoke and flame which cast a lurid glare at night over all the surrounding country-side. The flame was caused principally by the ignition of the escaping gases from the furnace top. But of late years modifications have been made in the construction of the furnaces so that the various gases, which formerly did great harm to vegetation, are carried off by pipes and utilized as fuel and for raising steam for the blowing-engine

During the last fifty years the demand for iron and steel has become so great that it has been difficult to keep pace with it. At the time of the accession of Queen Victoria, Britain was the only great iron-producing country in the world, but of late years Germany and the United States have become serious rivals in the iron trade, and they are able to export a great quantity of machinery and ironwork to most of the civilized countries of the world. It is well for commerce that these countries can produce more iron than is required for their own needs, for otherwise there would soon be an iron famine. In the future we shall look to our colonies for a supply of iron and iron ore, for Canada and Newfoundland have rich deposits of ore and other mineral wealth embedded in the earth, ready for the service of man when the time comes.



A Typical Heavy Foundry Casting at the Carron Works, Weight 27 Tons

Though the Cleveland and Cumberland mines are far from being worked out yet, still, for certain purposes, it is found necessary to import ore from other countries, and chiefly from Spain. In 1910 we imported iron ore to the value of more than £6,000,000. Our total exports of manufactured iron and steel amounted in that year to £43,000,000. A century ago the annual produce of British iron was about half a million tons; in 1909 we mined nearly five million tons of ore in this country, the value of which, at the place of production, was nearly £16,000,000.

CHAPTER XXVI

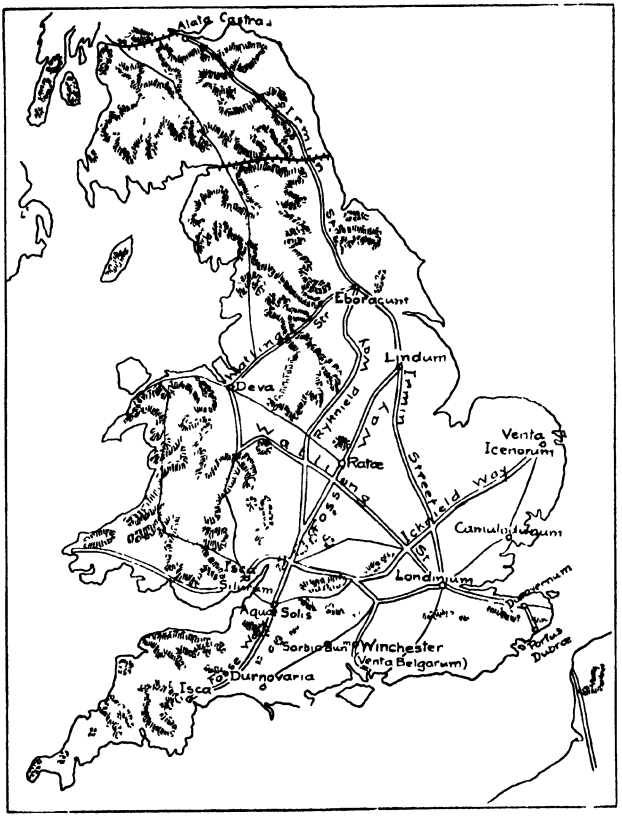
MEANS OF TRANSIT AND THEIR DEVELOPMENT

As commerce and industry depend to such a great extent on the facilities with which goods and other commodities can be carried from place to place, it will be agreed that a brief outline of the development of our modern methods of transit and transport will not be out of place here.

To the Romans is due the credit for having established our fine system of main roads. The construction of these roads was a marvellous feat of endurance and skill; marsh and morass had to be filled in, and tracks cut through dense forests, but the roads ran on in straight and never-ending lines up hill and down dale. These Roman roads were primarily used for the rapid transport of soldiers, both horse and foot, from one part of the country to another, but in time they became of the greatest service for wheeled traffic, and the old Roman roads still have the reputation of being the best roads in the country.

Now roads, like most other things, wear out quickly unless they receive careful and constant attention, and the upkeep of the main roads was for centuries the subject of great controversy between the people and the State. All through mediæval times they were sadly neglected, and in many cases they were nothing but tracks, whose ruts were so deep, that wheels sank therein nearly up to their axles. In very

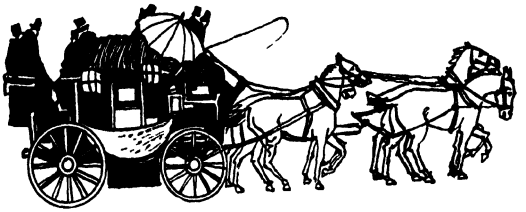
wet weather it was quite impossible to convey heavy loads along such roads. When the stage-coach came



MAP OF THE ROMAN ROADS
The shading shows the 600-feet contour

into use in the eighteenth century, long journeys in winter-time were made under very uncomfortable conditions;

frequently the coaches were snowed up; often, too, the journey was highly dangerous to life and limb; one side of the coach would sink into a very deep rut and the coach would be overturned; besides this, the roads were infested by highwaymen, who held up the coach and relieved the passengers of their jewellery and other articles of value. We are all familiar with the story of Dick Turpin, one of the most famous of highwaymen, and we have read accounts of his ride from London to York on Black Bess. (It is said that highwaymen,



A STAGE-COACH

in a sense, originated the 'rule of the road'; for, if one horseman met another he would pull out to the left so as to leave his sword-arm free in case of sudden attack.)

On certain roads there still exist the relics of ancient toll-gates or porters' lodges, and on some roads, privately owned, the toll-gate is even now made use of in levying a toll on the drivers of vehicles using the road. For many years the upkeep of the roads depended almost entirely on the amount of money taken as toll.

The original road on which the authorities were empowered by the State to levy a toll was the Great North Road. For some years this was tried only as an experiment, but there were two opinions in direct opposition

over the question of the toll. Those who owned and used vehicles considered that the amount charged was quite out of proportion to the benefits enjoyed; the poorer classes differed from them, and argued that it was unfair to make those repair the highways, who used only the footpaths. For centuries their forefathers had each been compelled by law to give six days' labour in the year, free of charge, on the repair of the roads, and it was not



OLD TOLL-GATE

until the middle of the seventeenth century that this practice was abolished.

But it was quite evident that the rapidly increasing trade of the country demanded better roads for the conveyance of merchandise; the 'pack horse' system of transporting goods from place to place had become of little use under the new order of things. On the whole it was found advisable to institute the system of payment by toll all over the country, and about a century after the experiment already mentioned had been tried, tolls were ordered to be paid on all the main roads or turnpikes.

It was not until about a century ago that the system of scientific road-making, which we know to-day, came into practice; before that time the deep ruts were filled up with stones as occasion required, and as the stones were of many different sizes and shapes they never fitted closely to each other and seldom 'worked in' to the road, so that heavy vehicles displaced them. Nowadays, the granite is broken into pieces of about equal size and similar shape, and when laid down there is greater chance of the stones fitting into each other and forming a compact surface.

John Loudon Macadam, a native of Ayr, in Scotland, invented the system of road-making, called after his name. After spending his early years in America he returned to Britain, and in 1815 was appointed surveyor of the British roads. Here he had an admirable opportunity to put his system into practice, and he spent a large part of his private income in carrying out his experiments in road-making. His plan was to make a road-crust with small broken pieces of granite to a considerable depth, and to compress this into one solid compact mass by carriages working over it. Nowadays, the steam roller does the work far better. So successful was Macadam's experiment that Parliament granted him ten thousand pounds.

Thomas Telford, the famous Scottish engineer, adopted a system somewhat similar to that of Macadam for road-making. It is said of him that "under his direction, during the first twenty years of the nineteenth century, no less than 920 miles of good roads were made, and no fewer than 1200 bridges built, some of stone, and some of iron, over streams and rivers that crossed the line of the roads,' and the same writer in referring to the advance-

ment of industry and civilization in the Highlands of Scotland through the improvement in road traffic says: "Every year, as new roads were made, the inhabitants of wild, remote districts of the north were brought into contact with the more civilized people of the south. Soon stone cottages took the place of mud hovels;



ISLINGTON, 1760

pigs and cattle were removed to sties and cow-houses; modern ploughs and other implements began to be used in the fields; and carts were seen carrying, along the new roads, the manure and other burdens which used to be borne on the backs of women or horses."

The really great change in transit and transport was due to the invention of the steam engine. This is usually credited to James Watt, which is hardly fair, for—as we have already mentioned—Thomas Savery had utilized

steam power for pumping purposes as early as 1698, and, after him, Newcomen had made the 'Newcomen' steam-pumping engine for mines. It is true that this engine was very imperfect, and would have been of little use in deep mines, but for the improvements Watt made in it; still it was the precursor of Watt's engine.

James Watt was born at Greenock on Clyde in 1736, and his early life was passed in business as a maker of mathematical instruments. When he was about thirty years of age a Newcomen engine was brought to him for repair, and no doubt Watt's thoughts turned then to the great possibilities of the power of steam, which, at that time were practically undiscovered. It is impossible here to compare Watt's inventions with those of Newcomen and other early inventors, because, for this, one would have to go into great detail in describing the various methods of condensing the steam, and a knowledge of engineering would be required in order to understand the various processes employed. Watt had to overcome enormous difficulties, but when he had once started on his task he determined that there should be no turning back. It is said of him: "Year after year he toiled amid endless difficulties, gathering debts that weighed heavily on his mind, and suffering constantly from acute headaches and low spirits." He had the idea of a serviceable engine all worked out in his brain, but the great trouble was to find a Glasgow smith with sufficient skill to construct such an engine from his plans. At last he was lucky enough to discover workmen at Birmingham who were able to make him a more correct model than had hitherto been produced, and soon one of his engines was installed in a Birmingham ironworks. This was quickly followed by others, used for such diverse

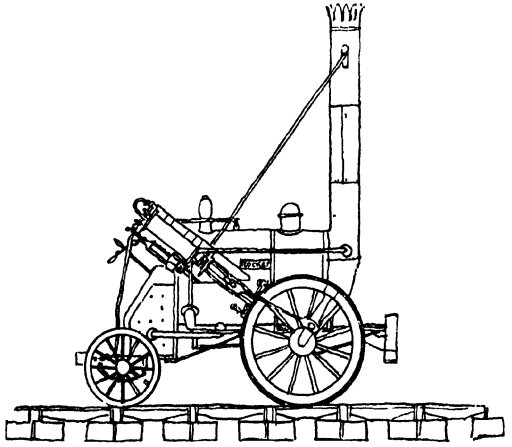
purposes as driving, weaving and spinning machines, grinding corn, and sawing timber.

After Watt had shown the world that he had made an engine capable of driving the machinery in a factory, pumping water and so on, other inventors turned their attention to the problem of making a locomotive engine that should run on rails. Many attempts were made, but most of them were unsuccessful. It was thought unsafe to use steam at a pressure sufficiently high to propel an engine with a load attached to it, and the smooth surface of the rails caused the engine wheels to skid when started. The inventor tried to overcome this difficulty by making cogged wheels and rails similar to those now in use on sundry mountain railways.

Visitors to Westminster Abbey may see commemorated on one of the beautiful stained-glass windows a Cornish engineer named Richard Trevithick, who is generally acknowledged to be the first inventor of an engine which could run on wheels. Passengers were first conveyed by steam by means of his road locomotive in 1801. His ideas were afterwards taken up and developed by other inventors, the greatest of whom was George Stephenson.

The story of Stephenson's life and his numerous inventions is highly romantic. He was born in 1781 at a village near Newcastle. His parents were in very humble circumstances; his father was fireman at a colliery, and as soon as George was old enough to work he was employed as assistant to his father, and afterwards was given charge of the donkey-engine at the pit-head. All his spare time was devoted to study, chiefly of the science of mechanics, for Stephenson was in the unfortunate position of having had little or no schooling in his boyhood.

He made such rapid progress in his studies that he obtained permission from one of the directors of the colliery to build a travelling engine for use in drawing the tubs along the colliery tramway. Upon this he made many improvements, and in 1821 he was appointed engineer of the Stockton and Darlington Railway, then under con-



THE ROCKET

struction. A few years afterward a substantial prize was offered by the directors of the Liverpool and Manchester Railway for the best engine to run on rails between Liverpool and Manchester. Many inventors competed for the prize but Stephenson's locomotive, called the *Rocket*, was accepted. At the trial trip in 1829 the *Rocket* surprised everyone by covering the distance at the very rapid rate of twenty-nine miles an hour.

Stephenson had to fight against the prejudice of many people—even of Parliament—before the passenger rail-

way service was firmly established, for it was thought that such rapid means of travelling would be highly dangerous both to the passengers and to people who lived near the railway. At length the opposition was overcome, and the Liverpool and Manchester Railway was, with one exception, the first of the enormous number of lines which now run in a network all over the kingdom. That exception—the first railway for the use of passengers and goods—was the Stockton and Darlington Railway, opened in 1825.

Although steam locomotion on rails developed with great rapidity when once it was really started, road locomotion was, for a long time, confined to traction engines, used for hauling agricultural machinery and other heavy loads from place to place. The speed of these engines was (very naturally) regulated strictly by a law which enjoined that a man, bearing a red flag, should walk in front of every engine driven along a road.

When the first motor-cars came into use, this law was still in force, and thus gave our foreign neighbours a temporary advantage over us. But the law was repealed in 1896, and since then road traffic in England has been transformed—you have seen it for yourselves—out of all knowledge.

Indeed, to-day we seem almost to have reached the limit in the development of traffic and transit; our large cities have the motor 'bus and the electric tram; Liverpool has the 'overhead' railway, and London the 'Tube.' And now has arrived the latest development—the aeroplane. There alone seems to be possibility of extension; our clever and intrepid 'pilots' and 'aerial' inventors have yet to discover whether the aeroplane can be adapted for practical commercial pur-

poses. But on this we shall touch in a later chapter. We now proceed to discuss certain further inventions (other than those concerned with motive power or transport) which have had their influence on commerce and industry in England.

CHAPTER XXVII

THE INTRODUCTION OF PRINTING AND ITS EFFECT ON THE PAPER-MAKING INDUSTRY

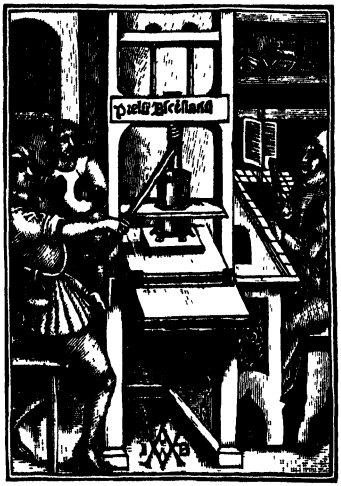
It has been said that no invention has had more far-reaching results than that of printing. Whether this be so or not, it is certain that the institution and general use of printing have conferred untold benefits upon the human race, and, indirectly, have had much to do with our country's industrial and commercial prosperity.

The rudiments of the art of printing were undoubtedly known to the Chinese nearly twenty centuries ago. This clever Eastern race took impressions from blocks of wood upon which the various symbols and characters were engraved, and this method is still practised in many parts of China. The great drawback to block-printing was that each block could be used only for a particular page or sheet, whereas the modern method of using moveable type allows the sets of letters forming each page to be distributed and set up again by the compositor to form quite different matter.

There is great difference of opinion regarding the real inventor of a system of moveable types. The general opinion assigns this honour to John Gutenberg, a German, but other historians ascribe it to Laurens Coster of Haarlem. Both inventors employed wooden types at first; the letters were each cut out in wood, and threaded on wire in the required order. Later on lead types were

used, to be shortly followed by types of tin and pewter. The types were inked and pressed by hand on parchment. Coster printed a complete Latin grammar in this way.

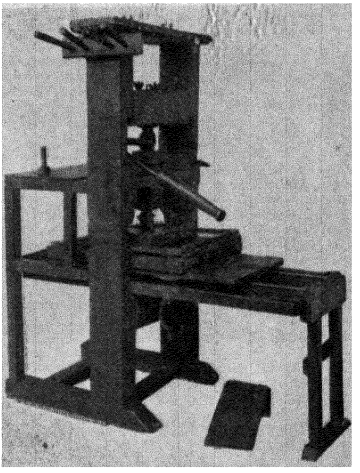
Gutenberg took the first step toward making a printing-press, for he made wooden frames or 'chases' in which to hold the types.



A PRINTING-PRESS OF ABOUT 1510

William Caxton will always be remembered as the man who introduced the art of printing into this country. He was born in the Weald of Kent about 1422, and after serving an apprenticeship to a London mercer he settled in Bruges as a wool merchant. Here he was very successful, and in time was appointed the Bruges representative, and afterward governor, of the London Association of Merchant Adventurers. The study of literature was Caxton's great hobby, and most of his spare time was devoted to writing and translating foreign works into English. Charles, Duke of Burgundy—who had married Margaret, the sister of Edward IV—appointed him to a small office in his household, and here he came under the notice of Margaret who became his great friend, and gave him every encouragement in his literary work. At her wish he gave up his business and devoted his time en-

tirely to translations. One of his most famous translations was *The History of Troy*, and in order to multiply copies quickly he set himself the task of learning the newly-discovered art of printing which was arousing such wonder in the minds of literary men. He soon learnt how to cut out types and fix them in a crude printing-press. With his own press he printed several copies of his translation and presented them to Margaret, who in turn gave them to her relatives and friends, one of whom was Edward IV. Soon afterward he printed a second book—*The Game and Playe of the Chesse*—which was widely read in England, and gained much fame for its English printer.



CAXTON PRINTING-PRESS

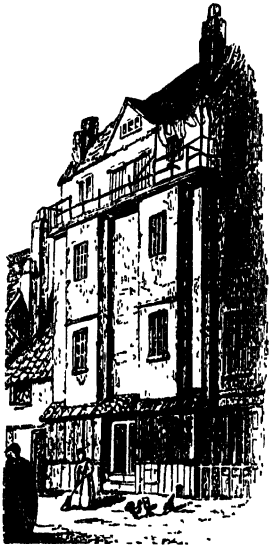
This is a very old hand-press at which it is said Benjamin Franklin worked; it resembles the earliest known form of printing-press

In the Victoria and Albert Museum

By permission of the Controller of H.M. Stationery Office

About the year 1475 Caxton decided to return to his native country, and he set up his press in the Almonry at Westminster in 1476. During the following year he printed *The Dictes and Sayings of the Philosophers.* This was the first book printed in England. Caxton was now nearly sixty years of age, but he threw himself wholeheartedly into his work, and for fifteen years he laboured

at his press, printing during that time nearly ninety volumes. And not only did Caxton print the books, but he bound them and published them as well. In fact, in some cases, he was the author, printer, bookbinder and publisher of a book. It is said that he even manufactured his own printers' 'ink' which he placed on the types by means of woollen balls covered with parchment.



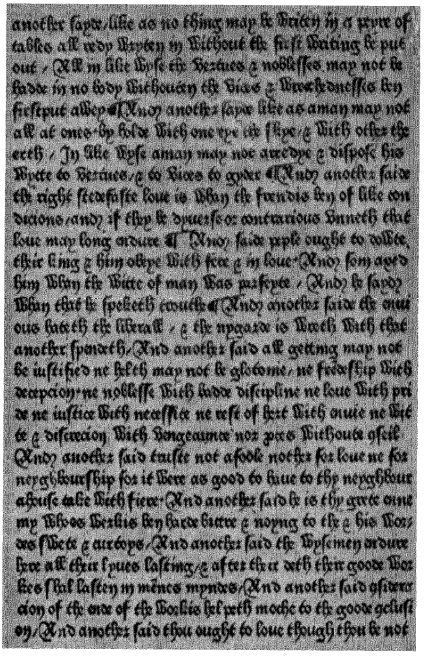
ALMONRY, WESTMINSTER, WHERE CAXTON'S PRINTING OFFICE WAS ESTABLISHED

An old print shows Caxton at work at his beloved press, surrounded by the courtiers and scholars who flocked daily to his workshop. Once at least the King paid him a visit.

Caxton lived to a ripe old age, and at his death he was accorded a 'national' funeral. Princes and nobles gathered together at Westminster to do him honour, and he was buried in the historic churchyard of St Margaret's, Westminster, which adjoins Westminster Abbey. In 1883 the London printers and publishers set up a memorial window to Caxton which may be seen at the east end of the south aisle.

Many of his works, which are of priceless value, are on view in the British Museum. His books are distinguished by a curious device consisting of the initial letters of his name, with a cipher between. The later books mark a great advance on his earliest work, for in

some of the latter the letters were joined together and the leaves were not numbered. The initial letter at the beginning of the chapters was afterward enlarged and

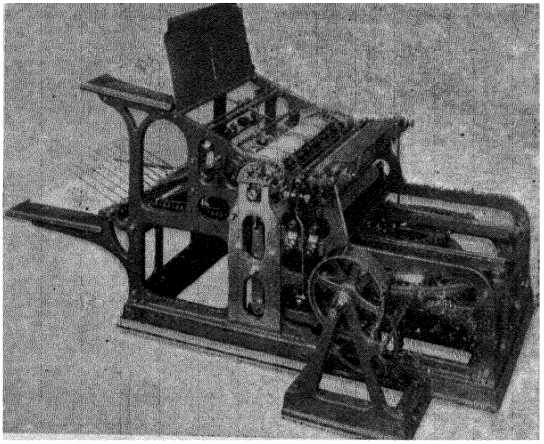


PAGE FROM CAXTON'S FIRST BOOK, PRINTED AT WESTMINSTER

illuminated by a scribe, who wrote it with a pen, with red, blue or green ink.

The introduction of the printing-press created an enormous demand for paper, and soon paper-mills began to be erected near many of the large towns. The earliest

form of paper appears to have been the sheets made from the Egyptian papyrus (whence the word *paper*), but this was different in texture from our modern paper; it has almost the appearance of canvas. Paper manufactured from cotton fibre was used by the Chinese two

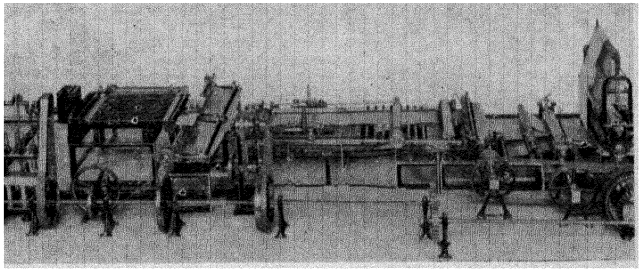


MODEL OF A SINGLE CYLINDER PRINTING-PRESS AS NOW USED
In the Victoria and Albert Museum
By permission of the Controller of H M. Stationery Office

centuries before the birth of Christ, and the secret of the manufacture is said to have been introduced into Europe by the Arabs. The first European paper-mills were erected at Ancona in the year 1340.

Professor Yeats in his admirable book, *The Technical History of Commerce*, says with regard to the materials used in paper-making during the early period of European manufacture: "There is in the British Museum a curious book produced by Jacob Christian Schaffer at Ratisbon,

A.D. 1775. It describes the manufacture of paper from different substances, the sixty leaves of the book being composed of as many different kinds of paper. The bark of the willow, beech, aspen, hawthorn, linden, and mulberry, the down of the catkins of the black poplar, and the silky down of the asclepias; the tendrils of the vine, the stalks of nettle, mugwort, and dyer's weed; various other kinds of leaf, fibre, and stalk; as well as

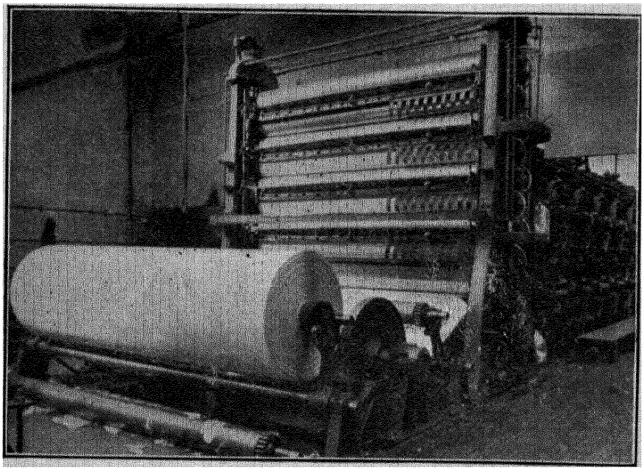


MODEL OF CONTINUOUS PAPER-MAKING MACHINE
In the Victoria and Albert Museum
By permission of the Controller of H.M. Stationery Office

straw, reeds, moss, lichens, wood-shavings, sawdust, potatoes, and fir-cones were employed. The paper in all the specimens is of very inferior quality. Many substances have been tried, but nothing has yet been found to answer so well for papermaking as linen, cotton, and hempen rags. Patents have been taken out for an extraordinary variety of substances, but with the exception of straw, esparto or Spanish grass, and (on a very limited scale) the hop bine, few new ones have come into anything like profitable use."

The earliest paper-mill known to have been set up in

this country was that of John Tate, at Stevenage, a village in Hertfordshire. This mill was erected in 1495, but it was not until 1588 that a second mill was built, at Dartford in Kent, by John Spielman, a German. For two or three centuries we relied mainly on France and Germany for the finer qualities of paper.



DRY END OF ONE OF LLOYDS' PAPER MACHINES

Late in the eighteenth century there were many English inventors and they produced various forms of paper-making machines, which gave a great impetus to the manufacture, and Britain thereby became one of the chief paper-producing countries of the world. The mills were invariably situated near large towns for the convenience of the rag-dealers who, of course, derived their supply of cotton and linen rags mainly from the towns. Of late years an enormous amount of the cheapest

kinds of paper, such as are used for newspapers, has been made from wool-pulp, and a good serviceable paper is manufactured from esparto grass. But for the very best paper, of which banknotes, drawing-paper, and note-paper are made, linen and cotton rags are still used.

The discovery of blotting-paper is said to have been due to an accident. One day some workmen, engaged in a Berkshire paper-mill, forgot to put the size into the pulp—size is a necessary ingredient in the paper manufacture—and the whole batch of material produced was thrown aside as useless. Someone tried to write on the damaged paper with ink, but he found to his great surprise that the ink was quickly soaked up. His immediate thought was—Could not this damaged paper be used to soak up wet ink on *ordinary* paper? The experiment was tried, and was a complete success. The owner of the mill, John Slade, took up the idea, and put a large quantity of blotting-paper on the market. The demand was enormous, and Slade soon made a fortune over 'Slade's original hand-made blotting,' as the advertisements stated. In a few years the original idea was greatly improved upon, and made almost perfect for its work—namely, that of soaking up ink without smearing the writing. Previous to this discovery of blotting-paper the universal means of drying up ink was to sprinkle the wet surface with sand. Even now this method is used in certain quarters, notably in some parts of Germany. The sand was sprinkled over the paper from a receptacle somewhat similar to a wooden pepper-pot.

CHAPTER XXVIII

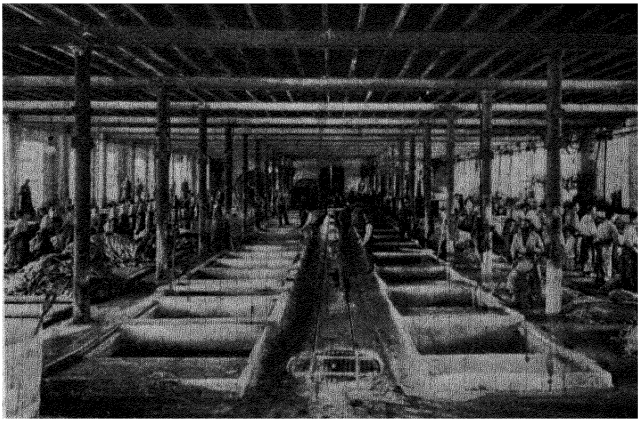
THE DEVELOPMENT OF THE LEATHER-WORKER'S CRAFT

'THERE'S nothing like leather,' is an old saying which acts as a sign for many a village cobbler's shop; and certainly it is hard to imagine how the cobbler's trade and those of the saddler and the glove-maker could do without the leather which supplies us with so much that we use in our everyday life.

It is rather difficult to define leather correctly; indeed, it is difficult to construct a perfect definition of anything, for as one etymologist remarked: "a definition must be inclusive, exclusive, and conclusive." Perhaps one of the best ways of defining leather is to say that it means the skins or hides of animals dressed and prepared for use by tanning, tawing, or other processes, for the purpose of preserving them from putrefaction, and making them pliable and tough. All leathers, whether they be the delicate and costly skins used by the glove-maker for the making of the very best qualities of gloves, or the thick sole-leather used by shoemakers, are produced from the skins and hides of animals.

Every part of the world is laid under contribution by the hide buyer for hides, and by the tanner for suitable tanning materials. A common belief is that leather is produced chiefly by taking the hide of the ox, or the skin of the sheep, and then tanning these with oak-bark. True, ox-hide and sheepskin are among the most important

materials used by the leather-maker, and oak-bark is undoubtedly used freely in the tan-pits; but of late years numerous tanning agents have been discovered, and many new varieties of hides and skins have appeared in the tan-yards of Bermondsey, Bristol, and other great centres of the leather trade.



TANNING PITS

Leather has a long history, but who discovered the process of its manufacture is not accurately known. We know by the discoveries in Egyptian tombs that leather was in use fifty centuries ago, and ancient sculptures show the tanner at work in the tan-pits with tools and appliances similar to those used in tanneries to-day.

Though, strictly speaking, the industrial history of ancient Egypt does not concern us here, yet it is well to remember that many of the trades and industries of

modern times originated in that wonderful country many centuries before the chief industrial countries of the modern world came into prominence—or, rather, into civilized existence!

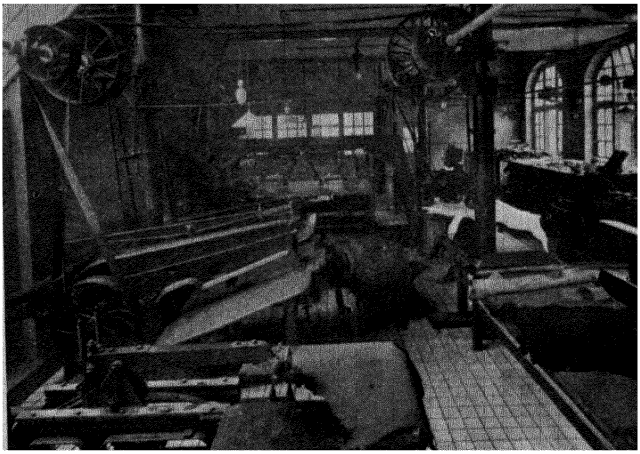
We know how these trades and industries sustain the busy life of the world of to-day; and we can see, from the relics of ancient Egypt, Greece and Rome, so freely displayed in our national museums, how these same trades and industries played the same part in the ancient world at a period before Britain existed in history.

An ingenious theory has been put forward as to the means whereby the art of tanning was discovered. We know that the ancient Britons used leather slings with which to cast their missiles at some fleeing animal, and we have evidence that leather formed some part of their scanty wearing apparel. It is suggested that the influence of oak-bark, acorns, etc., on the hides of animals was discovered accidentally, and one writer says, with regard to this: "In these early times, before draining was practised, there would be in the recesses of the forest many pools of stagnant water, which, through the course of years, would become mixed with tannic acid owing to the leaves and acorns falling from the trees above. Now, when the raw skin coats then worn by the inhabitants of the island became hard and brittle with the action of the sun, it is quite probable they would sometimes be left to soak in these pools to regain their natural softness; and if on any occasion the owner of one of these skin garments allowed his property to remain three months or more he would then find them converted into a species of tanned leather."

Another suggestion is that, in the coracles—or fishing-boats—of the ancient Britons, the action of the bark

frame of the coracle upon the hide that covered it converted the hide into a new substance somewhat resembling our modern leather.

In the earliest period of the history of leather manufacture in this country the sole tanning materials in use



FINISHING DEPARTMENT OF TANNERY

appear to have been oak-bark and oak-galls. The practice was to place layers of bark between layers of hides in a deep tan-pit and to keep them there for two or three years. But this was a lengthy process, and the price of leather, in consequence, remained very high. Experiments were therefore made (with the idea of lowering the price) with a solution of strong tannic acid (made from oak-bark) which was applied for a few days to the raw hides. But it was found that the leather that

resulted was of very inferior quality, and a return was therefore made to the original process.

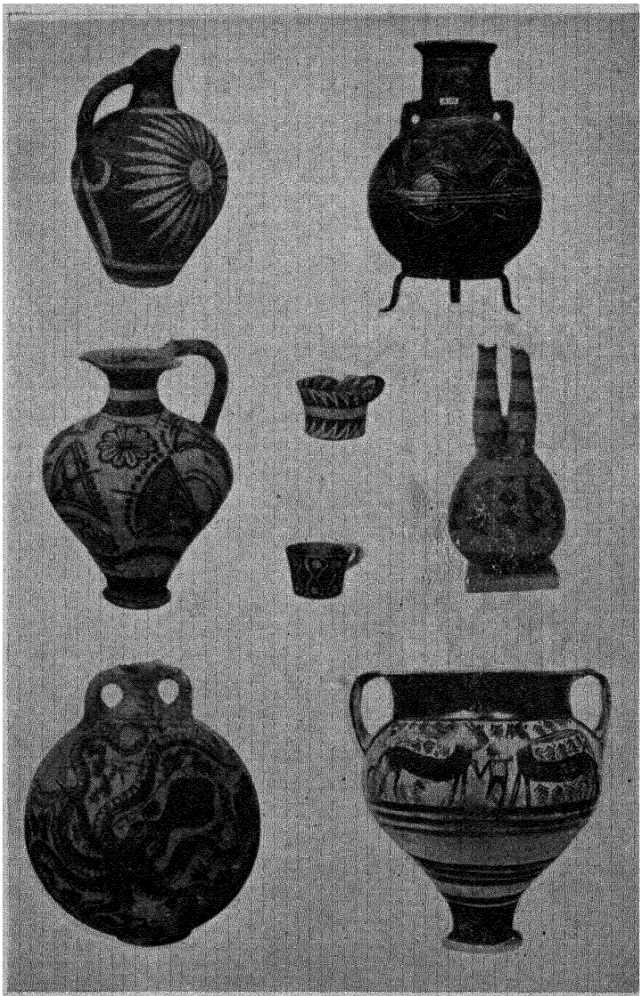
Of late years much progress has been made in the scientific methods of tanning; for that matter, it was not until the last century that the fact was established that tanning was a chemical process, and it is since that discovery that the industry has made its enormous progress A writer, remarking on this, says: "Up to about seventy years ago the tanners were men of small means, diffused throughout the country, unaided by railway communication and the advantages of machinery, while being utterly free from any knowledge of chemical principles. As a contrast to this condition of the trade, we have now an accumulation of extensive tanneries, many of which are situated near the great ports where the raw materials are landed from abroad. . . . In some of these the principles of the art are not only understood but more or less generally followed, while the advantages of labour-saving machinery have been recognized, and mechanical appliances adopted which the tanners of old would have looked at but to condemn"

CHAPTER XXIX

THE DEVELOPMENT OF THE POTTER'S ART

THERE is a district in North Staffordshire—some nine miles long and from three to four miles broad—which is known as 'The Potteries'; and here some of the most valuable pottery of the world is made This important English industry is of comparatively modern origin, for though coarse pottery was made in this country many centuries ago, it was not until the eighteenth century that the industry could be dignified by the name of 'art.'

But though the secret of making fine pottery was not introduced into England until mediæval times, it was known to the ancients many centuries before the Christian Era. The Egyptians were skilled potters, and the Ancient Greeks had important potteries at Athens and Corinth. Excavations among Babylonian ruins have disclosed glazed bricks, enamelled tiles, and glazed earthenware coffins. The Egyptians were highly skilled in making beautiful terra-cotta ware, and the Victoria and Albert Museum, at South Kensington, London, contains fine examples of ancient vases, which are of quaint design and rich colouring and decoration. The general colour scheme of Egyptian terra cottas is red on a buff-coloured ground, although some specimens are painted black. We know, too, from the paintings on the walls of ancient Egyptian buildings, that the potter's wheel



Mansell & Co.

POTTERY FROM MYCENÆ, CYPRUS, AND CRETE. 2000-1300 B.C.

From Mr H. B. Cotterill's "Ancient Greece"

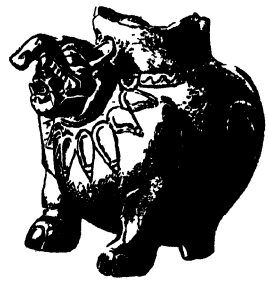
was in use many centuries before the birth of Christ, and, moreover, in construction and general use it was very similar to that in use to-day.



ANCIENT GREEK VASE.

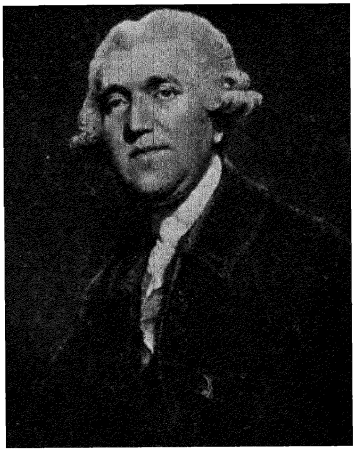
Pottery—and in a very fine form—was made by the ancient inhabitants of Peru so long ago as 5000 years before the Christian Era—so say the experts. Some very choice specimens are on view in the British Museum, and everyone who takes an interest in such things should make a point of visiting the collection. The work looks so clean and fresh, and the decoration is so vigorous and artistic (and in many cases, *humorous*) that it is almost impossible to imagine that it left the potter's hand no less than seventy centuries ago.

It is generally agreed that the Arabs introduced the art of making glazed ware into modern Europe. Professor Yeats says with regard to this: "The Arabs were perfect masters of the art of pottery. Their vases and amphoræ are of a kind of terra cotta; some are glazed, and some are of a soft, porous, biscuit-ware. No nation has exhibited so thorough a knowledge of the art of decorating with cheap materials as they; and the remains of their mosaic ornamentation, made of common clay, and glazed with varied



PIECE OF POTTERY REPRESENTING TAPIR, FROM GUATEMALA

colours, surpass anything else of the kind executed. The glazes they employed were of lead and tin. The Moorish ware was first introduced into Majorca, and thence, in 1115, it spread over Italy, under the name derived from that island, *Majolica.*"

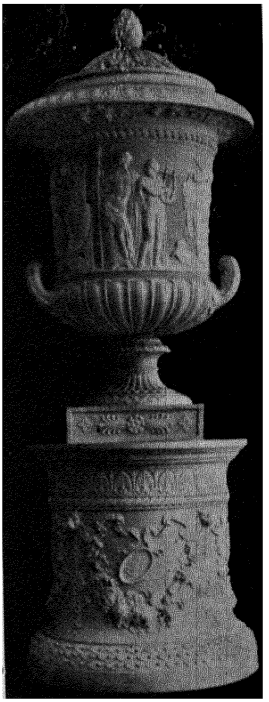


JOSIAH WEDGWOOD
From the painting by Sir Joshua Reynolds

For a long time Italy was the chief seat of the manufacture of mediæval pottery, and the Italians established an important factory at Faenza in the fifteenth century. From Italy the art passed into France and the special glazed ware made by the French was called by them *Faience*, because the secret of its manufacture was obtained from Faenza. Soon afterward an important Dutch factory was opened up at Delft. The Dutch, too, introduced into Europe from China the making of porcelain or chinaware at about the end of the sixteenth century. (The name 'china' under modern usage, includes nearly all domestic pottery ware, but, strictly speaking, it should refer exclusively to porcelain.)

The great outstanding figure in the history of English pottery is Josiah Wedgwood. He was born at Burslem, in Staffordshire, in 1730, and was the youngest member of a family of thirteen children. Josiah had few educa-

tional advantages in his boyhood, and at the age of eleven he was put to work at the potter's wheel in his brother's factory. It is said that he "took to his trade as a duck takes to water," and in about two years he was the most skilful potter in Burslem. At the age of twelve he was smitten with small-pox, which afflicted him with an incurable lameness, and even caused the loss of his right leg, which had to be amputated. This compelled him to give up his work at the wheel, and, as a further misfortune, his eyesight became seriously affected—so much so, that he was in grave danger of becoming blind. But amidst all these trials he laboured on, first at Stoke, and later at Burslem, where he set up a small factory of his own.



A PIECE OF WARE MANUFACTURED BY MESSRS JOSIAH WEDGWOOD & SONS, LTD.

Josiah's great ambition was to make richly designed and artistic pottery; he could not bear to spend his time over the coarser ware, and he was for twenty years experimenting with various clays, flints, glazes, and paints. It is said that during this period he made over six thousand 'trials,' many of which may be seen at the Wedgwood Museum, at Etruria, near Burslem. His chief

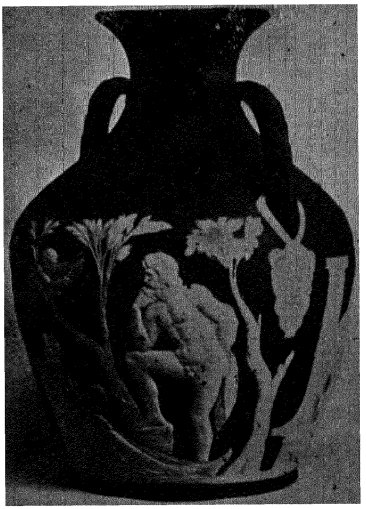
object was to discover the secret of making the 'black basalt' and the 'Jasper' ware and after many failures he was ultimately successful. The name of Wedgwood is associated in our minds with a rich blue ware, adorned with white designs in bas-relief; that is—the figures forming the design have a very slight relief or projection from the surface. Wedgwood also produced, and the firm still produces, a rich cream-coloured ware. Another of his great aims was to produce a ware, so hard and durable that works of art designed on it would be almost indestructible.

His business improved so rapidly that he was able to enlarge his factory; and the small Staffordshire village where his large works were built and now stand, and which is inhabited principally by the 'Wedgwood' workpeople, is named Etruria, after the birthplace of the ancient Etruscan art which was practised (before the foundation of ancient Rome) in that part of Italy known as Etruria. Perhaps no English potter has done more than Wedgwood to revive and bring to perfection this elegant ancient art.

The most perfect specimen of Etruscan ware is the Portland Vase in the British Museum; and Wedgwood crowned his fame by making a perfect copy of this vase.

The story of the Portland Vase is quite a romance. This priceless piece of pottery is really an ancient cinerary urn, or vase, of transparent dark-blue glass, coated with opaque white glass; it represents in relief the marriage of the hero Peleus with the sea-goddess Thetis. It was discovered in the seventeenth century, during some excavations near Monte del Grano, within the sarcophagus of the Emperor Alexander Severus, and it probably contained the ashes of some Roman patrician. It passed into the possession of a great Florentine family—

the Barberini—where it remained for more than a hundred years, side by side with the priceless artistic treasures for which this family was world-famed. Later, when the collection was sold in Rome, Sir William Hamilton bought the Barberini vase, as it was then called; he ultimately disposed of it to the Dowager Duchess of Portland. After her death it was again put up for sale, and became the property of the Duke of Portland who purchased it in 1786 for a thousand guineas. The Duke at once lent it to Wedgwood in order that he might copy it. At first he found the task was apparently beyond his powers; but at length after more than three years' labour, he succeeded in making a perfect replica. In 1810 the Duke allowed the original vase to be placed in the British Museum. For thirty-five years it remained intact, until one day it was smashed by some evilly-disposed person. However, the pieces were carefully collected and reunited, and in that state it was once more set up in the Museum, but was not shown to the public.

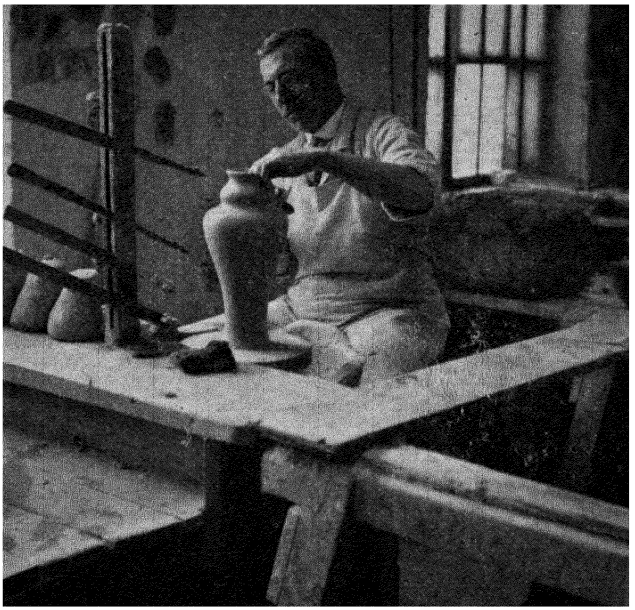


THE PORTLAND VASE.

By courtesy of Messrs Josiah Wedgwood & Sons, Ltd.

Lovers of artistic pottery delight in a visit to the

Wedgwood Museum. Here are contained treasures of untold value, many of which were accidentally discovered a few years ago in one of the old red-bricked buildings forming part of the pottery. Works of art designed by



THROWING.
Doulton & Co. Ltd.

such eminent artists as John Flaxman, Sir Joshua Reynolds, and Henry Webber are on view, together with the original matrices of plaster of Paris in which the designs were cast.

There have been, and are to-day, many eminent potters in the 'Five Towns,' but it is to Josiah Wedg-

wood that the potters owe it that they can rival the artistic productions of such famous factories as Sèvres in France; Meissen, near Dresden, in Germany; and Delft in Holland. Near the railway station at Stoke-upon-Trent the potters have set up a statue to Wedgwood.

Few potters have had a more honourable career than he. Nothing but the best was good enough for him, and even in such cheap articles as common domestic teacups, plates, etc. he required the 'thrower' to make them of as perfect a shape as possible. It is said that he frequently passed through his workrooms carrying a stout stick, and when he found any article not properly finished, either in shape, glazing, or firing, he would break it to pieces, with the remark, "This won't do for Josiah Wedgwood."

CHAPTER XXX

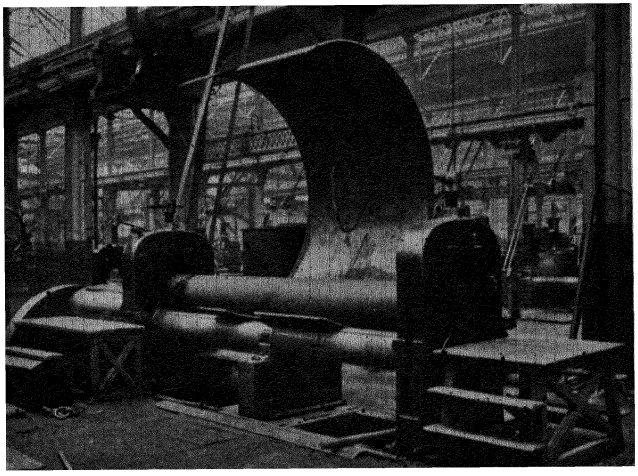
MACHINES AND THEIR EFFECT ON INDUSTRY, WITH A NOTE ON THE SEWING-MACHINE

DURING the last century or so nearly every industry in this country has been influenced in some way or other by the invention of machinery; indeed, it may be said that machinery has revolutionized industry.

But we have already spoken (Chapter XX) of "A Revolution in Industry," that was the revolution due to the discovery and use of steam. With machinery there is this difference that the mechanical 'revolution' is—so to speak—never at an end, whereas the steam revolution was sudden and final. The reason for this is that machines are always being developed and improved.

When the power and use of steam were discovered, steam-engines were made and factories sprang up all over the land: but steam—in itself—is to-day not different in any way from what it was when first revealed to humanity. Machines, on the other hand, are always changing; what was new a few years ago is to-day obsolete and old-fashioned. Indeed, if some of the industrial workers of early Victorian times could return to their places at the bench or in the factory, they would think there had been a sufficiently sudden and final revolution, for they would not recognize in the mechanical masterpieces now before them the old machines of their day!

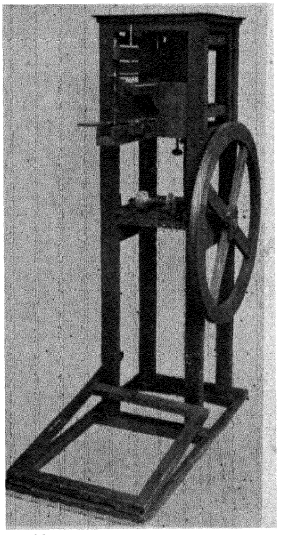
So numerous are the applications of machinery to various trades and industries that it would not be possible to describe in one chapter the thousandth part of them. We have previously spoken of the various spinning-machines, and later on we refer to the invention of the Nasmyth hammer. In our smelting-works there are machines for



LARGE BENDING ROLLS

rolling metal where thick bars of iron are flattened between rolling presses into the thinness of a pancake. Our great shipbuilding yards, ironworks, boilerworks, and cutlery works contain machinery for cutting, drilling, boring, filing and grooving the various metals employed. In every domain of industry the art of the machinist is in evidence. Even the quiet business office has installed the typewriter; shops have their automatic cash-registers; automatic, and 'penny-in-the-slot,' machines

are everywhere before us; and the great locomotive works and electric power-houses contain machinery of all descriptions. Neither has the farmer been neglected; M'Cormick's reaping-machine has taken the place of the sickle and the scythe, and we have now the self-binder, which will not only cut the corn, but will tie it up in bundles and throw the sheaves out in line, ready for the harvesters to make them into shocks. The double-furrow plough and steam-plough are also comparatively modern inventions, and so, too, are the various kinds of lawn-mowers now in use.

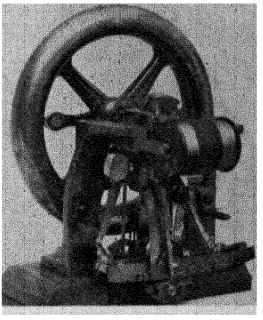


THIMMONIER'S SEWING-MACHINE
In the Victoria and Albert Museum
By permission of the Controller of H. M. Stationery Office

A machine, however, which is quite one of the most useful inventions made in the last century, deserves special mention: this is the sewing-machine. The first Englishman to make a machine which could sew plain stitches was Thomas Saint. Saint's machine, which was brought out in 1792, was intended for use in the leather trade. Later on, in 1804, Thomas Stone and James Henderson invented a machine for sewing on cloth. This contrivance imitated as closely as possible the movements of the hand in sewing; there were two pairs of pincers made to move mechanically, one of which seized the needle below, and the other above the cloth, and pulled it

quite through on either side alternately. Meanwhile several inventions of sewing-machines were appearing on the Continent, notably in France and Austria, the most important of which was made by a French tailor named Thimmonier.

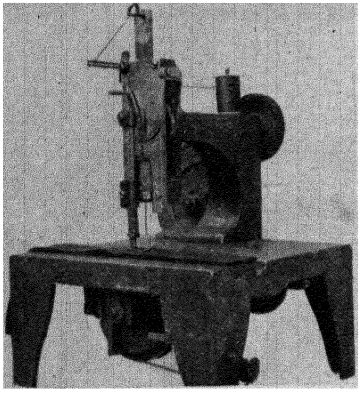
The first really satisfactory sewing-machine was made by a poor American mechanic named Elias Howe. In Howe's machine two threads were used, one of which passed through the eye of a needle, while another was enclosed in a shuttle. When in action a seam was made in the cloth in which each stitch was firmly locked, so that it could not come undone by pulling. The lock-stitch was a great improvement on the old chain-stitch, for in the latter the whole seam came undone if the end of the thread was pulled. Numerous improvements have since been made in Howe's machine, patented in 1841, but the principle employed by him is still in use in the construction of most sewing-machines.



HOWE'S SEWING-MACHINE
In the Victoria and Albert Museum
By permission of the Controller of H.M. Stationery Office

Howe tried to establish his machine in his native country, but the American tailors were in such great opposition to him that they threatened to smash his machines, and the poor inventor sent his brother to England to introduce the lock-stitch machine into this country. It was soon taken up by a corset-maker and Howe was invited to England when he was offered £250 for all rights in the English patent. On his return to

America he found that his machine had come into extensive use during his absence, and he sought the aid of the law to establish his right to reap the benefit of his ingenuity. This for a long time was not forthcoming. Howe used up nearly all his capital in the numerous and costly lawsuits which he undertook, but in the end the American law-courts decided that he should be paid a royalty on each machine the manufacturers produced.



THE ORIGINAL SINGER'S MACHINE, CONSTRUCTED IN 1854
In the Victoria and Albert Museum
By permission of the Controller of H.M. Stationery Office

Another inventor—perhaps the best known of all—was Singer, also an American, who devised a sewing-machine containing a mechanism for tying a knot in the seam at every eighth stitch, so as to lock the chain-stitch. Immense numbers of the Singer machine, which subsequently was greatly improved, have been, and still are, sold in this country, although for many years the manufacture of sewing-machines was more extensively carried on in America than in any other country.

CHAPTER XXXI

GREAT DISCOVERIES WHICH HAVE BEEN MADE BY CHANCE

HITHERTO we have seen that most of the great inventions have been the result of dogged perseverance, and an infinite capacity for taking pains on the part of the inventors. Very rarely does it happen that *invention* is the result of accident, but there are some outstanding examples of great *discoveries* which have been the result, more or less, of lucky chance. It would be as well to mention some of the most important of these.

Most of us wear felt in the form of slippers, socks for the boots, or hats, but few of us are aware of the accidental way in which the felting principle was discovered. Many centuries ago a good monk, St Clement, undertook long pilgrimages, and his journeys led him over snow-capped mountains and scorching sands. To protect his feet he put carded wool in his sandals. He found at his journey's end that the wool fibres, moistened by the perspiration from his feet, and turned over and over by constant movement, had been wrought into a close texture. Thus was the whole art of the felting industry accidentally discovered; for felt is a cloth, which is not woven, but consists, in its simplest form, of a layer of wool, the fibres of which have become pressed and interlaced into a unified substance.

If you make a tour round the Potteries in North

Staffordshire you will find that ground and burnt flints are extensively used in the making of various kinds of pottery ware. About two hundred years ago a Burslem potter, named Astbury, passed through Dunstable on horseback on his way to London. He noticed that his horse's eyes were much inflamed, and an hostler at the inn where he stayed told the potter that he knew how to cure them. The man took a flint stone, burned it, and then hammered it into a fine powder. When the powder was blown into the discharging eyes of the horse a creamy paste was formed, and the potter, always with a keen eye to business, thought that a similar rich-looking paste would mix well with potter's clay. On returning home he tried a few experiments with burnt flints, and so successful were they that in less than a year hundreds of potters were using ground flints with admirable results.

The discovery of glass is also said to be due to lucky chance. The famous Roman historian, Pliny, relates the story of some shipwrecked mariners who were cast ashore on the coast of Syria. Their cargo consisted of an alkali now known as nitre. The sailors are said to have encamped near the shore and, having no stones on which to rest their cooking utensils, they used pieces of the nitre washed up from the ship. The fire quickly melted these lumps, and the molten alkali flowed amongst the sand. Soon a clear transparent substance was formed which gave these Eastern sailors the first but crude idea of making glass.

A Middleburg spectacle-maker is credited with the discovery of the uses of lenses in the construction of the telescope; the story is rather romantic. His children while playing with some lenses on his work-table accidentally put two together in such a way that the weather-

cock on the parish church was apparently enlarged and brought much nearer. They pointed this out to their father, who, with the idea of making a simple toy for them, fixed the two lenses in the opposite ends of long tubes. The smaller tube was made to slide into the larger one, and the resulting instrument was nothing less than a crude telescope! Galileo, the famous Italian astronomer, greatly improved the instrument, and at length succeeded in making the first astronomical telescope.

To Galileo is also ascribed another accidental discovery—that of the principle underlying the working of the pendulum clock. When a youth he stood watching the swinging to and fro of the lamps in the cathedral at Pisa; and he was struck with the fact that each swing, or oscillation, was made in the same space of time Some years afterward he remembered the incident and gave to the world the action of the pendulum.

The rich purple dye used by the Phœnicians in the manufacture of their beautiful cloths was accidentally discovered by someone who happened to be watching a sheep-dog. This famous dye came from two species of molluscs, one of which Pliny called the *purpura*. One day a sheep-dog bit the shell of a purpura, and its mouth was coloured a rich red. This discovery is said to have been the origin of the important dyeing industry.

To a chicken we are said to owe the discovery of a process for whitening sugar. This famous fowl, after going through a clay puddle, strutted into a sugar factory, and left its tracks upon a heap of sugar. It was noticed that the clay, wherever it had dried on the sugar, had whitened it; and this discovery ultimately led to the adoption of moist clay in the process of refining sugar.

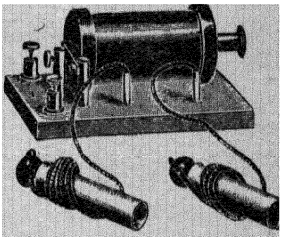
CHAPTER XXXII

ELECTRICITY AND ITS INFLUENCE ON COMMERCE

QUITE one of the mightiest and most subtle of natural forces which have been discovered in comparatively recent years is that of electricity. By this strange and almost uncanny power time and space are, for all practical purposes, annihilated, and the applications of electricity to science have produced more astounding and far-reaching results to commerce and industry than anything in the previous history of the world. It has been truly said that of all modern discoveries electricity has proved not only the most marvellous, but also, probably, the most useful. In whatever station of life we may be there are few of us who do not depend upon this mysterious force in some form or other; indeed, it is hard to think how the ordinary business of the world could be carried on without its use.

Let us go through a day in the life of an ordinary business man who lives, say, in suburban London, and find out a few of the ways in which electricity is of use to him. He rises in the morning and if he be a sufferer from rheumatism or kindred complaints it is quite possible that he uses an electric battery which exhilarates every nerve and muscle, to which it is applied. Should the morning be dark he switches on an electric light; in answer to the electric bell the maid brings up his shaving-water, and perhaps a portable electric lamp guides him

along the dark passages. When he sits down to breakfast he sees before him an electro-plated cruet and coffee-pot, and the spoon with which he stirs his coffee is coated by the same process. It is highly probable that the pictures and type of the illustrated newspaper which lies by his side were produced by the aid of electricity too. On starting out for business he boards an electric tramcar, and in a short time he is being lowered by means of an electric lift to the platform of a 'Tube' station which lies many feet below the surface of the earth. Soon the swift-moving electric train rushes up and he is borne through dark tunnels past signals also worked by electricity. As he moves along the streets luxurious electric broughams whizz by, and overhead there is a network of wires which conduct electricity to all parts of the country. After arriving at the office he is soon in conversation, by means of the electric telephone, with someone who may give him important news transmitted by the electrically-worked tape-machine, or who may be two or three hundred miles away. More mysterious still, he may be able to recognize the speaker's voice just as though he, or she, were in the next room. During the day he probably dispatches telegrams to places far away, and he has the assurance that his messages will reach their destination long before the swiftest train could convey them there. By the agency of the marvellous system of wireless telegraphy he can communicate with people on the high seas, and the



MEDICAL BATTERY

overseas cable will flash his message to distant continents.

"What is this strange and weird power?" you ask. It is difficult to answer such a question; no man living has ever been able to give a perfectly clear and accurate description of electricity, simply because no one knows the precise nature of this invisible agent which works such wonders in the everyday life of the world.



RECEIVING NEWS BY TAPE-MACHINE AND RE-TRANSMITTING BY TELEPHONE IN LLOYDS' PRINTING OFFICE

The word 'electricity' is derived from *ēlectron*, which is the Greek for *amber*. About 2500 years ago a famous Greek philosopher named Thales discovered that when amber was rubbed briskly with a piece of dry silk it immediately acquired the power of attracting to itself other light bodies, such as small pieces of paper, pith, down, or bran. For many centuries no other substance, with the exception of jet, was noticed to have this peculiar property when rubbed in a similar manner. Indeed, the ancients appear to have taken little notice of the discovery; certainly they could not have thought that they were on the very

brink of one of the greatest discoveries the world has ever seen.

The first Englishman who appears to have studied this subject seriously was a physician named William Gilbert, who lived at Colchester about three centuries ago. By innumerable experiments he found that other substances such as a glass rod, a stick of sealing-wax, sulphur, and so on, showed the same peculiarity as amber when sharply rubbed with flannel or silk, and he also noted that none of his experiments was successful when any of the articles used were damp.



A Leyden Jar

Gilbert's discovery soon excited public attention and it began to dawn on the minds of scientists that there was, behind all this, a mysterious hidden power which might be turned to practical use Before long a German invented a machine which produced electricity by friction, but the chief drawback to his machine was that it allowed the electricity to escape as soon as it was 'produced. However, the machine was a great advance on anything previously attempted.

The next important invention was that of the Leyden Jar, in 1746. By this useful contrivance electricity was not only produced, but stored, or accumulated. The credit of the invention must be given to a scientist named Cunæus, who lived at Leyden in Holland. It is said that his discovery was quite accidental. He was trying to collect the electricity produced by a small frictional machine in a bottle half filled with water. A nail protruding from the cork of the bottle was the means whereby the electricity was conducted from the machine to the water within the bottle. When Cunæus was

holding the bottle in one hand he touched the nail with the other hand, and immediately received a slight shock.

The results of this experiment were published far and wide, and scientists, both in Europe and America, turned their whole attention to this lucky discovery. Here was a means, at last, whereby they could accumulate their electricity, and harness it, so to speak, for future use. It is said that these results took such strong hold on public imagination that the houses of electricians were crowded with spectators assembled to watch the experiments.

From this time rapid progress was made, and both in Europe and America little else occupied the minds of scientists. Soon another German inventor made a small electric battery by which electricity could be condensed in still larger quantities. This battery consisted simply of a number of Leyden jars united with each other, and which could be charged and discharged in the same manner as the single jar. Sparks over an inch long were obtained from the battery.

We cannot here give a detailed account of Cooke and Wheatstone's needle-telegraph, of Morse's ingenious code for transmitting messages by the electric telegraph, of Bell's telephone, of Swan's and Edison's systems of generating electric light, nor of the numerous inventions in electric cables as the motive force for light railways. By patient toil and infinite perseverance these early inventors worked on in their little laboratories and did the work that was to make our modern systems of using electricity well-nigh perfect.

But we cannot close this chapter without referring to that marvellous inventor, Commendatore Marconi, whose name will always be remembered in connexion with the discovery of a means of transmitting signals

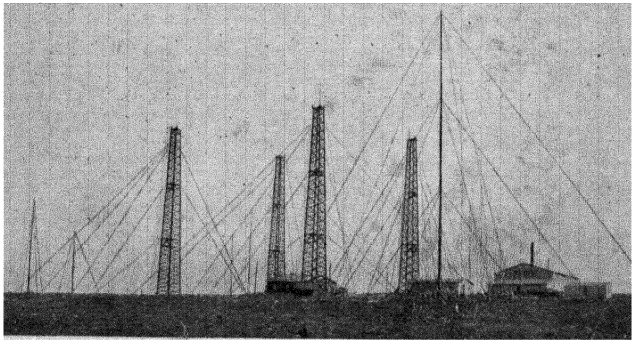
through the atmosphere without the aid of wires—known, for that reason, as *wireless telegraphy*.

Guglielmo Marconi was born in 1874 near Bologna, Italy. As a boy he was always devoted to electrical experiments, and at the University of Bologna he specialized in the study of electricity, and his progress was exceedingly rapid. In 1895 he carried out in Italy his first public experiments in wireless telegraphy, and communication was found to be possible over a distance of two miles. In 1896-7 tests were carried out for the British Post Office, and these were witnessed by representatives of the Admiralty and the War Office. Important experiments were made in England between buildings of the General Post Office in London, and afterward distances of 1¾ miles were obtained at Salisbury at the end of September 1896. In the following year the distance was extended, also at Salisbury, to nine miles. During this year he also carried out tests between warships for the Italian Government at Spezia, and communication was obtained up to twelve miles. Communication was established for the first time over the English Channel between England and France in March, 1899. The next important advance was to communicate between two stations situated on St Catherine's Point, Isle of Wight, and the Lizard, Cornwall, a distance of 155 miles.



COMMENDATORE MARCONI

Marconi's great ambition was to be able to transmit messages by means of 'wireless' over the Atlantic. There were many people who scoffed at the idea, and who believed that the astonishing experiments already successfully achieved were done in some way or other by trickery or fraud. But when he had once decided that a thing was to be done there was no turning back, and

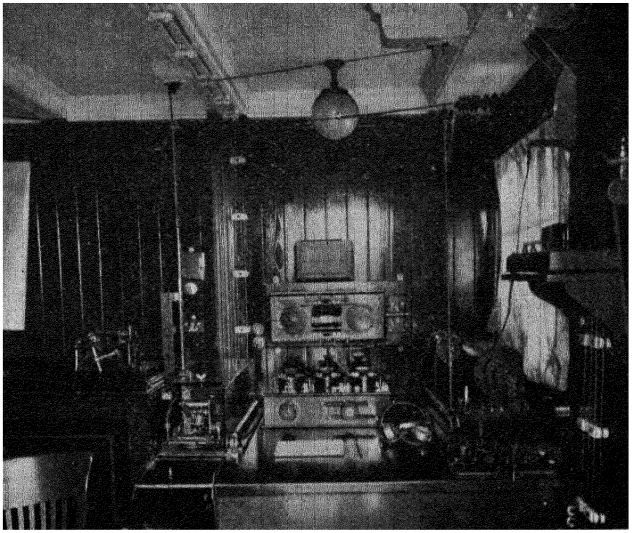


MARCONI LAND STATION AT GLACE BAY

obstacles which would have daunted the spirit of most inventors were, step by step, overcome. After numerous difficulties a station was erected at Poldhu, on the coast of Cornwall, and another station was set up near St Johns, in Newfoundland.

How delighted Marconi must have been, and how astounded were many of the world's scientists, when, on December 12th and 13th, 1901, signals were received by him and his assistants in Newfoundland which had been flashed across the wide ocean from Cornwall! In the words of the inventor: "The experience gained by these tests was sufficient to convince me that with per-

manent stations on both sides of the Atlantic, and by the employment of greater power, messages could be sent across the ocean with the same facility as had been done up to then over much shorter distances."



THE MARCONI APPARATUS ON S.S. "LUSITANIA"

During the following six years stations of much higher power were erected in Canada, and, after numerous experiments, a service of Press messages was commenced between England and America in October 1907. The following year the service was extended to ordinary commercial messages between London and Montreal.

To show the enormous speed at which wireless messages travel an interesting experiment was conducted a short

time ago by the *New York Times*. The proprietors of this paper made arrangements with the telegraph companies in America to have their lines specially cleared from Glace Bay, the Marconi station in Canada, to New York, and similar facilities were accorded to them by the telegraph authorities in England. In these conditions a message was sent from London and received in the office of the *New York Times* within *ten minutes of its being handed in at the telegraph office in London.*

The value of wireless telegraphy in shipping disasters was shown to the world by the wreck of the *Titanic*, and we cannot but recall the heroic deed of the operator in the wireless cabin of that ill-fated ship, who, knowing the mammoth liner was gradually sinking into the depths of the ocean, stuck to his post, and flashed out signals of distress for miles around. And we remember, too, how these signals were 'picked up' by a sister ship, which rushed through the dark night to the rescue and succeeded in saving hundreds of the panic-stricken passengers who, benumbed with cold, and overcome with the horrors they had witnessed, were being tossed about in open boats on the billows of the Atlantic.

CHAPTER XXXIII

THE CONQUEST OF THE AIR

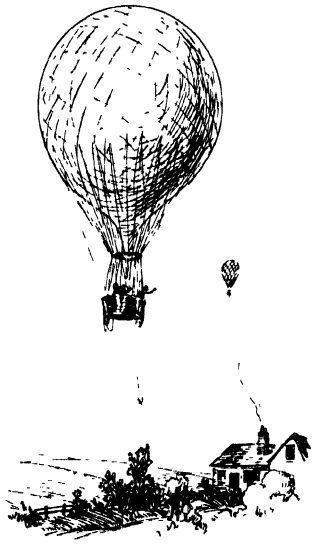
As we have remarked in a previous chapter, there was a time when our early forefathers and their merchandise travelled only on land; after some centuries of progress, the sea became an important commercial highway; to-day inventors have claimed the air as a medium for the third means of transit.

Whether the aeroplane can in time be made of reliable stability so as to be available for commercial purposes is at the moment little more than a matter for speculation. Certainly the progress of airmanship during the last few years has been quite remarkable, but there are still immense difficulties to be overcome before the 'conquest of the air' is complete. Only a short time has elapsed since the pioneers of aviation were just able to lift themselves in the air; to-day the curious musical hum of an aeroplane engine is familiar to many, and flying machines pass frequently to and from the Continent.

We have only to visit the great aerodromes at Hendon and Brooklands to see how much has been achieved in this modern industry, and there are, in England alone, hundreds of proficient pilots.

There is little comparison between the method of sailing through the air in a balloon—a means of travelling which has been in use for over a century—and that of flying in an aeroplane, for the former is filled with gas,

which makes it *lighter than the air* and thus causes it to rise and float, while the latter is *heavier than the air* and owes its ability to rise and cleave the air to mechanical contrivances. A balloon, too, is entirely at the mercy of the wind, and it must go in the direction in which the wind is blowing; on the other hand, the aeroplane can be made to fly against the wind, or in whatever direction the pilot wishes.



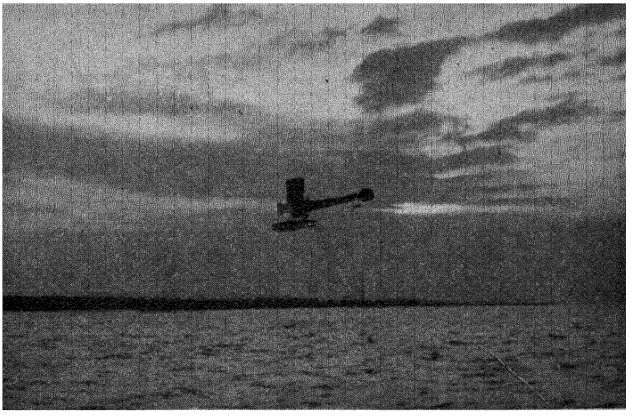
A BALLOON

The famous American aeronauts, Orville and Wilbur Wright, may claim to be the first inventors of a *practical* flying-machine, although successful experiments in flying and gliding had been previously carried out in France. The original 'Wright' machine, when placed alongside a modern aeroplane provides almost as great a contrast as Stephenson's 'Rocket' by the side of the latest engine of a modern express train.

But the main idea underlying the construction of the two machines is much the same, and it may be explained most simply by comparing the art of flying in an aeroplane with that of flying a boy's kite. You know that the kite is heavier than air; and of its own accord it could not rise from the ground, but you have many times made it fly by

inclining it to the wind and pulling it forward by means of a string against the wind. All that we require is to balance the kite properly by means of a tail and wings, and to affix the string in the correct position on the framework of the kite, and there are few boys—once that is achieved—who would be unable to make it rise high in the air.

Now the large canvas 'spreads' of an aeroplane may

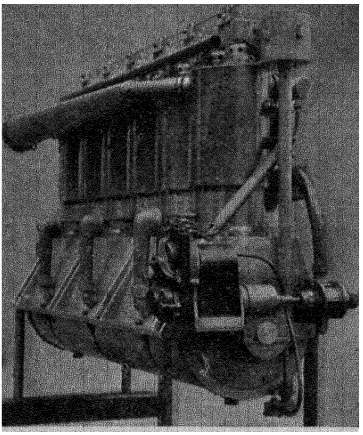


A Sopwith Waterplane in the Air

be compared with the cambric-covered framework of a kite, for they consist of canvas stretched tightly over strong ribs. At the back there is the rudder—a box-like arrangement also made of light spars covered with stretches of canvas, and in front there is another flat wing-like arrangement which can be tilted up or down.

We will imagine that the machine is removed from one of the 'hangars' or sheds—(we have taken the word bodily from the French) which, at our principal aerodromes, are becoming quite numerous, and that the pilot

has taken his seat in preparation for a flight. The machine, mounted on rubber-tyred wheels, is standing on a wide grass track, and the planes are spread out ready to catch the wind as it presses against them. So much depends on the proper working of the engine that before the pilot starts on his flight he tests the engine by running it while the aeroplane is held stationary by mechanics. As soon as he is assured that the engine is going properly he waves his left hand and says, "All right!" At once the mechanics rush away; the machine runs rapidly forward, and soon the wind presses against the tilted plane in front with such force that it presses the machine upward and it rises high in the air.

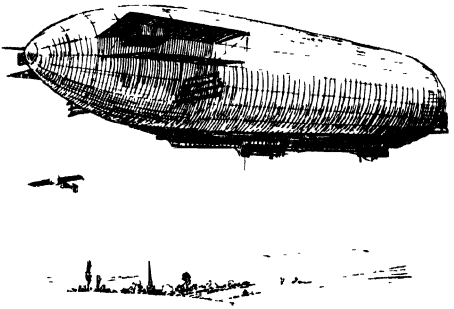


THE GREEN ENGINE · END VIEW

Once in full flight the pilot can, by means of 'controls' so adjust the various wings or planes, that he can raise or lower the machine as he likes, and any lateral direction may be taken by moving the rudder at the back. The descent is made usually by what is known as the *vol-plane* or gliding flight (as of a bird). The pilot cuts off the engine and tilts the machine downward; at once it rushes toward earth at an enormous pace, and the speed at which it falls (considerably faster than that of an express train) creates such a strong wind

that the propeller is kept revolving, although not nearly so quickly as when the engine is at work. To break his fall the pilot, just before reaching the ground, tilts the machine slightly upward and restarts the engine, alighting afterward as gently and gracefully as a bird.

One of the chief uses to which the aeroplane can at present be put is scouting work in time of war. Evidence of this was forthcoming in the great European War of



AN AIRSHIP

1914. The British official account of the operations of airmen during the early stages of the war paid tribute to the skill and valour of the British airmen in the following words:—

"Quite one of the features of the campaign, on our side, has been the success attained by the Royal Flying Corps. In regard to the collection of information it is impossible either to award too much praise to our aviators for the way they have carried out their duties or to over-estimate the value of the intelligence collected, more especially during the recent advance.

"That the services of our Flying Corps, which has really been on trial, are fully appreciated by our Allies is shown by the following message from the Commander-in-Chief of the French Armies received on the night of September 9th by Field-Marshal Sir John French:

"'Please express most particularly to Field-Marshal French my thanks for services rendered on every day by the English Flying Corps. The precision, exactitude, and regularity of the news brought in by its members are evidence of their perfect organisation and also of the perfect training of pilots and observers.'

"To give a rough idea of the amount of work to be carried out, it is sufficient to mention that during a period of twenty days up to September 10th a daily average of more than nine reconnaissance flights of over 100 miles each has been maintained.

"The constant object of our aviators has been to effect the accurate location of the enemy's forces, and incidentally—since the operations cover so large an area—of our own units. Nevertheless, the tactics adopted for dealing with hostile aircraft are to attack them instantly with one or more British machines. This has been so far successful that in five cases German pilots or observers have been shot in the air and their machines brought to the ground. As a consequence, the British Flying Corps has succeeded in establishing an individual ascendancy which is as serviceable to us as it is damaging to the enemy. How far it is due to this cause it is not possible at present to ascertain definitely, but the fact remains that the enemy have recently become much less enterprising in their flights. Something in the direction of the mastery of the air has already been gained.

"In pursuance of the principle that the main object of military aviators is the collection of information, bomb dropping has not been indulged in to any great extent. On one occasion a petrol bomb was successfully exploded in a German bivouac at night, while, from a diary found on a dead German cavalry soldier, it has been discovered that a high-explosive bomb thrown at a cavalry column from one of our aeroplanes struck an ammunition waggon. The resulting explosion killed fifteen of the enemy."

Germany prides herself on her fleet of Zeppelin airships, some of which are three or four hundred feet long. The airship is an enormous cylinder divided into a number of compartments, each of which is inflated by gas; and underneath the cylinder are one or more cars capable of holding ten or twelve people and a considerable 'cargo.' The chief distinction between the sailing of an airship and the floating of an ordinary balloon is that the former, being propelled by an engine, can be steered, whereas the latter is at the complete mercy of the wind. Great Britain believes rather in the more swiftly-moving aeroplane, and especially in the more recently invented hydroplane —which, fitted with floats, can rise from, or remain on, the sea.

In 1913 the British Government passed a law forbidding airmen to fly over certain fortifications, and there are also prohibited 'areas.' Among airmen, too, there are recognized 'airways' for journeys from town to town, or from one country to another.

It is highly probable that the construction of aircraft with suitable engines to propel them will be, in time, an important British industry. Hitherto our French rivals have been to the fore, and we have for some time relied on the Blériot and Farman machines and the Gnome

engines, but British constructors and engineers are making rapid headway in this branch of work, and there are in use a large number of British-manufactured flying-machines. One of our greatest inventors was "Colonel" Cody, an American who had become a naturalized Englishman, and who was attached to the Army Staff of airmen. For the last twelve years of his life he had been experimenting in flying, first with his famous box-kites, then with an airship, and finally with a biplane. It was a great loss to aviation when in 1913 he met with a tragic accident which ended his strenuous career. Truly the air demands great sacrifices of those who would conquer her!

CHAPTER XXXIV

FREE TRADE AND PROTECTION

As an account of our industrial and commercial history would be incomplete without reference to the great national policies of Free Trade and Protection, I have thought it advisable to explain briefly the main objects of the rival policies; but as the greatest captains of industry and leaders in commerce are not agreed as to whether our policy of Free Trade should be discontinued or not I must leave it to the reader to form his own opinion.

Broadly speaking, Free Trade is a policy whereby the government does not tax articles or materials imported from any other country, *except* for purposes of revenue; that is, a tax is not imposed to raise the price of imported goods, so that foreign traders should be handicapped in competing on favourable terms with our home manufacturers and producers.

Protection, on the other hand, seeks to place taxes of varying amounts on certain foreign-made materials and commodities imported into this country, in order to restrict the competition against the production or manufacture of these articles in our own country, or in our over-seas dominions. In short, Free Trade does not tax imports in order to protect home industries; Protection seeks to do so

The great advocate of Free Trade was Richard Cobden. He was born in 1804 and his parents were Sussex farmers.

Richard at an early age was apprenticed to a London draper, and later on he became a commercial traveller. About this time corn was at an extremely high price, for farmers were able to charge practically what they liked for their corn, as, in 1773, Parliament had made it illegal to import foreign wheat unless English wheat was selling at forty-eight shillings a quarter, which was almost a famine price. Later on, in 1804, the duty on imported corn was raised still higher and the poor people suffered severely from the high prices of food. These duties, together with the disastrous war with France, put up the price of a quartern loaf of bread to 1s. 4d. Riots broke out in different parts of the country and Cobden devoted himself earnestly to the effort to bring about the repeal of the Corn Laws. In 1838 an Anti-Corn-Law League was formed in Manchester, and at its head were Richard Cobden and John Bright. Cobden went all over the country advocating his policy of Free Trade, and maintaining that the daily bread of the people was the very last article upon which a tax should be levied, and that, in fact, it would be more profitable to our commerce and industry if the government instituted Free Trade for every commodity. The Protectionists, opposed to Cobden and his League, argued that our farmers ought to be protected and encouraged to farm as much arable land as possible, so that in time of war we should not be dependent on foreign countries for our staple food supplies.



RICHARD COBDEN

In 1841 Cobden became a member of Parliament for Stockport, and his power as an orator was so great that

he took a prominent position in the debates, which at that time were concerned mainly with the agitation then prevalent all through the country. Five years after he entered Parliament he had the gratification of seeing the Corn Laws suspended by Sir Robert Peel, the leader of the Conservative Party; furthermore, duties on imported cattle and on various kinds of produce were removed three years later.

The greatest opponent of Free Trade during recent times was Joseph Chamberlain, who was born in London in 1836. He first entered Parliament as a Liberal, but he differed from the Liberal Government on the question of Home Rule for Ireland, and became the head of a party known as the Liberal Unionists. Mr Chamberlain's name will always be associated with the principle of Tariff Reform, which, until stricken by a serious illness in 1906, he strenuously advocated both in Parliament and throughout the country. He desired to reform the tariffs, or duties, on goods brought into the country by imposing taxes on foreign products, so that our home industries and productions might be protected; and at the same time he sought to link up our over-seas dominions with the Mother Country by granting them a system of preferential tariffs which would give them, in their commercial relations with Great Britain, an advantage over foreign countries. Mr. Chamberlain died in 1914.



RIGHT HON. JOSEPH CHAMBERLAIN

One great argument advanced by those who advocate the continuance of our national policy of Free Trade

is that the growth of our enormous trade has in the past been greatly aided by this policy, and that therefore we should 'let well alone'; their opponents argue that other countries practise the policy of Protection, and that we ought to give our kith and kin in the colonies and dependencies preference in trade over the people of foreign nations

Both sides have thoughtful, earnest, and unselfish men in their ranks; and both parties apparently have very laudable objects, but, as I previously remarked, the reader must draw his own conclusions as to which is the better policy

CHAPTER XXXV

THE AGE OF INVENTION

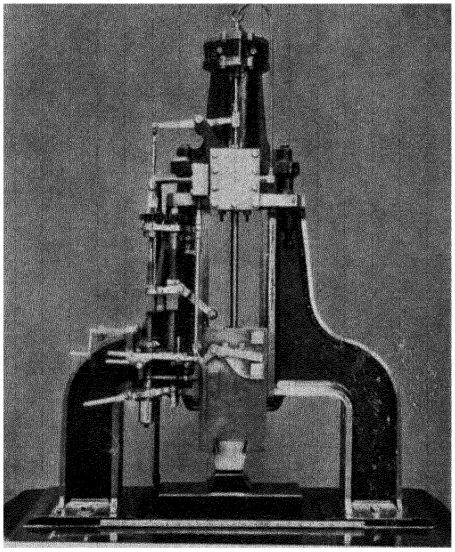
JUST as the Elizabethan Age is generally known as the Age of Discovery, so is the nineteenth century often described as the Age of Invention. There is not one of our great national industries which has not been influenced—nearly always for good—by the genius, and perseverance of thoughtful men, who frequently have laboured under enormous difficulties. Week by week the Patent Office has received applications for dozens of patents in some form or other, whether it be for an intricate design in machinery, or for a novel device in such a humble article as the safety-pin

The great outstanding inventions of the past century are those connected with electricity and the iron and steel trade, but as we have already spoken of these, we will pass on to other important discoveries

Side by side with the rise of the iron trade came an increased demand for better kinds of machinery; and to forge the enormous bars of iron required in certain machines it was found necessary to have a hammer of far greater power than those hitherto in use

The inventor of the steam-hammer was the great Scottish engineer and astronomer, James Nasmyth, who was born at Edinburgh in 1808. His father was a famous landscape painter, and an elder brother, Patrick, was also a popular painter. But art and mechanics, though

widely apart in the ordinary course of events, seem to have run side by side in this talented family, for both the father and his son James made a hobby of constructing mechanical toys, as well as more useful appliances, in



MODEL OF THE ORIGINAL STEAM-HAMMER INVENTED BY NASMYTH ABOUT 1839
In the Victoria and Albert Museum
By permission of the Controller of H.M. Stationery Office

their little workshop. At the age of sixteen James had many useful inventions to his credit, the chief of which was a small steam-engine used by his father for grinding painters' colours.

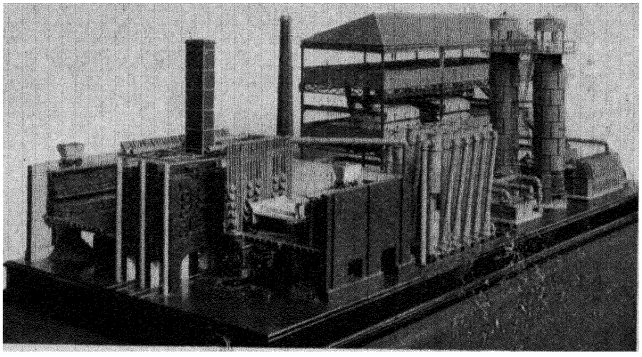
James received much of his early education in machine construction under a well-known London engineer named

Maudslay, but previous to this he had attended the School of Arts, Edinburgh. At the age of twenty-six he removed to Manchester where he set up in business as a machine-constructor.

It is said that the idea of making the steam-hammer came to Nasmyth quite suddenly, and that it was the result of a shipwright's letter to him, telling him that he could not find a hammer powerful enough to forge the paddle-shaft of the steamship *Great Britain*, then in course of construction. The only powerful hammer in use was James Watt's *tilt-hammer*; this was much like a huge hand-hammer, and consisted of an enormous head and a handle worked by steam When in action the head was raised to a height equal to the length of the handle, and was then allowed to fall down on the object beneath. The great drawback to the tilt-hammer was that it could not be raised high enough to have sufficient striking power; and, of course, the thicker the iron on the anvil, the weaker was the blow. Nasmyth at once saw that the force of gravitation must be employed in order to give the hammer additional power, and he invented a hammer which consisted of a very heavy bar of iron attached to a steam driving-rod. When in motion the iron was raised to a great height by steam-power, and then it fell down with all its weight on the huge anvil beneath. The Nasmyth steam-hammer has for the last sixty years been in use in most of the great engineering works in this country, and it has done much to render possible the production of the immense forgings required to-day.

One of the most useful discoveries in the nineteenth century was that of gas. Before the introduction of gas the streets in our large towns were lighted by candles placed over the door of every house. Laws were made

regulating the length of the candle-wick, and compelling each householder to place his candle inside a lantern, for many people had tried to evade the law by using only a small piece of candle which burnt away quickly, or by lighting the candle and then putting it out in a high wind. The next step was to light the streets by oil-lamps, and large oil-flares were hung from the tops of



MODEL OF A MODERN GASWORKS
In the Victoria and Albert Museum
By permission of the Controller of H.M. Stationery Office

church towers and other prominent buildings to guide pedestrians at night. The streets in those days were frequented by footpads and robbers who lurked in dark corners and pounced on unwary travellers.

One writer, in referring to the dangers of walking about the streets of our large towns after dark, said, "Two hundred years ago a journey on a winter evening from London to Kensington, only two miles from St Paul's Cathedral, was more perilous than a trip to Mecca or Pekin would be to-day."

The first house in England to be lighted by gas was that of a Scottish engineer named William Murdock. In 1792 Murdock set up near his cottage at Redruth, Cornwall, a small gas-making plant where he made sufficient gas for his personal requirements. Six years later he constructed a more extensive plant at Birmingham where he had been previously employed in Watt's engineering works. Here he constructed various machines and apparatus for making, storing, and purifying coal-gas for use. Soon after this his firm used gas for the illumination of their London offices at Soho.



LAMPLIGHTER, END OF EIGHTEENTH CENTURY

The first public building to be lighted by gas was the old Lyceum Theatre in London; a little later on, the experiment was tried of lighting the streets by gas. But the large number of accidents which occurred through defective pipes and other causes set public opinion against the use of gas for domestic purposes, and even at the present time there are to be found people who will on no account use gas in their houses for fear of explosions. It must be remembered, too, that the illuminating power of gas in the early part of the nineteenth century was

machine-gun which bears his name. During recent years many different types of vessels for use in warfare have been developed or invented, and the old British 'Hearts of Oak,' which so worthily upheld the honour of this country in Nelson's time, would be of little use in opposition to that 'floating raft of steel,' the modern Dreadnought, or against the deadly submarine

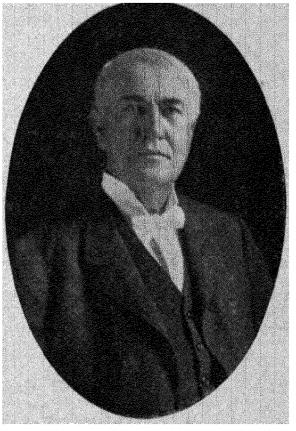
What a pity it is that the vast amount of labour and scientific thought required by and devoted to our arsenals and naval dockyards cannot be put to better account than the provision of men with weapons of destruction! But as long as tyranny and rivalry and oppression exist in the world, so long will the sword be needed; we can only say that one of the surest ways to prevent war is to be prepared for it.

One of the most deadly explosives the world has ever seen, namely dynamite, was invented by Alfred Nobel, a great Swedish engineer. Until his time gunpowder had been relied upon as the main explosive agent, but the world was astounded at the explosive force of Nobel's invention. In it he employed a substance called nitro-glycerine, which in itself is too easily exploded for safe use; when united with powdered charcoal or some other porous substance, it can be handled without danger, and used with the desired effect. Happily dynamite, and an even more powerful explosive—blasting gelatine—have served more peaceful and useful purposes in some of our industries, notably in the blasting of coal and slate, and in numerous engineering enterprises.

Most of you are aware that five 'Nobel' prizes of about £8000 each are awarded annually—three for the most important discoveries or inventions in physical, chemical, and medical science respectively, a fourth for

the chief literary work of the year, and the fifth for the greatest contribution toward the cause of international peace. The cost of these coveted prizes is defrayed by the interest on the vast fortune—estimated at £1,680,000—which Nobel left at his death.

Another famous American inventor of modern times is Thomas Alva Edison, who was born in Milan, in the State of Ohio, in 1847. Edison's life-story is most romantic. At twelve years of age he began to earn his own living as a newsboy; the greater part of such education as he possessed had been given him by his mother, who was passionately devoted to her son. He used to travel on the trains of the Grand Trunk Railway, selling his papers at each station at which the train stopped.



THOMAS EDISON
Photo Bieber

During this time the American Civil War broke out, and there was an extraordinary demand for news The newsboy's inventive faculties disclosed themselves even at this early age, for he saw that he would have larger sales for his paper if he whetted the reading appetites of the people at the next station by giving them a portion of the most important news in advance of the actual arrival of the newspaper. With this object in view he made arrangements with the telegraph operator at each station where the train stopped to telegraph one or two sentences of the most sensational news to the next station,

where it was written on a large board and displayed on the platform. It can be imagined what effect this would have on the crowd of people awaiting the train, especially in those days of warfare; Edison's van was besieged directly it came to a standstill. It is said that he demanded and received five or six times the value of the paper, and thus even during his boyhood his ingenious schemes began to be profitable to him.

His next venture was to set up a printing-press on the train, and here he wrote, printed, and published a paper, called the *Grand Trunk Herald*. This also was a huge success, but about this time a great misfortune overtook him and had far-reaching results. In one of the luggage-cars he had been allowed to fix up a little laboratory where, in his spare time, he could indulge in his great hobby of experimenting in chemistry. One day an accident upset his chemicals with the result that they took fire and the car was soon in flames. The conductor of the train was so infuriated that at the next station Edison and his belongings were bundled out, neck and crop, on to the platform, and the poor lad received as a parting gift a ringing box on the ear So severe was the blow that the drum of the ear was broken, and for the last fifty years Edison has scarcely been able to hear a sound by natural means. And yet, with this great drawback, he has succeeded in inventing the phonograph, an instrument which requires a keen sense of hearing for its construction. It is said that Edison cannot hear a phonograph three feet away from him, and when asked how it is that he is able to distinguish sounds in the instrument that are quite imperceptible to the ordinary ear, he replied: "I hear through my teeth, and through my skull. Ordinarily I place my head against

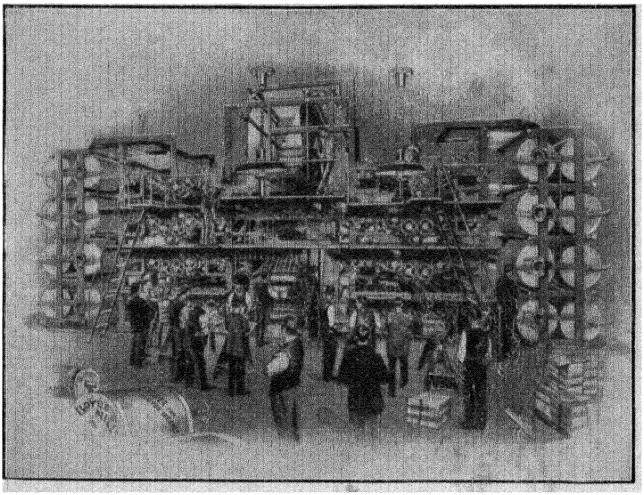
the phonograph. But if there is some faint sound that I don't quite catch in this way, I bite my teeth into the wood, and then I get it good and strong."

Edison's deafness seemed as if it had ruined his prospects in life, for he had to give up his printing-press, dismiss his staff of assistants, and resume his former occupation of newsboy. But fortune favoured him. One day, while standing on the platform of a railway station, he noticed the little son of the stationmaster playing on the line, and he was horrified to see an express train moving down upon the child. At great risk to his life he leapt down and succeeded in drawing the boy out of danger just as the train thundered by. The child's father was so grateful for the deed that he undertook to teach Edison telegraphy, and so rapidly did the lad learn his work that he quickly became a skilful operator, and was moved from one station to another until he settled in Boston. At twenty-four years of age he accepted an important post in New York, and his life as an inventor may be said to have begun with this transfer.

Edison's fame as an inventor will rest chiefly on the various telegraphic and other electrical appliances which he initiated, but numerous other inventions were patented by him. The chief of these were the incandescent electric light, the electric train, the electric pen, the carbon transmitter for the telephone, and the megaphone. It is estimated that Edison has patented more than four hundred inventions.

Of late years the phonograph has been his great hobby, and he believes that it can be made the greatest instrument for recording musical sounds the world has ever heard. Moreover, he says that he intends to make it

so; his whole soul is in music, and a writer gives us a splendid word-picture, in the following words, of the great inventor stealing at night to a quiet room, and listening to the immortal music of the great masters whose fame has gone all over the world. "His favourite 'music-



ONE OF LLOYDS' DOUBLE OCTUPLE PRINTING MACHINES

room' is over a machine shop, and there he goes at dead of night to listen to songs sung in Italy by singers he never saw nor even hopes to see. Beethoven, playing the sonatas that his deaf ears would not let him hear, formed no more pathetic picture than does Edison, with his grey head pressed against the machine that he made talk and sing. The only difference is that Beethoven was pathetic, while Edison only seems so. Beethoven's deafness embittered his life. Edison's deafness never put

a wrinkle on his brow or his heart. He still knows how to laugh and loses no opportunity to do so."

Even a cursory review of all the inventions and discoveries of the last century would fill a book much larger than this, so we will give here no more than the merest indication of certain recent inventions.

Our newspaper printing-offices are nowadays equipped with the famous Rotary machines which are capable of turning out many thousands of newspapers in an hour; in the place of the laborious and slow process of type-setting by hand now we use the Linotype machines and similar appliances which enable the type to be set with great rapidity and accuracy.

In our great business houses most of the correspondence is carried on through the media of the typewriter, and the invention of writing by means of a system of symbols, commonly called 'shorthand' writing, has done much to 'speed up' the amount of work accomplished in our great business offices.

Almost every home has benefited by one or other of the numerous sewing-machines, and it is to the sewing-machine that the large boot-factories of the Midlands are chiefly indebted for their phenomenal progress.

The various applications and developments of photography have been of service not only to art but to medical science, for the discovery of the X-rays has enabled hard and solid portions of the human body, such as bone, to be laid bare so that the source of injury can be perceived.

Years of toil in our large machine-construction works have produced for the farmer the self-binder reaping machine, the steam-plough, and numerous other agricultural implements. Even the deep-sea fishermen out

on the lonely fishing-grounds has profited by the results of invention, for he now has the rapid steam-trawlers, and also the motor boats and fast cutters which convey his night's catch of fish to port with such speed.

INDEX

Aeroplanes, 179, 221-228; **uses of, for scouting**, 225-227
Africa, 118, 119
Agricola, 38
Alexander Severus, 200
Alfred the Great, 42, 44, 47
Allen, Grant, 42
Almonry, 183
America, 120
American Civil War, 241
Ancona, 186
Angles, 41
Anglo-Saxon Chronicle, 44, 47, 98
Animal remains, 18, 21
Anti-Corn-Law League, 230
Antwerp, 116, 117
Arabs, 186, 197
Arab horses introduced, 58
Archæology, 13-16
Archimedes, **the**, 163
Arkwright, Richard, 147-151
Aryan family, 35
Ashburnham, 164
Aske, 102
Astbury, 210
Atlantic, 160, 161
Augustine, St, 98
Austria, 207
Avebury, Lord, 17, 26
Ayr, 174

Bacon, Roger, 101
Banbury, 70
Barberini, 201
Bartholomew Fair, 76
Battle Abbey, 97
Belfast, 161
Belgæ, 36, 37
Belgium, 35
Bell, Henry, 160, 161
Benedict, St, 97
Benedictines, 97, 98
Birmingham, 165, 176, 237
'Black basalt,' 200
Black Death, 86, 110, 111
Blackburn, 141
Blast-furnaces, 159, 166-168
Blériot, 227
Blotting-paper, 189
Boat-building: in Britain, 27, 30; **Egyptians skilled in**, 29; **under Alfred**, 44; **modern**, 160-164
Bologna, 217
Bolton, 150
Boston, 77, 120
Bradford, 135-137
Bright, John, 230
Bristol, 62, 103, 119
Britain: early inhabitants of, 17, 19-22, 35, 36; **cut off from other countries**, 29; **climate of**, 18, 19; **animals of**, 18, 19; **implements found in**, 28; **Roman occupation of**, 34-38; **Romans recalled from**, 38-41; **Saxons in**, 41, 42, 48; **monasteries in**, 97
British Museum, 28, 32, 47, 184, 186, 197, 201
Bronze Age, 17, 20, 28
Bronze, 28, 32, 37
Brooklands, 221
Browning, Elizabeth, 134
Bruges, 99, 182
Brythons, 36, 37
Burslem, 198, 199, 210

Cæsar, Julius, 13, 34, 37
Calais, 161
Caledonia, **the**, 162
Calcutta, 162

Canada, 169, 219, 220
Carlisle, 94
Carron, 159, 165
Cassiterides, the, 31
Cave-dwellers, 17, 19, 22, 24
Cave dwellings, 18, 20, 21
Caxton, William, 182-184
Celts, 17, 35, 36
Chamberlain, Joseph, 231
Charles I, 118, 156
Charles, D. of Burgundy, 182
Charlotte Dundas, **the**, 160
Cheddar, 20
Cheshire, 135, 136
Chester, 103
Child labour, 134-139
China, 57, 198
Chinese, 29; **knowledge of printing**, 181; **of paper**, 186
Churches, 50, 52
Cinque Ports, 62
Cistercians, 99
Clanny, 159
Clement, St, 209
Cleveland, 168, 169
Clyde, R., 160-163
Coal, 129, 130; **worked by Saxons**, 41, **by Romans**, 42, 154, **by Normans**, 154; **use of, prohibited**, 155; **taxed**, 156; **monopolies in, granted**, 156; **difficulties of mining**, 157
Cobden, Richard, 229-231
Cody, Colonel, 228
Colchester, 215
Colebrook Dale, 165
Comet, **the**, 160, 161
Commentaries **of Julius Cæsar**, 13, 34, 35, 45
Cooke, 216
Copper, 28, 37
Corn, production developed by Romans, 38; **ground by wind-power**, 58; **tax on foreign**, 230
Corn Laws, 230, 231
Corners, prohibition of, 69
Cornwall, 31, 217, 218
Coster, Laurens, 181, 182
Court-baron, 51, 52
Court-leet, 52
Cromford, 150
Crompton, Samuel, 150
Cromwell, Oliver, 118
Cromwell, Thomas, 102
Crusades, 55-59
Cumberland, 169
Cunæus, 215
Cunard, Samuel, 162

Danes, 44
Darby, Abraham, 165
Dartford, 188
Davy, Sir Humphry, 159
Defoe, Daniel, 70, 124
Delft, 198, 203
Derbyshire, 135, 136, 150
Derwent, R., 150
Devon, 31
Dictes and Sayings of the Philosophers, The, 183
Domesday Book, 49, 51
Dover, 161
Drake, 116
Druids, 37
Dublin, 163
Dunstable, 210
Durham, 154
Dwarf, **the**, 163
Dyeing, 108, 109, 211; **Saxons knowledge of**, 41; **hair-**, 148
Dynamite, 240

East India Company, 118
Eddystone Lighthouse, 166
Edison, Thomas, 216, 241-244
Edward I, 63
Edward III, 63, 86, 88, 94 96, 107, 113
Edward IV, 182
Egyptians, Arts of, 29, 30, 191
Electricity, 212-217
Enterprise, **the**, 162
Eskimos, 22
Essex, 114, 115
Etruria, 199, 200
European War, 225
Exeter, 70

Factory Act, 126, 138
Factory system, 131-139

Faenza, 198
'Faience,' 198
Fairs, 74-79
Falkirk, 159, 165
Falmouth, 162
Farman, 227
Felt, 209
Fire, 24-27
Fire Queen, the, 163
'Five Towns,' 202
Flanders, 85, 89 93, 95, 107, 117
Flanders, Countess of, 89-92
Flaxman, John, 202
Flemings, 93 96, 117, 119
Flint knapping, 26
Fossils, 21
Fountains Abbey, 97
France, 116, 122, 188, 203, 207
Francis, St, 100
Franciscans, 100, 101
Free Trade, 229-231
Fuller, 95, 96
Furness Abbey, 97

Galileo, 211
Game and Playe of the Chesse, The, 183
Gardiner, 93
Gas-lighting, 235, 237
Gatling gun, 238
Gaul, 34, 35, 38
George III, 150
Germany, 39, 169, 188, 189, 203
Ghent, 77, 99
Gibbins, 77
Gilbert, William, 215
Glace Bay, 220
Glasgow, 77, 160, 161, 163
Glass: Egyptians skilled in blowing, 29; Romans work in, 38; discovery of, 210
Glastonbury 19
Gloucester, 103
Gnome engine, 227
Goidels, 36
Gravesend, 161
Gray, 159
Great Britain, the, 235
Great North Road, 172
Greeks, 29
Greenock, 160, 161
Greenwich, 77
Grimsby, 62, 116, 120
Guilds· kinds of, 80; merchant-, 80-82; craft-, 82, 83; weavers', 94, 107; abolished, 108
Gutenberg, John, 181, 182

Haarlem, 181
Hadrian, Emp., 38
Halifax, 72, 135, 136
Hamilton, Sir William, 201
Hampshire, 159
Hargreaves, James, 141-145, 148, 149, 151
Harwich, 62, 116, 120
Hawkins, Sir John, 119
Helensburgh, 160
Hendon, 221
Henderson, James, 206
Henry I, 94
Henry III, 63, 155
Henry VII, 109, 120
Henry VIII, 99, 102
Herodotus, 19
Hertfordshire, 188
History of Troy, The, 183
Holland, 203, 215
Honorius, Emp , 38
Hood, Tom, 134
Hotchkiss gun, 238
Houses, 19; Saxon, 43 , in Scotland, 175; lighted by gas, 237
Howe, Elias, 207, 208
Huguenots, 121-123
Hull, 62, 63, 120
Hydroplanes, 227

Indentures, 83, 84
Indian Mutiny, 118
Ireland, 19, 36, 161
Iron, 37; discovery of, 32, 33; worked by Romans, 38; smelted by charcoal, 117, 164, by coal, 159, 164, 165, 168, by coke, 165, 166; demand for, 169
Iron Age, 17
Italy, 217
Ivernians, 36, 37

'Jaspar' ware, 200
Jerusalem, 57
John of Gaunt, 95
Jonson, Ben, 77
Jutes, 41
Jutland, 39

Kent, 18, 37, 114, 115, 164, 182, 188
Ket, Robert, 87
Kingsley, Charles, 138
Knight, Professor, 78, 88

Labourers, Statute of, 113, 114
Labrador, 18
Lake-dwellings, 19, 20
Lancashire, 135, 136
Lazar-squint, 101
Lead, 38
Leather-making, 190-194; Egyptians skilled in, 29, 191
Leeds, 135, 136; cloth-market, 70-73
Leicestershire, 135, 136
Leighton, Lord, 30
Leipzig, 76
Leprosy, 101
Levant, 119
Leyden Jar, 215
Liège, 77
Linlithgowshire, 160
Linotype machine, 245
Liverpool, 161
Liverpool and Manchester Railway, 178, 179
Lizard, the, 217
Locomotive engine, 177-179
Londinium, 38
London, 38, 44, 62, 114, 116, 160, 161; markets of, 66; commercial centre of the world, 117, 119
London Association of Merchant Adventurers, 182
London Museum, 164
Louis XIV of France, 121
Ludd, Ned, 152
Luddites, 152
Lynn, 62
Lyons, 76

Macadam, John Loudon, 174
Machinery, 204-208
'Majolica' ware, 198
Majorca, 198
Manors, 49-53
Marconi, Guglielmo, 216-218
Margaret, D. of Burgundy, 182, 183
Marjory, the, 161
Markets: established, 65; tolls of, 66, 115; rules of, 66-68; described, 70-73
Maudslay, 235
Maxim, Sir Hiram, 238
M'Cormick, 206
Meissen, 203
Mendip Hills, 18
Merthyr Tydvil, 159
Metal-work: Saxons' knowledge of, 41; practised in England, 57
Middleburg, 210
Mines Act, 138
Monks: rear sheep, 86, 94; orders of, 97-100; our debt to, 98; grow rich, 100; houses of, suppressed, 102
Monopolies, 120
Monte del Grano, 200
Montreal, 219
More, Sir Thomas, 88, 102
Morgan, J. Pierpont, 32
Morse code, 216
Mueseler, 159
Murdock, William, 237
Murphy, W. G., 106

Nantes, Edict of, 121
Napier, David, 161
Napier, Robert, 163
Nasmyth, James, 233-235
Nasmyth hammer, 205, 233, 235
Neilson, James, 167, 168
Neolithic Age, 17
Netherlands, 94, 116, 117
Newcastle, 155
Newcomen, Thomas, 157, 176
Newfoundland, 169, 218
New York, 161, 220
Nijni-Novgorod, 76
Nobel, Alfred, 240
Nobel Prizes, 240
Norfolk, 87
Nordenfeldt gun, 238

Norman barons. obtain land, 48, 49; lose power, 56
Norwich, 62, 64, 88, 94-96, 119, 130
Nottingham, 145, 149

Oceania, lake-dwellings in, 19
Oldham, 136
Oxford, 103

Palæolithic Age, 17, 21
Paper, 185-189
Pauperism, 102, 103
Peel, Sir Robert, 138, 231
Pendulum, the, 211
Peterborough, 77, 103
Philip II of Spain, 117
Phœnicians, 30, 211
Phonograph, the, 242, 243
Picts, 39
Pilgrimage of Grace, 102
Pisa, 211
Pliny, 210
Plymouth, 62
Poldhu, 218
Portland, D. of, 201
Portland Vase, 200, 201
'Potteries, the,' 195, 209
Pottery: Egyptians skilled in, 29, 195; Romans work in, 38; of Ancient Greece, 195; made in Peru, 197, by Arabs, 197, by Italians, 198, by Dutch, 198, in England, 195, 198-203
Preston, 147
Printing, 181-185
Printing-machines, 245
Protection, 229, 230, 232

Ragged Schools, 139
Raleigh, 116
Ransome, 55
Ratisbon, 186
Reading, 97
Redruth, 237
Reynolds, Sir Joshua, 202
Richard I, 55, 56
Richard II, 115
Roads: Roman, 170; upkeep of, 170, 172, 173; improvements in making, 174
Rob Roy, the, 161
Rocket, the, 178, 222
Roebuck, Dr, 165, 166
Romans in Britain, 34; develop natural resources, etc., 38; policy of, 39; set up a weaving-shed, 107; road system, 170
Rome, 201
Ross, 94
Rotary printing-machine, 245
Royal Flying Corps, 225, 226
'Rule of the Road,' 172
Russia, 76, 118

Sadler, Michael, 134
Saint, Thomas, 206
St Catherine's Pt., 217
St Johns, Newfoundland, 218
Salisbury, 217
Savannah, the, 161
Savery, Thomas, 157, 175
Saxons, 39, 41-43, 60
Schaffer, Jacob Christian, 186
Scotland, 36
Scots, 39
Serfs: in Saxon times, 43; under manorial system, 49; improved conditions of, 111; abolished, 115
Sèvres, 203
Sewing-machines, 206-208, 245
Shaftesbury, Lord, 134-139
Sheep cultivation, 85, 86; by monks, 86, 94, 99; influence of Black Death on, 86, 110; resented by poor, 87; limited by Act of Parliament, 87, 103
Shropshire, 135, 136
Sidon, 31
Silk trade, 122
Singer, 208
Sirius, the, 161
Slade, John, 189
Smeaton, 166
Smithfield, 77
Somerset, 18, 20
Song of the Shirt, The, 134
Southampton, 62, 63
Spain, 34, 116, 117, 169
Spanish Armada, 117, 11
Spezia, 217
Spielman, John, 18

Spinning, 53, 54, 140, 141; **early knowledge of**, 106; **-jenny invented**, 142, 143; **-frame invented**, 148; **-mule invented**, 151
Spitalfields, 122
Staffordshire, 135, 136, 198
Stages in manufacture, 80
Stanhill, 141
Staple towns, 63
Staples, 63
Steam-hammer, 233-235
Steam-power use of, 129, 177; **growth of industries under**, 129, 130, 204; **applied to navigation**, 160-163, **to transport**, 175-179; **used for pumping**, 157, 175
Stephen, King, 45
Stephenson, George, 177, 178
Stevenage, 188
Stirlingshire, 165
Stockport, 230
Stockton and Darlington Railway, 178, 179
Stoke-on-Trent, 199, 203
Stone, Thomas, 206
Stone Age, 17, 20, 28
Stone tools, 17
Stourbridge Fair, 77
Straw, Jack, 114
Sue, Eugène, 101
Suetonius Paulinus, 38
Suffolk, 26
Sugar-refining, 211
Surrey, 159
Sussex, 37, 159, 164
Swan, 216
Swanage, 20
Syria, 210

Tanning, 190-194
Tariff Reform, 231
Tate, John, 188
Taunton, 130
Technical History of Commerce, The, 186
Telegraphy: systems of, 216; **wireless**, 216-220
Telescope, 210
Telford, Thomas, 174
Temple, Sir Thomas, 156
Textile Industries, The, 106
Thales, 214
Thames, R., 162, 163
Thimmonier, 207
Tilly Whim Caves, 20
Tilt-hammer, 235
Tin, 28, 31, 37, 38
Tintern Abbey, 97, 99
Titanic, **the**, 220
Tolls, 172, 173
Tools of early man, 17, 21, 26
Tour through Great Britain, 70, 124
Tour through the Eastern Counties, 70
Townships, 48
Towns: obtain privileges by charter, 55, 56, 60; **Roman**, 60; **sites**, 61; **in Middle Ages**, 62; **origin of names of**, 64; **privileges of market-**, 66-69; **guilds established in**, 82; **growth of, owing to machinery**, 125-130, **lighting of**, 235-238
Trade, 62, 70, 89, 95, 116-120; **growth of, under Crusades**, 57-59; **in Elizabethan times**, 116; **with Antwerp**, 116
Trevithick, Richard, 177
Troglodytes, 17, 23
Turkey, 118, 119
Turpin, Dick, 172
Tyler, Wat, 114
Tyne, R., 162
Tyre, 31

United States, 169

Vanguard, **the**, 163
Victoria and Albert Museum, 195
Villeins, in Saxon times, 43; **under manorial system**, 49; **pay tithes**, 50; **improved conditions of**, 111; **after Black Death**, 113; **Parliamentary intervention regarding**, 113, 114; **rising of**, 114; **become free tenants**, 115

Wakefield, 72
Wales, 36, 135, 136, 159
Walloons, 94

Wandering Jew, The, 101
Warwick, Earl of, 87
Warwickshire, 135, 136
Water Babies, The, 138
Watt, James, 129, 157, 175-177, 235, 237
Wear, R., 162
Weaving, 140, 141; **Saxons' knowledge of**, 41; **in Norman times**, 53, 54; **Flemings' skill in**, 93-95, 107; **knowledge of, by neolithic man**, 106; **-shed, set up by Romans**, 107, **under modern conditions**, 127, 128
Webber, Henry, 202
Wedgwood, Josiah, 198-203
Wedgwood Museum, 202
Westminster, 103, 183, 184
Whitby Abbey, 97
Wigs, 147
William the Conqueror, 48, 94, 104
Winchester, 64, 77, 107
Windmills, 58
Wookey Hole, 18
Wool · a staple product, 63, 94; **production of, in England**, 85, 88; **manufacture of, promoted by Edward III**, 86, 107; **importance of trade in**, 86-89, 93, 119; **dispute with Flanders relating to**, 89-92; **export of, forbidden**, 94, 107; **revenues from**, 95, 108; **growth of manufacture of**, 96; **grown by Cistercians**, 99; **industry benefited by law**, 107-109; **burial in**, 109; **dyeing of**, 108, 109
Woolsack, 88
Wright, Orville, 222
Wright, Wilbur, 222

X-rays, 245

Yarmouth, 62, 64, 116
Yeats, Professor, 58, 186
York, 63
Yorkshire, 18, 124, 135-137

Zeppelin, 227

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