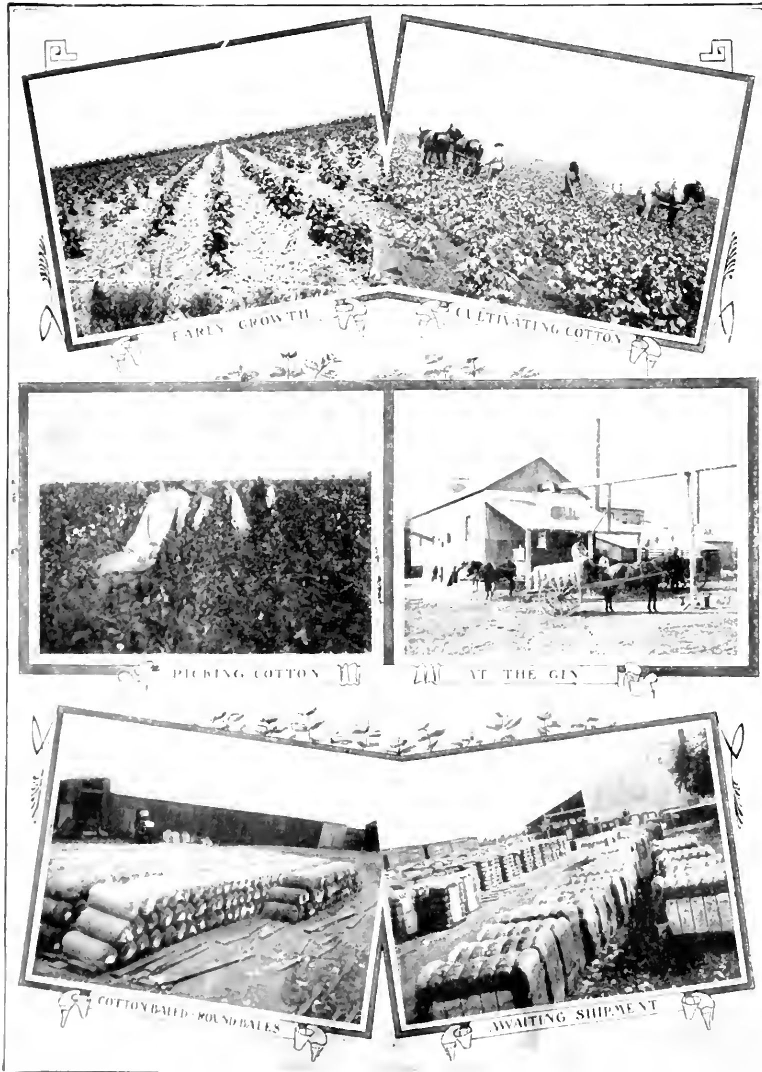

Courtesy M. K. & T. Ry.

AMERICA LEADS THE WORLD IN COTTON

INDUSTRIAL—COMMERCIAL

GEOGRAPHY

OF THE

UNITED STATES

By

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PREFACE

This book is not a technical treatise upon the industries discussed, but simply an attempt to describe, in a clear and simple way, some of the every-day features, as well as some of the unusual things, that belong to these industries. I have attempted to keep constantly in view the human elements of the stories. At the same time, the leading thought has been to emphasize the importance of these activities, as carried on in the United States. The student is free to investigate their existence in other countries should he desire to do so.

The nations that control the world are those which lead industrially, for this is an industrial age. Perhaps ninety per cent. of our pupils will enter some form of industrial life, as the whole world is united by a network of commerce and industry. The study of the great industries is the surest way to obtain a practical knowledge of any country. Commercial Geography is a study of the centralization of industry, and has become one of the most essential branches in our schools.

The most valuable stenographer is not simply the most speedy shorthand writer, but the one who can, by reason of her general knowledge, make the most intelligent and accurate transcript with reasonable speed. The best-salaried accountant is not alone the finest penman or most rapid calculator, but the one who is most familiar with the sources of supply, process of manufacture, and cost of the common commodities with which he has to reckon. Likewise, the most successful business man is not the narrow-minded tradesman, but the broad-gauged, calculating man of affairs, whose knowledge of the world's great industries gives him power to cope with the problems of business life.

"The teacher cannot teach that which he does not know; and he has not taught until the pupil has learned."

The teacher of commercial science must be able to inspire the class to investigation. These studies are simply used as types, and the earnest student will investigate others after the manner suggested here. It has not been my purpose to define a narrow method, or to prescribe any fixed number of topics, but rather to encourage variety and originality upon the part of both teacher and student.

I have had the greatest success with the topical or laboratory plan; and these chapters were written to fill a demand from teachers all over the country for concise, condensed information, not found in the ordinary text-book, which may be used in the school-room and illustrated by the use of process exhibits. These may be obtained from manufacturing concerns and from other sources.

Most of the information given in this book has been gathered by personal visits to the mines, mills, fields, forests, and centers of industry mentioned. The value of visits of inspection cannot be over-estimated.

Experience will evolve new methods, but my purpose has been to inspire a beginning and encourage the student to look beyond.

I am under obligations to the following firms for assistance, given by reading parts of the manuscript and for many valuable suggestions: The Union Pacific Railroad, Omaha, Neb.; The Cunard Steamship Company, New York; The Chicago Board of Trade; The Berkey and Gay Furniture Company, Grand Rapids, Michigan; The Atlas Portland Cement Company, New York; The Strathmore Paper Company, Mittineague, Mass.; The International Harvester Company, Service Department, Chicago, Ill.; Swift and Company, Chicago; Mr. R. W. Moore of Kirkendall Shoe Mfg. Company, Omaha, Neb.; The Pittsburgh Steamship Company, Cleveland, Ohio;

The American Smelting & Refining Company, Omaha, Neb.; The Rookwood Potteries, Cincinnati, Ohio; Washburn-Crosby Milling Company, Minneapolis, Minn.; Corticelli Silk Mills, Florence, Mass.; Belding Bros. Silk Co., Belding, Mich.; Calumet & Hecla Mining Company, Calumet, Mich.; The United States Steel Corporation; and many individuals who have shown me courtesies when visiting the mills, mines, factories and other industrial institutions.

L. C. R.

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CHAPTER I

THE EVOLUTION OF THE RAILWAY

Transportation and Commerce.—When studying any industry it is very necessary to become familiar with the lines of transportation connecting the points between which the commodity in question is shipped. Transportation and commerce are so intimately related that the student must become familiar with the leading systems of traffic; he must acquire an interest in tracing shipments and become proficient in estimating the cost of trips to various parts of the country. In the business world distances are measured for most purposes of commerce in hours, not in miles.

The more thrilling stories of human progress are intimately bound up in the problem of commerce and transportation. It was a commercial problem that furnished a motive for Columbus in his search for a new route to the Indies. The sea was ever the great highway of commerce for the ancients. But finally the invention of steam and electric motive power with their application to the railways worked a wonderful transformation. The problem of rapid transportation was solved.

We are nearer by hours to the remote parts of the earth today than we were to some of our own cities a few decades ago. Wonderful indeed have been the changes made during the past fifty years! Our food comes to our tables from distant places today almost as fresh as if it grew in our own gardens. Our parents remember when it cost fifteen dollars to haul a barrel of flour across the Alleghany mountains. Our grandmothers found it necessary to weave their cloth, and make the clothing, for the whole family, instead of buying the garments as we do today. Once it took two days to go by stagecoach from New York to Philadelphia, and a whole week from New York to Boston. Six weeks or more were required to cross the Atlantic. Half the world was in practical ignorance as to the doings of the other half. In what way can you account for the wonderful development of this country during the past hundred years?

Value of the Railroads.—The railroads of this country are largely responsible for this great development,

THE FORERUNNER OF THE RAILROAD

for they are inseparably connected with every commercial enterprise. Wherever there was anything to haul they built to it. No obstacle was too great for them to overcome. What do the railroads bring to our doors? How do they help us dispose of our surplus products? Why do they stand for prosperity and plenty? In what ways are their prosperity and that of the community they serve related? In what way has Stephenson's great discovery done more to bring mankind together than any other one discovery in the history of the world? Closely related to railroad development has been the evolution of the steel industry, which has made possible the great changes that have taken place in the construction of tracks, bridges, and the modern train. Railroad equipment with mammoth engines weighing two hundred and fifty tons, pulling entire trains of all-steel freight cars, or luxuriously equipped steel passenger coaches tell a story of wonderful progress.

A Story of Growth.—In 1831 the first railroad was operated in America. Then the entire equipment of

Courtesy N. Y. Central Lines

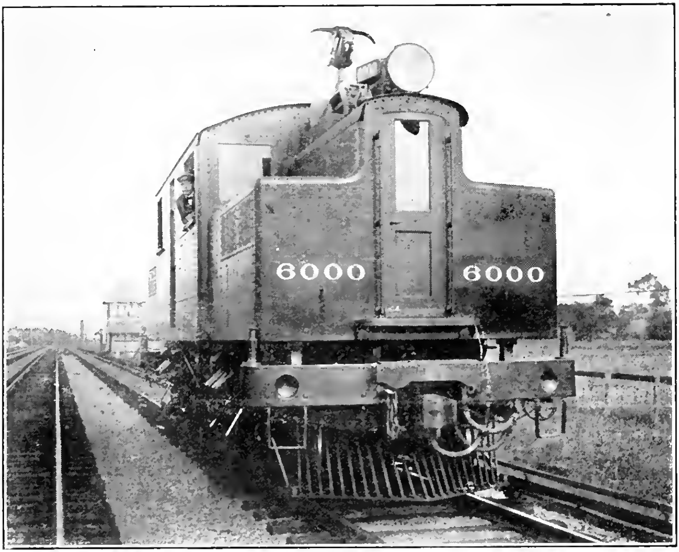
THE FIRST TRAIN IN AMERICA

what is now the great New York Central System consisted of the primitive locomotive, "DeWitt Clinton," and three very small passenger cars, old Concord coaches made over. The total length of the line was then seventeen miles and the speed of the train fourteen miles per hour! Today this one system maintains and operates over twelve thousand miles of track, hundreds of the most elaborately equipped passenger trains, made up from an equipment of over four thousand coaches and fifty-nine hundred locomotives. It uses over one hundred and seventy-five thousand freight cars, carrying in one year one hundred and five million tons of freight.

Contrast this with the time when the railroad directors elected "train captains," as the conductors were called, and when they passed resolutions that no credit be given for railroad passage. Yet, further back than this, in the history of American railroads, the engineer collected the fares and the fireman handled the baggage and freight. Also, imagine the consternation of an early president of one of the leading lines of today, when, having only two engines, he was forced to sell one to a rival road in order to obtain money with which to pay his taxes.

The Evolution of System.—In the early days companies were organized to build railways without regard to the trend of the traffic, and the result was that the East was covered by small roads, each operated independently. To make matters worse each company had its own idea as to the size of cars, and the "gauge" was from three to six feet, making transfer of cars impossible. At transfer points the passenger must look after his own baggage and buy a new ticket. To accommodate local interests the schedules were generally such that the passengers must wait over night before resuming their journey. The whole system was so unsatisfactory that many companies became bankrupt. Then Commodore Vanderbilt, who at that time owned large fleets of vessels, began to buy up the lines, consolidate them and put them on standard gauge. This action was fiercely opposed, as it ruined the hotel and transfer business for trains to run *through* the towns, but this opposition gave way to progress, and one of the world's greatest systems was founded.

How Communication Assists Civilization.—The civilization of today differs from that of past decades, principally on account of the changes that have been wrought by more rapid travel and communication. The states west of the Rocky Mountains could hardly have become an important integral part of this nation but for the railroads. It might be interesting to note, briefly, the enormous expense connected with the construction of the Union Pacific, the pioneer railroad of the West. Owing to the scarcity of timber in the territory through which the line was built, it was necessary to ship ties from the East, and the cost laid down at Omaha was $2.50 per tie. What is the average cost of railroad ties?



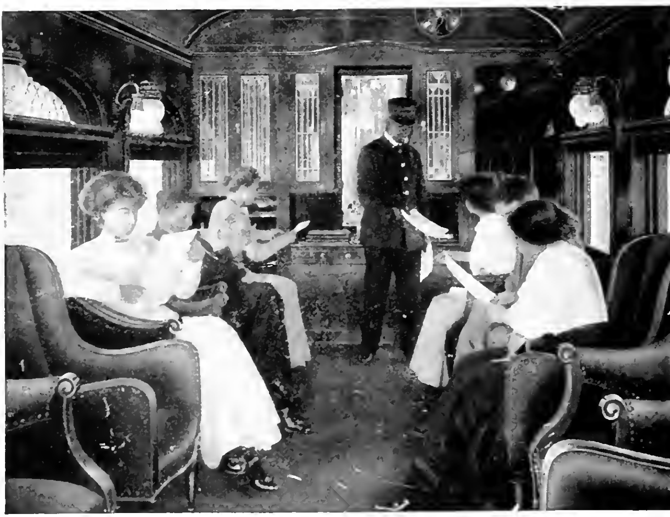
Courtesy N. Y. Central Lines

MODERN ELECTRIC LOCOMOTIVE

Mention of the vast saving in the transportation of postal matter will at least be interesting. In one year alone (1854) the Government paid $80,000 for monthly mail stage from the Missouri River to Stockton, California, and the receipts for postage during that year were only $1,255. The letter postage rate was ten cents per half ounce.

The railroad companies build for the future, knowing that the traffic will eventually warrant the expenditure. They set the pace and the country builds to it. In this way railroads do for civilization what individuals and communities could never do for themselves. Our fields and mines, our forests and factories, owe their development to the coming of railroads.

Competition and Skill.—These conditions have not come without much competition, by which the most powerful lines have absorbed the weaker ones. The fight



Courtesy Burlington Route

THE LUXURIES OF TRAVEL

for industrial progress has been a very fierce one. People have different views upon the value of consolidation, just as they did in earlier days. Such combinations, however, are likely to continue so long as the industrial situation makes them possible.

The world has witnessed great feats of engineering skill during recent years, which makes us wonder what is yet to come. Perhaps, within a decade, we may go by train direct from New York to South America, or, via Alaska, across the Bering Sea, to China and across Asia to Europe. This does not seem so wonderful when we think of a few things that have been accomplished in America. Already we have a railroad over the sea, for of the 128 miles between Homestead and Key West, Florida, 75 miles are over water. At one place there is a steel and concrete viaduct seven miles long, the entire track being thirty-three feet above low tide water mark. Many miles of the track are built of re-enforced concrete arches, varying from fifteen to fifty feet in width, built

Courtesy Florida East Coast Ry.

A RAILROAD RUNS TO KEY WEST

to last for centuries. This brings the Florida East Coast Railroad within ninety miles of Cuba.

To save forty-four miles and avoid some steep grades, in a race across the continent, Harriman built the Great Salt Lake cut-off, a trestle over sixty miles long across Great Salt Lake. It is one of the most wonderful and courageous engineering feats of modern times and cost ten million dollars, but it saves the Union Pacific a million dollars a year in operating expenses.

Many other feats performed in building American railways are equally wonderful. In the Royal Gorge of the Arkansas, the cleft between the rocks is too narrow for both road and river, so the railway bridge is swung from steel girders, from which the walls rise almost perpendicularly for three thousand feet. The Moffat road is demonstrating what has always been considered the impossible, by building an air-line between Denver and Salt Lake. The first seventy-five miles of this railroad cost $100,000 per mile. It runs through thirty-two tunnels, yet it is a standard gauge road with easy grades. Only recently the Pennsylvania System has accomplished the task of tunneling under the Hudson River, and laying double tracks within immense steel tubes under the river and into the very heart of New York City.

Electricity as Motive Power.—Other wonders may be accomplished by the use of electricity as motive power. The first electric car to be operated in the United States was installed in 1886. The progress of electric railroads has been very rapid. City after city made use, in rapid succession, of the trolley service, for the people did n t have to be persuaded to forsake the horse-car and the steam "dummy." Then came the interurban, and now the most populous sections of the country are netted with trolley lines. In many Eastern sections, they have been the means of reducing rates for passenger and freight traffic and the service is first-class.

All roads now use electric locomotives for service in long tunnels and in cities where there are ordinances against the smoke nuisance. The New York Central and Pennsylvania systems, as well as other lines, use them for pulling all trains within the city limits.

The gasoline motor car is very practical for service on short lines and for suburban traffic. The latest models are practically dust-proof and run with almost the ease of the automobile.

The easy and cheap transportation of commercial products afforded by the rapid growth of railroads has greatly increased the exchange of products. Why, then, has the evolution of the railroads been a great factor in the enormous development of this country?

FOR RESEARCH

1. What railroads enter the city where you live? What are their principal terminal points? Obtain folders and study the maps showing these lines and connecting lines.

2. What is a pool? A differential? What is the purpose of the Interstate Commerce Commission? What State Officials attend to the interests of the people in their dealings with the railroads?

3. What would be the advantage of Government ownership over corporate control?

4. What is the right of *eminent domain?* What do the people get in return for the bestowal of this right?

5. How may a shipper know that he is not paying more than the established freight rates? What is a rebate? Are rebates legal?

6. What are the advantages of electric locomotives over those propelled by steam?

7. What is the comparative maintenance cost of automobiles, automobile trucks and carriages pulled by horses?

8. What precautions are taken by the railroads to prevent accidents? In case of lawsuits, what courts have jurisdiction?

9. Why should not the freight rate for hauling crated furniture and iron ore be the same per ton?

10. How are railroads factors in the location of towns and cities?

11. Obtain folders and other printed matter at the local ticket office and learn the principal terminal points of various lines.

CHAPTER II

THE EVOLUTION OF THE STEAMBOAT

Commerce Promotes Progress.—A hundred years or more ago, each section of this country was practically self-sustaining. Each locality grew its own foodstuffs and manufactured its own clothing. There was not much necessity for transportation facilities of any kind. But such life was detrimental to the progress of civilization. Commerce increases intelligence, and under the conditions that formerly prevailed there was little of the present-day enlightenment that comes with the exchange of products as well as of ideas.

The Need of Transportation.—As the natural resources of this country began to be exploited there grew up a demand for means of transportation, the first being ox-carts, pack-horses and boats of various kinds. Our early manufacturer found it necessary to look to others for his food and clothing as well as for the materials needed in his business. In a like manner countries must look to each other for what they cannot produce, each selling to the others that of which they have an abundance. In this way transportation has become a necessity, just as important as any other industry, for without it business on a large scale could not exist. The whole world looks to the United States for cotton, meat, wheat and steel, to Australia for wool and to the Orient for tea. At the present time about ninety thousand sailing vessels and forty thousand steamships are in commission upon the high seas, effecting this exchange among nations.

How the Ocean Is Used.—The ocean is the common highway of all countries. Our international commerce is carried on upon it, and established ocean routes between all important countries and seaports have been in existence for centuries. Formerly sailing vessels were used exclusively, and they yet occupy an important place, there being approximately three times as many sailing vessels in commission as there are steamships; however, the largest vessels all belong to the latter class. Slow freight, or that which is imperishable, can be transported upon sailing vessels at the lowest possible cost, as the boats are cheaper in construction, require no machinery, and can be manned with smaller crews.

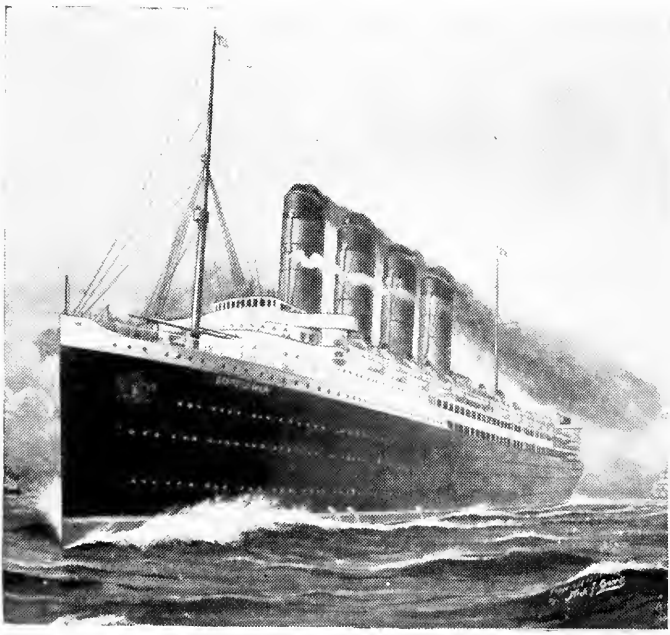
The Development of the Steamboat.—In 1807 Robert Fulton's *Clermont*, the first practical steamboat ever built, ran up the Hudson River. The world looked upon it as a pretty toy and had no conception of what it meant, but it made possible mighty things.

The hull of the *Clermont* was one hundred and forty feet long, sixteen feet wide and seven feet deep. As there were no shops in this country, the engine was built in England. The boiler was made of copper plates so poorly put together that leaks were frequent, and they were stopped with melted lead. The fire box was made of masonry. As Fulton stood in the crowd which was assembled to see the *Clermont* attempt to steam away on her first trip, he was jeered and hooted as a lunatic. And this was only a little over a hundred years ago!

But the *Clermont* was a money-maker from the very beginning and Fulton soon became a monopolist. Succeeding improvements were made in the details rather than in the principles of the machinery. Steam navigation quickly asserted itself, new ideas were rapidly developed, and such craft soon ceased to be a novelty.

The *Clermont*, driven by a four horse-power engine, attained a speed of about seven miles per hour. The cylinders were twenty-two to twenty-four inches in diameter. Today they run as high as one hundred and twenty-four inches in diameter. Instead of four horse-power, the engines of the *Olympic* and *Imperator* of today develop eighty thousand horse-power.

The First Ocean Steamers.—It was a long step from the traffic on inland waters to the navigation of the ocean. The *Savannah*, a vessel equipped with both sails and engines, is generally conceded to be the first steamship to cross the ocean; the trip being made in 1819, however, steam was used on this trip only when there was no wind. The *Royal William*, a Canadian boat, was the first



Courtesy Cunard S.S. Co.

A $7,000,000 STEAMSHIP

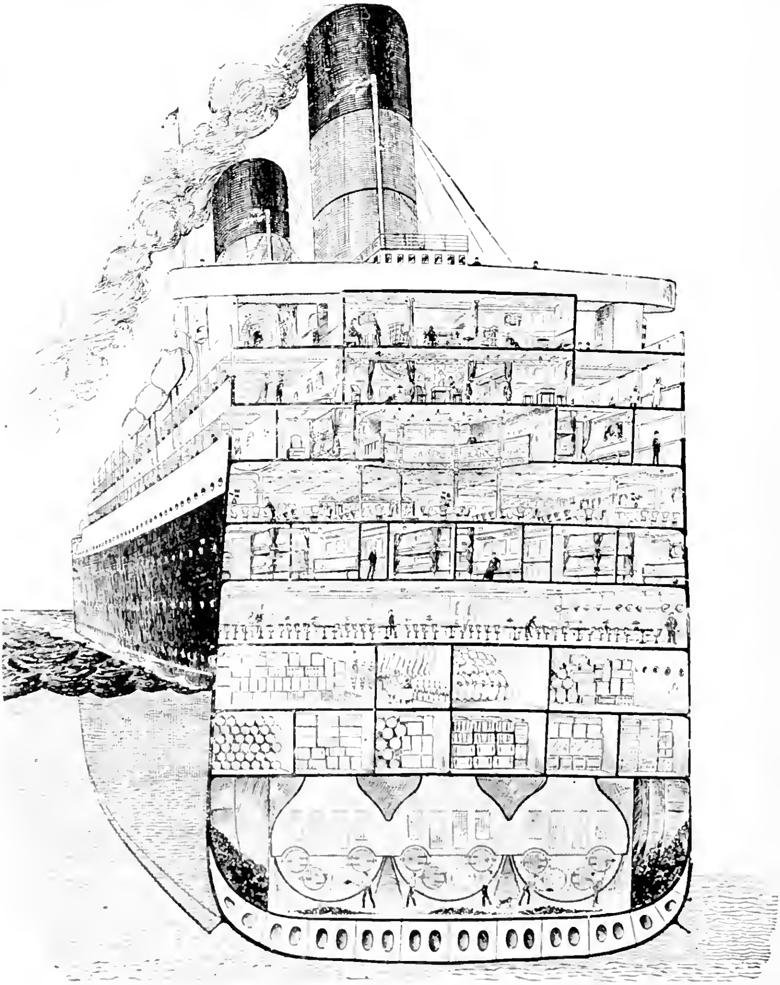
to cross the ocean entirely under steam power, which she did in 1833. The *Royal William* was considered a perfect type of boat to be duplicated for decades, but how soon progress upset these ideals. She was one hundred and seventy-six feet long, twenty-nine feet four inches beam and seventeen feet nine inches deep. She was a sidewheeler and required twenty-five days to make the trip across the Atlantic.

About the year 1840 inventors began to experiment with a screw propeller as a substitute for the cumbersome, expensive and inefficient paddle-wheel of that day. In 1839 such a ship had been built in England, and had proven a success, and now a larger vessel with an iron hull, the *Great Britain,* was constructed and met every requirement, until she was grounded after three years' service. But navigators were skeptical about the use of iron vessels, which they thought would destroy the usefulness of the compass. The disposition of iron to foul so rapidly was another objection; however, the introduction and use of the floating compass and anti-fouling compositions for painting the hulls soon remedied these defects, and with the construction of direct-acting engines the screw propeller became a great success.

The greatest improvements in ocean service are due, perhaps, to the development of the engines. The compound engine and multiple expansion engine have been followed by the triple expansion engine, and this great mechanism seems now to be rapidly giving way to the turbine engine, which gives greater power and occupies less space. Iron hulls have been displaced by those of steel, the screw propeller has been supplanted by twin, triple and quadruple propellers and many other improvements that a century ago would have been thought impossible.

Modern Ocean Liners.—One of the greatest ships in the world today is the *Imperator* of the Hamburg-American Line. This monster is nine hundred feet long, ninety feet wide and has nine decks above the water line. It registers 50,000 tons, with a displacement of 70,000 tons, and has a speed of twenty-five knots per hour.

The *Lusitania* has established the world's record for speed, crossing the Atlantic in a trifle over four and one-half days, and no one knows when this record may be broken. Such vessels are greater than some of the biggest things in the world. Two of them are as long as the Brooklyn bridge. One of them is longer than the Auditorium Hotel and Annex of Chicago, the largest hotel in the world.



Courtesy Cunard S.S. Co.

A PALATIAL FLOATING HOTEL

The *Imperator* can carry, with perfect comfort, over five thousand passengers. It requires a crew of one thousand to man her. It is two hundred and fifty feet longer than the great Marshall Field store of Chicago. One could step from the upper deck of this vessel into a ninth story window, the funnels extending six stories higher and the masts reaching above the roof.

No hotel in the world is finished with finer or more expensive woods or furnished more luxuriously than are these great ships. There are electric elevators connecting all decks, telephones to all parts, electric signals that warn of approaching danger and the wireless telegraph, by which one can communicate with any part of the earth. A daily newspaper gives the guests the news of the world and a first-class theatre furnishes evening amusement. There are regal suites, adorned with delicate tapestries, open fire-places, and cozy window corners, which make one forget he is upon the ocean.

Think of the amount of provisions necessary for a trip of one of these great liners! The meat alone consists of fifty cattle, eighty sheep, one hundred and fifty pigs, twelve calves, sixty lambs, two hundred and fifty partridges, two hundred and fifty grouse, eight hundred quail, two hundred snipe, one hundred geese, one hundred and fifty turkeys, three hundred and fifty ducks and two thousand smaller fowls. There are also twelve barrels of salmon, sixty boxes of kippers, forty-five boxes of fresh fish, eighty-four boxes of haddock, and twenty kegs of oysters.

In addition to passengers and provisions, all ships carry thousands of dollars worth of freight as "ballast," which serves the double purpose of bringing in revenue and weighting the ship. The enormous freight carried on one of these great ocean liners is sufficient to load a freight train forty miles long. Its capacious hold will accommodate over half a million bushels of grain, thirty-five thousand bales of cotton, twenty thousand tons of

Courtesy Hamburg-Amer. Line

OCEAN TRAVEL COMBINES ALL COMFORTS

metal, or seventy thousand barrels of oil. The hulls, below water line, are divided into as many as one hundred and seventy-five water-tight compartments, which are designed to render the vessel unsinkable. This is an age of wonderful progress, and it seems that perfection in steamboat service has nearly been attained.

The greatest steamships are owned and operated by German and English companies. These governments use every effort to encourage this industry, by granting subsidies and by other methods. On account of this, and also from the fact that every other nation can man its ships at a lower average wage than is possible in this country, the United States cannot successfully compete with other countries. Most of the steamship lines on the Pacific are controlled by Japanese companies.

National governments aid navigation further by removing obstacles to the entrance of harbors, constructing piers, maintaining lighthouses and other signals to mark dangerous places. They also establish regulations that must be complied with by all ocean-going vessels when within three miles of shore, so that none are in danger by running at a high rate of speed in narrow and dangerous channels. All vessels are taken in and out of port by licensed pilots who, having spent many years familiarizing themselves with the harbor, are able to guide the vessels safely over natural obstructions as well as over the mines and other fortifications placed there by the War Department. The immense size of the vessels built within the past few years has made it necessary to reconstruct the harbors at an enormous cost. In the past ten years the ocean liner has leaped from 20,000 to 50,000 tons and there is a possibility that the 100,000 ton ship may yet come.

FOR RESEARCH

1. How much time was required for the fleet of Columbus to cross the ocean? How much time is now required?

2. What was the "Embargo" Act? The "Non-intercourse" Acts?

3. What is a Marconigram? How may a ship be located while at sea?

4. What is meant by first, second and third-class passage? What is steerage?

5. Discuss: Square rigging. Fore and aft rigging. A clipper. A schooner. A tender. A tug.

6. Why do steamships coming to this country stop at quarantine? Through what processes must emigrants pass?

7. In what respect do reciprocating engines differ from turbines? Make a diagram illustrating the principle of double, triple and quadruple expansion as applied to engines.

8. Describe and illustrate the new ocean routes established by the completion of the Panama Canal.

9. Show the route of a cargo from Manila to Hamburg. From Constantinople to San Francisco. From Ceylon to New York.

10. What is a port of entry? To what extent do the Customs officials examine goods entering this country?

11. What was the cause of the *Titanic* disaster? What did shipbuilders learn from it?

12. Obtain, from the nearest offices of the principal steamship companies, folders showing the routes traversed by their lines. Also obtain an assortment of illustrated literature.

CHAPTER III

THE COMMERCE OF OUR INLAND SEAS

Our Lake Ports.—Those who have not traveled upon the Great Lakes or visited some of their principal receiving and distributing docks, many of them a mile

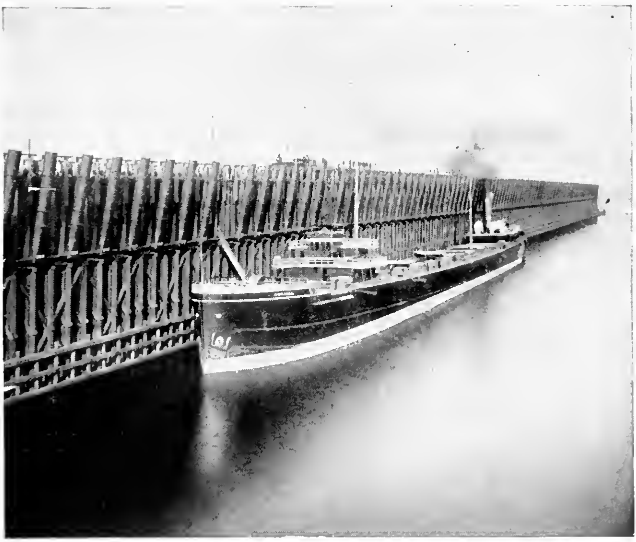
Photograph by L. C. Rusmisel
DULUTH HARBOR AND AERIAL BRIDGE

or so from the general harbor, have no idea of the great shipping interests on the Great Lakes, where there are immense ore docks, beside which thirty steamers may load at a time. They have no conception of the big tank elevators holding as high as seven million bushels of wheat each, of the great warehouses filled with valuable merchandise, of the heaped-up coal yards and the incessant coming and going of the huge freighters which carry this produce where railroads may distribute it to mills, smelters and inland towns. A long water haul is so much cheaper than a rail haul that the ability to ship large cargoes direct from Lake Superior ports eight hundred to fifteen hundred miles, or even across the seas, has transformed the United States and changed her position among the nations.

Transportation Facilities of the Lakes. — Wheat, coming from Canada, the Dakotas and Minnesota, finds its way to Duluth, Superior, Milwaukee and Chicago. Practically all of our corn is shipped from Chicago. From these ports these grains are shipped by boat to Liverpool. The lumber of Michigan, Wisconsin and Minnesota, as well as much from Oregon and Washington, passes through the lakes. The copper of Michigan is usable for results not attempted with the product of other mines. Before the lake movement began the iron industry was having a fierce struggle for existence with the lean Pennsylvania ores. Now, after transferring the rich Superior ores, we can undersell every other country, and our iron industry is the key to the commercial supremacy of the world. There is nothing bigger in the history of civilization than the "Soo" Canal, which connects Lakes Superior and Huron and makes possible this and countless other benefits to mankind.

Facilities for Handling Freight.—A freight system adequate to meet these conditions has become a necessity. It is so masterful and supreme as to almost baffle description. Imagine a steel boat, four to six hundred feet long, with six to twelve thousand tons capacity, steaming up to an elevator. Her hatches are opened by machinery before she stops, and immediately the grain descends from bins above, which are constantly being refilled by incoming trains. The process of transferring grain from farm to elevator, elevator to boat, and from the boat to receiving elevator, at the other end of the lakes, has been reduced to a science.

Ore Shipment on the Great Lakes.—An even greater wonder is the shipment of ore on the lakes. A fleet of boats, each longer than a city block, is continually carrying ore to receiving ports and returning at once to the North to reload. A boat holding ten thousand tons has been loaded in eighty minutes and unloaded in two hours, by means of machinery which is manipulated by one man. Machinery lifts the ore, dumps it on immense ore docks, sends it from big pockets down into the boat, scoops it



Courtesy Duluth Chamber of Commerce

A LAKE FREIGHTER PREPARING TO LOAD

out of the hold, loads it on cars, and transfers it to the smelter, where the work is finished. Some of these ore boats are 605 feet long, 58 feet wide and 32 feet deep, and such a boat can be manned by twenty men. One company alone owns boats that have taken ten million tons of ore down the lakes in one year. It seems incredible that, in a little less than four days after loading at Duluth, these great steel boats may be found unloading eight hundred miles away. This moving is at the rate of about eleven miles an hour, almost as fast as the lake passenger steamships.

A Lake Freighter. — These boats are unlike any others in the world. They look like from four to six hundred feet of steel trough with a lid on, at one end a steel house, at the other a smokestack and row of cabins, and between them a clear stretch of deck almost a block long. They are a triumph of American ingenuity, and can handle more cargo in less time than any other transportation device ever made.

Passenger Service on the Great Lakes.—Little less wonderful is the passenger service. Each year over sixteen million passengers are carried on the Great Lakes. Many of the passenger steamers are rivaled only by those upon the oceans. Some of them have five hundred staterooms and are equipped with telephones, running water, grate fires, electric elevators, wireless telegraph, washed-air ventilation, private dining rooms, convention halls, Venetian gardens, and every modern convenience.

Passenger travel on the Great Lakes costs less per mile than on any other highway in the world. The thousand-mile trip from Buffalo to Duluth, on one of the finest passenger steamers ever built for use upon fresh water, is an ideal one. One may board a steamer at Buffalo, cross Lake Erie to Cleveland, spend a day of pleasure there, take up the journey again by boat and go to Detroit, in many ways the most remarkable city on the continent, sail up the river and Lake Huron, then through the canal at the "Soo," go on through Lake Superior to picturesque Duluth. Then return by way of Lake Michigan to Chicago, the food market of the world, and continue the journey all the way by boat to the starting point at Buffalo, after having sailed more miles than would be covered in crossing the ocean, and for one-third of the expense. All of the accommodations on board are in every way equal to those of the ocean liner.

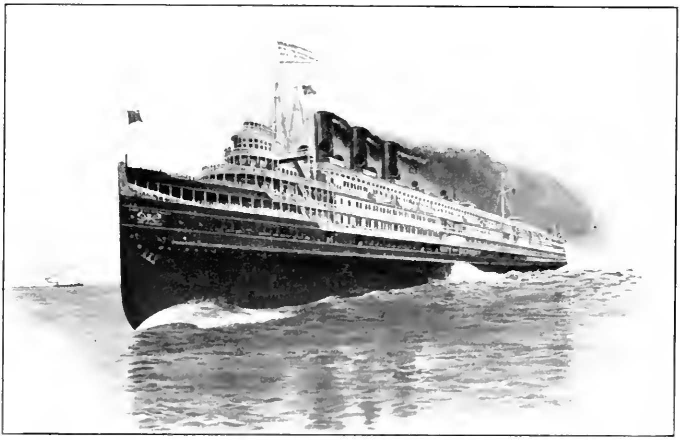
The "Soo" Canal.—The commerce of the lakes may be viewed at its best at the locks of the Sault Ste. Marie (Rapids of St. Mary's) or "Soo" Canal, the greatest throat of commerce on earth. Suez, the ungated highway to nations that were old before the dawn of history, cannot claim a traffic equal to one-fifth of it. Here may be seen a great wonder of the world which has been wrought by human hands. The combined tonnage of New York, Liverpool and Hamburg would not equal that

Pohl Printing Co., Detroit, Mich.

COMPARATIVE LENGTH OF LAKE FREIGHTER AND NATIONAL CAPITOL

which passes through this canal during the eight months it is possible for vessels to operate. On the average a great steamer passes through the locks every fifteen minutes, night and day.

Only fifty years have elapsed since the opening of the first canal at Sault Ste. Marie. Then wise Americans considered the expenditure as extravagant and visionary beyond words. The discovery of ore on the shore of Lake Superior was the principal factor which led to its establishment. Learned engineers decided that a lock three hundred and fifty feet long would accommodate the largest vessels ever possible to navigate those waters. In 1870 it was torn out and two others built, the longest five hundred and fifteen feet long, but these soon became inadequate and in 1896 the Poe Lock was completed, at a cost of five million dollars. It is eight hundred feet long and is one of the greatest artificial chambers in the world, originally intended to accommodate four vessels at once, yet today it accommodates only one. The smaller vessels are accommodated by the Weitzel Lock, which was built beside the Poe Lock, and also by the



Courtesy D. & C. SS. Line

THE LARGEST STEAMBOAT OF THE LAKES

Canadian Lock on the other side of the river. The Federal Government has allowed its ocean merchant marine to languish and die, but it has spent over fifty million dollars in deepening channels and building canals between the Great Lakes.

To comprehend this great industry best, watch one of these great vessels steam from the canal into the cradling basin of masonry. In length, nine of her would measure a mile, the length of the canal. She is loaded with ten thousand tons of ore, which was poured into her hold at the Duluth docks like a dusty avalanche, and the steel mills at Pittsburgh are anxious for this great cargo which is waiting to be lowered, with the ship that contains it, twenty-two feet to the water level below. A few men push levers that set engines to work and the massive gate closes behind the vessel. Powerful pumps begin their toil and the vessel commences to drop, foot by foot, until, in a few minutes, she rides out into the channel on the other side. All day long, and through the night, on the average one hundred and fifty of these great cargo-carriers are raised and lowered every day, with no more flurry than the operation of an elevator in an office building.

Once through the lock, the steamer moves on her course to her distant dock, there to be unloaded by another handful of men, who manipulate machines which set to work the strength of thousands of men, focused in steam and electric power. On a magnificent scale, invention and organization have worked to reduce the cost of the product of the mine, the farm and forest. Not more than fifty men are required to handle ten thousand tons of ore through all its stages of transportation. Forty years ago the freight rate from Marquette to Ohio ports was from three to six dollars per ton. Today it averages seventy-five cents per ton from any of the Lake Superior ports.

The Great Lakes.—A few condensed facts regarding the Great Lakes may be interesting. Altogether they have an area of one hundred thousand square miles. The eight states that border them contain more than one-third of the population of North America. There are over fifteen hundred vessels on the lakes and approximately one million people are employed in the traffic. Three millions of tons of coal are consumed by these steamers each year, the sailing vessels being practically obsolete.

The fisheries of the Great Lakes are the most valuable in the world. Last year (1913) there passed through the "Soo" Canal: 57,895,145 tons of freight of all classes; 40,014,978 tons of iron ore; 127,212 tons of copper; 9,940,-026 tons of coal; 113,253,561 bushels of wheat; 47,512,863 bushels of other grains and 7,088,865 barrels of flour.

A cargo of copper ingots worth $1,020,000 and a cargo of flax worth $504,000 were the most valuable single shipments. The fleet of the United States Steel Corporation, numbering 110 vessels, the largest commercial navy on the lakes, can move 648,000 tons per trip, equal to a loaded train 120 miles long. The lakes mean more to the American people than do all the oceans.

FOR RESEARCH

1. What relation exists between the Great Lakes and the Iron, Coal and Wheat Industries?

2. Why is a canal being constructed from Pittsburgh to Lake Erie?

3. What is the principle of a lock canal? Make a diagram illustrating it.

4. Discuss the difference between side-wheel steamships and screw-propellers. Both methods are used by the largest steamships on the Great Lakes. Why?

5. When does the season for lake navigation open and close? What risks does a boat run by sailing after the season has officially closed?

6. Does the Navy Department have any boats on the Great Lakes? Why?

7. Where are train ferries operated upon the lakes?

8. What has the National Government done to safeguard traffic on the Great Lakes? What are the principal requirements exacted by the conditions of a steamship license?

9. For what are these lake ports noted? Duluth? Fort William? Ashland? Superior? Two Harbors? Milwaukee? Houghton? Chicago? Detroit? Cleveland? Buffalo?

10. Write one hundred words covering the principal features of the "Soo" Canal.

11. What great industries are made possible at Sault Ste. Marie on account of the water power?

CHAPTER IV

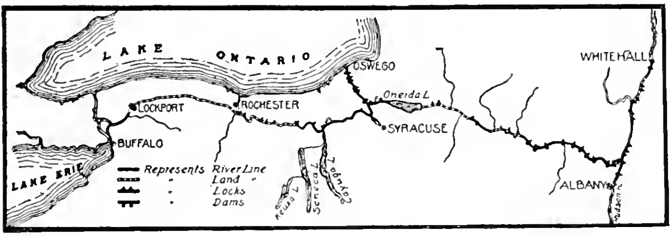
FOUR GREAT CANALS

Ever since the earth has been inhabited, man has been busy making over its face to suit his varying requirements. Mountains which have stood in his way have been tunneled or removed, rivers bridged and oceans joined by artificial waterways. All of this has been done in the interest of commerce. Even where the immediate motive has been military advantage the impelling cause has been the consideration of profitable trade. One hundred and fifty years before the Christian era there was a primitive canal across the Isthmus of Suez. In China canals have existed from the earliest ages, and Egypt was intersected with them. However, the world's canals of ante-railroad days and the vast ship canals of the present, are very different undertakings. From the old Erie Canal to the Panama represents a whole era of the world's commercial history.

The Erie Canal, connecting the Great Lakes with the Hudson River, was completed in 1825 at a cost of sixty-two million dollars. It is 363 miles long and was the greatest industrial enterprise of its day. Water transportation over this route has been, from the earliest days, the key to the commerce of the Northwest, as it brought to the port of New York the products of the great central granary. As this canal antedates railway transportation in this country it was of immense value in its earlier days, but later it failed to secure the business it should have on account of railroad competition and also from the fact that it was not large enough to accommodate the boats that traverse the Great Lakes, thus all of its freight had to be transferred to smaller boats.

Grain, iron ore, lumber and coal comprise 90 per cent. of the freight of the lakes, and as the time element is not important in the transportation of these commodities they can be satisfactorily handled by water at a lower cost, where facilities are suitable. This has induced the New York Legislature to authorize the expenditure of enough money to enlarge the old Erie Canal sufficiently to accommodate a 1,000-ton barge and it is expected that, upon completion, its business will be largely revived.

The St. Mary's Falls Canal, The "Soo."—The greatest artery of commerce in the world is the canal which connects Lakes Superior and Huron, although it is scarcely a mile in length. The total tonnage passing



THE ROUTE OF THE ERIE CANAL

through this canal during the open season of less than eight months is greater than the combined tonnage of coastwise clearances of England, France and Germany. There is nothing like it in the world. Its commerce, consisting principally of iron ore, lumber, grain and coal, is more than five times as great as that of the Suez Canal. It is five times as great as that of the foreign tonnage of New York harbor and greater than the combined tonnage of Liverpool, London and Hamburg.

There are two locks there. The *Weitzel* Lock is five hundred and fifteen feet long, and eighty feet wide, narrowing to sixty feet at the gates. It has a depth of thirty-nine and one-half feet. The lift of the lock is eighteen feet.

The *Poe* Lock is eight hundred feet long, uniformly one hundred feet wide and twenty-one feet deep, with a lift of eighteen feet. It was built to accommodate four vessels at one time; by the time it was finished in 1896 it could take only two, and today one of the largest ore carriers will almost fill it. Its total cost was five million dollars. It is the largest single artificial chamber in the world. This canal is owned and operated by the United States Government. The service is free. A smaller canal is operated by the Canadian Government on the north side of the St. Mary's River.

THE SAULT STE. MARIE—"SOO"—CANAL

The Suez Canal.—The great Suez Canal, as it stands today, was built by the French Government. It connects the Red Sea with the Mediterranean. It was completed in 1869 and is one hundred miles long, of which seventy-six miles is actual canal and twenty-four miles is canalized lakes. As enlarged in 1896 it is over three hundred feet wide at the top, one hundred and twenty-five feet at the bottom with a minimum depth of twenty-seven feet ten inches. While its total cost was $120,000,000, during the past ten years the receipts from shipping passing through it have been about twice this amount. The greatest difficulty experienced while building it was the interference of the British Government, which eventually assumed control of it.

About thirteen hours are required to pass through the canal by ordinary steamer. As it is well lighted, it is in use by night as well as by day.

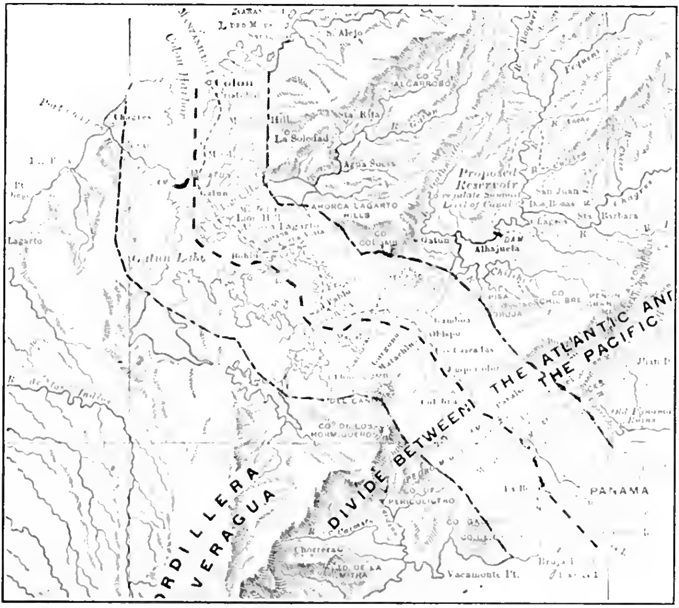
The opening of the Suez Canal was a severe blow to the waning commercial importance of the city of Alexandria, which for centuries had enjoyed the overland trade between Europe and the East Indies. While it is open to all the world, in time of war neither the canal or its terminals can be made a base of operations by any nation.

It is in the trade with India, China and Australia that the Suez Canal is chiefly valuable. It saves 5,500 miles in the voyage between London and Bombay and 4,100 miles between London and Hong-Kong. Sailing vessels and steamers trading with New Zealand find it more economical to save tolls by making the longer voyage around the Cape of Good Hope and returning by way of Cape Horn. About 4,000 ships annually pass through this canal, with a tonnage of about 10,000,000 tons, or about the same as that of New York Harbor. The building of the canal was a triumph of organization which up to that time had no parallel in engineering history. At times as many as 30,000 laborers were employed and sanitary and medical services, schools, boarding houses, banks, asylums and other adjuncts of a permanent community had to be provided by the construction company, as is the case at the present time in the Panama Canal Zone.

The Panama Canal.—It has been the peculiar fate of French foreign canal building, as in French colonizing, that much of what has been done by the French has gone to benefit other nations. For example, New France long ago became a part of the British Empire. The Suez Canal is now largely owned and administered by the

British and the beginnings made by the French at Panama have been continued by the United States. While the most ingenious machinery known was used in the construction of the Suez Canal, the same machinery, perfected by years of experience, was found utterly worthless at Panama on account of changed conditions in the soil.

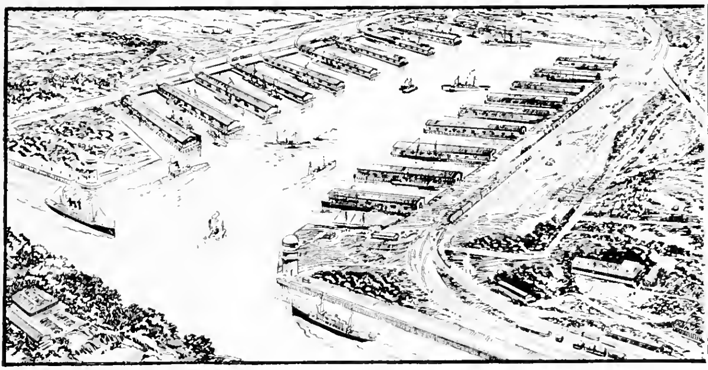
For four hundred years everybody interested in



THE PANAMA CANAL ZONE

commerce has dreamed of the day when ships can pass from the Atlantic to the Pacific without making the long journey around South America, and this the French attempted to do by digging a canal across the Isthmus of Panama, but after seven years' trial they gave up the project, afterwards selling their rights to the United States Government, which began operations in 1904, completing the work in 1914. The project was similar to that of the Suez enterprise in many ways. Forty thousand men were constantly employed, for the care of whom the Government had to provide by building houses, schools and hospitals. The total cost has been very close to $400,000,000.

The canal is fifty miles long and it requires thirteen hours for a vessel to pass through it. It is a lock canal with dams and embankments as well as excavations. On the Atlantic side the sea level entrance channel is seven



DOCKS AT COLON—PACIFIC TERMINUS, PANAMA CANAL

miles long and five hundred feet wide up to the Gatun lock. At Gatun an eighty-foot lake level is obtained by a great dam. Vessels pass from sea level to lake level by a series of three adjoining locks, each with a lift of twenty-eight feet. The lake has an area of 164 square miles, and on the Pacific side, thirty-two miles away, is confined by a smaller dam at which there is a lift with duplicate locks, letting vessels down into a smaller lake that is fifty-five feet above the level of the Pacific. At the other end of this lake are the Miraflores locks, where, by two lifts by duplicate locks, vessels will reach sea-level on the Pacific side. Here is being constructed one of the largest and most completely equipped harbors in the world.

Commercial Importance of the Panama Canal.—One of our swiftest steamers would require over a month to make the trip from New York to San Francisco by going around Cape Horn. By going through the Panama Canal the trip can be made in twelve days, or less. Of course, the completion of the canal should mean cheaper freights and the effect upon the people of this country should be very marked. To the South, New Orleans and Galveston will be near enough to become ports of the greatest importance, as they are the natural outlets for the Mississippi valley, the greatest agricultural region in the world. Therefore, the cereals, sugar, cotton, turpentine, lumber, and machinery, stoves and other manufactured articles of the North will pass through these ports and the canal to the South American and Asiatic markets.

The South American countries want our machinery, iron and steel, and many other things which, before the construction of the canal, they could only obtain after having them shipped across this continent by rail to California ports. An all-water route will so cheapen these articles that the sale will be immensely greater.

Again, the South American countries are rich in resources yet practically undeveloped. The nation that gets in closest touch with them will secure that trade and profit by their rise in commercial importance. It is possible that this country may become the leading market of the world for hides and leather, tin, nitrates, cocoa, vanilla, rubber and many other things which now pass through some other country to which we pay tribute.

It may be computed that the sailing distance from New York to almost any Oriental port will be reduced by half, which should mean a great saving in anything we have to buy from there, and a greater demand for what we have to sell to them. When vessels have only half as far to travel they can make twice as many trips and more profit for their owners. Consequently when they bring more of their foreign products to us at a cheaper price, they will also carry away our steel rails and building iron, engines, harvesters, canned foods and manufactured articles. So we will buy more cheaply from them and sell them greater quantities, for a ship that brings a load must carry something back in return.

FOR RESEARCH

1. How were boats propelled through canals before the use of steam power was applied?

2. Does the United States own the Panama Canal zone? How is it controlled?

3. Why was the Welland Canal constructed? The Chicago Sanitary canal?

4. What canal connects the North Sea with the Baltic? What is its purpose? Where is the Manchester Ship Canal?

5. Make a diagram illustrating the location of the Suez Canal, showing how it changed the commerce of the world. Illustrate on this map the route taken by Vasco da Gama in 1497.

6. How could the famous trip of the Battleship *Oregon*, during the Spanish-American War, have been shortened had the Panama Canal been in existence at that time? Illustrate.

7. What advantages will the Panama Canal give California and other Western States?

8. How does the United States compare with other countries, in respect to the number of canals and importance of its canal system?

9. What canal is used by boats to get around Niagara Falls? Is it upon the American or Canadian side?

CHAPTER V

WATERING THE WASTE PLACES

We hear a great deal about the natural resources of this country, which we generally think of as being timber, iron, coal, gold, silver, stone and petroleum. However, the greatest of all natural resources is water, for,

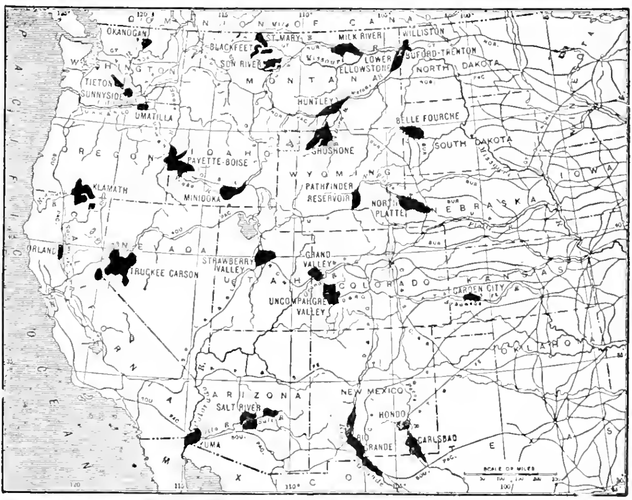
U. S. Reclamation Service

THE "GREAT AMERICAN DESERT"

without it in abundance, all the other resources would amount to nothing; famine would take the place of plenty and all our prosperity would vanish. In order to make the water supply absolutely certain, all countries have always resorted to irrigation.

The Value of Irrigation.—The rainless lands that cradled the human race were made productive by irrigation. Over four thousand years ago the vast region dominated by the Babylonian kings was a network of reservoirs, canals and laterals. The skill and science displayed in the building of ditches, dams and reservoirs, and in the use and distribution of water, causes the modern irrigator to marvel and gather wisdom. Irrigation was in use when recorded history began.

Trace agriculture to its source, and you will find it began in an irrigation ditch. Irrigation demands and develops the highest degree of intelligence, for it requires labor, calculation and genius. If we read the history of the mighty and mysterious ruins that litter the



U. S. Reclamation Service

U. S. RECLAMATION PROJECTS

paths of the early world empires, we find that all were located in arid lands. The restored and re-built canal in Egypt, which cost England two and one-half million dollars, will water four million acres. English capital has irrigated twenty-six million acres in India, and has saved millions of people from starvation; however, the beneficiaries are paying a tax of thirty per cent. upon the investment. The richest part of Italy is her three million acres of irrigated land.

Irrigation is not new in the Western Hemisphere. Cortez found it prevailing in Mexico and Central America, and Pizarro was amazed at the massive work on the reservoirs and canals in Peru. The long tunnels, which carried rivers under mountains to distant fertile valleys, amazed him most. Arizona and New Mexico are gridironed with the tracks of ancient irrigation canals, unused for centuries. Their cliffs are honeycombed with rock-drilled and built habitations of a vanished race. But a few scattered thousands now exist where millions may have flourished by the arts of irrigation. In California, about one hundred and forty years ago, the Franciscan friars induced the Indians to build irrigation ditches leading to their many missions.

The first modern scientific irrigation project in North America was done by the Mormons about forty years ago. The next cooperative system was at Greeley, Colorado, and the success of these experiments led to many similar ventures. The certainty of results incited great interest and activity, and a new agricultural age began. The fruits, the wonderful crops, and the hunger for homes, have captured the imagination of the American people.

The United States Government has been awakened to the importance of irrigation, and millions are being given to build reservoirs and conserve our water supply. While many of these ventures seem great, they are not so when compared with the work of the ancients. The Imperial Canal of China was 650 miles long. From the Tigris were dug canals 400 miles long and 400 feet wide. Over three hundred million gallons of mountain water were brought into Rome by aqueducts every day during the years of its greatness. The irrigated lands of ancient Peru yielded enough each harvest to feed the people for seven years. Perhaps, some day, America will produce a genius who will make every part of the land bloom with fertility. Should he come tomorrow he would tap the Missouri River and bring its floods across the States of the Dakotas, Nebraska, Kansas, Colorado and Texas.

The Reclamation Act.—On June 17, 1902, the Reclamation Act became a law. Under its provisions, "all moneys received from the disposal of public lands in sixteen Western states, except five per cent. reserved for educational and other purposes, are set aside as a

Courtesy Northern Pac. Ry.

MAIN CANAL—LOWER YELLOWSTONE PROJECT

special fund to be used for the construction and maintenance of irrigation works for the storage, diversion and development of waters for the reclamation of arid lands in these states."

The lands so reclaimed are subject to homestead entry, and there is absolutely no charge for the land itself, except the usual filing fees. However, the settler must pay the government, in not more than ten annual installments, without interest, his proportion according to the number of acres he owns, of the amount expended in reclaiming this land.

Another law, called the "Carey Act," had been passed in 1894, which donated one million acres, in each of the arid states, to the states themselves, to be reclaimed by the states or through private corporations. The states protect the rights of the settlers, and act as a court of last resort in case of controversy between the settlers and water companies. When the major portion

Courtesy Northern Pac. Ry.

250 BUSHELS OF POTATOES PER ACRE

of the land irrigated under a canal system is sold, the management of the system passes to the settlers. After the last payment on the water is made, the settlers have to pay only enough to keep the canal in repair and provide for its operating expenses.

The Rio Grande Project.—One of the greatest of these Government canals is the Rio Grande project, by which 180,000 acres of land in Texas, New Mexico and

Mexico will be reached. Mexico will be furnished free water, to settle the claim of that country for taking the water from the Rio Grande. This project will approximately cost nine million dollars. The lands lie on both sides of the Rio Grande for a hundred miles north of El Paso, and for many miles south of that city. In Colorado the Gunnison River, one of the largest streams in the state, was diverted from its course, through a six-

Courtesy So. Pac. Ry.

TEN TONS OF GRAPES FROM ONE VINE

mile tunnel under the mountains, and turned into the fertile Uncompahgre Valley, comprising over a hundred thousand acres. For all time to come the waters of this river will leave the granite-bound channel they have followed for ages and bring prosperity and fertility to the people on the other side of the mountains.

The water rights in this valley cost the settlers, approximately, $35.00 per acre, the only restriction being that the lands must be held by bona-fide resident settlers. This land cannot be held by non-residents, or rented.

The Huntley, Montana, project accommodates six hundred farms of forty acres each. In this section the large holdings, under private ownership, are under contract to be sub-divided and sold to actual settlers. All unallotted government farms are open to homestead entry. These are thrown open in units and are ready for settlement as soon as the units are made ready. The beginning of this project is in the Valley of the Yellowstone River, about twelve miles below Billings, Montana.

The Lower Yellowstone project covers 67,000 acres of land in Eastern Montana and Western North Dakota. This region is particularly productive and the country is undergoing a rapid change.

The great Shoshone dam, in the Big Horn Basin, Wyoming, is 325 feet high, and creates a great storage reservoir in the valley above for the flood waters of the river. About a quarter of a million acres of land is supplied with water from this reservoir. During the spring and early summer the melting snows of the mountains swell the volume of these mountain streams to large proportions, while in the late summer the long-continued droughts shrink their volume to that of small streams. On account of this irregularity of flow it was found necessary to provide means for the storage of the waters of the spring and early summer.

Another great dam constructed for this purpose is the Pathfinder, in the North Platte project. It is 215 feet high and 225 feet long and has capacity for enough water to supply 125,000 acres. Other great projects that have been constructed are the Carson-Truckee in Nevada, the Fayette-Boise in Idaho, the Klamath in Oregon, the Salt River in Arizona and others, twenty-six in all. It is one of the most beneficent works ever carried on by any government for its people.

Fertility of Reclaimed Land.—Most of the land that is being reclaimed has wonderful fertility, when sufficiently supplied with moisture. It is possible to support a family from one acre, by intensive cultivation in fruits and vegetables. In most sections five acres is enough and ten acres is all that one family can take care of properly. Fruit growing has become one of our greatest industries, especially in our irrigated sections, and what was formerly the "Great American Desert" has become valuable to the extreme, land selling anywhere from fifty dollars to two thousand dollars per acre.

Better Methods of Farming Needed.—The great need of additions to the tillable area of the United States is forcibly shown when we consider the rapid increase of our population—practically one million emigrants enter this country every year—in addition to the natural increase of our population. The question of homes for future generations is of great importance. There will never be any more land in the country than there is now, and, as the number of inhabitants increases, the proportionate increased value of the land is evident. Forty years ago the Mississippi Valley was spoken of as "out West," and the Missouri Valley was the frontier. Now the entire country has been settled and developed to the Pacific coast. In a very few years there will not be a tillable farm in the public domain, outside of the reclamation area. The situation is being relieved by the introduction of new and better methods of farming.

Dry Farming has made productive large regions in the middle West that were formerly regarded as of little or no value. During the past ten years over 160,000,000 acres of public lands have been taken up, but, real homemakers have settled upon only a small proportion of this vast area. However, the day of the large farm is rapidly nearing its close. The farm containing a quarter of a section, or more, carelessly cultivated, comparatively, requiring ceaseless work and yielding a proportionately small return per acre, cannot hold its own against the satisfaction and ample rewards of the smaller farm.

Irrigation Means Stability.—Where irrigation prevails there is certainty, abundance and variety of products. Unfavorable seasons do not exist, as water may be procured at will and the growth of the products is at the command of the farmer. The marvelous yields from irrigated lands at first seemed incredible, yet the Mormons in Utah created wealth of more than half a billion dollars from a desert of alkali and sage brush, almost before we knew what they were doing. An enormous advantage over farmers in the humid states will soon be enjoyed by the dweller in the one-time desert, when the great water powers there are completely harnessed and utilized for his needs. It is entirely probable that in a few years the farmers there will do all of their heavy work with electricity, and their wives will have all of their burdens greatly lightened by the same force. It is very probable that in the West will be developed the most nearly perfect farm conditions in the whole country. The irrigation farmer will become a *manufacturer* of farm products.

Results of Irrigation in America.—The great American desert is vanishing from the map as if by magic. Twelve million acres of this barren tract have already been subdued by means of irrigation and agriculture, and are producing bountiful and assured harvests every year. A quarter of a million families are residing upon farms and as many more have found homes and occupations in the cities. Towns and villages have sprung up in the midst of this modern agricultural area. Hundreds of thousands of people in the cities and towns of the East have invested in these lands and are getting them ready for occupancy. These people look forward to a future spent in wholesome and pleasant labor tilling the soil. Great dams have been constructed to impound the floods, and, through seventy thousand miles of canals and ditches, the life-giving water has been turned upon the dusty desert. The streams have also been harnessed for power and an area of manufacturing is dawning in which all of the raw products of the farm, the forests and the mines will be prepared for the markets of the world.

FOR RESEARCH

1. What is meant by intensive farming?

2. Explain how it is possible for a family to live from the proceeds of very small farms.

3. Land in irrigated valleys often sells for a thousand dollars or more an acre, yet there is frequently more profit from farming such land than from much less expensive land depending upon rainfall. Discuss reasons.

4. Does the position of a state affect its rainfall and temperature?

5. What part of the United States was affected by the prehistoric glaciers?

6. Sketch a map of the United States showing the glacial areas. The irrigated areas.

7. Where are the Everglades? Can they be successfully reclaimed? In some parts of the country millions of feet of tiling are used by the farmers. Discuss its value.

8. Is there a possibility that the supply of water for irrigation will ever be exhausted?

9. Why are the Mississippi, the Missouri and other rivers much more shallow during the summer months than formerly?

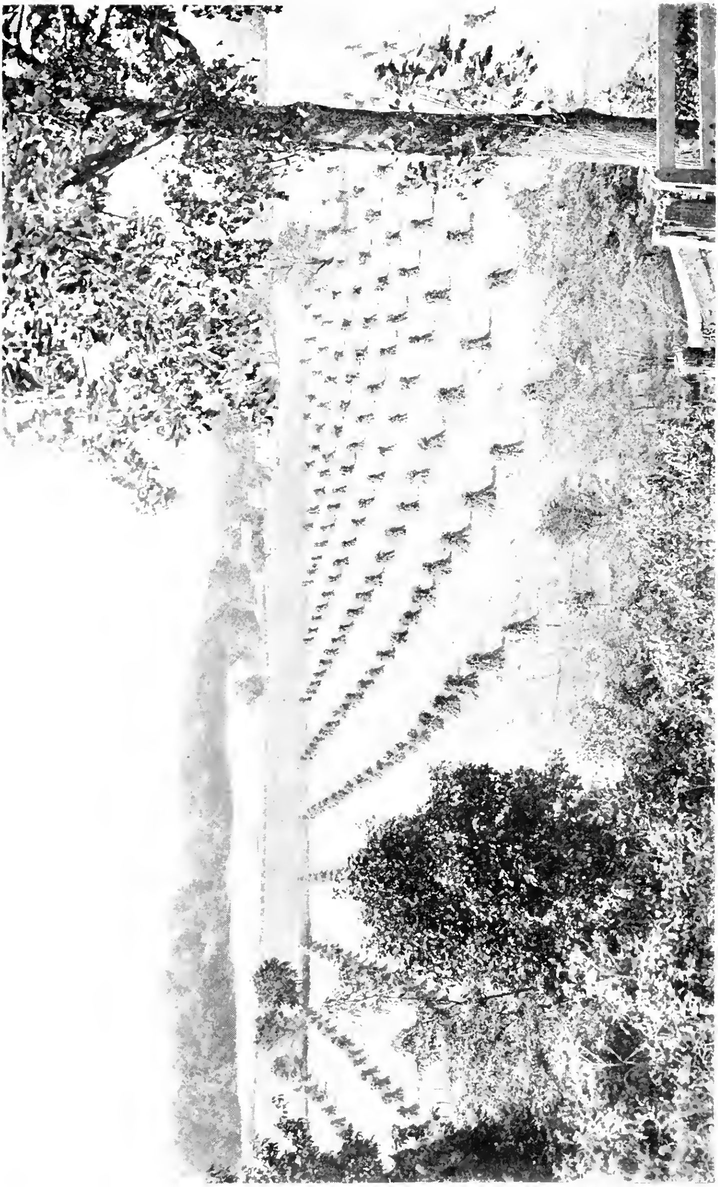
CHAPTER VI

THE FARMING INDUSTRY

There are about twelve million people engaged in agriculture in the United States, notwithstanding the heavy demands made by the cities for workers for the many other industries. Agriculture is the most nearly fundamental of all industries, and, in point of the number of people engaged in it, is the chief industry of this country. Its importance may be better understood by considering that agricultural products constitute eighty per cent. of all our exports. The ten leading products of our fields require a farming area larger than all the British Isles and France combined.

The Relation of Farming to Location.—The American farmer occupies a unique position, as his status is entirely different from that of any other in the world. Farming, like other industries, may be either a business or a mere occupation. Every year it is becoming, more and more, one of the most highly specialized industries. Those who contemplate entering this occupation should first determine what particular crop will thrive best in the locality under consideration. We have cotton in the South, corn in the middle West, wheat in the North Central States and fruit in the West and Southwest. Sugar beets, staple vegetables and other products represent a wide range of territory and the products of the market garden are most profitable in the vicinity of large cities.

Scientific Farming.—The farmer today must be something of a chemist and a botanist, at least to the extent of understanding the requirements of the soil in his locality. He must know what necessary elements are

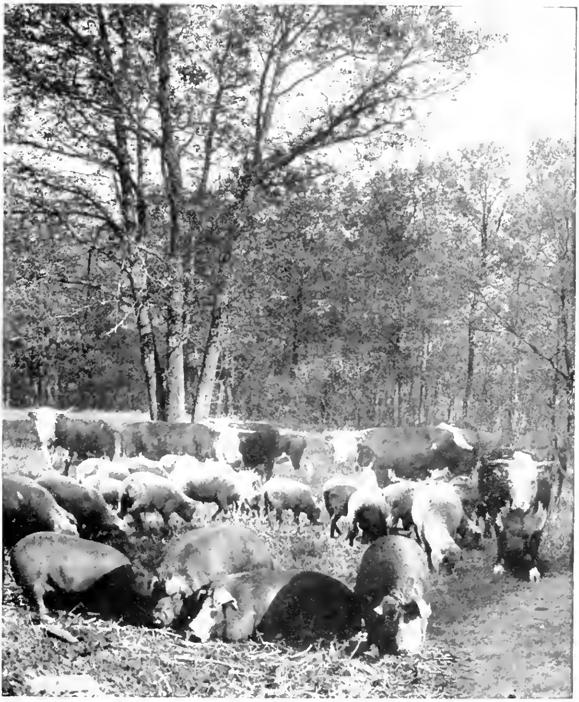


Courtesy Swift & Co.

MORE GRAIN AND OTHER FEED MUST BE RAISED lacking and how to supply them with artificial means. He must have a good general idea as to drainage, in order to obtain the best advantage from his land and he must understand what elements of its food a plant derives from the atmosphere. It is a simple thing to know that grapes grow best on a hillside, where they get the advantage of the sun's rays a greater part of the day, and this is particularly true of melons and other fruits. A few such facts, understood and applied some years ago, would have rendered many an abandoned farm profitable.

Education and Its Relation to Agriculture.—In the same manner, the dairyman should understand the chemistry and bacteriology of milk, together with the kind of feed best calculated to produce good butter and cheese qualities. He should also have a good understanding of the points that mark good cattle and know how to treat their common disorders, in order to raise them successfully. This is the day of the educated farmer, and great strides have been made during the past decade, in every state, to provide the proper kind of training along this line. Among the greatest educational institutions of the land are the agricultural colleges of such states as Iowa, Kansas, South Dakota, Minnesota, and North Dakota, while many other institutions of renown, such as Cornell University, and the state universities of Michigan, Wisconsin, Missouri, Nebraska and many other states provide exceptional training along this line.

At the agricultural colleges the courses are very thorough and their completion leads to the degree of Bachelor of Agriculture, yet there are shorter courses where, by intensive study, one may take training along any particular line. These courses are sometimes given during the winter months, when there is little work upon the farms, or they may be taken at some other time of the year during a lull in the work. Thousands of farmers take courses every year in seed selection, stock judging, plant spraying, motor engineering, and other branches. The farmer is thus brought to realize that his farm is something like the factory, or some other great business institution, for the production of necessities or luxuries for the public, which may be made to yield the highest profits if handled in an intelligent and well-informed manner.



Courtesy Swift & Co.

THE FARM'S GREATEST SOURCE OF REVENUE

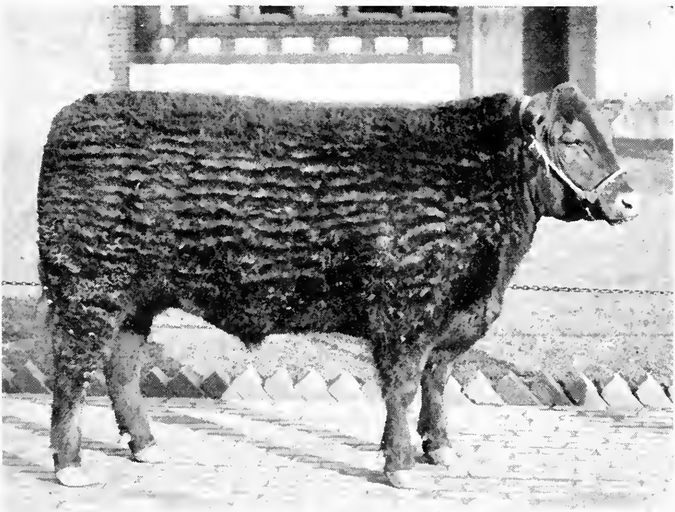
Agricultural Experiment Stations.—Nearly every state conducts an experiment station in connection with its school of agriculture. Here several hundred acres are kept under constant intelligent cultivation, both in raising all kinds of vegetable crops, and in pasturing and feeding domestic live stock, horses, cattle, sheep and hogs. Every suggested experiment is here thoroughly tried and all improvements are made public, that the farmers may profit by them.

Farm Machinery and Its Relation to Food Production.—At the beginning of the past century only three per cent. of the inhabitants of this country lived in cities, the remainder lived in small towns and on the farms, and were dependent upon agriculture for subsistence. There was little manufacturing, as almost everything, except the products of the soil, was imported. At that time there was not enough wheat raised in this country for bread, and it was feared that the food supply would not keep pace with the increasing population. The limit of food production with the sickle had been reached. However, immediately following the invention of the reaper, the number of bushels per acre began to increase, as well as the size of the farms, as much more grain could be handled by machine than by hand labor.

From the ninety-seven per cent. of people on the farms in 1800, the number has gradually decreased, until now there are only about thirty-six per cent. of our population left to work the farms. There has been a constant flow of young men from the farm to the city, yet the farms of today produce, with only one-third of the labor, enough to feed the entire population and export one hundred million dollars worth of products per year.

There has been no such achievement elsewhere in the history of the world. Much, of course, is due to the fertile soil of our great plains and valleys, much to the government which has given security to property, and much to the great railroads that have transported the products across the continent. Much more is due, however, to our great number of inventors, who have recognized the necessity of improved methods on the farm, and who have provided the farmers with tools and implements, that have enabled them to produce more cheaply than any other nation in the world. In no other country could be harvested so expeditiously, eighty million acres of corn, forty million acres of wheat, thirty million acres of oats, twenty million acres of cotton and fifty million acres of grass, every year.

Consider for a moment how it would seem to attempt to harvest eighty million acres of wheat with the sickle and thresh it with a flail! How absurd it would be to attempt to gin ten million bales of cotton by hand!



Courtesy Swift & Co.

PROGRESSIVE FARMERS RAISE FINE CATTLE

While the cotton crop gives employment to more capital and labor than any other one product of the farm, yet the area planted in cotton is only one-fourth that planted in corn, and now we are picking cotton by machinery and a new era has opened.

The plow, seeder, planter and cultivator have produced areas of the small grains that it would be impossible to harvest without the self-binder. The crooked stick—the plow for centuries—merely scratched the surface of the ground. Our inventors have so fashioned the plow that the soil is completely turned over. The operator now rides, and in place of one furrow he turns over two or more, and the latest wonder is as many as twenty gang plows pulled by a traction engine! Harrows from eight to thirty feet in width follow the plowing and prepare the soil perfectly for the seed. The improvements in planters and drills have not added so much to the area as they have to the quality of the planting. Cotton can stand in the field for three months after it ripens and corn can be picked after the snow falls, but wheat and other small grains must be harvested when ripe. The reaper is, therefore, the forerunner of civilization.

Increasing Value of Farms.—It seems hardly possible that, within the last fifty years, the total value of the farms of the United States has increased twenty-five-fold, but such is the case. The Great American Desert has been made over, by irrigation, into the most productive region imaginable. A million people pour into this country every year, in addition to the natural increase by a like number. This all means that the farms must gradually become smaller and the farming more intensive, as is the case in foreign countries having a congested population. The education of our farmers will enable them to produce greater yields per acre with correspondingly greater returns.

Farms in the United States are operated by three classes of people: owners, cash tenants and share tenants. About sixty per cent of the farms are operated by the first class, and this number is gradually increasing. In some sections of the country the land is owned by large syndicates, who operate upon an elaborate scale.

This is particularly true in those sections adapted for the growing of wheat and cotton.

Tenant farmers are of two classes: those who were formerly farm owners and have taken a step downward and those who were formerly farm laborers and have taken a step upward. We often hear it said that it is impossible for a young man to begin with nothing and become the possessor of a good farm clear from incumbrances. Yet, during the past decade the number of farms worked by their owners has increased twenty per cent. There are great opportunities for the farm hand who is industrious and economical.

Of all classes of help the farm laborer is the most difficult to find and retain. Such labor is so scarce in some states that it is necessary to import men, who are usually novices, to do the work. This is particularly true in the wheat belt. In the West and Northwest the majority of the laborers are Chinese and Japanese and in the South many negroes are employed. In many states the farm hands are almost as well off as their employers. Machinery has reduced their drudgery to the minimum, while their wages have steadily advanced.

Opportunity for the Farmer.—The freedom from restraint, the feeling of equality and knowledge of opportunity, which lies before every farmer, should be an inspiration, and spur every one to efforts such as have wrought the marvelous progress in farming, which has been made during the past century. The field lay open to all at the beginning, but it was only the American farmer who found out, accepted and successfully used new methods, new implements and machines, thereby increasing many times his power of production and enabling him to compete in the markets of the world against cheap labor. At the same time he is the best fed and best dressed farmer in the world and has every opportunity for culture and refinement.

FOR RESEARCH

1. What is a homestead? A timber claim?

2. May land yet be taken by homestead or timber claim? Who is entitled to the right?

3. How are forest reserves or Indian lands thrown open to settlement? What is the cost of entry?

4. What is a patent? A quit-claim deed? Warranty deed? Deed of trust? Obtain samples of each and study provisions.

5. What effect does climate have upon determining what crops are suitable for each section?

6. Why is New England better adapted for manufacturing than farming? What can you say of the farms there?

7. Why is farming, in general, not carried on upon a large scale near the cities?

8. New York has gradually changed from a farming state to a dairying state. Why?

9. What is meant by crop rotation? Why is it practised? How is it possible to raise cotton in the South and wheat in the Middle West, year after year, with no decrease in the yield?

10. What have the Agricultural Colleges, the Department of Agriculture and the great implement companies done toward increasing the yield of the farms and the education of the farmers?

11. Obtain Farmers' Bulletins from the Department of Agriculture and from the Agricultural department of your own state.

CHAPTER VII

THE CORN CROP

Corn was the name formerly applied by the people of every land to their leading grain. Maize, or Indian corn, was first found in America, and now furnishes food for a larger part of the human race than any other grain except rice. It is the most valuable crop grown on American soil. While this country gave it to the world and taught all people how to use it for bread, as well as for many other things, we still produce over four-fifths of the world's crop, amounting to over two billion bushels per year, which is grown upon over 90,000,000 acres of ground.

The Corn Crop.—The most striking facts in the history of the world's agriculture are given in a recent report of the Secretary of Agriculture. In this report the value of the corn crop is given as $1,720,000,000—enough to pay for the clothing and personal adornment of all the people in this country. The gold and silver coins and bullion of the United States are not of greater value. This wonderful crop has grown up from the soil and out of the air in 120 days—enough value to build two of the greatest battleships on earth every day! One cannot realize how much corn this is. Loaded in freight cars it would make a train that would reach around the earth. It has given the states of the corn belt most of their wealth and helped to establish most of their industries. Wonderful as this may seem, the average yield per acre is only about twenty-six bushels. What will it be when we produce fifty bushels per acre?

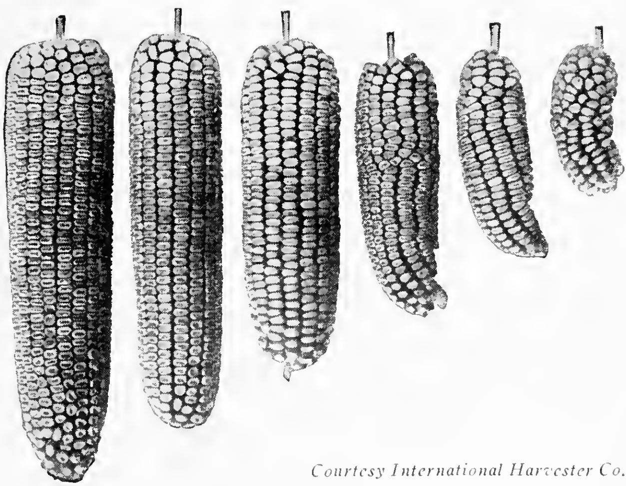
Corn Products.—As a breadstuff corn is second only to wheat, and its consumption for this purpose is rapidly increasing. But this is only one of many uses. So extensively does it enter into our daily life that we encounter a great many things that impress us with the importance of this regal grain. The hominy mills consume great quantities of corn and many of the leading breakfast foods are made from it. Corn oil is almost indispensable in the manufacture of the better grades

Photograph by L. C. Rusmisel

"WHEN THE FROST IS ON THE PUNKIN AN' THE FODDER'S IN THE SHOCK"

of soap, and it is also used as a substitute for olive oil, and even a substitute for rubber has been made from it. Most of the starches upon the market are pure corn products. Four-fifths of the syrups used in America are made from corn, and most candies contain corn syrup or glucose as a basis. The coloring of most of the cloth about the household was probably done through the use of dextrine, which is used as a medium for holding the color during the printing processes.

We seldom speak of meat or live-stock without thinking of "corn on the hoof." The horses and other animals on the farm were fattened upon corn. Corn is also used very extensively by distilleries in the manufacture of spirituous liquors, and a large proportion of the sugar used in the United States is made from corn. It also furnishes a good substitute for gum Arabic which is used in the preparation of the white pastes in common use. Over one hundred distinct products are made from this grain, and there are countless uses for the stalks, cobs and husks.



Courtesy International Harvester Co.

EVERY EAR SHOULD HAVE BEEN GOOD

From the corn pith we obtain cellulose, an indispensable article used between the inner and outer hulls of battleships. When the hull of the vessel is pierced the cellulose swells almost instantly, upon coming in contact with water, and automatically closes the aperture. Denatured alcohol is made from the stalk as well as from the grain. The husks are largely used in the manufacture of mattresses. The cobs are valuable for fuel, and in Missouri alone, over twenty-five million corn-cob pipes were made last year. Is it any wonder that we speak of corn as the King of Grains?

Corn Growing Sections.—While corn may be profitably grown in all of the states of the Union, Illinois, Iowa, Missouri, Indiana, Kansas and parts of Ohio and Nebraska comprise what is generally known as the "corn belt," for here the acreage and yield is greatest. In these states the average production is about thirty-five bushels per acre. The plant requires a rich, loamy soil, long summers and warm nights. While it requires an abundance of moisture, too much rainfall is disastrous. Corn thrives well in Italy, Austria and the Balkan Peninsula and is a very important crop in Australia. It is also a staple crop in Mexico and from it the natives make their *tortillas*.

Seed Selection.—Mr. P. G. Holden, when connected with the Iowa State College, did more than any other man to increase the yield and quality of corn, by carrying his ideas directly to the farmers. He was the originator of the "corn gospel" train, which has traversed all of the states of the corn belt many times. Mr. Holden began this campaign for more and better corn by telling the farmers that they should carefully select their seed corn, test it in a germinating box and plant only seed from such ears as were found to possess perfect vitality. If a single grain failed to sprout, the entire ear should be rejected. He argued that money spent for the best seed corn was well spent, no matter what the price may be. If a farmer had an imperfect stand, or if part of the stalks produced "nubbins," then the same proportion of the farmer's labor was wasted.

Suppose that the product of a single hill is four ears of various size and quality, we seldom attach any importance to this, as it is such a common occurrence. The condition of soil, climate and moisture were the same, and each stalk in the hill received the same cultivation. The difference lies entirely in the character of the seed planted. This condition can only be remedied by testing every ear of seed corn before planting, and using only such ears as show good, healthy sprouts.

The germinating box is usually made about six inches deep, divided into smaller rectangular compartments and partially filled with moist sand or sawdust, each square being numbered to correspond to the ears being tested. Six grains are taken from different parts of each ear, and placed in the proper compartment, and

Courtesy International Harvester Co.

SELECTING GRAINS FOR TESTING

they should germinate in from four to six days. At that time the ears corresponding to those grains showing weak vitality should be rejected.

Soil Preparation.—The yield may also be increased by scientific selection and preparation of the ground. The old-time farmer planted the same ground in corn, year after year, and wondered why the yield gradually decreased. This condition can be remedied by a systematic rotation of crops, by the use of fertilizer, or by sowing the ground to clover, alfalfa or other humous crops for a time, which will restore the exhausted elements to the soil. The use of modern machinery will also materially increase the production, as perfect cultivation is always essential.

Some varieties of corn are much better adapted to certain localities than others. In some sections the white yields better than the yellow, and in other localities the small varieties actually produce more bushels to the acre than the large ears. Among the leading varieties are: Boone County White, Reid's Yellow Dent, Iowa Silver Mine, Golden Eagle, Leaming and Cattle King.

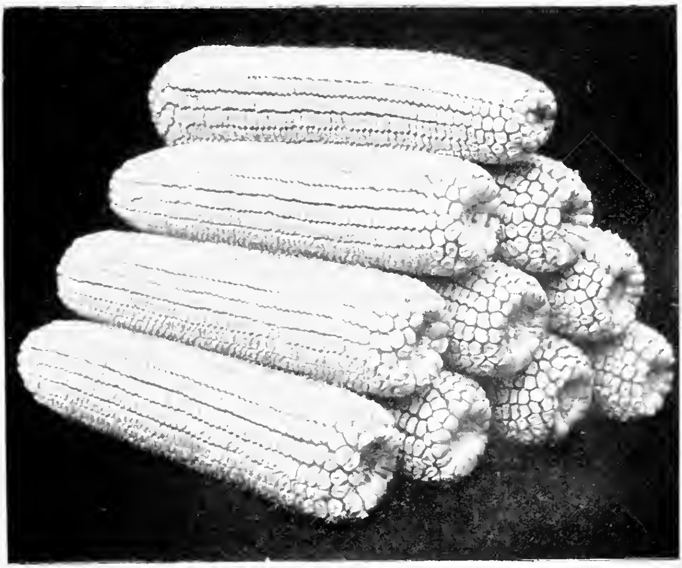
Flint corn is grown extensively in the eastern and northern parts of the United States, the grains being characterized by a hard outer covering, nature's protection from the cold.

In the extremely northern states a small variety called "squaw" corn is the only one that can be grown, as it ripens in the short season of ninety days or less. Sometimes half a dozen stalks will branch out from one root. The ears are very small but the number of bushels per acre is often as great as from the standard varieties grown farther south.

Corn Canning Industry.—The growing of corn for canning is an important industry in Illinois, Iowa, New York, Ohio, Maine and some other states, and the industry is growing very rapidly. For this purpose sweet corn is used and there are many varieties grown, Stowell's Evergreen being the most popular. The corn is gathered while green and the kernels cut from the cob.

Everybody is familiar with the many tasteful preparations made from popcorn, the growing of which has become an enormous industry in the United States. The most popular variety is called White Rice, and much is exported each year.

How Corn is Harvested.—The invention and manufacture of modern machinery has facilitated the handling of corn to a wonderful extent. The corn binder minimizes labor for shocking and hauling, and some of these devices are so simple that they can be constructed by the farmer himself. The binder will handle corn that has been blown down, and drop the bunches at convenient places for shocking. By using one of the very latest machines a shock is built upon a platform as the machine moves along and it is shifted to the ground when completed. The husker and shredder removes the



Courtesy John Dere Plant Co.

KINGS OF THE CORN SNOW

husk at the barn and automatically stores the shreds away for use as feed. No machine has yet been invented to husk the corn successfully in the field, although several have been tried. This operation must yet be done by hand, in which case the stalks are left standing in the field. Stock will eat the fodder during the winter and in the spring the remaining stalks are plowed under the ground.

The Marketing of Corn.—While the market for corn is always brisk, it will bring about four times as much, depending upon current prices, of course, when fed to hogs or cattle. The most successful corn growers are, consequently, heavy feeders. This is exemplified at the largest corn farm in the world, the Rankin Farm near Tarkio, Missouri. Here are grown about 20,000 acres of corn every year, the farm consisting of 30,000 acres. On this farm over 1,500,000 bushels are grown every year, and as much more is usually purchased, every bushel of which is used for feed. On the average, $100 worth of corn is fed every hour, 4,000 bushels daily, to 6,000 cattle and 20,000 hogs.

To plant and cultivate this crop requires an investment of $50,000 worth of machinery. In every operation a man cares for two rows at a time, each man covering about twenty acres in a single day. This modest Missouri farmer is the real "Corn King," whether the "bears" or the "bulls" are in the ascendancy, producing more than any other farmer in the world, and feeding a larger number of cattle and hogs than any other individual. And he began, on part of the present farm, with a yoke of oxen, an old-fashioned plow and plenty of ambition!

The methods of selling corn are the same as those used in the sale of all other grains, as described in the Study of the Grain Market.

FOR RESEARCH

1. Make a map of the United States, coloring the states producing the most corn.

2. How does corn compare with wheat as a productive plant? Which is the most useful?

3. Why is corn most successfully grown in the Mississippi Valley?

4. How does the Department of Agriculture assist corn growers? What action have the states, individually, taken along this line?

5. Name the Agricultural Colleges that have been of most assistance to the corn growers. Locate them upon your map.

6. What railroads enter the corn belt? Sketch them upon your map, showing the principal points reached.

7. Make a germinating box and test a number of ears of seed corn. What is a grader? What is pollen? What is the tassel? What purpose does the silk serve?

8. Write to the nearest Agricultural College for grading blanks and learn to score ears of corn.

9. Why do cities go to great expense in sending out seed corn "specials" to teach the farmers to raise better corn?

10. What effect has the advent of the silo had upon the corn industry?

11. Where has the National Corn Show been held and of what state have the prize winners generally been residents?

12. What are the characteristics of a good ear of corn?

CHAPTER VIII

THE WHEAT INDUSTRY

Wheat occupies the highest place among food plants. Its origin is older than civilization, being spoken of as "corn" in olden times. It was the favorite grain

Courtesy Rock Island Lines

A FIELD OF SHOCKED WHEAT

of the old Egyptians and to this day the Valley of the Nile still furnishes a wealth of wheat to its crowded population. The countries most noted for its production are: the United States, South America, Russia, France and India, the United States being the foremost; as the invention and use of improved machinery in this country has been responsible for an increased production that is unparalleled.

The Production of Wheat.—There was a time when our methods were as crude as they are yet in some parts of Mexico, Russia and other foreign countries, for, one hundred years ago we could not raise enough wheat for our own use, while at that time 97 per cent. of our population lived on the farm. Today about 36 per cent. of our people are farmers and they raise over 700,000,000 bushels per year, enough to provide one and one-half loaves per day, for every inhabitant of the land, for a year.

The cultivation of wheat is unlike that of most crops, for, after seeding, there is little work to be done until harvest time. The plowing is done in the early fall, and winter wheat is sown at once, the fields becoming green before the snow falls. Where the winters are severe the wheat is sown early in the spring. Wheat grows best in cool weather, with occasional rains, and ripens best in cool, cloudy weather, but, during harvest time every hour of sunshine is cause for gratitude. Formerly, all work was done by the use of horse power, but the traction engine is rapidly being utilized. The perfection of the gasoline engine has been the crowning step in the history of power development.

By the old method, the ground was plowed with a single plow, the wheat sown broadcast and harrowed in. Today the press drill is in almost universal use. It drops the grain in rows four inches apart and insures an even stand. There are many varieties of wheat, each adapted to some particular locality. The duram and macaroni varieties will grow in arid regions where no other variety will thrive; then there are the bald, bearded, hard, soft, white and red, each occupying its particular sphere. The wheat plant branches very extensively, an average of five hundred grains as the product of a single grain being a moderate estimate.

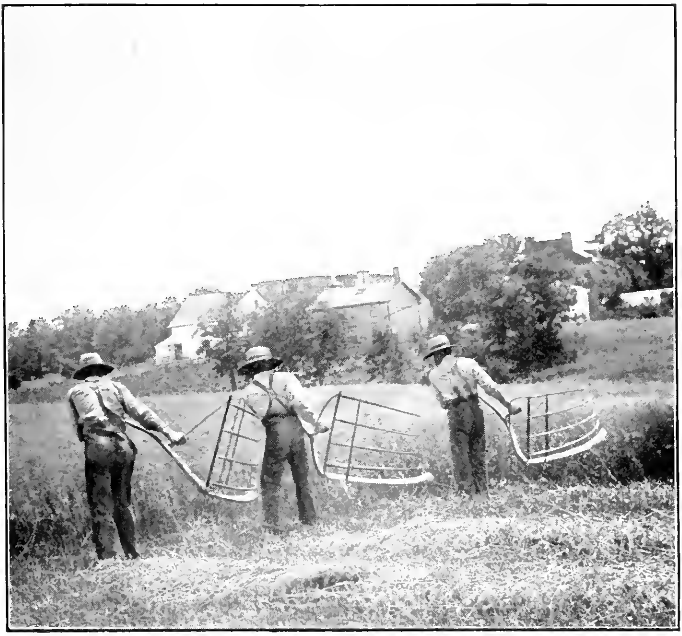
Harvesting Wheat.—The primitive method of harvesting was with the knife, a handful at a time, care being taken not to lose a single head; then the sickle came into use, as it would cut a larger amount with greater ease. This method was never used in this country, except on small farms for gathering fallen grain, but it was the only implement known in foreign lands for centuries. The scythe took the place of the sickle, as it would cut a still larger amount, and, by adding several wooden fingers above the blade, we were given the cradle, which gave the wheat industry a new impetus, as

Courtesy International Harvester Co.

REAPING WITH SICKLES IN ALGIERS

it would cut a wide swath and keep the straws straight at the same time; but this has also been abandoned, except in hilly countries where the ground is too steep for wheeled machinery. A man walked behind the cradle and bound the wheat into sheaves by hand, another set the sheaves into shocks, breaking two sheaves in such a manner as to form a roof for the shocks.

The Self-binder and Reaper.—Within the memory of men still living the reaper was invented. This machine was first demonstrated by Cyrus McCormick, on a Virginia farm, in 1831. This machine not only cut the

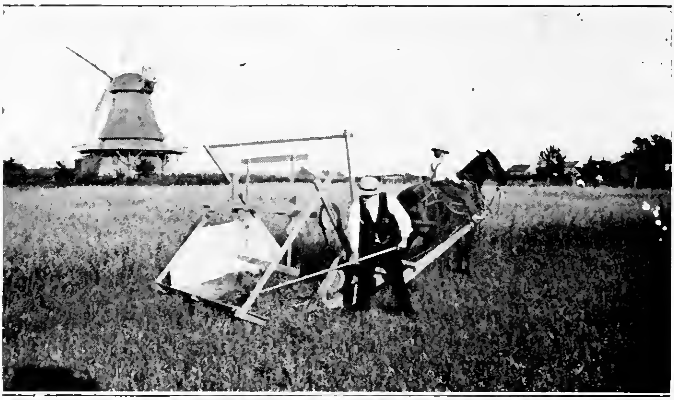


Courtesy International Harvester Co.

REAPING WITH CRADLES, PENNSYLVANIA

grain easily, but it encouraged the farmers to grow larger crops. When the self-binding attachment was added in 1870, a wonderful change took place. It is claimed that this invention moved civilization westward at the rate of thirty miles per year, as more ground was needed, that the farmer could have larger fields to harvest. As farm machinery was improved, our agricultural empire expanded, until it embraced what is now the greatest wheat district in the world.

It is a great sight to visit a bonanza farm while harvesting is at its height. In the early morning, while the dew glistens upon the grain, the harvesters move into the cutting line until there may be forty of them fringing the waving field for a quarter of a mile. The reels whirl like great wings, and a swath of grain six feet wide goes down at every turn, the whole line of machines leaving a trail of sheaves. Each machine cuts twenty acres per



Courtesy International Harvester Co.

McCORMICK'S FIRST HARVESTER

day, eight hundred acres for all! Fortune hangs in the balance of the waving wheat, for it is the only crop in its chosen section. That is why the army of harvesters are at work at break of day, and sometimes the harvest moon silvers the scene as the binders rattle throughout the entire night.

In the southern part of the wheat belt the header has been used almost exclusively. This machine reaps the grain much more rapidly than the binder, it being cut about five inches below the heads, as the machine is pushed ahead of the horses through the grain. An automatic carrier elevates it into a large barge, and, as soon as one is filled another takes its place. Some of these machines cut an area as much as twenty feet wide, but it is not practical where there is enough rain to endanger the wheat in the shock, as it will not turn water like bound grain.

The Combined Harvester and Thresher.—In California and other parts of the West we may see the modern giant of the harvest field, the combined harvester and thresher. This machine heads the wheat, threshes it, sacks the wheat and ties the straw into bundles! About thirty horses are required to pull one of these machines, very frequently traction engines are used. These machines are only practical in the West, for, on account of the long dry season, the wheat may be allowed to stand until entirely ripe, and the ground also becomes sufficiently hardened to bear the great weight of the machine. Western wheat is always sold in the sack, and, after harvest, thousands of bushels are frequently stacked at the railroad stations awaiting shipment. Our growing relations with Oriental countries have created a great market for wheat.

Methods of Threshing Wheat.—The oldest method of threshing grain was to tramp it out with horses or other animals. For centuries it was pounded out upon a threshing floor with the flail, and when the heads were all shelled, the straw was raked off, the grain and chaff were then elevated and allowed to drop through the air, the wind blowing the chaff away. A hand-operated fanning mill afterwards took the place of this process.

Threshing is now the picturesque coloring feature of the harvesting. A machine and outfit costs about $3,000, and it travels about, from farm to farm, threshing for a certain price per bushel. In the center of the field the long, red thresher stands, and a hundred feet away, linked by a broad belt, quivers the traction engine. A loaded wagon stands by each side of the machine, meanwhile two men pitch the sheaves upon the self-feeder of the hungry chattering thing. The steel arms greedily thresh it back and forth and the chaff and straw are blown through the long metal self-stacker. Down a spout into a wagon-box pour the sun-flecked kernels of wheat, which is hauled to the farmer's bins, where he holds it until the market suits, or it may be hauled at once to the elevator, many of which may be found along the railroads traversing the wheat belt.

Courtesy International Harvester Co.

COMBINED HARVESTER-THRESHER

After the wheat is graded and weighed it is elevated to the bins, to be later shipped in freight cars from this primary market to a terminal market. One of the greatest of these markets is Duluth, Minnesota. Some of the elevators there hold two million bushels and from them the grain is shipped by steamer through the Great Lakes to Chicago, Buffalo, New York or some foreign country. However, millions of bushels of wheat lie in the farmers' bins and in the local elevators. Fortunes and destinies of men are tied up in it. At Chicago, the Food Market of the World, in the Board of Trade building, the dealers, every day, buy and sell millions of bushels of wheat that they never see, and make fortunes for people they never know.

The Milling Industry.—Wheat was first ground into flour between two stones. The early colonists harnessed the wind and made it give motion to the wheels which ground the grain. The old Dutch windmill was a common sight in this country until a decade ago, when it entirely gave way to the tide of progress. Upon the shores of swift-running streams the early settlers also built mills, using the water as power. To these mills the people came for many miles, but these are also silenced now by greater ones. The center of the milling industry was first at Wilmington, Delaware, later at Baltimore, Md., then at Rochester, N. Y., and finally Minneapolis became the greatest flour-milling center in the entire world. There are, altogether, 25,000 flour mills in the United States, most of them being near the fields or at terminal markets.

A Flour-Producing Center.—At Minneapolis the power is obtained from St. Anthony's Falls for the greater part of the year. It is an inspiration to view the world's greatest granary. Alongside the mammoth steel elevators the cars shuttle back and forth, automatic shovels scoop the grain from them, and empty it into hoppers, from which it is lifted to the top of the great elevators by an endless chain of buckets. Two hundred thousand bushels of wheat pass through these mills every working day of the year, issuing forth eighty thousand barrels of flour. Day after day this flood of wheat rushes into Minneapolis, 90,000,000 bushels a year, a torrent mightier than Niagara!

Making Flour.—In the first mills in this country the grain was crushed between two large circular stones called burr-stones. But the hard wheat of the North dulled the corrugated surface of these stones so quickly that they became useless. Then the process of grinding between steel rolls was introduced from Hungary, and this, with the invention of the middlings purifier, has revolutionized the milling industry quite as much as the harvester revolutionized the wheat industry.

There are over one hundred and fifty separations made in handling the stock from the time the wheat enters the mill until the flour is ready for the market. Milling flour is not like grinding coffee. After the grain is washed and thoroughly cleaned, it is passed into steel heaters, which toughen the outer covering of the grain and prevent its breaking into particles and entering the flour. The rollers crush the grain, passing it through six reductions in the first series, each reducing it a little finer. It is then passed through the bolting machinery where the middlings are separated, the residue being sent on to another set of rollers, which crush it more finely, then back through a finer bolting cloth, this process being repeated six times. The middlings are then passed through the purifier which extracts the germs. They are then mixed with the bran for feed, the remaining part of the middlings being then finally ground into flour. The whole process is one of purification. From the time the cars are unloaded by automatic shovels, the wheat, middlings, and flour are elevated and conveyed in all directions by automatic machinery, without the direct intervention of man. And the finest flour we produce in this country goes,—not abroad, but into our own homes, to help produce a better succeeding generation.

The harvester has been called the barometer of civilization, as it is not found where slavery and barbarism exist. The only place where there is no call for it is in those countries where the luxury of the cities is built upon the plunder of men and women who work in the fields. The harvester has made a greater advance in Russia in recent years than in any other country. More business is now being done in that country than was done in the whole world ten years ago. In many parts of Russia today farming is done under the most approved methods, where, a generation ago, the wooden plow, the sickle and the flail were the only implements used.

Wheat-Producing Countries.—Argentina stands in the front rank as a wheat producing country today, although the crop has only received marked attention there for about twenty years. It is now the South American Minnesota, only eleven times larger. Two million dollars' worth of harvesters annually go to Australia, and along almost any of the historic roadways of the world may be seen American machinery. "On the Road to Mandalay," along the Appian Way, and on the trail that marks the flight of Napoleon from Moscow, will be found these indispensable machines. They are cutting wheat on the battlefields of Austerlitz, Sedan and Waterloo!

In Mexico, in the very shadow of Popocatepetl, we find American harvesters. Mules carry them over the Andes, and the wheelbarrow takes them into Central China. They are for sale in the holy cities of Rome, Jerusalem and Mecca! The Sphinx may yet look across yellow fields where the American binder is clicking cheerfully!

Like the advance of the Boers into the Transvaal and the Japanese into Korea, there has been an advance of three hundred thousand American farmers into Western Canada, and they are upbuilding a civilization which assures us that this part of North America will be the wheat land of tomorrow, one of the greatest in the world. The American harvester is much more than a handy device for cutting grain, it is a national emblem which makes democracy possible.

FOR RESEARCH

1. Make an outline map showing the "wheat belt" of the United States. Make another, showing the leading wheat-producing countries.

2. What are the principal railroads traversing the greatest wheat-producing areas? Where do they take the grain? Trace a car of wheat from Central Kansas to Chicago. From Aberdeen, S. D., to Minneapolis.

3. When does wheat ripen in the Southern part of the "wheat belt"? In Kansas? Nebraska? South Dakota? North Dakota and Minnesota? In Canada?

4. Name two great railroads in Canada. What are their principal terminals?

5. When is wheat from Argentina placed upon the market? From Australia? From Russia? From what do the Russian people make most of their bread?

6. Why is the yield, per acre, of wheat from two to three times greater in Europe than in the United States?

7. Between what parallels of latitude are the greatest wheat countries of the world situated? Why?

8. Why is wheat a valuable grain for food? Make a list of its principal uses.

9. To what countries do we sell our surplus crop? Trace a shipment of wheat from Buenos Ayres to London. From New York to Calcutta.

10. What is a disc harrow? A gang plow? From what is binding twine made? Where is it obtained?

11. Why is wheat usually sold in bulk?

12. Where are oats, rye and barley grown and how do they compare with wheat as articles of food and from a commercial standpoint?

CHAPTER IX

RICE, THE ROYAL CEREAL

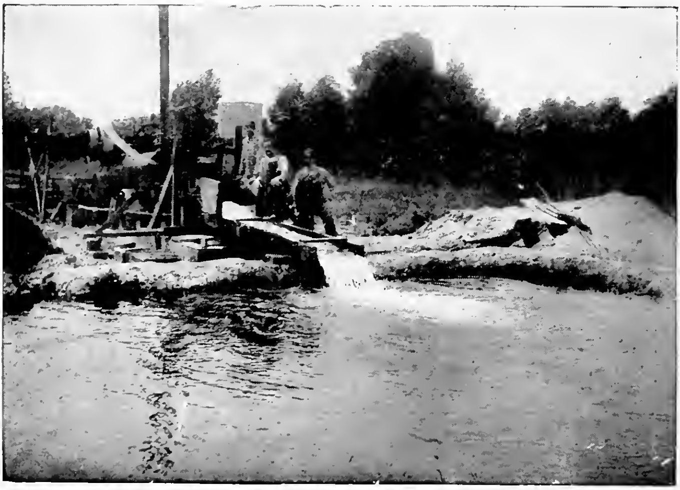
Rice is not only the most important of all the cereals, but it is by far the most important of all food products. It is almost the exclusive diet of 5% of the human race. In addition to being the most extensively used and most widely distributed of the world's foods, it produces more muscular energy and physical endurance than any other food. It is the chief diet of the wonderful Japanese soldiery, whose strength compels the admiration and wonder of the world. It is eaten almost exclusively by the coolies of India and China, those human machines who can carry all day, under a burning sun, a load that would stagger an American or European.

The Food Value of Rice.—The main reason for the superiority of rice over all other forms of food is its ready digestibility, plain boiled rice being assimilated in one hour, while the other cereals, legumes and meats, and most vegetables, require from three and one-half to five hours. Rice thus enables a man to economize fully 75% of the time and energy expended in the digestion of ordinary food, setting it free to be used in his daily vocation.

Where Rice Is Grown.—Rice is a cereal of the grass family. It is an annual, reaching two to five feet in height at maturity. It is indigenous in certain parts of India and tropical Australia. So far as is known it was the first cereal used by man. The Aryans carried it with them in their migratory marches from the cradle of the human race. It was introduced into China about 3000

B. C., and was grown in the Valley of the Euphrates 500 B. C. The Arabs took it to Spain, and, sustained by its marvelous nourishment, planted their victorious banner everywhere.

It was introduced into Italy in 1468. Sir William Berkeley first cultivated it in Virginia in 1647. Today it is grown as the staple article of food by the millions of India, Siam, China, Japan and Africa. In the Mediterranean countries and in the tropical and semi-tropical



Courtesy Mo. Pac. Ry.

RICE PUMP IN ACTION AND IMPROVISED RESERVOIR

regions of North and South America it is cultivated as a principal means of subsistence. It was introduced into Louisiana soon after the Civil War, and, at the present time, the lowlands along the Mississippi and Gulf Coast are practically given over to its culture. In more recent years it has been carried to South Carolina, Arkansas and Texas and has become one of the most profitable crops in those states.

Rice Culture in the United States.—The advantages of the rice grower in this country, over others, are many. One is freedom from tax, for, in Japan, there is an eight-dollar per acre expense for fertilizer. In India there is a $4.80 tax, per acre. There is no reason why the United States should not grow and mill all of its own rice and become an exporter. The American grower uses the improved methods and modern implements of the northern wheat fields: the gang plow, the self-binder and steam thresher, together with a boundless supply of water from the most modern and economical machinery. He is exempt from a large part of the labor expense, so proportionately great under Oriental methods. The number of acres that can be grown under the Oriental system, by one man, is, in Japan one-half of an acre, in China one-half to two and one-half acres. In this country one man can successfully care for 160 acres of the grain.

Rice Culture in Japan.—In Oriental countries the processes of cultivation and harvesting are yet carried on by the primitive methods of antiquity. In Japan, the plow is almost unknown. The soil is dug up and worked over with a mattock; sometimes a crude harrow is used for pulverizing. A horse or an ox may be occasionally used, but most of the labor is by hand. The rice is sown in beds, which are watered and carefully tended until the plants are from six to ten inches high, when they are taken up and set in rows, a plant at a time, the fields having been prepared and flooded with two or three inches of water. When mature the rice is cut with a sickle, bound in small sheaves, and tied to poles for drying. Threshing and winnowing are done mostly by hand. In every mountain village in Japan may be found rice mills operated by one-man power, pounding the grain with a stone or wooden pestle, and a one-woman power at a crude fanning mill cleans the grain of the hulls. Contrast this with our modern rice mill which is an automaton of complicated machinery, into which the rough grain passes and finally appears, ready for market, graded, sacked and weighed, at the rate of 20,000 to 200,000 pounds per day.

Rice Farming.—Rice, in the field or in the sheaf, somewhat resembles oats. From ten to one hundred straws grow from a single seed and a single head contains from one hundred to four hundred grains. It is a water plant, but it does not grow in swamps. The rice farm must be high and smooth, though not necessarily

Courtesy Cotton Belt Route

A FIELD OF RICE—LOUISIANA

absolutely level. It must be well drained or susceptible of perfect drainage. A shallow soil with clay sub-soil is also very desirable, in order that the water may be held at an even depth over the entire field. When the land is not perfectly level the field is sub-divided into "cuts" or smaller fields of from ten to twenty-five acres each, and each field is then leveled so that the water may stand at about the same depth over each cut. Around each cut, levees are built to hold a supply of water when needed.

The levee lines are usually staked out to give a fall of from three to five inches from levee to levee. The work of constructing levees is generally done after the seed is sown, and requires little time. Water is not used until the rice is six or eight inches high. In some sections the water supply is obtained from the streams, through canals, but in most cases the farmer operates his own well and pumping plant. Sometimes pumping companies water many farms from one plant and charge the farmer one-fifth of the crop for water. A well, fitted with an eight-inch centrifugal pump, will throw a stream of water sufficient for a 160-acre field.

Soil Culture For Rice.—In preparing the soil for planting rice the same methods are followed as for wheat or oats. The ground is plowed with an ordinary sulky or gang plow and pulverized with a disc harrow. The seed is then drilled with a press drill. About one-third of a barrel of rice seed is required to plant an acre. The sowing time is from March to May—the earlier the better. When the rice stalk is from six to eight inches high the water is turned on and kept at a depth of from four to six inches for sixty or seventy days. Some farmers think it best to drain their fields for a few hours, perhaps for a day, about four times during the growing season. This gives the sun a chance to warm the roots and permits of a supply of fresh water over the entire field.

When the rice is headed out, and the golden tint begins to supplant the green in the stem and blade, harvest time is near at hand. The flood gates are thrown open and the field is thoroughly drained. The beautiful golden grain is then harvested with self-binders and shocked and stacked exactly like wheat and oats. The threshing is done in the same manner, but that machine leaves the "grain in the hull" called "paddy" and is similar to threshed oats.

The rice is now sacked and sent to the rice mill, where, by a special milling process, the hull is removed and the pearly grain made ready for table use. This last process is unnecessary, but the American rice-buying public is guided almost entirely by looks when making retail purchases. The rice is put through a polishing process and coated with paraffine and talcum powder. Chemical analysis shows that it thereby loses eleven per cent. in proteids and sixty-five per cent. in fat. If American users could learn what the Orientals have known

Courtesy Cotton Belt Route

CUTTING RICE WITH SELF-BINDERS

for centuries, that the best rice does not glisten but has a dull, powdered appearance, then the first step would have been taken toward the rational use, in this country, of one of the greatest of all foods.

The area susceptible of actual cultivation in rice in the United States is approximately 1,250,000 acres. The present area in cultivation, 450,000 acres, produces about one-half of the amount of rice we consume. Our rate of consumption is increasing 20,000,000 pounds per year, which would indicate that it will be several years before we produce enough rice to supply even our home demand. The industry has assumed greatest proportions in Texas, Arkansas, Louisiana, Mississippi and other Southern states.

FOR RESEARCH

1. Why is intensive farming so extensively practised in Japan and China?

2. What are the principal differences in the methods used in planting and cultivating rice in this country and in Oriental countries?

Courtesy Mo. Pac. Ry.

THRESHING RICE

3. Why are the lowlands of the Southern states particularly adapted to the growing of rice?

4. Would American methods be practical in China and Japan? Is there any possibility that they will ever be adopted?

5. What effort has been made to introduce American harvesting machinery into these countries?

6. Obtain samples of head rice, oats, barley, rye and wheat and compare them. Which of these thresh out clean and which retain the husk like rice?

7. What is paddy? How is it treated in Oriental countries?

8. What is the value of rice as a foodstuff?

9. On a map of the world, locate the principal rice-producing countries.

CHAPTER X

THE GRAIN MARKET

The outlet for the farmer's surplus grain is found chiefly through the grain dealer, who operates an elevator, and who represents what is commonly known as the *local market.* This market is operated upon grain

Courtesy International Harvester Co.

THRESHING WHEAT WITH FLAILS

quotations from the Board of Trade of the City of Chicago.

The statement is frequently made that the speculative market has much to do in regulating values. While it may be that this market does influence values, in a way, the most potent factor in determining values is the law of *Supply* and *Demand.* Many attempts have been made to overthrow the power of this law, but, even though artificial values have been made and maintained for a time, prices have always sought the old level. It is, therefore, very essential for the producer to have an intelligent knowledge of crop statistics and understand some of the reasonably reliable methods for determining values in this remarkable branch of commerce, which has grown to such gigantic proportions that scarcely any one can fully comprehend them.

The chief grain crops of this country fix rates of interest, determine, largely, rates of transportation, measure the extent of credits given by merchants and bankers and place a proper value upon all kinds of collateral. Chicago is the great central market, the grain clearing-house of the world. Behind the manipulations of the market of this city are the grain crops of the entire

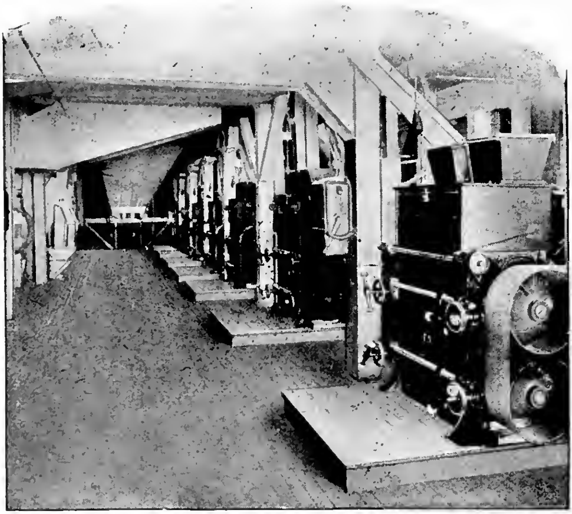
Courtesy International Harvester Co.

A MODERN THRESHER, KANSAS

world. Here is collected all information regarding crops and their movement, on the bulletins of the Board of Trade are posted the prices of wheat, corn, oats and provisions in every market throughout the world. This information is given out for the benefit of the producer and consumer alike, for the business is conducted free from restraint of trade.

Every exchange must be for cash, as it has no credit system. The breadth and activity of the market give to registered warehouse receipts an instant negotiable value. "Short" and "call" loans, made on these warehouse receipts, protected by law and recognized by the rules of the Board, are regarded as very desirable by the National banks.

Some idea of the vastness of this grain business may be gained when we consider that all of the gold mines of the world have not produced a greater value than the farmers produced in two years. This year's product is worth over six times the amount of the capital stock of all National banks; it is worth, approximately, three times the value of all minerals produced in this country, including coal, iron-ore, gold, silver, and quarried stone.



Courtesy Washburne-Crosby Co.

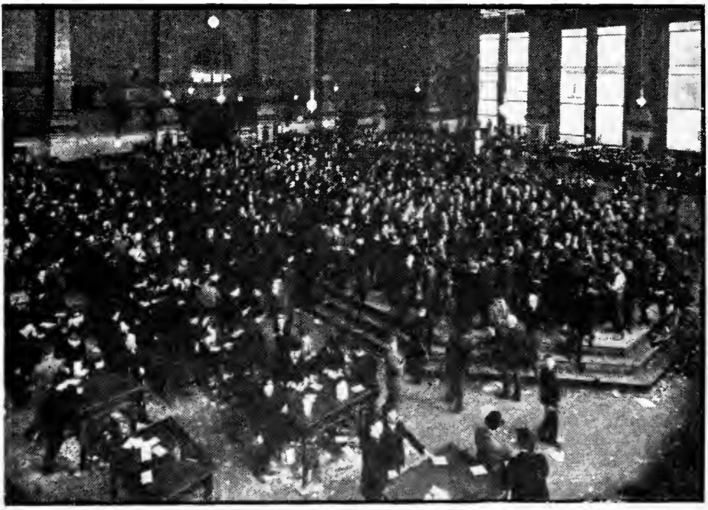
INTERIOR FLOUR MILL, MINNEAPOLIS

Many people seem to think that the terms, Board of Trade, cash selling, future options, speculation, bucket-shopping and gambling are synonymous. This is a very prejudiced opinion which should be corrected, for young men connected with the stock market should not feel that they have to go through life identified, either directly or indirectly, with gambling institutions.

Cash sales and future options are the legitimate forms of trading, recognized by the highest courts as a safe and legitimate means of selling and *distributing* our surplus farm crops. Of course sales are identified with the speculative market, but in this, as in all other lines of business, it is very difficult to draw the line between legitimate business risks and speculation. The fact that men take advantage of these forms of trading is evidence of its similarity to most other forms of business, and it must be expected that it may be abused. "Bucket-shopping" is a form of alleged trading that is purely a gambling proposition. Such transactions are simply bets that the market will fluctuate one way or the other, and the bets are placed in the hands of scalpers who pretend to register them by telegraph upon Board of Trade quotations. The keepers undertake to execute their deals, charging a commission of 25 per cent., which must be paid, no matter which way the market fluctuates. It is well for the uninitiated to remember that the Board of Trade does not buy, neither does it sell, nor make the price, for either buyer or seller, upon any commodity whatever. It simply maintains an exchange hall and enacts a code of rules governing the action of its members. The *individual* members, trading upon the exchange, fix all prices.

In addition to the "cash" market for grain and provisions the Board provides a market for "future delivery" of all such products. The grain dealer bases his prices to the producer upon market quotations, allowing for his profit and the freight. Suppose he buys 5,000 bushels of wheat to-day; he will then wire his commission merchant to sell, upon the Board, 5,000 bushels, which he is buying. He may advise selling for "immediate shipment" which allows him three business days in which to deliver the wheat upon the Chicago market. "Quick shipment" allows him five business days, "prompt shipment" allows him ten business days. Should the wheat be damp or not fit for shipment he may sell for

"June" delivery, store the wheat until then, when the order may be filled. The Board, therefore, affords him a market for his wheat that is ready to sell, and, likewise, provides a market *at once* for grain that it is more desirable to hold until June, July or some other months. This plan also eliminates the risk that would otherwise be encountered while the grain is in transit, and affords a market for the buyer as soon as he purchases from the farmer. Therefore, "cash" trades and "futures" are



Courtesy Chicago Bd. of Trade

THE "PIT," CHICAGO—WORLD'S GREATEST MARKET

closely identified with our every-day markets. Instead of "futures" proving a speculative form of trading for the grain dealer, it is just the opposite, he sells futures to *avoid* speculating on the market.

A large percentage of the wheat sold by the farmers goes direct to the mills. These are located in almost every town and city, the greatest mills in the world, and the center of the milling industry being at Minneapolis. These mills are usually on the market for wheat, and a supply sufficient to run them throughout the year necessitates a large investment during the summer months. They do not need all of the wheat at once, but they must take it when the farmers are ready to sell, or it will go to the grain dealer.

In self-defense, we will suppose a miller buys 50,000 bushels of wheat and pays for it. He can grind but 500 bushels per day, but he feels that he must buy and save the freight that he would have to stand, should the wheat be shipped away and back again. If the price is 80c. it costs him $40,000. If the market should decline two cents per bushel the miller's loss would be $1,000. In order to protect himself against a declining market he *sells* "futures" upon the Chicago Board of Trade to the extent of 50,000 bushels. "Future" trading is always done in lots of 5,000 bushels which facilitates trading. He, therefore, sells ten "lots" of wheat for delivery any month in the future he may select. The $1,000 loss that he might sustain on the wheat that he holds is "hedged" by the gain he would make on the "futures" that he has sold. The "future" market is nearly always in sympathy with the "cash" market. Should the future market advance 2c., the miller would profit $1,000 on the cash wheat that he holds, but he would lose the same amount on the "future" that he has sold. If he has ground part of the wheat into flour that is unsold, the protection exists, just the same, as the quotations on wheat and flour are always sympathetic. Instead of the miller speculating upon the Board of Trade, he has simply insured himself against the fluctuations of the market.

Selling "futures" may be likened to the dairyman's contract to supply milk during the entire year, his tickets corresponding to the grain dealer's warehouse receipts. Neither can have the entire quantity on hand at any one time, and the purchaser would not know what to do with it if he had it, but each will secure the quantity needed from time to time to fill the contract.

Visitors watching operations in the "Pit" at Chicago usually fail to detect definite business transactions amid such turmoil, but the trader sees the fierce determination of the "bulls" to sell at the highest price or of the "bears" to buy at the lowest. Speech is not only impossible, but an attempt to speak is useless, although the brokers produce the ceaseless din by calling out their bids as loudly as possible. The sign trading of the "pit" is very simple. When a buyer signals that he will take

Photograph by L. C. Rusmisel

"THE CONSUMER"

"50 wheat at 90," he means 50,000 bushels of wheat at 90c. The seller, in reply, holds his right hand with the index finger extended horizontally which means that he wants 90⅛c. The buyer signals back "⅛." The two traders note the transaction on their cards, and, after leaving the pit, meet and check the operation. The clenched fist represents the price in even cents, each finger representing one-eighth up to five-eighths. The extended hand with the fingers close together means three-fourths, and the thumb, only, signals seven-eighths.

The whole hand displayed vertically means 25,000 bushels, each finger counting 5,000 bushels.

During business hours the excitement is intense, especially when some speculator is trying to "corner" the market. At such a time, should you enter the main hall of the Exchange Building, the situation will seem tragic in the extreme, the noise is deafening, and you will appreciate the description by Frank Norris, in his book, "The Pit," which is a very interesting bit of fiction. "What do we know of that other existence of these men of the 'pit' which they pass through while trading is at its best? The gentle-mannered fellow, clear-minded, clean-handed, of the breakfast or dinner table was one man, the other, who and what was he? Down there in the dust and din of Chicago's great business district raged the Battle of the Pit, and therein he was being transformed, case-hardened, supremely selfish, asking no quarter; no, nor giving any. Fouled with the clutchings and grapplings of the attack, besmirched with the elbowings of associates and allies, he set his feet towards conquest, and mingled with the marchings of an army that surged forever forward and back; now in merciless assault, beating the fallen enemy under foot, now in repulse, equally merciless, trampling down the auxiliaries of the day before, in a panic dash for safety, always selfish, always pitiless." While this great drama of business may not appeal to all in exactly the same light, it is clear that the "Pit" is no place for sentiment and the shrewdest are the most successful.

FOR RESEARCH

1. How has Chicago become the center of the grain trade in this country?

2. What are the current prices of wheat, corn, oats, and barley today?

3. What is meant by: No. 1 red? A corner? "Bulls" and "Bears"? Futures? Margin? A ticker?

4. How is membership on the Chicago Board of Trade regulated? What other products are sold there besides grains?

5. What is a "bucket shop"? Describe its operations. Is such trading legal?

6. Describe a warehouse receipt? What is its value at a bank?

7. Has any one ever "cornered" the grain market? Describe some recent attempts.

8. Which is worth the most upon the market, hard wheat or soft wheat, of the same grade?

9. How does the grain market affect the live stock market?

10. What circumstances might cause a flurry in the grain market? How is it influenced by the encroachment of insect pests, rust, dry or wet seasons?

11. What is meant by buying "shorts"?

12. Write the Secretary of the Chicago Board of Trade for any information you may desire.

CHAPTER XI

THE PRODUCTION AND MANUFACTURE OF SUGAR

The history of the sugar industry is one of the most interesting chapters in the development of our resources. For centuries sugar was regarded as a luxury, but it is

Courtesy M., K. & T. Ry. Co.

A FIELD OF SUGAR CANE

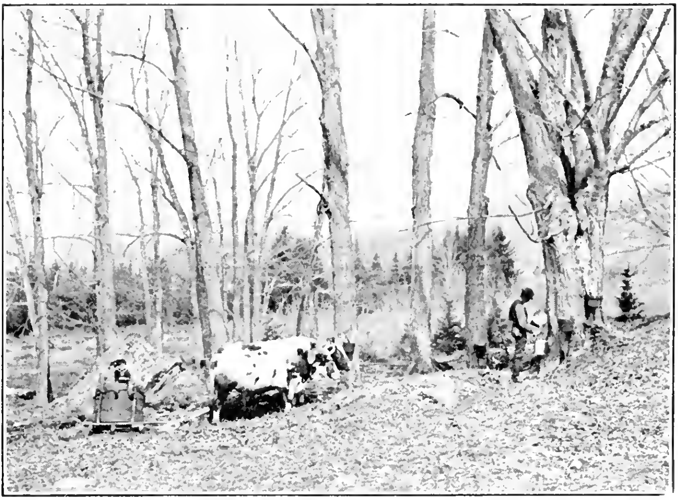
now considered a necessity. The Jesuits first introduced sugar into Louisiana in 1751, but it was not until 1795, when Etienne de Bore developed an improved method of extraction, that it became a merchantable article. In those days the mills were driven by horse or cattle power, but de Bore's success attracted additional capital to be used in developing the new industry. Steam mills were introduced, and from that time the progress of the industry was rapid. Cuba and the West India islands are better adapted for the growing of sugar cane than any other part of the world. Each year the United States consumes about 3,643,000 tons of sugar. Of this amount about 390,000 tons come from the Louisiana and Texas cane fields, 500,000 tons from American beet sugar fields, 700,000 tons from our island possessions, and the balance from Cuba and foreign countries.

Consumption of Sugar.—The general consumption of sugar in the United States grows faster than that of any other product, doubling about every twenty years. On the average, every man, woman and child uses, in some form, eighty-two pounds of sugar per year, which is a greater consumption, per capita, than in any other country except England.

Planting Sugar.—The ground is prepared for planting sugar cane as for any other product, and the cuttings (sections of the stalk containing a joint) are planted in rows about six feet apart. As it is a perennial plant it does not require frequent planting, some of the fields yielding well for from five to fifteen years. The stalks grow from three to twelve feet high and over an inch in diameter, long slender leaves growing profusely from the bamboo-like joints. The ripening season is in the early spring and the mills run night and day to care for all the crop before the rainy season interferes.

Harvesting Sugar.—The cane is cut close to the top of the ground with a *machete* and hauled to the mills in large carts drawn by oxen. There it is placed in a great trough, in the bottom of which is an endless chain which carries it through the crusher, and the juice falls into the receivers below. The crushed cane is called *bagazo* and is dried for fuel. From the receiving tanks the green juice runs into vats called *defecators*, where it is heated by steam from the engine. This first heating causes a dark scum to rise to the top, where it is skimmed off.

After passing through a series of these *defecators*, the juice enters a train of *caldrons*—deep copper vats well heated. When the juice, which is now syrup, reaches the last caldron it becomes crystallized, and runs into smaller pans called *coolers*. It now looks very brown, almost black, and is called raw sugar. It is next put into hogsheads, in the ends of which are several round holes. These hogsheads are stood on end over copper receivers, which catch all the drippings. These drippings are the molasses of commerce.



Photograph by L. C. Rusmisel

GATHERING MAPLE SAP

Refining Sugar.—At the refineries the hogsheads are emptied over a grating and the sugar drops into melting pans. After heating and melting the liquid is passed to another vat, where it is tested for temperature and density, after which it is strained to remove the largest particles of coarse foreign matter, then it is filtered several times through a mixture of burnt bone and charcoal. Practically all the bone supply from the packing houses is used at the sugar refineries for filtering. From the filters the liquid passes to the vacuum pans, where it is crystallized, and thence to the centrifugal filter, which revolves from 600 to 1200 times per minute. This machine catches the syrup in a receptacle for the purpose. The sugar, when thoroughly dry, is then molded into cubes and sold as loaf sugar, or is pulverized or granulated.

The Beet Sugar Industry.—A clear understanding of the possibilities and profits in raising sugar beets, and a study of the most approved methods of their culture,

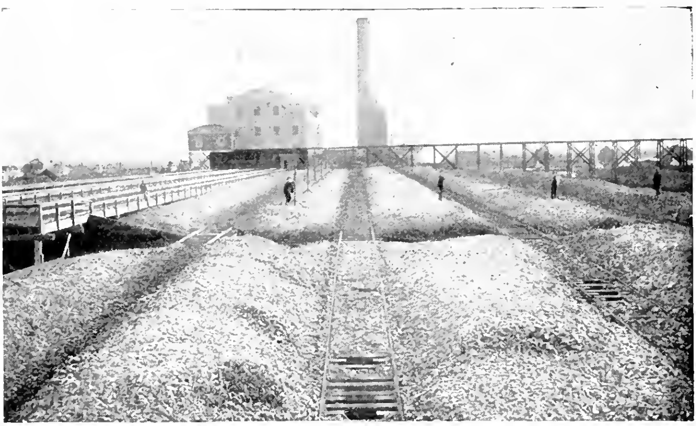
Courtesy Union Pac. Ry. Co.

SUGAR BEETS—WESTERN NEBRASKA

would annually divert millions of dollars of American money from the foreign cane growers to the American farmers, provided legislation is enacted to protect the growers from existing circumstances. Under proper conditions sugar beets can be very successfully grown in many parts of the United States. They have been proven a very successful crop, particularly in the sandy and arid regions.

There are many factories for the manufacture of beet sugar in California, Nebraska, Michigan, Utah, Colorado and several other states. The beets require careful culture and a vast amount of labor, especially during the thinning and pulling seasons. On account of the peculiar shape of the seed it must be drilled entirely too thick and the plants "chopped out" by hand, like young cotton.

Making Beet Sugar.—After pulling, by aid of a peculiarly shaped plow, the roots are topped and hauled to the sugar factory, which is supplied through a system of contracts, these having been signed by the farmers



Courtesy So. Pacific Ry. Co.

BEETS AT REFINERY—OXNARD, CALIF.

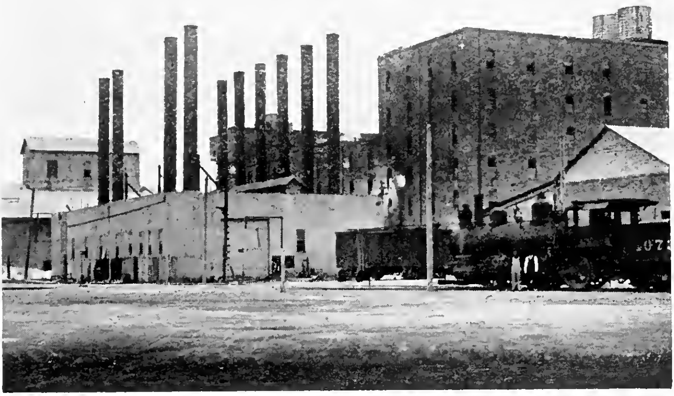
at the beginning of the season. At the factory the beets are thoroughly washed, sliced into long grooved pieces, resembling the letter "V." These slices are placed into large iron vessels, and covered with water at 160 degrees Fahrenheit. The juice is extracted by what is termed the *diffusion* process. After passing through a series of these vessels, the contents are pressed to remove the liquid and the pulp is fed to stock. Most of the factories keep large herds of cattle which they fatten from this pulp during the refining season. After the juice is extracted from the beets the following processes are very similar to those through which the cane juice is subjected, as mentioned before.

Beet and cane sugar show the same chemical analysis, but it is generally conceded that the beet product lacks sweetness and should be sold for less than corresponding grades of cane sugar. Partially fill a glass with sugar, cover it with water, and allow it to stand several hours. If a blue scum appears, you have beet sugar.

Maple Sugar.—The demand for maple sugar, on account of its peculiar flavor, will always, perhaps, be greater than the supply. Until the passage of the recent Pure Food Laws pure maple sugar and syrup were almost displaced by substitutions and adulterations, and these are still on the market under misleading names. The industry has assumed commercial proportions in several Northern states, Vermont, New York, Ohio and Indiana taking the lead. Pure maple syrup cannot be sold for less than about $1.50 per gallon, but pure "maple flavor" syrup may be bought for a dollar. A resident of Indiana has a patent upon a process whereby he obtains a maple flavor from hickory bark. It may also be obtained by boiling corncobs in water, to which solution is added enough brown sugar to produce the proper consistency.

The maple sugar season ranges from February to April, depending upon the latitude. When the season "opens" at the beginning of the first thaws in the spring, the hard maple trees are "tapped" by boring holes, into which wood or metal "spiles" or spouts are driven. The sap will then drip into a vessel placed below. When filled these are carried or emptied into barrels, and hauled to the "sugar house" where the sap is evaporated in open pans or in the modern evaporators. While in some localities this industry has been developed upon a large scale, the bulk of the supply of real maple sugar and syrup comes from farms where the families supply the labor, and the equipment is very primitive.

Sugar is also obtained from several other sources, the chief among these being the grape and corn. Glucose, used in the manufacture of candies and all kinds of confections, is a pure corn product. Much brown sugar and syrup is also made of corn and is of good quality. Aside from the economic and commercial sides of the study of this industry there is an unlimited opportunity for the study of geography by locating the areas of production in all parts of the world, considering the con-



Courtesy So. Pacific Ry. Co.

SUGAR REFINERY—CALIFORNIA

ditions existing there and facilities necessary to deliver the product to the door of the consumer.

FOR RESEARCH

1. What parts of the United States are best adapted for beet sugar production? For the production of sugar cane? Tint these sections upon an outline map. Also shade the sections where maple sugar is produced.

2. Contrast conditions existing upon sugar plantations in this country and in Cuba and the Philippines.

3. The most important refineries are at Brooklyn, Jersey City, Philadelphia, Boston, Baltimore, New Orleans and San Francisco. Give reasons for their location. Indicate their location upon your map and draw lines to represent the railroad or steamship lines used to transport the raw product.

4. The average consumption of sugar, per capita, in this country is about seventy-five pounds. How much would ninety million people use in a year? What would it be worth at five cents per pound?

5. Why do the prices of sugar and tin plate rise and fall together? At what season of the year are they highest? Why?

6. What effect has the introduction of the sugar beet into this country had upon the sugar market? Of what country is the sugar beet a native? What is its general appearance?

7. Obtain specimens of granulated and brown sugars, of different grades, and examine them under a magnifying glass? Why can one merchant sell more pounds of granulated sugar for a dollar than another?

8. Learn the difference between hard and soft maple trees? When is maple syrup or sugar made? Why has the price of these products advanced within recent years?

9. How does corn sugar or syrup compare in quality with that obtained from sugar cane or the beet? What railroad line would carry a shipment of corn syrup from Chicago to a candy factory at Cincinnati?

10. What railroad lines would carry a shipment of beet sugar from Garden City, Kansas, to Butte, Montana? A shipment of cane sugar from New Orleans to Chicago?

CHAPTER XII

COFFEE, TEA AND COCOA

While the coffee plant does not grow in the United States, and its production is not a North American industry, our people are the greatest coffee drinkers in the world, annually importing more than one billion pounds, or an average of over eleven pounds per capita. Germany is our nearest rival, using six pounds per capita, while the people of the British Empire each use less than one pound, as they are the greatest users of tea in the world. In Australia the per-capita consumption of tea is eight pounds, while in Great Britain and Canada the average is over six pounds.

All beverages derived from plants owe their popularity to their stimulating effects. In coffee this principle is called *caffein*, in tea it is called *tannin*.

The coffee plant is probably a native of Abyssinia, and its culture was confined to Arabia until about the eighteenth century, when it was introduced into the Dutch East Indies. It is now cultivated in all tropical countries, chief among these being Africa, Madagascar, Ceylon, India, Brazil, Venezuela, Central America, the West Indies and Mexico.

The coffee of commerce is the seed of a berry grown upon a small tree. In its native state the tree may become forty feet high, but the groves are generally pruned down to about eight feet in height, for convenience in picking. The trees are usually planted in rows, about eight feet apart, in each direction. The most famous coffees have always come from Mocha, Java and Sumatra, although about half of all the coffee used in the world comes from South America.

The trees begin to bear when three or four years old, and at seven they are in full bearing, each tree yielding from three to four pounds. The tree has a profusion of dark green leaves, the fruit, or berry, being much like our cherry, in appearance. The berries, when ripe, are dark red in color, the pulp consisting of five different parts covering the two beans, or seeds, which lie within, face to face. If there is only one bean it is

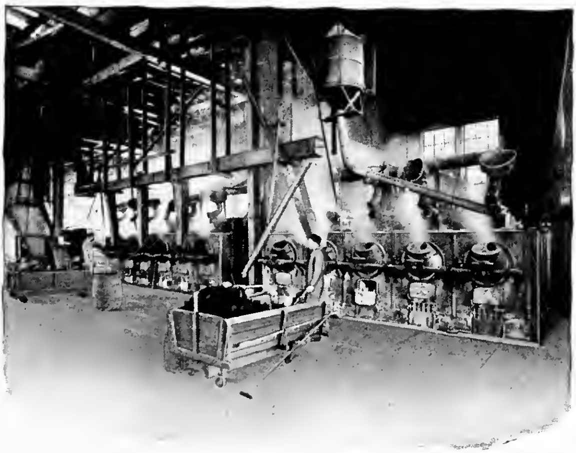
Courtesy German-American Coffee Co.

COFFEE TREE IN BEARING

round, and is called a "peaberry." Mocha coffees are peaberries.

Kinds of Coffee.—In Brazil the picking season begins in April or May, and continues until September. In Java the picking begins in January, and continues for three or four months. The different varieties derive their names from the countries where they are grown, or from the ports from which they are shipped. Brazilian coffees are commercially known as *Rio*, as they are shipped from Rio de Janeiro. Most Venezuelan coffees are called *Maracaibo*, although there are many varieties. Most of the East Indian product is known as *Java*, whether it came from the Island of Java or not, and like that shipped from Central America is known as *Costa Rica*.

Coffee improves with age, and it was formerly the custom of the Government to keep the better grades in



Courtesy German-American Coffee Co.

COFFEE ROASTERS IN OPERATION

storage for years in Java, which gives us the term "Old Government Java." This plan is seldom practised at the present time.

Preparing Coffee for Market.—After the berries are picked they are prepared for the market by "pulping." One way is to dry the berries and then remove the pulp in a huller. By the other method the skin and pulp are removed by being macerated and washed, after which the beans are dried in the sun. The former method is the oldest and most used. After the pulp is removed the coffee is sacked and placed upon the market, good, bad and indifferent, all together. At the coffee plants in this country the beans are first passed through a grader, which separates them as to size. The rarest and most expensive coffees are sorted by hand on the plantation, but little of these grades ever reaches this country. Their sale is usually controlled by the governments of the countries where grown.

The most essential process in the production of a cup of coffee is the roasting. The best coffee, poorly roasted, is not as good as the poorest well roasted. This is done in large revolving ovens, the grains being continually in motion, and this process requires the attention of an expert. At the proper moment these ovens are emptied into larger pans, with perforated bottoms, and cooled almost instantly by suction, which is an essential point, otherwise the flavor might be ruined. Most of the coffee in the market is blended by mixing, scientifically, several kinds, to produce different flavors. Coffee does not retain its flavor long after roasting, unless kept in air-tight receptacles.

While many of the finer grades of coffee are handled through the London market, Hamburg is the world's central market for high-grade coffees, most of the product of all of the districts passing through the hands of the German brokers. The choicest grades are sold to the European trade, which pays a much higher price than the New York market.

Tea.—Tea is the cheapest beverage known, costing only one cent for five cups, at fifty cents per pound. Tea is the only beverage guaranteed to be pure by the Government, as the law excludes all adulterated teas.

The tea plant is a perennial, but only the tender, green leaves are picked. The great tea districts of the world are in China, Japan, India and Ceylon. The two general varieties upon the market are called *green* and *black.* Green teas are grown, principally, in the Northern part of China, and their chief market is Shanghai. They are known as: Gunpowders, Imperials, Young Hysons, and Hysons, according to the shape the leaves take in the process of firing. They may all come from the same plant. The flavors differ radically, according to the districts from which they come.

Preparing Tea for Market.—When the leaves become wilted, after picking, they are rolled by hand into little balls and dried rapidly over ovens, coloring mat-

Courtesy Hamburg-Amer. Line

A JAPANESE TEA PARTY

ter sometimes being supplied to give them a handsome appearance. The greatest consumption of green teas in this country is in the Middle States or Mississippi Valley. The most popular teas in England, the greatest tea-drinking country in the world, are what are known as black teas. The four leading varieties are: Congous, Indias, Ceylons and Oolongs. The first three of these are fermented teas. These are first exposed to the air, after picking, until fermentation takes place, which causes them to have, after firing, a malty, heavy flavor. There are over seven hundred tea estates in India, and the same number in Ceylon, the product of each having a peculiar flavor, or "bouquet." All of these flavors are readily recognized by experts. To these, add the thousands of varieties from China and Japan, and imagine the task of the taster, whose expert training enables him to pass judgment upon any of them. Many of these men are able to name any tea, and tell from what locality it came, by tasting it.

Tea is successfully grown in South Carolina, Texas and other Southern States. It is not probable, however, that the industry will ever assume proportions worthy of much notice, in this country, as the cost of labor for picking and curing is so high, comparatively, that we can never compete with Oriental countries.

Cocoa and Chocolate.—Chocolate and cocoa differ from tea and coffee as beverages, from the fact that they are not merely stimulants, but foods as well, as they contain a large per cent. of vegetable oil. The cacao tree is a tropical product, being found in South America, the West India Islands and Central America. The trees produce best when grown under the shade of other trees. The seeds of the tree are enclosed in pods, measuring from eight to twelve inches in length and half as much in diameter. Each of these pods are filled with closely packed beans or seeds, about three dozen in number. The natives pick the pods from the trees by use of long poles, with hooked knives on the end, and, after gathering them from the ground, the pods are broken open and the seeds removed. These must then be dried on platforms arranged for the purpose. Like the tea and coffee plants, the cacao tree is an evergreen.

The cocoa beans are placed upon the market in their raw state. At the mills they are scientifically roasted, and, when thoroughly pulverized, form the chocolate of commerce. If, before grinding, cocoa is desired, the beans are subjected to great pressure, by which about half of their weight is removed as cocoa oil or butter, largely used as a cosmetic and for other purposes. Then the solid substance remaining, when ground into powder, is called cocoa. The difference, therefore, between chocolate and cocoa, as beverages, is that the latter contains much less of the oil.

Courtesy Walter Baker Co.

COCOA PODS AND LEAVES

Chocolate and cocoa were first manufactured in this country in 1765, near Dorchester, Massachusetts. Like all other articles of commerce, chocolate and cocoa are sometimes adulterated by the addition of other substances, or by the use of inferior beans, ground hulls or other ingredients.

Where Cocoa Comes From.—The greatest part of the cocoa product comes from Ecuador, Guayaquil being the world's chief market; however, the finest product comes from Venezuela and Brazil. Spain, Portugal and France are the chief consumers, the per-capita use in Spain being about six times as great as in any other country. The United States annually consumes about sixty-five million pounds of cocoa, principally in the manufacture of confectionery.

Coffee, tea and cocoa, are all wholesome drinks, and cannot harm any one when properly prepared and used in moderation. However, too little study and care is generally given to this simple process, and, oftentimes, as much courage is required to partake of one's favorite beverage, as was possessed by the first man who ate an oyster!

FOR RESEARCH

1. Trace the route of a cargo of coffee from Rio de Janeiro to New York. From the City of Mexico, overland, to Chicago.

2. Obtain samples of dried coffee berries, coffee in the parchment, also some specimens of Mocha, Java, Sumatra, Rio, Maracaibo, and Liberian coffees for examinations. What differences can you detect?

3. Why were strong efforts made to discourage the use of coffee when it was first introduced?

4. What can you learn of the efforts made to close the coffee-houses in London, Constantinople and other cities?

5. Read the history of the tea-houses of London and other cities. Why has tea-drinking always been popular with the English?

6. Trace a shipment of tea from Hong Kong to London, by water. How would the same be shipped *via* the United States? Why is the latter route more economical?

7. Obtain samples of several varieties of both green and black teas. Moisten and unroll the leaves and note the difference. If possible, visit a wholesale grocery house, where you may test the leading varieties of coffee and tea in the cup.

8. What are some of the substitutes for tea and coffee? Where is maté tea grown?

9. On a map of the world, locate the Russian "caravan" route to Europe. Where may tea shipped by this route reach the Trans-Siberian Railway? This is a very expensive method of shipping tea to Europe. Why is it used?

CHAPTER XIII

COTTON IS KING

"The rose has a thousand lovers, because
Of her delicate grace and perfume,
But lovers, for sturdier reasons, give
Their hearts to the Cotton bloom.

It grows in a dazzling, ample land,
Of measureless breadth and room—
And the wealth of the splendid tropical sun
Dowers this Cotton bloom.

Courtesy Mo. Pac. Ry. Co.

PICKING COTTON BY HAND

And Capital keeps his eyes on the field,
While he hears the hum of the loom,
And his anxious visage glows and pales
At the nod of the Cotton bloom."

—HOWARD WEEDEN.

The cotton plant is a small shrub, from two to four feet in height, with very extensive branches. The leaves are a dark green and the blossoms are pale yellow at first but turn purple when fully developed. In their place grow the tiny bolls which develop until the size of a small egg and which, when ripe, open into several compartments which hold the seed and lint.

Cotton Planting.—Cotton is planted about the first of March in the southern belt of the United States, and as late as April 20th farther north. Plowing should begin as soon as possible in the Spring, in order to have a perfect seed-bed. The day of the small cotton planter is practically past; occasionally a negro "mammy," with her primitive methods, plows a few acres to support an indolent husband, but modern machinery has invaded the South and farming is there receiving as much attention

Courtesy Frisco System

"WEIGHING UP" COTTON AT SUNDOWN

as in the northern states. The ground is being restored to its full capacity by the use of fertilizer and crop rotation, and the results are all that could be expected.

A good day's work was one acre, when cotton was planted with a hoe, but now with a mule and a planter a man can plant six times as much. We do not have a machine that will drop the linty seed with any degree of regularity, which necessitates dropping it entirely too thick, and when the stand is safe, the extra plants are chopped out with a hoe.

When the tender plants are about four inches high they are ready for the first plowing. The old-time single shovel-plow has been superseded by a cultivator which takes care of both sides of a row at the same time, making three furrows on each side. This process is repeated about as often as corn is cultivated farther north. At first cotton grows slowly, as it is a tender plant. It requires a long growing season and a frost, later than April

Courtesy Campbell Cotton Picker Co.

THE CAMPBELL COTTON PICKER

first or earlier than November first, is likely to be disastrous. A well-distributed rainfall is essential during the growing season and a long dry season is desirable while the crop is ripening.

The Cotton Belt.—Cotton is grown to some extent in many tropical countries, but eleven of our southern states furnish over three-fourths of the world's supply, and, perhaps, will always continue to do so. However, we allow other nations to rob us of a great part of the profit, for we do not lead in cotton manufacturing.

The use of cotton is as old as history, for it was grown upon a small scale in the earliest known settlements. Egypt and India cultivated cotton long before this country was settled. Cotton is the most indispensable plant in the vegetable kingdom, because it has no substitute. The proceeds from one year's crop will more than buy all others, combined. All the gold that has been mined for the past five years would scarcely pay for the cotton which the South sent abroad last year, and much more would be required to purchase the foreign-made goods that are annually returned to us.

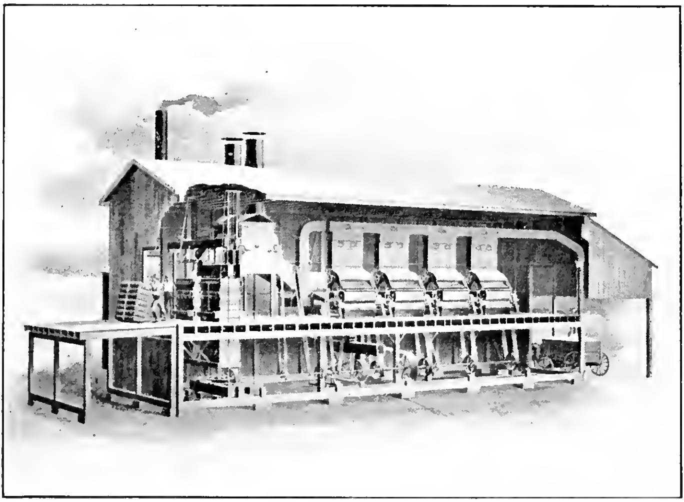
The Use of Cotton Universal.—You arose this morning from a cotton bed, stepped upon a cotton rug, dressed in cotton, raised a cotton window-shade, used soap made from cotton oil, and dried your face upon a cotton towel. You ate biscuits shortened with cotton oil, and your steak was fattened upon cotton-seed. Your olive oil possibly was first shipped to Italy, then returned with a title. Your butter may have been largely a cotton product.

The South was so much impoverished by the Civil War, and so many changes took place, that the cotton industry was for a time paralyzed. The planters began again by leasing out their land to negroes, requiring them to plant cotton only. The merchants would sell these tenants' supplies, taking a lien upon their crops as security. Usually, when the crop was gathered and settlement was made with the merchant and landlord, the tenant was in debt sufficiently to insure his farming the land for several years in succession. It was a common expression upon the plantations at that time:

"Naught's a naught—figger's a figger,
All for the white man, none for the nigger."

But these methods seldom exist at the present time; many of the negroes have become land owners themselves, and the large plantations have been divided into smaller farms, and such fields as are now grown, as the result of practical farming, would astonish the planters of ante-bellum days.

The public has always pictured the negro, the mule and the cotton field together, and most books show these "Cotton-tots" laboring with the fleecy staple. It may surprise many to know that hundreds of thousands of white people raise cotton without the help of the negroes at all, and thousands of others only call them in during



Courtesy Continental Gin Co.

A MODERN COTTON GIN HOUSE

the busy season. Cotton pickers pick by weight, receiving about fifty cents per hundred pounds. Each worker has a pile at the end of the field and these piles are weighed at sundown and each picker is paid in money. They will not wait until the end of the week, and the end of the month is out of the question. The negroes pick in baskets, which they push ahead of them on the ground, while the white pickers use long sacks thrown around the shoulders.

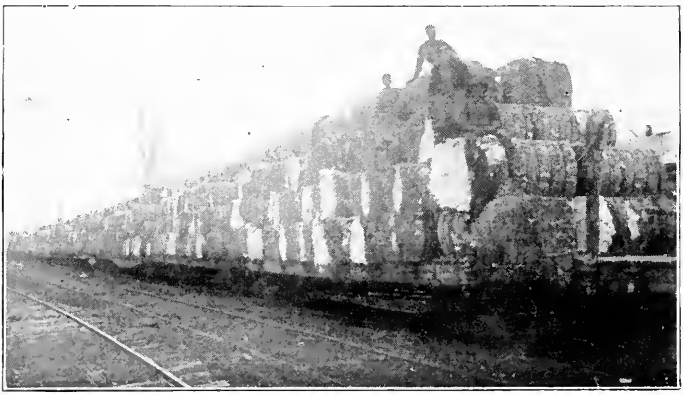
The picking season begins about the first of August and lasts from ninety to one hundred days. The average yield is about half a bale per acre, while under good conditions as much as three bales have been grown on one acre. The problem of the cotton planter, like that of the grain farmer farther north, is to increase the production. This is being accomplished by better plowing, better fertilizing, better seed selection, and better cultivation.

Most of our cotton crop is picked today just as it was gathered a thousand years ago, although every other crop has some labor-saving machine for harvesting. Fifty years were required to perfect the wheat harvester, but that was simple on account of the nature of the crop. The cotton picker must be able to pick the open bolls, at whatever height they may grow, and it must distinguish between ripe and unripe bolls, for the crop does not all ripen at the same time, and the field must be gone over three or four times at intervals of, perhaps, three weeks. The great hope of the country has been that some machine may be invented that will lessen the cost of picking, and it seems that the hope has been realized.

The Campbell Cotton Picker was first demonstrated before the public in 1910. It resembles a large motor-truck and, as it drives through the field, picks the open bolls by suction, seemingly being able to distinguish between the ripe and unripe bolls. This machine will do the work of thirty men and it is expected that it will revolutionize the industry.

Preparing Cotton for Shipment.—Cotton gins are located at almost every railroad station throughout the cotton belt. The planters haul their cotton to these in an open wagon-box. Suction tubes unload the wagons quickly and, in a short time, the bales are ready to be loaded and hauled back to the farm or to market.

Whitney's gin has been much improved, yet remains the same in principle. It consists of a series of finetoothed circular saws, about three-fourths of an inch apart, revolving through slits in a steel table. The teeth pull the cotton through the slits and the seed is carried off the other way. It would take a man two years to pick enough cotton by hand to make a bale, while a gin will turn out fifty or more bales in a day. Bales are cared for just as we care for wheat and corn in the North —held until the market suits, or piled at the railroad stations until they can be hauled away. Cotton is usually sold through an agent, called a factor. His commission is usually one dollar per bale. A square bale is usually about three by three by four feet in size, and weighs four



Courtesy Continental Gin Co.

ENTIRE TRAIN-LOAD OF COTTON

hundred pounds. When cotton is to be shipped any great distance it is usually compressed into cylindrical bales, eighteen inches in diameter and four feet long. In either case they are covered with burlap and secured by iron bands.

The Use of the Cotton Seed.—For a hundred years the greatest waste ever known to any industry resulted from not using the cotton seed. At the time of the Civil War laws were in effect requiring gins to be built over water, that the seed might be washed away, or it must be buried or burned that it might not rot and become a nuisance. Now the seed is worth one-fifth as much as the cotton itself. It is even claimed that cotton would be a profitable crop if raised for the seed alone. Some planters haul the seed back to the farm, where it is valuable as stock food or fertilizer, or it may be sold to the oil mills for about twenty dollars per ton. There it is converted into cotton-seed meal, oil and hulls. A ton of seed contains 900 pounds of hulls and 700 pounds of meal, which is one of the very best fat-producing foods on the market for cattle. A ton of seed also produces forty gallons of "summer yellow," which when refined may be manufactured into salad oil, cottolene, compound lard, soaps and oleomargarine.

Cotton Shipping Centers.—Galveston and New Orleans are the great cotton markets of this country and the total value of shipping from these ports ranks next to that of New York. Vessels from many foreign countries receive cargoes there, which are distributed to every part of the world. Where modern methods of transportation pause, primitive carriers take up the burden. Under the midnight sun, dogs draw sleds laden with cotton goods, and pack trains carry the product of European mills across the Andes. The yak carries a load into Thibet and the Chinese junk carries cotton garments to the interior tribes. The elephants of India and camels of Egypt carry goods made from American cotton. It is almost inconceivable that this enormous traffic is pushed by countries that cannot raise the raw supply, and America, which does furnish it and makes possible this greatest commercial invasion in the world, makes the least profit from the industry.

The first cotton raised in this country was made into threads upon the old-fashioned spinning-wheel, but its monotonous, melancholy roar is seldom heard now. Our grandmothers spun the thread, wove the cloth on hand looms and dyed it to suit their fancy, after which they made garments for the household.

The cotton industry of the United States was early established in New England, where there were present two natural conditions, a moist climate and an abundant and cheap water power. At present artificial means are used to moisten the air and cheaper power can be found elsewhere.

Cotton manufacturing is, therefore, taking place nearer the cotton fields. North and South Carolina have recently come to the front as cotton manufacturing states. Why? After the Civil War the South began to give the manufacturing part of the industry some encouragement and, in recent years, the number of mills has increased materially, as water power is as plentiful there as in Massachusetts. Atlanta is now called the "Fall River of the South." The planter has been greatly benefited by having a market nearer home and the people have been benefited by having employment throughout the year. Only about one-third of our cotton is manufactured in this country.

The Exporting of Cotton.—There was a time when American packets carried our goods around the world, but they have almost vanished from the seas. Our domestic commerce is more than double that of all other nations, but foreign vessels carry almost all of our exports. If our American cotton could be manufactured at American mills and carried in American vessels, it would be a rich heritage, indeed. A crop that is worth more than all others combined, a monopoly of the one great crop of the world, for which there is no substitute. It is to be hoped that our manufacture of cotton goods may grow, until the hum of our spindles will be heard as far as those of England, and we can then export cotton goods instead of cotton bales.

Henry W. Grady told the story very concisely when he said: "What a royal plant cotton is! The world waits in attendance upon its growth; the showers that fall whispering upon its leaves are heard around the earth; the sun that shines on it is tempered by the prayers of all the people; the frost that chills it and the dew that descends from the stars are noted, and the trespass of a little green worm upon its leaf is more to England than the advance of a Russian army upon her Asiatic outposts. It is gold from the instant it puts forth its tiny shoots. Its fiber is current in every bank, and when, loosing its fleeces to the sun, it floats a sunny banner that glorifies the fields of the humble planter, and wrings a subsidy from every nation on earth."

FOR RESEARCH

1. What position does Manchester, England, occupy in the cotton trade?

2. What is the greatest foe of the cotton planter? What steps have been taken by the States and Nation to exterminate this pest? With what success?

3. What effect have Watt's steam engine, Arkwright's spinning frame, Hargreaves' spinning jenney and Whitney's cotton gin had upon the industry?

4. Why were most of the textile mills first built in the New England States?

5. What is a spinning "jenney"? How many spindles are there upon one?

6. Obtain some cotton seed from the Department of Agriculture, or elsewhere, and grow some plants for examination.

7. What countries besides the United States grow cotton? How does it compare in quality with our product?

8. What is raw cotton worth upon the market today? What is the price of unbleached muslin? Why are these prices higher than they were ten years ago?

9. Make a map of the "Cotton States of America," and locate the principal markets and manufacturing centers.

10. Trace a shipment of cotton from Mobile to Japan, via the Panama Canal. What steamship line would probably carry the shipment?

11. What line might carry cotton from Galveston to Manchester, England? Through what canal would it pass?

12. What laws have been enacted relating to child labor in the mills of this country? Why are they necessary?

CHAPTER XIV

SHEEP AND WOOL

Wool is the most important animal fiber we have, and it is the most valuable product of the sheep. It is finer than hair and its surface is covered with many overlapping projections which give it its felting property, and in this respect it differs from any other fiber. Among the textile industries wool manufacturing is second only to that of cotton.

The greatest wool market in this country is Boston, but the center of manufacture is Philadelphia, while Lawrence, Mass., and Providence, R. I., are of next importance. In point of production the United States stands fourth, producing about eleven per cent. of the world's wool supply, but this order is reversed from a manufacturing standpoint, as we lead all nations by weaving twenty-six per cent. of the world's supply; a striking contrast when compared with our manufacture of cotton cloth.

Sheep Raising—Leading Countries.—The finest and softest wool is grown in arid plateau regions. The fibers are finer than silk, and the goods made from them are softer. The chief producing countries are Australia, Argentina, Russia, United States, Asia, New Zealand and Great Britain, although some sheep are produced in every civilized country. In the United States, while sheep are raised with profit in every state, the business is carried on upon the greatest scale in Colorado, Montana, Utah, Wyoming and Idaho, where there are vast areas of native grass which the herders appropriate to their use free of charge. In those states it is a rare thing for a ranchman to ever feed his sheep anything except the native grass.

Varieties of Sheep.—There are many varieties of sheep, each particularly adapted to the locality where it is grown. There are the long-wool sheep, such as the Lincolns, Leicesters and Cotswolds which produce a

Photograph by L. C. Rusmisel

A FLOCK OF THOROUGHBREDS

coarse wool sometimes twenty inches long. The Shropshires, Downes, and Horned Dorsets are medium-wooled sheep whose fibers are shorter and finer, but most important of all are the various breeds of Merinos. The wool of these sheep is beautifully wavy and crimped. The finest wool sometimes has thirty crimps to the inch, and, it is claimed, that one pound may be spun into a thread one hundred miles long. The Mission wools of California, and those used by the Navajo Indians in the manufacture of their beautiful blankets, are the product of Merino sheep. The coarsest wools are nearly straight and are unfitted for general use, however, each is indispensable for some certain use.

The rug wools grown in Persia, Turkey, and Asia vary in fineness, and, because they do not felt readily, they are the best in the world for rug stock. The "pile" or surface of the rug remains elastic and stands upright,

Courtesy American Woolen Co.

OPENING AND SORTING THE BALES

even after a hundred years of wear. This quality is due more to climatic conditions and food than to the species of sheep. In fact, any variety of sheep will produce a different quality of wool when removed from its natural environment. The great care given the sheep by the expert rug makers must also be considered. It is claimed that the Turks and Persians comb the sheep every day in order to keep the wool straight. In Russia, Asia Minor, China and Spain the sheep have undergone no improvement and produce the longest and coarsest combing wools, which are used in carpet weaving.

The Carpet Industry.—The carpet industry forms one of the most important branches of wool manufacture in this country, due principally to several American inventions, the chief one being the adaptation of the power loom to the weaving of ingrain carpets, a power loom for the weaving of Jacquard Brussels and Wilton carpets and several machines for weaving Tapestry Brussels and Axminster carpets.

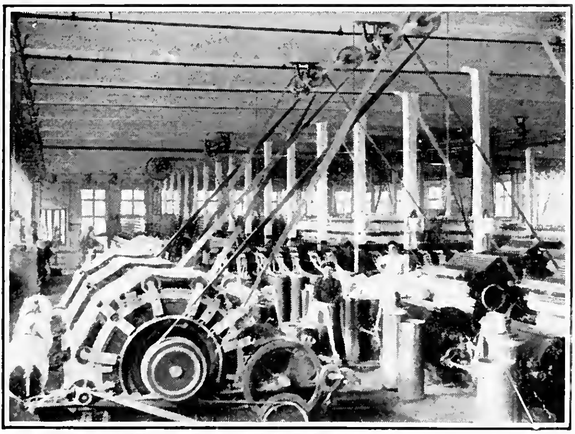
The Preparation of Wool.—The wool of the sheep, as it grows, is saturated with a natural grease or oil

Courtesy A. F. S. F. Ry. Co.

PRIMITIVE METHOD—NAVAJO RUG MAKER

which causes it to shed water and prevents it from felting on the sheep's back. When the wool is sheared it does not fall apart like bunches of hair, but holds together and each fleece is tied in a bundle separately. When the fleeces are opened at the mills they are spread out and sorted into many varieties or grades of wool, according to fineness and length of fiber. Each variety is then washed in hot soapsuds to remove the grease and dirt. The grease is saved and refined into lanolin, used by manufacturing chemists as a base. Sometimes the grease is manufactured into soap for use in washing more wool.

When converting the wool into yarn it must be carded by being passed through a machine which picks it to pieces and untangles the fibers, after which they are spun into threads by the "jenney" or "mule" and passed on to the loom room. If not more than three colors are desired the weaving is done on "Dobby" looms, but where any variety of colors and patterns of intricate design are desired the wonderful Jacquard loom does the work. This machine works from a perforated pattern resem-



Courtesy M., K. & T. Ry. Co.

IN A MODERN WOOLEN MILL

bling, somewhat, the perforated music of the player-piano. In the manufacture of felt the wool is neither spun nor woven, but is simply tangled and pressed.

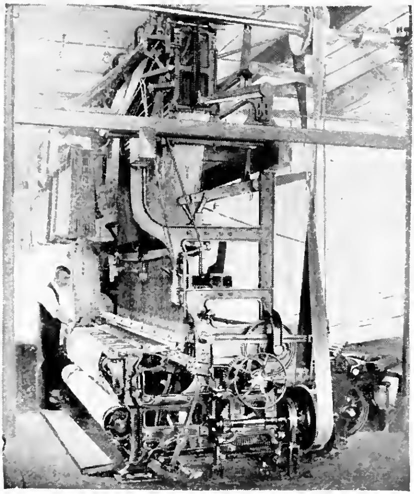
Sheep Herding.—Sheep herds range in size from one thousand to one hundred thousand sheep, and are "run" or grazed in flocks ranging from one thousand to thirty-five hundred head. The lack of initiative spirit in sheep makes it possible for one man and a Collie dog to handle this number easily, where fences and folds and pasture limits are unknown. The small herds are generally owned by the men who care for them, the larger ones by companies that employ herders. A man starting in the business must first make sure of his watering places, as sheep must have water every three or four days during summer, unless there is heavy dew, in which case they can get along a week. In winter they will eat snow, which enables the herder to pasture them over a wider range.

The herder makes his home in the sheep wagon, which is fitted up with a bunk, cooking utensils and a supply of provisions. This wagon he moves about from place to place as the pasture is exhausted. Sheep eat the grass into the very earth and it is at least two years before the same territory can be pastured over again. If a man prospers, and his herd increases, he may, in a few years, leave his wagon and make his home in a ranch house and later in a town residence. But many of the herders, often with their families, have followed their flocks in wagons for years.

In the Northwest people catch the "sheep fever" just as they formerly caught the "gold fever" and many have made great fortunes, although it is estimated that about twenty per cent. fail. The large drovers may have as many as twenty herders, each with his three thousand sheep. These men get forty dollars per month and "keep." Every two or three weeks the camp mover, who does nothing else, comes along and takes the herder's wagon to the top of another ridge where the forage is good, re-stocks the wagon with supplies, and passes on to the next herder. No one ever molests supplies in a herder's wagon—it is one of the small confidences in humankind which survives in the West, and it is never betrayed.

In summer the herder must rise early to get his sheep out before the dew is gone, in winter he must do likewise, because the days are short and the sheep need all the feed they can get. Sheep are entirely dependent upon the herder. They will not stir from the bedding ground until he rousts them out, or do anything for their own welfare unless driven by him. When they do act upon their own volition it is generally to their own destruction.

The herder's dogs are remarkably intelligent and well trained. One of them will do as much work with a herd of sheep as ten men could do. They will spread the



Courtesy American Woolen Co.

A JACQUARD LOOM

flock, turn the sheep, or bunch them, following the herder's orders so long as they can see or hear him.

At evening the herd is brought back near the wagon and bedded against a hillside, choosing the location with regard to the wind, which must blow over them and not against them, or they will stampede. When they lie down and become quiet the herder may go to his wagon, cook his supper and "turn in." In winter the sheep must be fed "against" the wind, for if they were started out with it they would never come back. If the great prairie has not yielded enough feed for them they must return at night and wait for another day, to again tussle with wind and snow and hunger until starvation relieves them or spring comes.

The rougher the weather the more essential it is that the sheep be driven out early, for there is nothing else for them but the dry grass which they snip when it is often thirty-five degrees below zero. And little better off is the herder than his sheep, for there he exists, day after day, never seeing a human being except the camp mover. Many of them become inveterate readers, but the illiterate ones do not have this consolation even, and they frequently lose their minds.

In Australia laws have been enacted requiring herders to be sent out in pairs, thus relieving the terrible strain upon their minds. When a man cannot read, and there is no one to whom he may talk, his "thought reel" gets to whirling so rapidly that it muddles his brain. It is noticeable that most men who have been sheep herders on the great plains of the Northwest draw the upper lip back from the teeth, exposing them, rabbit fashion. This is a confirmed habit, perhaps due to the strong white light upon the vast stretches of prairie.

Sheep Shearing.—Sheep shearing is to the wool industry what harvesting is to wheat. Professional shearers start in Mexico early in the spring and work north, getting about four months work each year and making about ten dollars a day. They are paid about nine cents per head for their work. The compressed air clipper has practically supplanted the old hand shears. The sheep, stripped of their wool, are unable to stand much cold, and great care must be taken not to shear too early. One man at Caspar, Wyoming, sheared too early and lost 2,400 sheep in one night, in a blizzard.

The shearer draws a sheep out of the pen, squats it on its haunches, clasps it with his knees, and begins to cut away the fleece at the point of the shoulder. In from two to five minutes his work is done and the fleece rolls to the floor. He ties this in a bundle and tosses it aside to make room for another.

The fleeces are placed in long burlap sacks and tramped down until each sack weighs three hundred pounds. In the East sheep are washed before shearing but this is not the custom in the West. Fleeces are cut from millions of sheep every year far from any railroad. The long sacks are placed upon wagons and hauled to the nearest station. It is no unusual thing to see a train of four or five wagons hauling perhaps twenty thousand dollars worth of wool to the market.

The flocks are mostly ewes, the wethers being marketed while lambs. Not counting the lambs she yields, each ewe, during her useful period, delivers to the owner an average of eight dollars worth of wool. It has not cost anything to feed her on the range. Then, when these old ewes become what are called "bad risks" they are shipped to stations near Chicago, Kansas City, Omaha or St. Joseph where they are known as "feeders," and speculators buy them, fatten them on hay and grain and sell them to the packing houses, after which they become *lamb chops*.

FOR RESEARCH

1. What states produce the most sheep? Tint these states upon an outline map of the United States.

2. Trace a shipment of wool from Caspar, Wyoming, to Boston, naming the railroads over which it would pass. Where would changes be made and to what roads?

3. What natural features make Australia and Argentina the greatest wool-producing countries? Trace a shipment of wool from Buenos Ayres to Manchester, England. From Melbourne to Fall River, Mass.

4. What is cashmere? Alpaca? Angora? Long staple? Short staple? What is a spinning jenney?

5. Obtain specimens of as many kinds of woolen goods as possible and note the difference. How can you distinguish all-wool goods from part cotton? What is shoddy?

6. In the grazing country, why is there a continual conflict between cattle and sheep owners?

7. What is the chief industry of New Zealand?

8. Why is London the largest wool market in the world?

9. If possible, visit a woolen mill and trace the wool from the time the sacks are opened until the cloth is ready for the market. Visit a packing house and note the different methods of preparing mutton for different markets.

CHAPTER XV

SILK—"THE GOLD OF TEXTILES"

Silk Culture.—For nearly thirty centuries silk culture was one of China's cherished secrets. During the greater part of this time caravans plodded across the con-

Courtesy Corticelli Silk Mills

SILK-WORM AT WORK

tinent to Persia, loaded with their precious bales. The Persian traders sold the silk to Syria, Egypt and Greece. So well did the Chinese guard their secret that the origin of silk was not known to the Western world until the middle of the sixth century. It is said that two monks smuggled a few eggs to Constantinople in their pilgrim's staffs, and from these all the silkworms in the Western world are descended.

Three hundred years before that a descendant of a Chinese Emperor fled to Japan, carrying a few of the precious eggs with him, with which he paid for protection from his pursuers. The Moors brought the silkworm to Spain in the tenth century, and from there the industry was soon extended to Greece and Italy, and to France about three hundred years later.

Silk is the gold of textiles. In ancient times kings and emperors have weighed their treasures of silk with their gems and precious metals. Only within the past twenty years has American skill perfected the weaving of silk by power-looms, and revolutionized and cheapened the processes of manufacture, until silk fabrics are within the reach of all.

Manufacture of Silk.—Silk is one of the most sensitive of the great barometers of trade, as it is the first to be affected by financial disturbances. The prosperity of nations may be judged by their consumption of silk. The United States is the greatest consumer of raw silk in the world. About half of the silk used in this country is manufactured here, and there is very little exported. Our annual purchases of raw silk from France, and other countries, amounts to about forty million dollars. There is more raw silk sold annually in New York City than is bought by France, which country led in this industry until recently. The annual product of our looms is about one hundred and fifty million dollars and we spend, altogether, for silk goods, as much as we spend for education.

The breeding and management of silk worms, called sericulture, has never been successful in this country, although it has been tried many times, dating back to the first attempt in the Virginia Colony in 1624. These efforts have failed for the reason that the cost of labor for producing reeled silk in Europe is from eight to twenty-five cents a day, and in Asia as low as two cents a day, a competition that we will never be able to meet. It is a unique product, its raw material being produced by the cheapest labor in the world, and the finished product being the most costly merchandise.

Centers of the Silk Industry in America.—The manufacture of silk goods in this country has grown to such an extent during the past forty years, that the raw silk supply has increased two and one-half times. The first

Courtesy Belding Bros. Silk Mills

GATHERING THE COCOONS

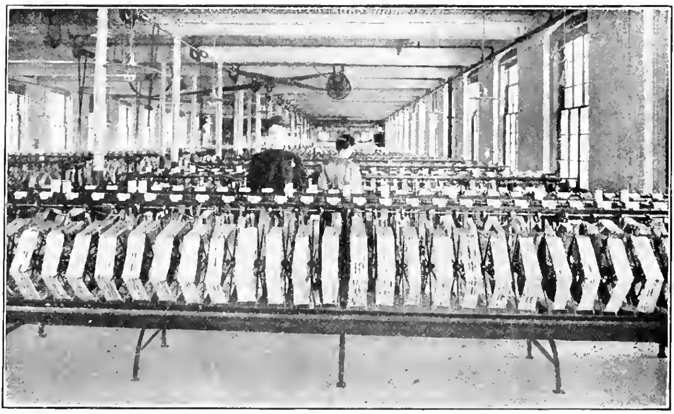
mill in this country was built at Mansfield, Conn., in 1810, and it is still standing, a little building fifteen by twenty feet in size, built over a swift-running stream. There are now about seven hundred silk mills in the United States, employing over one hundred thousand operatives. In this industry New Jersey leads, Pennsylvania stands second and New York third. The greatest silk city in this country is Paterson, N. J., there being over three hundred mills there, with a product of over thirty million dollars per year.

The Silkworm.—The silkworm is cultivated principally in China, Japan, India and the Mediterranean countries of Europe. China exports about thirty million pounds of raw silk every year, which is almost double the amount sold by Japan.

There are four stages in the development of the silkworm—the eggs, the larva, the chrysalis and the moth, the span of its life being only about fifty days. One moth will lay about four hundred eggs, and forty thousand of them will weigh an ounce! The eggs may be hatched by heat at any time—they may be kept in a warm dry place almost indefinitely. When the worm is hatched it is black in color and scarcely an eighth of an inch long. It has four moulting seasons, at which times the old skin breaks at the nose, and the worm wriggles and twists until it entirely emerges from it. As it grows older and larger the silkworm becomes lighter in color until it is almost white. Each change gives the worm an insatiable hunger and it feeds ravenously upon the leaves of the mulberry tree, which are picked and placed upon trays daily. Several thousand of the worms eating make a noise like the pattering of rain.

In about forty days the worm is full grown and ready to begin spinning its cocoon. It climbs up from the feeding tray to the branches above it in search of a suitable twig upon which to begin its spinning. It loses its appetite and shrinks nearly an inch in length. Then it throws out silken guy lines to secure the cocoon in its place and gradually wraps itself in a much closer covering, an oval ball the size of a pigeon's egg, which is called a cocoon. The silken threads come from two semi-fluid glands near the head which unite within a small orifice below the mouth, from which the silk issues in a glutinous state, the two threads appearing as one. The motion of the worm's head is very rapid and from nine to twelve inches of silk flow in a minute. The thread is not wound around the cocoon but is laid in short figure-eight loops, so that when the cocoon is unwound several yards of silk may be taken off without turning it. The worm makes seventy-five elliptical motions of its head per minute, or about three hundred thousand in the construction of a cocoon, which it makes in about five days.

As soon as the worm is in its chrysalis state, the cocoons, except those required for breeding, are collected and stifled in a steam-heater. If the moths were allowed to emerge they would break so many threads that the cocoons would be ruined for reeling. In the best cocoons



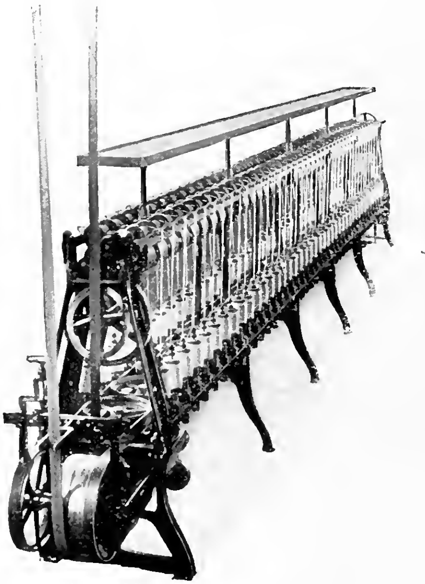
Courtesy Belding Bros. Silk Mills

REELING THE SILK INTO SKEINS

the silk thread will measure about 1200 feet in length. The outer loose layer is known as "floss," which is made into spun silk, no effort being made to use the continuous thread, but it is woven like cotton or wool.

The thread in the core of the cocoon is so fine that it is unfit for manufacture, therefore several are unwound at the same time. In Japan and China this is usually done by hand, although in many places machinery is coming into use. The cocoons are first placed in hot water, which softens the gum so the required number of threads may be picked out, and they are run through a guide on a reel, hardening again into a single thread.

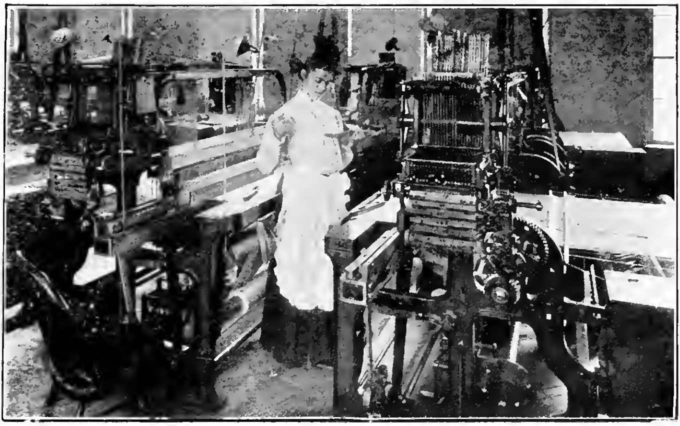
The finest sizes reeled run 491,000 yards, or 297 miles, to the pound, although the average thread runs about 150,000 yards to the pound. After drying, the skeins are tied up in packages of five and put into a tough, water-proof cover. From twenty-eight to thirty-two of these packages are then tied with ropes, wrapped



Courtesy Corticelli Silk Mills
WINDING THREAD ON SPOOLS

with oiled paper, then covered with matting and bound for shipment, in which form it reaches this country for manufacture.

The Process of Silk Manufacture.—The silk mill of today is the result of one of the greatest industrial developments in this country. There are seven separate divisions in the manufacture of silk: throwing, dyeing in the skein, winding, weaving, dyeing in the piece, printing and finishing. The raw silk is too fine for ordinary use and it is the throwster's task to wind, clean, double-twist, rewind and reel it into more substantial yarn. He converts it into singles, tram or organzine according to the purpose for which it is to be used. Before reeling, the threads must be stretched, which evens them and gives firmness and uniformity of size. Singles, tram, organzine, sewing silk and machine twist are then transferred to a reel and made into skeins for dyeing.



Courtesy Belding Bros. Silk Mills

WEAVING SILK CLOTH

They are now boiled in soapsuds to free them of the remaining gum and to give them lustre. This process removes about one-fourth of the original weight. Next it is put into the dye vat, where the adulteration or "weighting" is done, if at all. Proper dyeing adds about ten per cent. to the weight, but, by dipping again and again in the heavy metallic dyes, as much as seventy-five per cent. in weight may be added. Any silk, if heavily loaded, will break easily, an experience which every purchaser has had.

After the silk is dyed it is known as "soft silk."

Then it is ready to be wound in skeins or on spools for the market, or ready for weaving into broad goods. Every woven fabric consists of a warp and a woof or filling. There are two systems of threads, the former running lengthwise and the latter crosswise, under and over alternately, this interlacing being called the weave. The three foundation weaves are called taffeta, serge and satin. The finest grade of velvet is made by looping the warp thread over fine wires, which give, by their size, the desired length of pile. When a few inches of web is woven the weaver stops and cuts the fine loops with a knife. Other grades are made by the use of the power loom.

All goods requiring more than three colors, or those demanding intricacy of design, are woven by the Jacquard loom, an improvement or addition to the ordinary "Dobby" loom, consisting of a set of strings, one for each of the warp threads, suspended from the top. The pattern is cut in cards, resembling the music for a player-piano, this being engaged by the strings, so that any desired effect or design may be obtained. This machine has been so changed by American invention that little of the original loom, except the idea, remains. The really efficient power loom dates back only about twenty years. In the past ten years more progress has been made in improved mill machinery than in the thirty preceding. The modern power loom of today is equipped with mechanical devices that work automatically to save time, material and labor.

Substitutes for Silk.—Many attempts have been made to find a substitute for silk. Cotton thread, under various names, is used in imitation of silk, but vegetable fiber becomes worthless when affected by dampness. Silk, however, is in its element when wet, being originally an animal product. In 1874 a silk mill was destroyed by the breaking of a dam in Massachusetts and sewing silk was scattered for miles below. This has been frequently plowed up by farmers since and found to have retained its original strength.

Silk Thread.—In addition to the manufacture of silk cloth the silk thread industry has assumed great proportions in this country, many of the mills about Florence, Massachusetts, confining their operations to this one branch of the industry alone, manufacturing, in addition to the ordinary spool silk, machine twist, crochet silk, knitting silk, lace silk, floss, embroidery silk and many others.

Various Uses of Silk.—The electrician uses silk thread for insulating wires; it is carbonized and used for filaments for the incandescent lights. The surgeon uses it for sewing incisions, also for adhesive plasters; the dentist to clean between the teeth; the bookbinder to tie fancy booklets and cards, and for the binding itself, and the fisherman uses it to snell his hook. Silk, which for centuries was considered a luxury, has become so cheap that it is now a necessity.

FOR RESEARCH

1. If we cannot compete with foreign countries in the production of silk, why can we surpass them in its manufacture?

2. Upon an outline map of the world, color the countries noted for silk production, also indicate those countries leading in its manufacture.

3. Trace a shipment of raw silk from Hong Kong to Paterson, N. J. What steamship and railroad lines would perhaps carry it and where would transfers be made?

4. What tests can you apply to determine the quality of silk?

5. Gather some mulberry leaves in the fall, then obtain from the Department of Agriculture some silkworm eggs in January and practically illustrate silk culture.

6. How does the Government encourage silk manufacture?

7. Examine and discuss specimens of cocoons, raw silk, gros-grain cloth, tussar silk, pongee, satin and velvets.

8. What position in the silk trade do the cities of Shanghai, Canton and Yokohama occupy?

9. What is mercerized silk?

CHAPTER XVI

THE LUMBER INDUSTRY

The lumber business occupies fourth place among the great industries of this country. Few of us fully realize its vastness. It exceeds in value the production

Courtesy Gt. Northern Ry. Co.

TIMBER REGION OF THE NORTHWEST

of iron, coal, petroleum, gold, silver, copper and other metals, added to the total value of the entire wheat crop of the United States. The lumber business is more highly developed in this country than in any other part of the world.

Lumber Regions of the United States.—Although there are forests in every state, there are four distinct districts of this country which produce the lumber of commerce—the Northeastern, comprising the New England States, New York and Pennsylvania; the Northern, comprising the States of Wisconsin, Michigan and Minnesota; the Southern, including Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Arkansas and Missouri; and the Pacific, including California, Oregon and Washington.

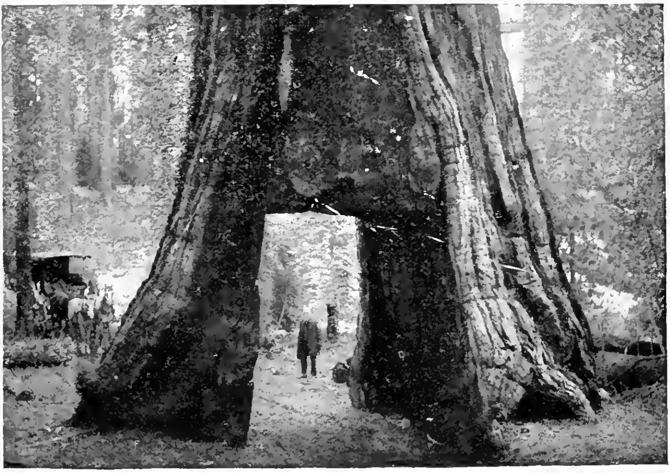
The Southern district, up to the present time, has held first place, as here is the home of the long-leaf yellow

Courtesy Gt. Northern Ry. Co.

A FOREST OF MAMMOTH OREGON FIR

pine, that peerless American tree, the product of which may soon be practically exhausted if the present slaughter continues. In this belt are located half of the sawmills of the United States, employing about half of the labor engaged in lumbering. The largest market for yellow pine lumber is Pensacola, Fla., closely followed by Mobile, Ala., Gulfport and Pascagoula, Miss., and Sabine Pass, Texas. This lumber is shipped to all parts of the civilized world, yet three-fourths of the supply is used in this country.

The leading lumber district of the future will certainly be the Pacific, as the supply from the Northern and Northeastern districts is practically exhausted and that of the Southern cannot last long. Authorities claim that ten years will exhaust the supply at the present rate of consumption. The Northern district has been the great source from which we have been getting our supply of white pine, the sawmills at Minneapolis, at one time, ranking among the greatest in this country,



Courtesy So. Pacific Ry. Co.

WAWONA—GIANT REDWOOD

but now the forests are practically exterminated and few of the mills are running. The many varieties of conifers—hard pine, hemlock, fir and spruce are found in profusion in all the timber regions, but produce grades of lumber inferior to the white pine; however, they are rapidly coming into use as the only available substitutes.

The forests of the Pacific region, at present the heaviest of the world, consist almost entirely of conifers, red fir, spruce, hemlock, yellow pine and the giant redwood. In the Northern part of this region one-third of the territory is covered by forests of fir. These trees sometimes attain a height of two hundred and fifty feet and many are as much as fifteen feet in diameter. The trunks are so clear and straight that they are in demand the world over by ship-builders, who use them for masts. A staff of this wood supports the British flag over Windsor Castle, and another upholds the Japanese banner over the Mikado's palace at Tokio. The masts and spars of the great fleets of Great Britain and Germany were shipped from Oregon and Washington. This wood rivals pine in lightness and oak in strength.

The most wonderful trees in the world are the giant Sequoia, or redwood, of California. Fortunately, the Government has protected the choicest specimens, from the ravages of the lumberman, by including them in National Parks. The tallest of these measures almost four hundred feet, and the largest diameter is forty feet. No man knows how old these trees are, but they are, without doubt, the largest and oldest living things in the world. Some are estimated to be eight thousand years old. When Moses was found floating among the bulrushes, some of these trees had bark a foot thick. One of them fell, a thousand years or so ago, and it is large enough for a coach and six to drive upon the greater part of its length. Another was some time damaged by fire, and a road, which is wide enough for two stages to pass within its trunk, has been built through it. The wood is light and red and makes excellent shingles and siding, which, on account of the scarcity of pine, is rapidly coming into use.

The place of white pine for interior finishing has been largely taken by the hardwoods, oak, birch, maple, beech, hickory, sycamore and ash, found to some extent in almost every state producing lumber. Memphis, Tennessee, is the largest hardwood market in the world, and San Francisco has also a large domestic and foreign trade in this class of woods. The finest furniture is made exclusively of hard woods.

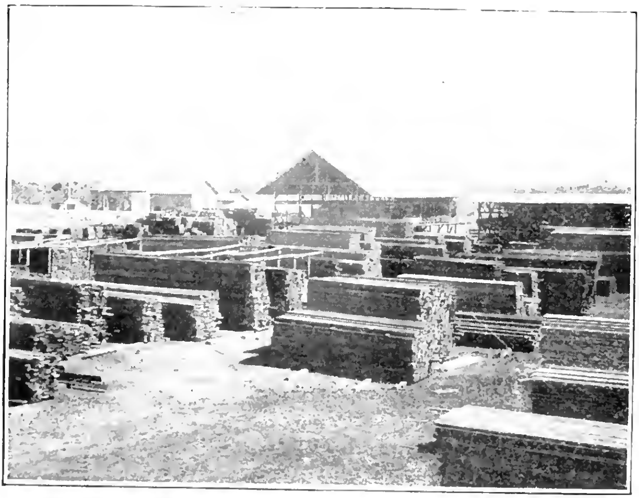
The methods used in a logging camp are very interesting and instructive. They vary according to local conditions, but, in the main, they are the same in all the districts. The principal stages are the felling, by use of axes or "cross-cut" saws, the sawing of the trees into logs of the desired length, and the transporting of these logs from the forests to the sawmills. Only a few

Courtesy E. D. Labaugh, Chicago, Ills.

A LOAD OF WISCONSIN LOGS—12,000 FT.

years ago water was the only means used for such transportation, but, under prevailing methods, railroads are built directly into the timber districts. Formerly the loading upon cars was done by the use of oxen or horses, but in the modern camp this slow, picturesque system has been superseded by loading machines, which are, in reality, "donkey-engines" in box cars, which operate reels, wound with steel cables from one-half to one inch thick, and from five hundred to twenty-five hundred feet long. The cable is fastened to the log and it is drawn quickly to the track, another cable, swung from a large crane, catches the log and lifts it into place upon the car.

In the Northwest the logs are sometimes "skidded" in ditches or "flumes" from the interior camps to the mills. One of these flumes, in California, is over sixty miles long, and from one week's end to another the lumber goes sliding down this flume, crossing deep gulches, and skirting the sides of the canyon until it reaches the market.



Courtesy Long-Bell Lbr. Co.

A RETAIL LUMBER YARD

In the Northwest region, the rafting business has attained immense proportions, as this is the cheapest method for conveying the logs to San Francisco. In still water, adjacent to the rivers, an immense "cradle" is built of heavy timbers between rows of piling, which allows the raft to rise and fall with the water. The logs are now lifted, one at a time, into the "cradle" by a derrick. When the logs are all in place they are securely fastened with heavy chains, seventy-five or one hundred tons of which are sometimes used for one raft. Many of these rafts are frequently towed from the mouth of the Columbia River to San Francisco. One raft, which recently made this trip, the result of a season's work in the fir forests, was over seven hundred feet long, fifty-five feet wide and drew twenty-three feet of water.

The majority of the large sawmills are built beside some body of water, in order to be able to handle the logs easily and with a minimum cost, to provide a place for storing a reserve supply and, frequently, that the sawed lumber may be shipped cheaply.

A large sawmill in operation is a fascinating part of the industry. There is the shriek of the saw, as it revolves with lightning speed through what was recently a monarch of the forest. Then, there is the clashing of chains, the roar of the machinery, as the log carriage moves back and forth, and onward moves the lumber, first to the kilns, then to the planning mills and later to the markets of the world. In one year enough yellow pine lumber alone is sawed, which if sawed into boards one inch thick and one foot wide, would, placed end to end, reach from the earth to the moon eight times. Three-fourths of this lumber would build a house large enough to accommodate all the men, women and children in this country, giving each a room containing sixteen square feet of space.

The men of the lumber camps are usually Scandinavians, although many French Canadians are found in the Northern camps. In the South many negroes are employed in the mills, but they do not work well in the forests.

Forest Conservation.—Russia leads the world in the planting of forests, the United States in their wholesale destruction. Recent action on the part of the Government, toward conservation of timber tracts, is a step in the right direction. It is to be hoped that future administrations will take further action to prevent ruthless and unnecessary destruction of timber. In other countries a number of young trees must be planted to replace each one cut. Here this requirement is not only ignored, but, through carelessness, what were recently virgin tracts of timber land are often blackened, desolate, barren, swept yearly by forest fires, producing nothing but scrub oak and stunted field-pines. There is not enough standing timber left in some places to hold the melting snows until late in the season, allowing them to melt gradually and distribute the water supply. Consequently we have great floods early in the spring and droughts in the summer, the rich soil is washed into the rivers and on to the sea. All these disasters occur because our people do not realize what a valuable heritage we have. The attention of every one should be directed toward the National Forestry Department, which can solve this great economic problem if given proper support by the people.

FOR RESEARCH

1. What benefits are derived from forests besides their use for lumber and fuel?

2. What cities are great lumber markets?

3. What countries supply boxwood? Rosewood? Sandalwood? Ebony? Cinchona? Mahogany? Circassian walnut?

4. How does the United States Government protect forests?

5. Make a list of soft-wood trees, also one of hard-woods. How many of these do you know? How many grow in your own state?

6. In what way has iron or steel taken the place of lumber? In the manufacture of what article has lumber taken the place of rags?

7. Indicate the lumber regions of the United States on an outline map, showing also the principal markets. What railroads haul the lumber to the markets?

8. In what way is lumber of value to the railroads? To the tanner? To the paper maker?

9. For what use is yellow pine best suited? White pine? Redwood? Cedar? Spruce? Oak? Maple?

10. What is a timber reserve? A timber claim? How does the Government encourage the planting of trees? Do the individual states assist in this manner?

11. From what kind of trees are turpentine and pitch obtained? From what lumber district is the greatest amount obtained?

CHAPTER XVII

FURNITURE—FROM FOREST TO FIRESIDE

There is as much deception practised in the manufacture of furniture as there is in the manufacture of clothing, and every one should know some of the points of excellence in order to purchase intelligently. The center of the furniture industry of this country, and perhaps of the world, is Grand Rapids, Michigan. In this delightful Northern city, any amount of time may be profitably spent, visiting one or more of the great factories and studying the processes of manufacture. So famous has the Grand Rapids furniture become that buyers from all over the world come there to make their selections. For their convenience there are three immense buildings used exclusively for the display of samples, over a million dollars worth in each of them. This is in addition to the display rooms maintained by each of the factories located there, in fact there are several factories whose display rooms contain samples of their own manufacture that will run over the half-million dollar mark in value. Factories from all over the country constantly keep their samples on display in the general display buildings, and find it a profitable investment on account of the prestige gained by being represented at "furniture headquarters."

Good furniture strongly appeals to people of intelligence and refinement. It creates in them a keen desire for acquisition and association. If its appearance and style are pleasing, its acquirement is likely to be sought. It should also show qualities that will permit of its treatment as an heirloom, good for generations to come. To possess these qualities furniture must receive artistic and skillful treatment as to design, material and construction, being dependent alike upon capable service of both the designer and the artisan. The designer must have a wide knowledge of the history of the times, the characteristics of which he seeks to portray. His acquaintance with the productions of other periods must

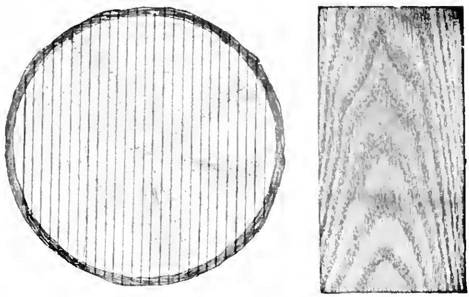


Fig. 1. Plain-Sawed

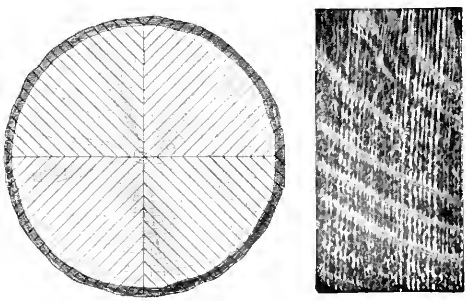


Fig. 2. Quarter-Sawed

Courtesy S. C. Johnson & Sons

be extensive. He must study the life and spirit of the people whose ideas he seeks to illustrate. He should also have the inventive ability to set forth in pleasing and practical form his own interpretation of the culture and intellectual strength reached by designers of previous ages.

The furniture of the ages is a book, on the pages of which are indelibly engraved the prevailing architecture of the peoples that have occupied the stage throughout the drama of human existence. Many parallels could be drawn between Louis XIV furniture and the gorgeous dress of that period; between the classical furniture of Napoleon's time and the severe gowns of the Empire; and the stately furniture of the Colonial period and the equally stately costumes.

The Renaissance raised furniture-making to a fine art. Pupils were apprenticed to a master and studied with him until they had perfected their craft, when they opened workshops of their own. The pieces produced in these great studio-shops united beauty with utility. Designs were made with reference to their setting, and houses possessed a harmony that had hitherto been absent. This period produced some of the greatest masters the world has ever known. The genius, which for centuries had been struggling for expression, burst forth in a mighty flood. The creations of the great masters of this period form a monument that becomes more imposing with the passing of the years. There have always been those who preserved and cherished the work of the great masters, and, in recent years, there has been a gradual turning toward the beautiful in furniture and the styles of the great masters are being copied and restored.

Furniture Designs.—Many of the designers of the early centuries signed their work, just as the great painters placed their names upon their canvasses, and this custom is now being restored by some of the great factories, to assure the possessors that their furniture is correct in design and superior in workmanship. The old masters brought to bear upon their work the whole power of their being, no detail was a trifle, there were no dark corners to be slighted. They selected their wood with the greatest care, its kind, grain and fibre must be of such a character as to best lend itself to the finished product. In order to create furniture to meet the ideals of the old masters, designers of the highest type, who have made a life study of the work, must be secured. The very finest woods from the markets of the world must be obtained and the men in the shop must be trained. In many of the large factories are workmen who have been there since they were boys, and in some cases their fathers spent their lives there before them, handing their knowledge down to their sons. To them

PRODUCT OF A MANUAL TRAINING SCHOOL

their work is not merely a means by which to make their living, but to create expression in their work of the high ideals of the masters which they interpret.

Selecting Material.—The material from which furniture is to be fashioned must not only be well-seasoned and perfectly sound, but it should be so cut as to show nature's handiwork in the beautiful tracings and colorings to be seen in the texture. All of this takes care, dressing and joining must be skilfully done, and there must be no dishonest workmanship or a shoddy product will result. Months must elapse between the importation of the raw material and the day when it is finished into furniture.

It is an interesting process that transforms rough lumber into a finished piece of good furniture. The wood goes through a long drying process: after reaching the factory every piece of wood must be kept in the dry-kilns from one to two years, depending upon its size

Courtesy Berkey & Gay

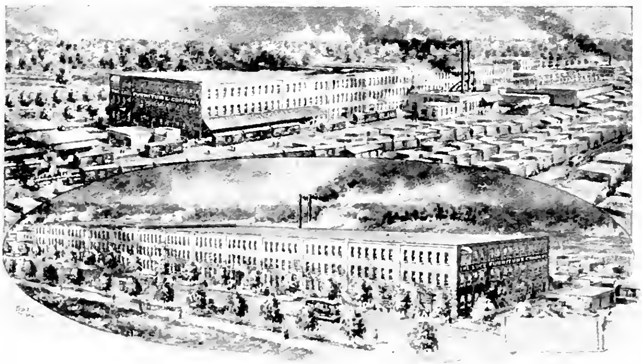
AN EXPENSIVE TABLE—ITALIAN RENAISSANCE

and thickness, for it must be thoroughly seasoned. While much of the work in the manufacture of cheap furniture is done by machinery, in making good furniture most of the labor is done by hand. When the pieces are finally ready to join together, then comes the process of smoothing, staining, varnishing, rubbing with pumice, re-varnishing, re-rubbing, all by hand, many times over, making haste impossible but achievement certain. The completed pieces should not conceal any careless weaknesses under an attractive external appearance. To produce furniture of the highest type means more than the use of good material, it requires time, experience, the sense of fitness and the artistic spirit.

Mission Furniture.—One of the most common styles in furniture is the Mission, so named because it was made by the early priests for use in their missions. Description of this style is unnecessary, as most people are familiar with its design. It is one of the easiest styles to make and, consequently, a favorite style among amateurs and in manual training shops in the schools. In many schools it is a very common thing for students to turn out tables, desks and other pieces that could not be duplicated in the stores for less than fifty dollars. Flanders and Holland Dutch furniture is of somewhat similar design, especially in finish. It bears strong characteristics of the early Seventeenth-Century styles, which have been revived in recent years. All of these are usually made of solid oak and are built to stand the test of time. The finish is usually in dark brown, stained or fumed and they are seldom varnished, having a soft finish instead.

The Colonial styles have been modeled from those first used by the colonists in this country, many originals of which are yet preserved as priceless heirlooms. The designs have always leaned toward simplicity. It is this quality that renders Colonial furniture as satisfactory today as when it came from the hands of its originators. The bed with four tall posts belongs to this period. Sometimes the pieces have the characteristic leaf and feather carving on the posts, and the chicken-claw feet, and it is made in walnut and mahogany.

Louis XV Models.—A favorite design among people of taste is that of the Louis XV models. To conform with tastes of the day, decorators of this period introduced the Rococo style. The workmanship of this furniture, which was of high order, bordered on the fantastic, and the greatest artists of the day bestowed their skill upon it. While the designs were extravagant in the extreme, abounding in curves and carvings, the spirit of the times is well shown in the revival of this style. During the reign of Louis XVI straight lines replaced the flowing scrolls. Horizontal bands superseded the broken and tortuous mouldings. Irregular panels, painted with cupids and rose garlands, gave way to rectangular spaces ornamented with classic emblems. The refined influence of Marie Antoinette lives in the revival of these beautiful designs, which combine grace with simplicity, and they are as suitable in a refined



Courtesy Luce Furn. Co.

A GREAT FURNITURE FACTORY

American home of the present day as they were in a French palace of the Eighteenth Century.

The Sheraton.—The work of Sheraton is the most popular of any of the English designers. His creations have the imaginative quality combined with perfect proportion and rare restraint. Ornament for ornament's sake was never countenanced by him. He used the fluted post of the time of Louis XVI with severe lines and quiet ornament. He made use of the fluted columns and often used square supports, believing that a rectangular back demanded a rectangular base. On the same theory he always combined curved supports with curved models. He worked principally in mahogany, but wielded other colored woods as the painter wields his pigments. His decorations consisted almost entirely of marquetry and inlay, although a lightly carved leaf was sometimes countenanced. He met the fate of many men who have attempted to do a thing too well, but his furniture will, perhaps, live forever. His untiring and hopeful labors gave to the world one of the most beautiful styles of furniture ever designed.

Chippendale was another famous English designer; however, he was an adapter of styles rather than an originator. His more solid designs, with cabriole legs and claw-and-ball feet and divided splat back were taken from the Dutch, and the straight square heavy legs from the Gothic style. His most beautiful creations, with backs ornamented with exquisitely carved ribbons and lovers' knots, and the carved cabriole leg, were from the French; while a later design, used principally in chairs, with an interlaced strap work back, was from the Chinese. Once seen, this beautiful design will always be readily recognized.

The styles of the William and Mary period occupy a unique place among English designs. With the accession of William, Dutch artisans flocked to England and the intermingling of designs worked many changes in the handicraft of that country. The tendency seemed to be toward the production of more graceful and lighter furniture. The fundamental principles in these designs were of the underbracing, turned uprights, and other vigorous, straightforward designs to portray the characteristics of the period.

Furniture of the Flemish and Italian Renaissance is distinguished first by the abundance of hand-carving. Heads and grotesque masks were introduced, but always with marked effect. The Dutch excelled in marquetry and the Italians in boldness of design. In the great Grand Rapids factories there are men who work as patiently and as skilfully, while carving a design, as any master ever worked upon the canvas. Time is never an item to be considered, as the designs of the old masters must be reproduced with equal skill. One dining-room set in a Grand Rapids display room represents a year's work of one man. Only four sets were made, one was sold in New York, one in Philadelphia and another in Chicago, the fourth will probably go to St. Louis. The set was priced at five thousand dollars. It is one of the most solid and stable designs ever constructed

There are other designs galore, but a study of these principal productions will prove very interesting, aside from the standpoint of commercial importance. In our homes environment plays an important part, and a spirit of harmony and good cheer should emanate from furnishings and decoration. American organization has greatly cheapened the cost of furniture, and the invention and use of modern machinery has also played an important part.

FOR RESEARCH

1. What is veneered furniture? Why is furniture made from expensive woods usually veneered?

2. Can you distinguish the difference between veneered and solid furniture? What is grained furniture?

3. Name the greatest furniture markets in this country? What woods are used most in the manufacture of pianos? In the making of chairs and tables?

4. What is inlaid furniture? What woods are generally used in its manufacture? Why is quarter-sawed wood more valuable than straight-sawed?

5. Obtain specimens of woods of various kinds which are finished in different manners. Why are some articles of furniture varnished several times, while others are simply stained and rubbed?

6. If possible, visit a furniture factory and follow the wood from the dry-kiln to the show-room.

7. Visit a manual training department and inspect the work. Learn how wood is prepared, how joinings are made and finish applied.

8. Why does a highly polished, varnished article frequently "check"? How can this be prevented?

9. What is the most expensive wood used in the manufacture of furniture? Where is the greatest market for black walnut?

CHAPTER XVIII

PORTLAND CEMENT AND CONCRETE CONSTRUCTION

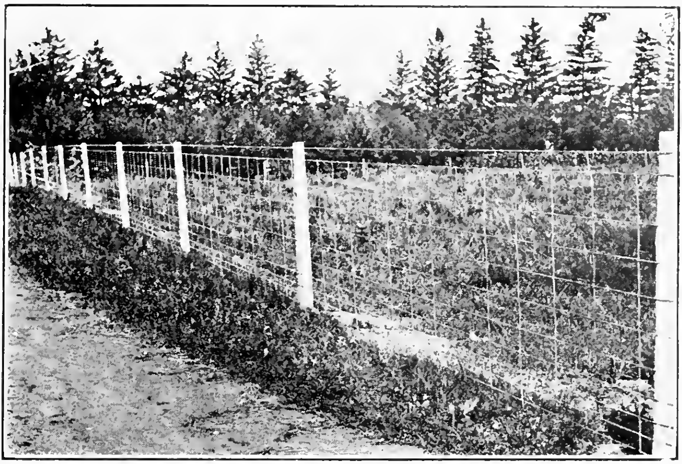
During the past few years the price of lumber has advanced so rapidly that a substitute for its use has become imperative. It is gratifying to know that such a substitute has been found which affords the added features of moderate cost and durability. At the same time this comparatively new material possesses all the advantages of lumber in the line of beautiful designs which may be constructed from it, as many unique and pleasing effects may be obtained.

Portland Cement is an invention of modern times, having come into universal use only within the past twenty-five years, or less. Concrete made from a natural cement was used for construction purposes by the ancient Romans, who secured good results from a mixture of slaked lime, volcanic dust and crushed stone. While this material was crude, in comparison with that in use today, it produced an artificial stone which has stood the test of time for nearly two thousand years. Many of the works in Rome are in perfect state of preservation today. Concrete construction, of similar nature, done in prehistoric times, has also been unearthed in the arid lands of the western part of the United States.

In 1824 Joseph Aspdin, of Leeds, England, secured a patent for the manufacture of Portland Cement, which he so named on account of its resemblance, in color, to a popular limestone quarried on the Island of Portland.

Manufacture was at once begun, but progress was very slow until about 1850, when its success was insured, commercially, by the adoption of improved methods of manufacture and general recognition of its merits as a building material.

The manufacture of Portland Cement was early begun by the Germans and the French, who, by reason of their more scientific efforts, greatly improved the quality of the finished product, as well as the processes of manufacture. The process was first brought to the United States in 1872, but it did not come into general use for nearly twenty years.



Courtesy Atlas Portland Cement Co.

CONCRETE FENCE POSTS

Portland Cement is manufactured from a mixture of two materials—one of them supplying the lime, for which limestone, or the softer material, chalk, is used—and clay, which is supplied by a soft clay or often a hardened clay, such as shale rock. The exact proportions of this mixture must be determined by chemical tests, or the finished material will be unsatisfactory. The materials are crushed separately, mixed in the proper quantities and then ground to a very fine powder. This powder is then fed into long rotary kilns, which are iron tubes about six feet to twelve feet in diameter, and from one hundred to two hundred fifty feet long, lined with fire brick. Powdered coal is used for burning this powder and is injected into the kilns by an air blast. A temperature of about three thousand degrees Fahrenheit is obtained in this manner; greater heat than is used in melting iron, and the fine, carefully proportioned powder is fused to a clinker, resembling lava. This clinker is cooled, crushed and ground again into a still finer powder, ready to be placed in storage for shipment.

Cement is manufactured in many parts of the United States; Pennsylvania, Missouri, Illinois, Kansas, Iowa and California perhaps being in the lead, yet the materials are so common that immense plants are being established at new locations every year. The abundance of good sand, in most places, and low freight rates on the same, and crushed stone or flint, greatly cheapens the process of concrete construction.

Concrete, or artificial stone, is made by mixing a coarse aggregate of broken rock, or, clean coarse cinder with clean sand and Portland Cement, using enough water to make a mushy mixture. The cement and water cause the mixture to begin to stiffen in half an hour, and in from ten to twenty-four hours it becomes hard enough to resist an impression. In a month's time the mass becomes a solid stone. It will harden under water in the same manner, which makes it the most desirable material for bridge, dam and tunnel construction.

Uses of Concrete.—There are countless uses for concrete, with many of which every one is familiar. Where concrete is likely to be pulled or bent, as in buildings, dams and tanks, it is generally reinforced by imbedding iron or steel rods within the construction. Concrete shrinks, like other materials, when the weather is cold, and will crack unless either heavily reinforced or jointed frequently. While experienced engineers or architects should be employed in the building of large structures, the process is so comparatively simple that small concrete construction may be done by workmen of little experience.

After concrete is perfectly hardened and finished, it resists acetic acid more thoroughly than any other materials of reasonable cost. This feature makes it especially desirable in the construction of silos, as the acid formed by the decomposition of green food is the greatest foe of wooden and steel silos. The concrete silo is also water and air-tight, vermin and rat-proof and will not burn or blow over when empty. These same properties make the material unsurpassed for barn construction.

Government statistics show that, notwithstanding the abundance of fresh air, fresh food and pure water, the death rate is greater in the country than in the city. Official tests of the water supply have shown beyond a doubt that the waters of many ordinary shallow and unprotected wells contain the germs of such dangerous diseases as typhoid fever. To prevent the polluted surface waters from seeping into the wells, many farmers are covering them and walling them up with water-tight concrete. Many sink "driven" wells and protect them with concrete housings.

The principle of deep wells, for pure water, has largely relegated the windmill and made gasoline engines a necessity upon the farm. These engines, and hydraulic rams, at springs, firmly set and housed in concrete, supply an abundance of water for the concrete reservoirs or elevated, reinforced pressure tanks, thus giving the farmer all the advantages of a city water system. From these places of storage, water is distributed to float-controlled, rot-proof watering tanks and troughs of the same material. Even springs and mouths of drain tile are improved and the water made clean and wholesome through the use of concrete.

The Department of Agriculture is stamping out Texas fever and sheep scab, as well as many other infectious diseases upon the farm, by insisting upon the use of dipping tanks in the infected districts. A hog wallow, with concrete walls and bottom, gives the animals the pleasure of a running stream, and at the same time protects them from their greatest foe, cholera.

In concrete the farmers and ranchmen have found the ideal floor material. Such floors not only effect a saving in feed, a shortening in the time of fattening and a

Courtesy Atlas Portland Cement Co.

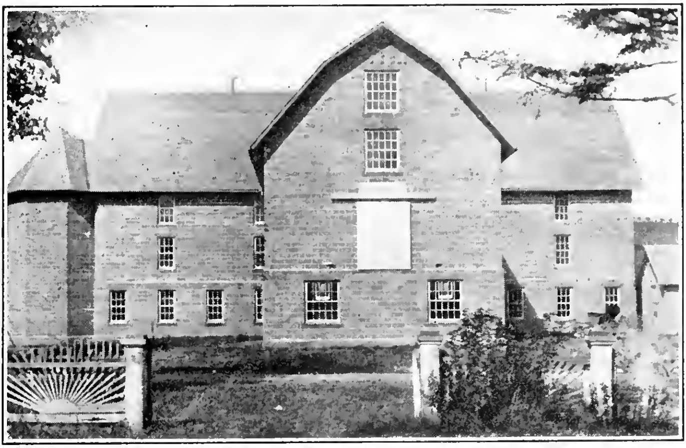
A CONCRETE RESIDENCE

decrease in labor, but such floors do not soak up water and become infected with disease germs of any kind. Their surfaces can be easily cleaned and thoroughly disinfected. They can be easily repaired, as concrete is the only material which can be used for any small purpose without having to be cut to the size desired. Careful tests have shown that, through the saving of grain from vermin and other loss, concrete floors pay for their construction within a very few years.

The National and State Governments, and the railroads, are large users of concrete, for many purposes.

The concrete residence has become an assured success, on account of its many desirable features and architectural beauty. Steel and concrete construction is revolutionizing the architecture of our cities, making possible the structure of from twenty to forty stories in height, as these buildings, representing an enormous investment, may now be built to withstand the ravages of time.

For veneering new buildings, or protecting old



Courtesy Atlas Portland Cem. nt Co.

CONCRETE BLOCK BARN

structures, or wherever the cost of concrete is prohibitive, stucco, or cement plastering, is durable, artistic and impervious to weather.

Some of the many uses for concrete may be of particular interest, as it is now extremely practical for the construction of fence posts, horse blocks, watering troughs, fertilizer tanks, retaining walls, dams, columns, steps and stairs, sidewalks, curbs and gutters, barns, floors, drains, cesspools, dairies, silos, grain elevators, corn cribs, etc.

The great million-bushel grain elevators and storage tanks, upon the Great Lakes, are now being built of reinforced concrete, as are also the newest and largest docks for the loading of iron ore.

The largest undertakings in the world, which could not have been accomplished without the use of concrete, are the Key West extension of the Florida East Coast

Courtesy Mississippi Power Co.

CONCRETE POWER DAM—KEOKUK, IOWA

Railway, the Keokuk Dam across the Mississippi River, and the Panama Canal, each of which has required the use of several million barrels of cement. So great and universal has the use of this material become that the present will no doubt be recorded in history as the Cement Age.

FOR RESEARCH

1. From any manufacturer of Cement you can obtain samples of ingredients used. Examine same and note properties of each.

2. If there is a cement works in your city, visit same and note the variety of articles manufactured. The workmen will explain important steps in the process.

3. How many cement or concrete productions can you find about your home and on the way to school?

4. Contrast the construction of a reinforced concrete structure with a steel-supported building.

5. Why is concrete construction particularly desirable for elevators, grain bins, silos and other uses about the farm?

6. What is the comparative cost of a brick or stone house and one of concrete blocks? Between a boarded or shingled structure and one covered with stucco?

7. How do cities or contractors test concrete to determine quality?

8. Why do some walks and walls scale and crumble while others remain solid for many years?

9. How should a concrete water-tank be constructed to avoid cracking when the water freezes?

10. What is "Joplin flint"? Why is it valuable in concrete construction? Why must care be used in the selection of sand.

11. Could the Panama Canal, the Keokuk Dam and Key West Railroad have been constructed without the use of concrete? Why were the steel tunnels under the Detroit River at Detroit, and the Hudson River at New York, lined with concrete?

12. Trace a shipment of concrete from Chicago to the Panama Canal.

CHAPTER XIX

THE HISTORY AND MANUFACTURE OF PAPER

The hornet and the wasp were the first paper makers, and they used the same raw product that is most used today,—wood pulp. The first paper manufactured by hand was from the *papyrus* plant which grew in Abyssinia on the Nile. The papyrus rolls, upon which were written the biographies of ancient kings, were made from the fiber of this plant. Paper, as we know it today, is the invention of the Chinese, and they made it from cotton. The Persians and Arabians learned the method from the Chinese and carried it to the nations of Europe, the first mill being established in Germany the latter part of the 13th century. After this the industry spread over the continent, Holland and France making most progress. The Hollanders were the first to use machinery for the maceration processes.

The first paper mill in this country was built in 1690, near Philadelphia, on the banks of a stream still known as "Paper Mill Run." For several centuries all paper was made by hand labor, the process being very slow and the product of very inferior quality. That used during the sixteenth century was of a quality far inferior to that now used by butchers and grocers as wrapping paper.

Paper-Producing Countries.—The United States is, by far, the greatest paper-producing country in the world, the annual output being in excess of 1,500,000 tons. The next largest producer is England, followed in succession by France, Germany, Austria and Italy.

As paper has been the medium by which learning and culture have been transmitted, so has the manufacture of paper been borne on the wings of commerce and so have the highest art and skill entered into its manufacture. From the first mill in Pennsylvania the industry has continued to grow, during the three centuries of its existence, until it has attained the high state of perfection it now holds.

The printing and publishing business, from the be-

Courtesy Rock Island Lines

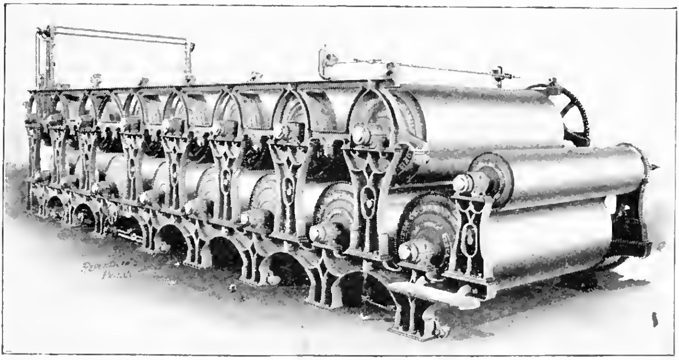
"THE FOREST PRIMEVAL"

ginning of the manufacture of raw materials until the finished product is placed upon the market, is one of our greatest industries. It has made more rapid strides forward during the past decade than perhaps any other.

Supply of Paper.—The most important feature of the business is the supply of paper and the demand has become so great that manufacturers are becoming very much interested in regard to the source of the future supply. The high-grade papers are made from rags, which are collected from the garment factories and done up in bales, or they are collected by rag pickers who drive down the alleys and come to the back doors to barter for whatever they may be able to find. For this class of material there is very little need for alarm, as the supply becomes greater every year and the price does not necessarily advance. The cheaper grades, however, such as are used for books and newspapers, are made from wood pulp, and here is the cause for alarm.

Wood Pulp.—The great bulk of ground wood pulp is made from spruce timber, of which it is estimated there are seventy-five million cords in the United States, and many times as much in Canada. The average price of spruce timber in Canada is six dollars per cord, with a charge of about three dollars per cord for freight, while the cost in this country is about nine dollars per cord, therefore the Canadian timber costs the manufacturer about as much as the home-grown product. There are over two hundred and fifty factories in the United States engaged in the manufacture of wood pulp. They annually use 3,400,000 cords of wood, which costs, approximately, thirty million dollars. Estimating that five cords is the product of an acre of ground, 670,000 acres are cleared of their timber every year for paper-making alone. Here the same difficulty arises as was discussed in our study of the lumber industry, the demand is so much greater than the supply, that the supply will ultimately be exhausted unless something effective is done to conserve the standing timber. This has become doubly necessary on account of the action of the provinces of Quebec and Ontario, in prohibiting the exportation of unmanufactured wood and pulp from their territory, and British Columbia will doubtless follow their lead in a very short time. Newfoundland has also passed laws of a similar nature and it is possible that the entire Dominion of Canada may do the same. This will particularly affect the newspapers and publishers of cheap literature, for they cannot very well raise the price, as the tendency is down instead of up. The rise in price of raw materials in other lines has often been an excuse for doubling, and even trebling, the price of the finished article, but it will be difficult for the publisher to do this, as an advance in price generally reduces the circulation.

Paper Making.—The principles of paper making are very little understood, especially outside of the Northern timber regions. In Wisconsin, the Michigan Peninsula,

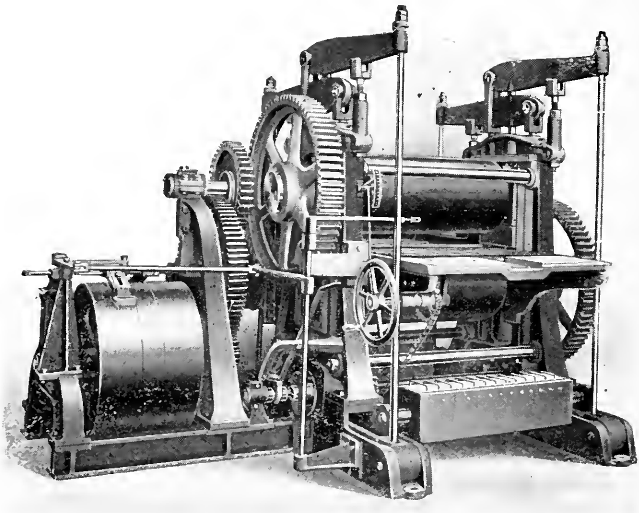


Courtesy Paper Trade Journal

ROLL CALENDER MACHINE

Northern Minnesota, along the Canadian line and in parts of New England, the pulp mill is a very common sight. While about two-thirds of the wood supply is spruce, others may be used successfully. These are principally poplar, hemlock, pine and fir. Wood pulp cannot be produced successfully with steam or other expensive power, therefore in the timber regions there are generally pulp mills wherever there is water power. One of the greatest on the continent is at Sault Ste. Marie, on the Canadian side, where a great water-power canal has been constructed. The manufacturers resort to an ingenious trick to evade the duty on a finished product by arranging the rollers so that frequent holes are punched in the large sheets, and they come across as raw material. In the yards of many mills these sheets of pulp may be seen, stacked like boards in a lumber yard.

A piece of wood consists of fiber and binding material, and to manufacture pulp it is necessary to separate



Courtesy Paper Trade Journal

PLATER—FOR FINISHING HEAVY COATED PAPERS

them, as the fiber is to be used and the latter discarded. Three processes are used, but the great bulk of the pulp used in paper making is produced by the mechanical process. The highest grade papers are produced by an acid process, while other grades are made by the use of alkali.

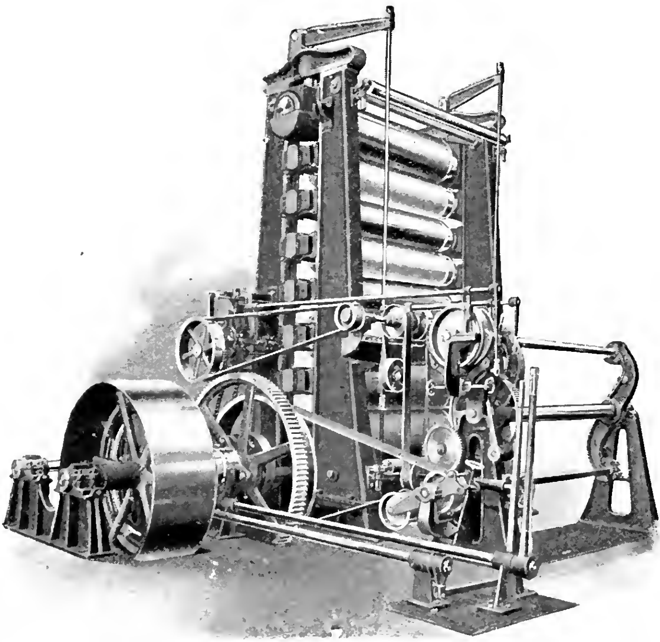
The Sulphite Process.—Pulp for the high-grade papers, manufactured by the sulphite process, where acids are used for separating the materials, costs twice as much as that produced by mechanical processes, or about thirty dollars per ton. This is used principally in the manufacture of books and other high-grade printing.

By the mechanical process, the bark is first removed from the sticks of wood and they are then ground into splinters, by being pressed by hydraulic force against a gigantic grindstone. Water constantly plays upon this stone, to prevent the wood from becoming overheated and also to carry off the ground particles to the drying room, where it is drained to a paste-like consistency, rolled between hot rollers, which dry it thoroughly and it is then ready for shipment to the paper mill. In making sulphite pulp the wood is "rossed,"—or the bark is removed,—then cut into very fine chips and finally placed in a machine called a "digester," where the mass is cooked for from eight to twelve hours in sulphurous acid, under great pressure. It is then taken out and the refuse removed. The chips must be very short, otherwise the digesting agent will not follow the fiber. Practically the same process is followed when caustic soda is used. The drying process is the same as that used when the pulp is obtained by mechanical method.

Making High-Grade Papers.—The very highest grade papers, the linens and bonds, used for fine stationery and books, are made from the trimmings obtained from shirt and garment factories. Other grades are made from various kinds of cotton and linen rags. When the bales are opened at the mills, and most of these are located in Massachusetts, New Hampshire and New York, they are placed in the "thresher," and the dust is carried off by suction tubes. From the thresher they are taken to the sorting room, where all foreign material, such as buttons, buckles, hooks and eyes, etc., are removed by women known as sorters, and from this room they go under a roll, having blades on its surface, which cuts them into small pieces.

The next machine is called a duster, which gives the rags such a chastening with its spiked teeth that it loosens the last vestige of dirt and lint, it all being removed finally by passing into a sieve-like concern where alternate suction and blowing removes all dust.

The rags next pass into the cooker, and are boiled and tumbled and tossed again and again. This mass is



Courtesy Paper Trade Journal

SHEET CALENDER MACHINE

then passed to a washing machine, where it is cut and strained, torn and washed, until pure white, and the water that runs through it is clear and sparkling.

Next the pulp goes to the drainer and then to the beater, which manipulates and mixes it with bluing, which bleaches it whiter still. Next comes the sizing, the changing of what is now blotting paper into those grades adapted for printing and writing purposes. This operation is followed, in quick succession, by a number of others, which transform it into finished paper.

The principal machine used during the processes is called the Fourdrinier machine, through which the pulp passes to an endless belt of fine wire cloth. Straps of rubber determine the width of the paper and as this passes along, all the water drains out. The paper then passes over a unique machine which produces the watermark or other characteristics of any peculiar nature. Passing through felt rolls, which remove the last vestige of water, it then passes between the calendering rolls which give it its finished appearance, and it is ready for the market, after being cut to the desired size and boxed or rolled.

Any vegetable fiber can be manufactured into paper of some quality. Straw, hemp, jute and sisal, a sort of grass, have been used and it is hoped that a successful process may be discovered for utilizing the cotton stalk.

FOR RESEARCH

1. Where is wood pulp manufactured? Where are most of the paper mills in this country? Why are the mills located there?

2. Obtain samples of: news, book, cover, linen, ledger, bond, tissue, wrapping and other papers and learn from what material each was made.

3. What is parchment? Vellum? How is cardboard made? From what material is paper-box stock made? For what is rice paper used?

4. Why is paper making a great industry at Sault Ste. Marie? What peculiarity in manufacture enables the manufacturers to sell their raw stock to mills in the United States free of duty?

5. What is a linotype? What effect did its invention have upon the printing industry?

6. Why were early books printed by hand and illuminated?

7. Visit a newspaper office and study the process of printing.

8. Obtain samples of as many kinds of paper as possible and determine from what each was made. Estimate the probable cost of each, per pound.

CHAPTER XX

PRINTING AND ALLIED INDUSTRIES

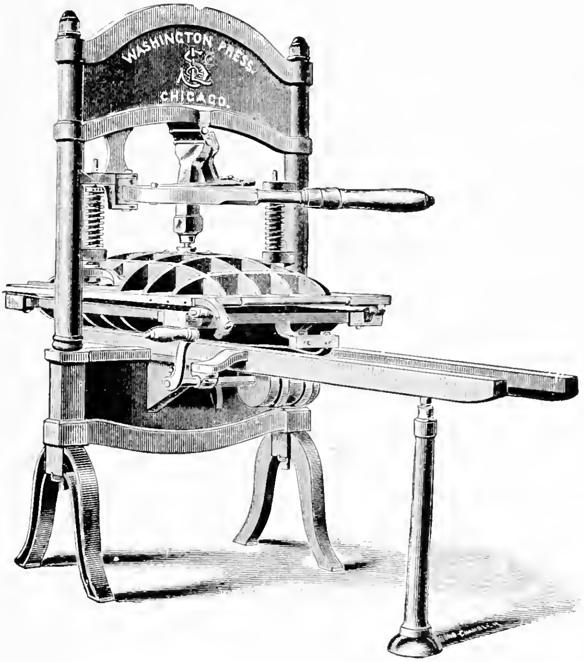
The Printing Press.—One of the most wonderful developments of modern times has been the evolution of the printing press. Within the memory of many printers now in active duty the old Washington hand-press was almost in universal use, and now it has almost entirely given way to the great rotary web printing machines, which, a quarter of a century ago, it was thought would never be used outside of the largest cities. This remarkable mechanical achievement has been forced upon the publishers, that they may keep pace with a never-satisfied news-reading public.

Types of Presses.—The Washington hand-press had answered for many, many years, and, during the time of Franklin's career, and later, it answered every purpose. Compare it today with the great Hoe sextuple machine which will print in colors on paper in rolls, paste, fold and stack 48,000 newspapers in an hour. Large newspapers also use the great octuple rotaries, the greatest triumph of the printing age, which will print as many as 194,000 papers in one color, per hour. Such a machine requires an 80-horse-power electric motor to start it in motion, and in ten hours will run more than a thousand miles of white paper through its flying machinery.

Color Printing.—Even more remarkable is the development of the perfecting press, for the very finest work in type and cuts. While these machines work as rapidly as if they were printing newspapers, their work is of the highest quality. A machine is now able to print in the colors of nature, as the evolution of the processes of illustration has kept pace with other improvements. In the days of the Washington press all illustrations were carved by hand from blocks of wood or steel, or lithographed from stone. Aside from being expensive processes, they were altogether too slow, as it required many hours—sometimes days—to produce a single printing plate. This would not at all be in harmony with our modern idea, where we expect to see an important event pictured in the daily paper a few hours after it transpires.

Photo-engraving was introduced first in 1875 and today is the most perfect method for reproducing pictures of any kind. The object, or picture, is photographed through a glass screen of extreme fineness upon a negative, and the film is then removed and placed upon a sensitized plate of highly polished copper. This plate is then passed through a chemical process whereby the shadows of the picture are burned in upon the plate, which is then mounted ready for printing. Fine-screened cuts, with perfect press work, give results fully equal to photographs. The zinc-etching process is virtually the same. Pen and ink or line drawings, in perfectly black ink, are required and there is no screen. This is the simplest method of making printing plates, but photographs, or wash drawings, or paintings cannot be reproduced in this way. Color printing is done from half-tone plates.

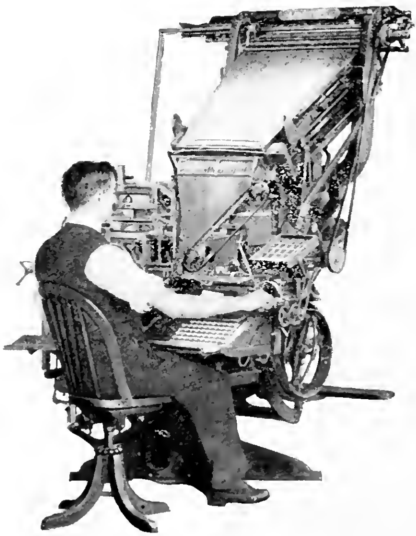
Stereotyping has been in use since 1861 and there has been no change in the process. It is a method for duplicating type forms, by taking a papier-maché impression, placing the same in a casting box, after which melted stereotype metal is poured in and the plate is then trimmed and used as required, thus saving the wear upon type and cuts. Where a great many impressions are required, or for the duplication of fine half-tone plates, electrotyping is used. A wax mold is made from the cut or type and suspended in a bath which holds copper in solution. By an electric current the copper is deposited upon the wax and when this becomes of the proper thickness it is backed with base metal and is ready for printing.



THE KIND BEN FRANKLIN USED

Lithographing is still largely used for certain classes of work, principally show bills and posters and fine stationery. The design is traced upon a rare stone, obtained principally from Austria, the printing ink adhering only to the traced lines. Steel engraving and copper plate work is used where a raised effect is desired, in the reproduction of fine lettering or script, these being the most expensive of the engraving and printing processes.

Type-setting Machines.—In the old days all type was set, laboriously, by hand in a printer's "stick." Now even the smallest villages often possess modern type-setting machines of some kind. Chief among these is the Mergenthaler linotype. As the name implies, the machine does not set movable type, but casts a line-o'-type, through the use of about 1500 brass molds or matrices. It is operated by one person, the keyboard resembling that of a typewriter. Touching a letter upon



Courtesy Mergenthaler Linotype Co.

THE LINOTYPE

the keyboard releases a corresponding matrix and when a line has been set, molten metal is released which casts, automatically, the solid printing line of type. The amount of copy that may be set by an expert linotype operator in an hour is almost unbelievable, 14,000 ems having been set during this time, although the average speed is perhaps about 4,000 ems.

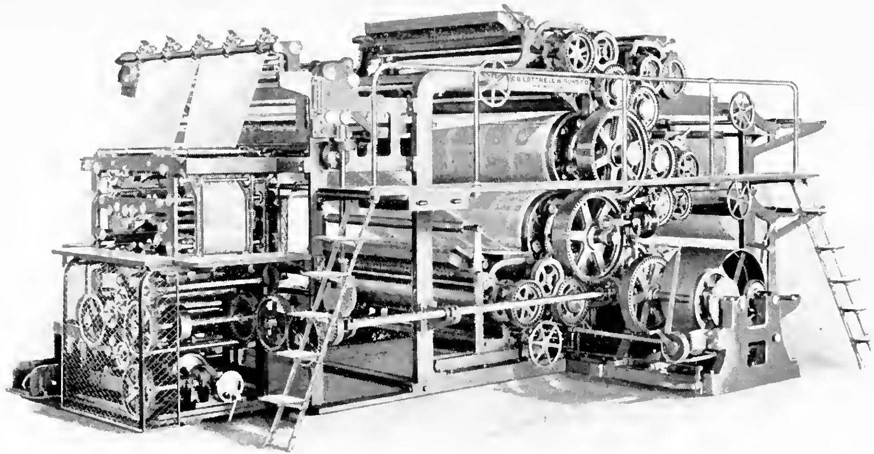
The Lanston Monotype produces single types, cast in the order of their use. Two machines are used, however, one being a perforating device, operated by a keyboard, and the other a casting machine. There are several other machines which set and distribute movable type, all of which are more or less in use for certain kinds of work, but the machine of the newspaper world is the linotype. After using, the type is melted and cast over again.

The Publishing Business.—Publishers are sometimes mere followers of the local or national trend of thought, but the aim of the true publisher should be to lead the minds of the people into higher channels and develop a taste for what is pure in literature. The greatest readers and book-buyers in the world are the people of the United States. Where there is illiteracy there can be no demand for reading matter. The chief book markets of this country are New York, Philadelphia, Boston and Chicago. As the centers of population move westward, new book markets are created, and it is only a matter of time until Kansas City, St. Louis and other western cities will rank with those of the East. The public spends annually about forty million dollars for fiction and general reading matter, and a like amount for school and library books. Modern fiction is, in the main, short-lived. At the public libraries, one-third of the new books published any particular year are not called for upon the same date the following year. One-third of all new books live only one or two years, while the great majority of them become dead stock in six or seven years.

The discovery of the art of making paper from wood pulp has contributed much toward cheapening newspapers, but has done a great damage to the quality of books, as the fabric of the average book today is not as good as it was fifty years ago, when the paper was made of cotton and linen rags. Newspaper may be bought for about three cents per pound, but a good grade of book paper costs from twelve to fifteen cents per pound, while the best hand-made papers cost as much as sixty cents per pound.

The cheap magazine has seized upon the attention of the public. In 1890 most magazines sold at twenty-five cents per copy. The reduction of "Munsey's," the first to drop to ten cents, increased the circulation of that periodical to such an extent that the presses had to be stopped from printing the first edition to permit the printing of the next month's issue. Others quickly followed this drop in price, which was raised to fifteen cents ten years later, on account of a general advance in the cost of labor and material. The circulation of some of the leading magazines has far exceeded the two and one-half million mark per month. Today we have magazines representing every trade and industry, and they form a most important adjunct to the press of the country.

The newspaper press of today is a most colossal institution, as its ramifications are limitless. Every class of people is interested in it, as the present tone is more educational and less oracular than formerly. No outside force can now hold a great newspaper in its power and the business is progressing so rapidly that no one can foresee its possibilities. In New York City over two and one-half million newspapers are sold every day, but, great as is this circulation, the receipts from sales pay only about one-third of the expenses of a great newspaper. The first thought of the publisher is to keep the cost of the white paper used for each copy down to what he gets for the printed paper, the profits are all to come from advertising. Some of the great newspapers receive as high as an average of fifty thousand dollars per week for advertising space. The Sunday issue is the great money-maker, as there are sometimes as many as ninety pages, and a correspondingly large part is advertising, worth about seventy-five dollars per column. The greatest item of expense is, of course, the gathering together of the news. An important occurrence is reported with



Courtesy C. R. Cottrell Sons Co.

DOUBLE WEB ROTARY PERFECTING PRESS

This is a double web illustrated periodical press, arranged for printing in colors on the top web. It is possible for this combination to distribute the color-printed pages throughout the publication. The product is delivered in 8, 12, 16, 20, 24, 28, 32, 40, 48, 56 or 64 page signatures, folded, pasted and trimmed. By using duplicate sets of plates up to thirty-two pages, double the product can be obtained.

the same disregard for space, whether it happened in the antipodes or around the corner. All of the news from foreign countries, as well as the larger portion of that within our own borders, is reported by telegraph. The cost of transmission is lessened, somewhat, by the organization of syndicates, but rivalry is so intense that the greatest papers obtain exclusive reports at whatever cost is necessary to get the news.

The newspapers in smaller cities and towns obtain syndicate matter, and that already used by the original purchasers, through associations which distribute patent insides, stereotype plates, and electrotypes, which is an enormous industry in itself. Almost all of the weekly newspapers are served this way. The advent of the telephone, rural free delivery of mail and other forces, has tended to increase the circulation of daily newspapers.

The press of the twentieth century is one of the greatest powers of the earth, whether that power be used for good or evil. It is also certain that the taste of the people of any country is reflected in the literature they prefer.

FOR RESEARCH

1. How many people are engaged in the printing, and allied trades, in your city?

2. Obtain specimens of both metal and wood type. Why is it notched on the side?

3. Why is most printing not done from type, direct?

4. Visit a printing office and obtain samples of linotype work. If possible secure an etching, wood cut, electrotype, stereotype, half-tone, lithograph, steel die and copper plate, and samples of printing from each.

5. Visit a newspaper office and follow the processes of gathering news, preparing it for the linotype, assem-

bling the forms, preparing for the press and distribution of the papers.

6. Where do local newspapers secure their white paper? What railroad lines transport it?

7. Name three factors which have been combined to give us the cheap newspaper, book, and magazine.

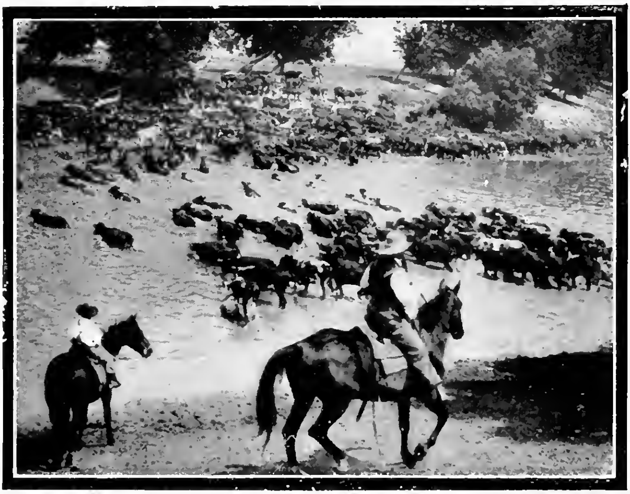
8. If there is a paper mill or bindery in your city, obtain as much information as possible regarding these phases of industry.

9. What is a job press? A cylinder press? Which is generally used for printing magazines and books?

CHAPTER XXI

DAIRY PRODUCTS

It has not been long since the products of the dairy were principally confined to those made by the women on the farms. In those days the utensils were as crude



Courtesy A. F. S. F. Ry. Co.

A WESTERN HERD

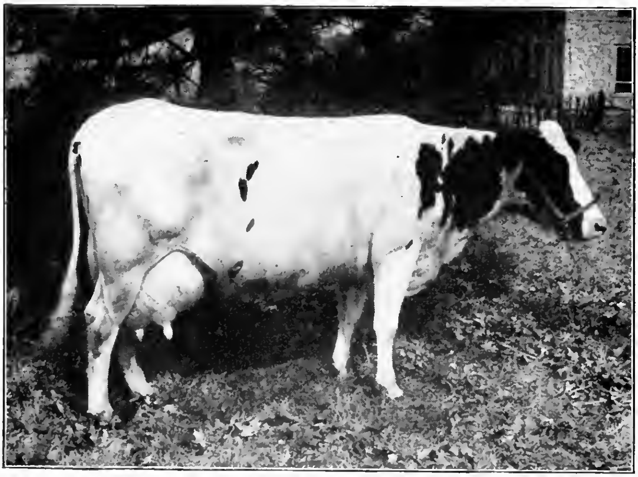
as the methods used, yet prices were only about half what they are today. How many of us have ever thought what an immense supply of these products is necessary to feed nearly a hundred million people in this country. Nineteen pounds per capita, average, are consumed yearly by every person in the United States.

Before the present system was inaugurated the supply for the market was very irregular, as the cows were principally "natives," with occasionally a few good dairy cattle. The milk was set in shallow earthen vessels, for the cream to rise, and a simple dash-churn was used in the process of making butter. The first improvement was the use of spring houses, where the vessels holding the milk were set in cool flowing water, and it was very common to churn all the milk. This practice is still followed in some of the Southern states. The butter was usually packed in large firkins and sent to market once or twice a year, as we did not have railroads then as we have today, to make the markets accessible. Under those conditions the quality of the product was not at all satisfactory.

Milk Stations.—About fifty years ago the cooperative plan was inaugurated, which was the beginning of our present factory system. A number of farmers would bring their milk to a central station every day, where the butter and cheese was made by a skilled operator. At the present time there are over twelve thousand of these stations. This system has so far taken the place of home dairying that in many states the cheese-vat and farm churn are as rare as the spinning wheel and hand loom.

Under this arrangement the farmers are joint owners, and all who contribute milk are entitled to their pro rata share of the returns. In the early days of the industry the milk was placed in long shallow pans for the cream to rise. The first improvement was the installation of deep settling vats below the floor level, through which cool water flowed from springs near by, and the milk was set in them, in cans, for the cream to form. The cans were about the size of the ordinary milk can of today.

Machinery Used in Dairying.—The greatest step in advance was the introduction of mechanical cream separators to take place of the gravity system. These machines separate the milk from the cream by centrifugal force, and this process can be accomplished immediately after milking. The cream can be churned at once, but it is usually cooled, and then warmed slowly, to ripen it for churning. The milk can be used at once on the farm, for feeding to the young animals. The mechanical process is very efficient and very little butter-fat is lost. Separators are made in various sizes for farm use and they may be operated by any kind of power, thus entirely removing the drudgery of butter-making from the farm. In some localities the farmers haul the milk to the cream-



Courtesy Mo. State University

EMPRESS JOSEPHINE, WORLD'S CHAMPION HOLSTEIN-FRIESIAN

ery, and it is separated there, and the skimmed milk may be taken back to the farms. In other places there are skimming stations at convenient points, equipped with power separators, to which the milk is hauled from the near-by farms, and from these stations the cream is shipped to the creamery. There it is sterilized and a "starter" added, after which it is ripened and churned, the butter worked, salted and packed for the market.

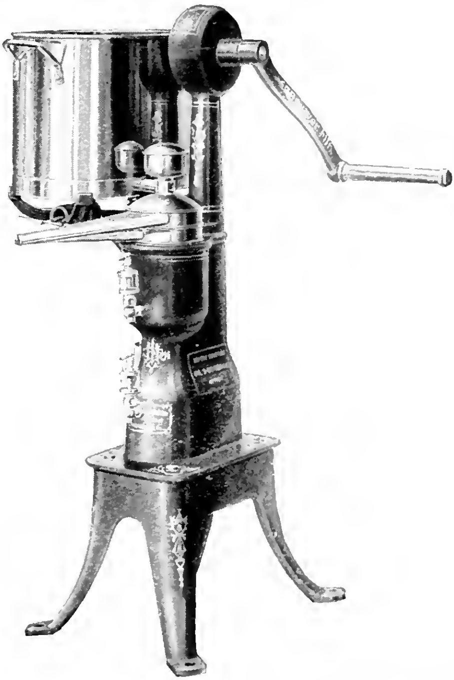
The centrifugal cream separator is a marvel to those who have not seen it. The warm milk is placed in a large bowl above the machine, from which it flows into a strong steel bowl in an iron frame. This bowl is then made to revolve at a rate of from fifteen hundred to twenty-five thousand times per minute, and, from two projecting tubes, the cream and skimmed milk flow in continuous streams. Cream of any desired thickness or quality may be obtained by regulating the machine. Very few farmers who keep cows feel that they can afford to be without one of these useful machines, as they have been perfected and popularized to the stage where they are comparatively inexpensive.

Courtesy International Harvester Co.

SILO AND DAIRY BARN

The first creameries paid for milk or cream by the gallon, but this has been changed by the introduction of the Babcock test, through the use of which it is paid for in proportion to the amount of butter-fat it contains. These machines are a simple and accurate substitute for a chemical test, and the percentage of fat may be very quickly determined. In advancing the economics of dairying this invention is second only to the cream separator.

Butter Making.—There is still much more butter made on the farms than in the creameries, although the spring house is no longer found and the churn is not now an adjunct of the dark corner beside the open fireplace. The markets are controlled by creamery butter, that from the farm making little impression upon the trade, as most of it is consumed there. The average quality of



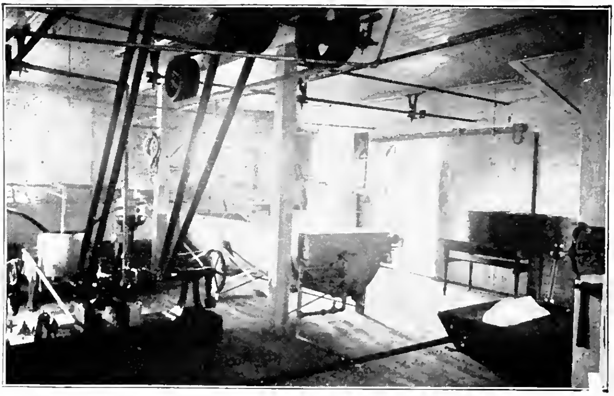
Courtesy International Harvester Co.
CREAM SEPARATOR

butter has improved very materially since the advent of modern methods. While a large amount of poor butter is still made, collected at country stores and renovated at creameries, many states have passed laws requiring the product to be identified for the benefit of the consumer. The United States Government also has very stringent laws along this line.

The Manufacture of Cheese has also been transferred from the realm of domestic arts to that of manufacture. Farm-made cheese is a very rare article and is seldom found on the market. Fifty years ago one hundred million pounds of cheese were made annually, all of it in farm dairies. Now over three hundred million pounds are made annually, all of it in factories. The first factory was established at Oneida, New York, in 1851, and there are now nearly four thousand, New York and Wisconsin maintaining three-fourths of the number.

The progressive farmer keeps only the finest cattle in his herd, Jerseys, Holsteins, Guernseys, or other choice varieties, for they are the easiest to feed and the milk is of a much higher quality. Much more care must be taken with the milk intended for cheese than with that used for butter. It is usually delivered at the factory very early in the morning, where it is carefully inspected before being accepted, after which it is passed to the receiving vats, each holding about five thousand pounds of milk. The temperature is raised by heating a jacket of water, surrounding the vat, by steam. The next step is to test it for the suitable condition for adding the rennet. This being determined, enough rennet is added to coagulate the casein in about thirty minutes. Next, after cutting the mass into small cubes, the "curd agitator" is attached to the vat and the contents stirred by steam for several hours, until the curd will string one-fourth of an inch, when the whey is drawn off. The residue is then manipulated to remove the surplus moisture, salted, ground, placed in hoops, pressed and stored in the curing-room, where it remains for several weeks to ripen, after which it is branded and placed upon the market. Nine-tenths of all the cheese made in this country is of the standard familiar variety, made to imitate the English Cheddar; however, new varieties are increasing. We do not use cheese as they do in Europe, our per capita amount not exceeding three and one-half pounds.

The Condensed Milk Industry was started in this country about the same time as the factory system for making butter and cheese. The semi-liquid form is in general use, and the industry has become very extensive. Condensed milk is prepared in fifteen different states, although New York and Illinois contain over half of the factories.



Courtesy International Harvester Co.

A FARM DAIRY

The principle of condensing milk is to reduce it, in a vacuum, at a temperature of about one hundred and thirty degrees, Fahrenheit. The very essential point is that the milk should be from healthy cows, handled in a cleanly manner and free from taints of any kind. One of the greatest of these factories has invented a process for combining the condensed milk with the extracts of malted barley and wheat, and reducing the product to a powder form, in which it keeps indefinitely in any climate. This product has a world-wide sale.

The Milking Machine.—It is not a very delightful task to milk a number of cows, especially during the winter time, but this obstacle is being removed by the invention of the milking machine, a devise which accommodates two cows at a time, and is operated by the vacuum process, a gasoline engine furnishing the motive power.

The discriminating public has caused the products of the dairy to become an illustrated story of the whole process or manufacture, a veritable picture gallery of men, cows and surroundings, a condensed narrative of praise or blame for all who have been interested in their making. Most essential of all, perhaps, is that the cows themselves shall be high-grade animals, whether pedigreed or not.

Efficiency Dairying.—The utmost measure of the dairyman's success is the largest quantity of products, produced at least cost, and sold at the highest price. This means, first, that the cows must be well fed. The farm should produce all that is needed, in order to reduce the cost to a minimum. In all Northern states there are at least two crops that are essential, corn and clover. Of these corn will produce a greater amount of feed per acre than any other crop, if wisely grown. Since the advent of the silo few dairymen attempt to get along without them, for by their use green feed may be kept in succulent and palatable condition for a year or more. Silage is a safe feed and is probably the cheapest source of starch, sugar and similar compounds that the dairyman possesses.

With the silage, the economical dairyman will feed clover hay, for it is one crop that affords a large yield of forage and, at the same time, leaves the ground in better shape than before growing it. Experiments have shown that in the roots of medium red clover, yielding a ton and a half of dry hay to the acre, there was as much plant food as in perhaps eight or more tons of ordinary fertilizer.

Alfalfa is a comparatively new feed that is finding rapid favor as a dairy food, as it is claimed that cows fed upon it will produce more milk than from any other food. The leaves are very rich in protein and the chopped stems are nearly as palatable as wheat bran. Consequently, alfalfa may largely take the place of the grain ration, and as three or more crops may be grown from the same ground in one season, it is a very cheap feed. Corn, alone, is not a desirable food for dairy cattle, and fodder, hay, straw, sorghum and the whole list of forage crops are deficient in protein when compared with alfalfa.

The housing of dairy cattle has undergone as radical a change as has any other phase of the business. We no longer find the cows huddled together in open, dark and unclean barns. Now we have them in barns with long rows of stalls, with concrete floors and perfect drainage and ventilation. Cleanliness begins in the stable, and should continue through the entire history of the milk.

FOR RESEARCH

1. Why is there not much dairying on the plains?

2. What is a refrigerator car? A refrigerator ship?

3. What qualities are necessary in good dairy cattle? How is dairy stock judged? Obtain a chart from the nearest agricultural college and become familiar with the value of the points considered.

4. Make an outline map showing the areas best suited for the production of dairy cattle. What is the relative location of these sections, as compared with the areas of production of beef cattle?

5. What is a dual-purpose cow? Name some varieties.

6. In what places did the following breeds of dairy cattle originate: Jerseys, Holstein-Friesians, Guernseys, Ayrshires, Dutch Belted, Shorthorns, Brown Swiss? Locate these countries upon a map of the world.

7. Why is New York a great dairy state? Vermont? Illinois? Wisconsin? Missouri? Ohio? Indiana?

8. Missouri Chief Josephine produced 21,698 pounds of milk in eight months. Compute the approximate value of this milk and the butter it would make.

9. Why has Elgin, Illinois, become a great market for butter and cheese? How does the market there regulate the market in all tributary territory?

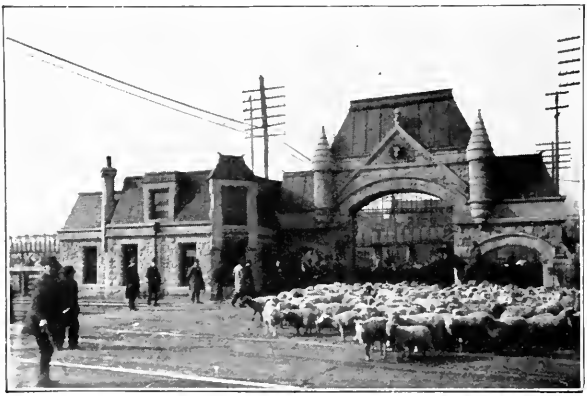
10. What is oleomargarine? Butterine? Cottolene? What laws are in force, relating to the use of these products?

11. What railroads supply Chicago with dairy products? New York? Boston? Kansas City? Cleveland? Minneapolis and St. Paul? New Orleans? Cincinnati?

CHAPTER XXII

A TRIP THROUGH PACKING TOWN

The modern packing plant is one of our national institutions. It represents American ingenuity, energy and resourcefulness. In the brief period of a third of a

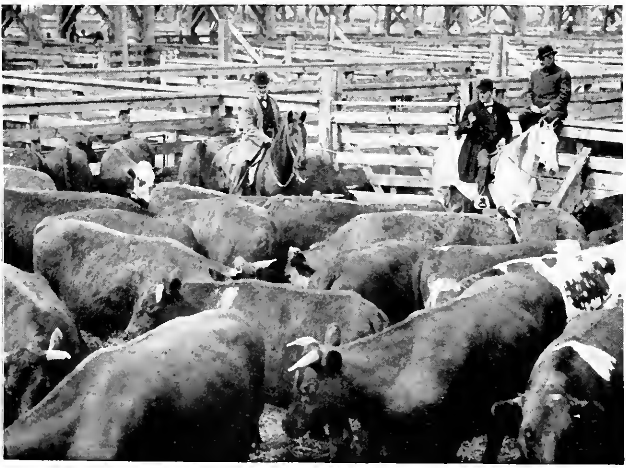


Courtesy Swift & Co.

ENTRANCE—CHICAGO STOCK YARDS

century it has been developed to its present efficiency. The value of live stock in the United States exceeds that of the fields, forests and mines combined; consequently, meat packing represents the greatest value in investment and production among the food industries, and very properly may be classed as a manufacturing industry.

Consolidation and Its Effects.—The great growth of this industry can be attributed to the rapid settlement of the Western country, and its exploitation by the great railway systems. The development of the processes of preparing meat for the market has been as wonderful as the story of cotton or iron. The present large establishments are the direct result of growth and expansion. Instead of a small butcher, in each locality, supplying the local market through limited facilities, we now have great abattoirs, handling thousands of cattle, sheep and hogs per day. Such expansion has brought about conditions which would have been practically impossible, had the industry remained in its original state. The principal

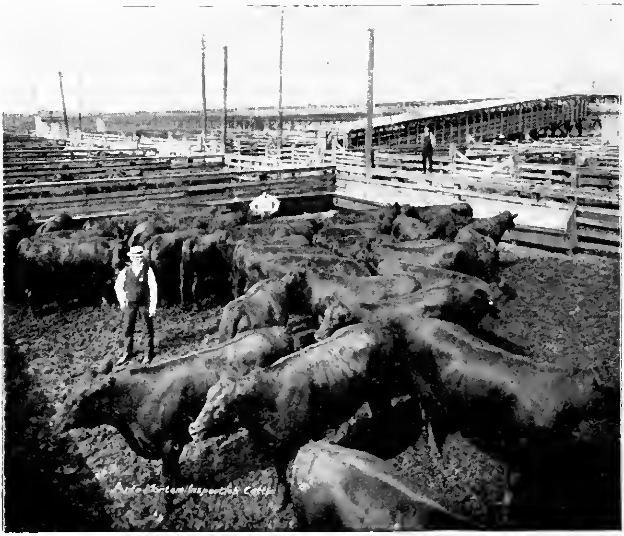


Courtesy Swift & Co.

BUYERS SELECTING CATTLE

results secured have been the sanitary care of the product, and utilization of every portion of the animal, thus entirely eliminating waste. Although the present prices seem high, we can hardly estimate the cost of meat were it prepared now under the old conditions. Present prices are the result of conditions which may be changed, if we study the matter from the proper standpoint.

Cost of Meats.—The prosperity of the American people has caused them to become fixed in their habits of extravagance with regard to their choice of beef cuts. A live animal weighing over 1,000 pounds will produce about 550 pounds of beef. Of these 550 pounds, about 144 pounds can be sold over the counter as tenderloin and sirloin steaks and rib roasts. Most of us wish these choice cuts, although no more nutritious than the remainder of the beef,—chuck, brisket, flank, or round, which equal in food value the finest roast, but they require more care to prepare and more time to cook.



Courtesy Swift & Co.

ANTE-MORTEM INSPECTION

If the American housewife would give a little more time to the study of the cooking and serving of the many inviting and palatable dishes that can be made from the cheaper cuts, she would at once affect the law of supply and demand for rib roasts and porterhouse, and the retail prices of these aristocratic cuts would forthwith decline. The European housewife has learned this economic law, but it is not necessary at this time to discuss the economic side of this topic, further than to state that the great packers have shown, by the care practised through every process, that no laws could enforce greater efforts toward cleanliness. Statistical information is easily available.

Meat Packing Centers.—Being a western business, its great market and base of supplies naturally centers in Chicago, but the tendency is to get near the corn belt, as

Courtesy Swift & Co.

FINAL U. S. INSPECTION

is shown by the development of the business in Kansas City, St. Joseph, Omaha, St. Paul, Sioux City and Indianapolis. A trip through one of these plants affords one of the most interesting and instructive lessons imaginable. Here the cattle, sheep and hogs, come in by the train-loads, from all parts of the middle West, and they are soon unloaded into the feeding pens to rest after their journey.

Among these pens, from morning until the close of the market, buyers on horseback are carefully examining the stock and making purchases. Even while the visitor is admiring the various breeds, among them Aberdeen-Angus, Galloway, Durham and Hereford cattle, Merino and Leicestershire sheep and Poland-China, Jersey Red and Berkshire hogs, the United States Government Inspectors are busy at work looking for outward evidence of the unfitness of animals for food. It is within reach of any one living near the packing centers to see how thoroughly all this work is done.

Courtesy Swift & Co.

MUTTON COOLER

At the Beef House.—Following the cattle up a long walk to the top of the "beef house" we see them quickly dispatched by the most humane and hygienic methods. Here is a perfect beehive of industry, for every man has some special task to perform. Some are busy removing the hides, others are dressing and washing the huge beeves, others cutting and removing certain parts, as the beeves pass each workman by means of an overhead trolley. The inspectors are ever present and vigilant, and, as the meat passes them, it is weighed and passed on into the cooling rooms, the entire process having taken only thirty-five minutes for each beef.

In this great room, containing row after row of beeves, perhaps three thousand sides at a time, the meat is kept at a temperature of thirty-eight degrees for several days, and is then ready for the refrigerator car, where it is ingeniously loaded without ever coming in contact with the outside air. Now it is sent in special trains speeding to all parts of this country, as well as to every part of the civilized world. Many of these cars go directly to the Atlantic seaboard, where the beef is loaded

Courtesy Swift & Co.

BEEF COOLER

into refrigerator ships, to be delivered a week or so later to the markets of Great Britain, Europe, Asia, Africa or some other section of the earth. What a wonderful lesson in Geography one may learn, by tracing these shipments from the ranch to the retailer!

How Invention Has Helped.—The business never could have assumed its present proportions but for the invention, first of the stationary refrigerator, which enabled the packers to keep their products in storage, and of the refrigerator car in 1871, in which the meat could be shipped from the plants near the source of supply, to the consumer in other parts of the country, and allowing the manufacture of what was formerly waste into by-products at once, rather than to transport the live animals long distances. The process of preparing mutton is very similar to that of beef, except that they are sent practically whole to the coolers, and are shipped in that form instead of being cut up. The slaughter and dressing require about 26 minutes for each animal.

Pork Packing.—The complete dressing of a hog requires only about twenty minutes. Hundreds of men are employed in each plant, each being assigned some special duty, including killing, scraping, taking out the leaf fat, dividing, trimming and scrubbing with hot water. As in the other buildings, the process begins on the top floor, and down story after story, room after room, go these fat porkers, on their way to the dry-room, which may have a capacity of from five thousand to twenty thousand animals. For four hours they remain here, to allow the excess moisture to leave the meat before going to the refrigerator room, where they are chilled for two days, and then sent to the chopping rooms. There the workmen dexterously cut off the hams, shoulders, sides, and special cuts required by various markets. The meats intended to be smoked are first cured in a sweet pickle of sugar, salt and water, or in dry salt, the weight of the meat determining the period, which will average forty days. Now, in the smoke-house, over slow-burning fires of hickory wood, they are smoked for from thirty to forty-eight hours. In another room men are busy branding the hams and bacon with red-hot irons, for each piece must bear the stamp of quality. Next they are wrapped in parchment paper, by deft-fingered girls, and are ready for the market.

Handling the By-Products.—While the amount of sales of packing-house products amounts to a "king's ransom" each year, the profit is comparatively small, about three cents on each dollar of sales, from the dressed meat and the many by-products. As we approach the sausage-room, which is pervaded by the smell of spices, we note the presence of many white-aproned men and women dexterously cutting the pork trimmings into delicious sausage. The summer sausages are packed by hand, the others are forced by machines into hygienically clean casings of different sizes, and quickly passed to the drying rooms. The refining of lard is an interesting sight, for here the pork trimmings are rendered into this product. The animal fat is first steamed in huge kettles, where it is melted and purified, until run into the last kettle, after a final filtering. After being properly cooled it is run into another kettle, where it is gradually cooled in great revolving cylinders, filled with ice-water, from which it is carried through pipes to the pails and tierces.

All fat not utilized for any other purpose finds its way to the soap factory. In a series of great kettles the fats are boiled, after which the substance is pumped into revolving crushers, where perfumes are added and the whole thoroughly cooled, after which it is automatically cut into cakes, of various shapes and sizes.

After leaving the beef house we seem to be in a model creamery, for the odor of milk and butter is detected, but it is the butterine factory. This product is made by churning together oleo, neutral, milk and cream. Oleo oil is made from beef suet, and neutral from leaf fat, both coming from Government-inspected animals. All the mixing is done in sterilized vessels, and, as in all departments, cleanliness is the watchword. After mixing the constituents in proper proportions, they are churned in jacketed vats, containing milk and cream, and turned into a runway containing ice and filtered water, where it turns into golden globules. The butterine is then "worked" like butter, salted, moulded into prints of various shapes, wrapped in parchment paper and packed for the market.

There are so many things to see about one of these plants that we may spend the greater part of the day visiting the many departments. Students of agriculture visit the fertilizer plant, in which the process of converting animal matter, such as blood, bone and tankage, into products for vitalizing the soil is studied, and this opens up a topic which is the very foundation of agriculture, for the substance taken from the earth must be returned in some form or other. Here are also manufactured the animal foods.

At the wool house thousands of sheep pelts are dressed every day, the wool being pulled from the skins and washed and baled, while the skins are sent to the tanner. The hoofs are made into fertilizer, glue, buttons and other articles. The bones are boiled to secure all the glue, after which they are sold to the sugar factories to be made into bone black, for filtering and bleaching sugar, or they may be made into other products. The bristles from the hogs are even carefully preserved, and used in saddle factories and in plastering, and the beef hides go to the tanneries. In fact, everything is utilized for something: every drop of blood and even the teeth are converted into a marketable product.

Had we the space we might also go into the details of the manufacture of many pharmaceutical preparations, from parts of the animals, which would interest the students of science as well as those of commerce and industry. The making of extract of beef, with the description of the enormous vacuum pans, and white-capped girls packing the precious essense into little jars and bottles, might be instructive, but this is nothing compared with the valuable medicines made from various glands. Under this head comes the manufacture of the digestive ferments, such as pepsin and pancreatin. It is claimed that the meat industry is the foundation of perhaps twenty lesser industries, and day after day, week after week, month after month, the slaughter goes on, over eleven million cattle, fourteen million sheep, and twenty-five million hogs every year!

FOR RESEARCH

1. Name, in order, the states, from Canada to the Gulf of Mexico, across which the Great Plains extend.

2. Make a map showing the location of the packing centers. From these cities trace railroad lines connecting them with the sections producing the most live-stock.

3. Why are more mules raised in Missouri than in any other state? From what states do we get the largest number of beef cattle? The largest number of hogs? The most sheep?

4. Why are the packing plants located where they are?

5. Why have American meats sometimes been barred from European markets? What other countries rival the United States in the production of cattle and hogs for the market?

6. What requirements are made of shippers of live stock? How are cattle herded on the plains? Get all the information possible in regard to life on a cattle ranch. How do cattle from the plains compare with those shipped from the farms?

7. How do beef cattle differ from dairy cattle? Why are some sheep sold for mutton while others are kept on the ranch for their wool? What is a wool-pullery?

8. Where are the principal tanneries located? What cities are great leather markets? Where are the greatest shoe factories located? Why?

9. At what price, per hundred, are beef cattle, sheep and hogs selling today? How does the corn market affect the live-stock market?

10. If possible, visit a packing house, a cattle ranch, a shoe factory or a tannery.

CHAPTER XXIII

THE LEATHER INDUSTRY AND SHOE MANUFACTURE

The Tanning Industry is one of the very few in which American manufacturers, while paying higher wages, are able to compete successfully with foreign factories, operated by cheap labor. This is possible on account of our greatly improved methods of tanning and manufacture with which foreign countries have been unable to compete.

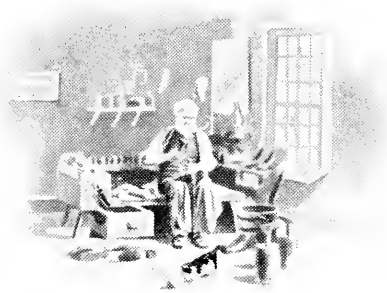
The skins of the ox, cow and horse are used in the soles of shoes, for harness and belting, the skins of the calf in shoe-uppers and book covers and that of the sheep and goats in whips, aprons, cushions and gloves. The skin of the hog is used for traveling bags and saddles and the skin of the dog furnishes us half the gloves we wear. Our tanneries also handle the skins of the elephant, rhinoceros, walrus, shark, deer, alligator, hippopotamus, buffalo, kangaroo, and other animals, and thus thousands of men are given employment to supply the demand. Over sixty thousand men are employed in the tanneries of the United States.

Centers of the Leather Industry.—The principal centers of the leather industry in this country are: Philadelphia, Milwaukee, Newark, Wilmington, Chicago, and Peabody, Mass., and they are important in the order named. Some idea of the magnitude of the industry may be had from the fact that last year over 110,000,000 hides were tanned into leather, valued at over $260,000,000. Over a million and a half cords of tanbark were used, in addition to other tanning material.

Formerly oak and hemlock bark furnished all the tannin used, but there are now many improved substitutes in Chrome and vegetable tannings.

Science and Chemistry have done much for this industry by shortening very materially the time required for tanning.

The Process of Tanning.—The process, in brief, consists of the immersion of the "green" hide for an extended period, in a solution of tannin, the process requiring from two to seven months. After tanning comes the



WHEN ONE MAN MADE SHOES

processes of currying, splitting and retanning, for the purpose of bringing the leather to the desired state of perfection, for it must be pliable and elastic and, in most cases, have a handsome finish. Black leathers are immersed in a solution of logwood, after which they are finished in embossed, smooth or pebbled leather, as desired.

Uses For the By-Products.—There is very little waste in the leather industry, as all cuttings or scraps are used for some purpose. They may be pressed into decorative floor cloth, or reduced to a pulp and pressed into shoe heels or inner soles, for use in the cheaper grades of shoes. Scraps and skins may be used in making glue, the hair for padding or cheap blankets and cloth, or in plastering. In this industry absolutely nothing goes to waste.

Boots and Shoes.—The manufacture of boots and shoes ranks first in the important uses of leather, for in

Courtesy United Shoe Mach. Co.

GOODYEAR WELT AND TURN SHOE MACHINE

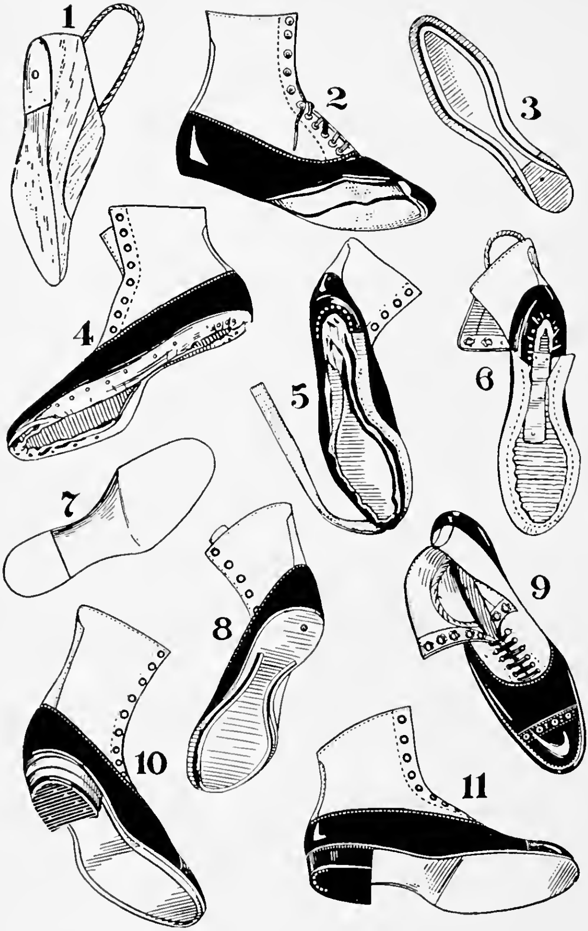
the expansion of all of our material resources, and in the history of our commercial development, there is no instance of so great an advance in productive capacity as that of the manufacture of shoes.

This is one of the most ancient of human handicrafts, and its development has been accomplished within the last fifty years. Many people now actively engaged in business life can remember when all the pieces from which a shoe is made were sewn together, slowly, by hand. In those days the old-time cobbler, with his bench and apron, lapstone and hammer, awl and waxend, was to be found in every hamlet. Some of us have watched him at work, without realizing that we were gazing upon tools and methods which had hardly changed since the dawn of history.

Shoe-Making Machinery.—We have now seen the ancient ways give place to a marvelous system of machines, which turn out hundreds of shoes in the time required for the old-fashioned shoemaker to finish a pair. We may discover the secret of this transformation by going back fifty years to the invention of the sewing machine, and, afterwards, the Welt system of machinery, invented by Charles Goodyear, a son of the man who gave the world the use of rubber.

Of all the products of American ingenuity there is none which is more the child of machinery than is the modern shoe. Textiles are woven or spun on looms or spindles, but which have little diversity of design; the parts of watches are made and assembled by machines as delicate as themselves, but no more delicate or intricate than those devised for fashioning the shoe, and nothing like the infinite variety. The path of the development of this system is strewn with lost fortunes and shattered hopes, and lighted by fine examples of business courage.

Every operation in the manufacture of shoes has yielded to invention. Besides the welting and stitching machines, there are machines for pulling the leather over the last, thus developing the shoe's finest lines; machines for cutting the soles and uppers; for shaping, compressing and nailing heels; for attaching soles to uppers; for rounding, buffing and polishing the soles; for trimming and setting the edges of the soles; for performing in-



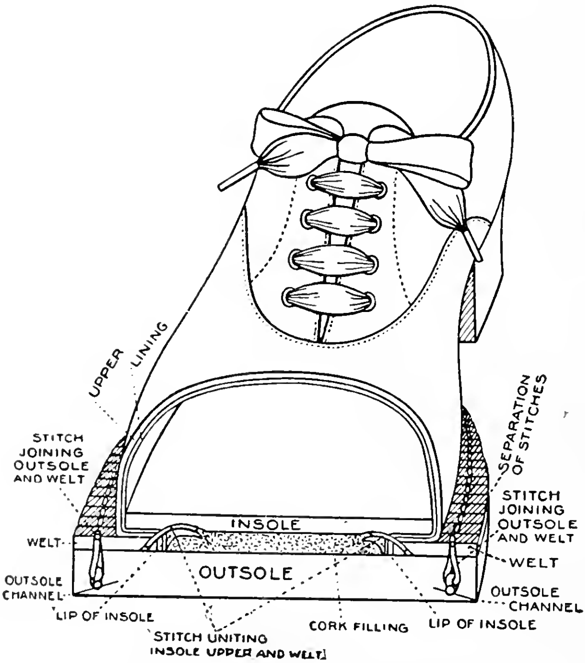
1. Last. 2. Upper. 3. Insole. 4. Lasted shoe. 5. Welt partially sewed. 6. Welt sewed. 7. Outsole. 8. Ready for stitching. 9. Sole stitched. 10. Heel in place. 11. Ready finishing.

numerable operations, all essential to perfection in comfort, durability and style.

In the early days, as new machines were invented, companies were organized to manufacture them, until there were many small concerns, some of them barely existing. Every manufacturer had to deal with many of them, and as there was always difficulty in securing one machine or another, the business was unstable. In 1899 the majority of these concerns were consolidated. The gathering of these companies into a single organization wrought an instant change. Uniform methods now prevail, any kind of machine can be secured on short notice, either by purchase or under the royalty plan, which is the most common. Machines are rented to the manufacturers and kept in perfect condition, and also replaced when worn or out-of-date. The greatest factory for the manufacture of machinery is located at Beverly, Mass. It employs nearly four thousand people, ships twenty thousand machines a year, and replaces fifteen million parts. This company does business in every part of the civilized world, and its sales value in the United States represents forty million dollars annually.

The genius who brought about the standardization of modern shoe-making devices, and who is enthroned today as the machinery king of New England, is Sidney W. Winslow, the son of a humble shoemaker, who worked with his father at the bench, at Lynn, Mass. The capital of the shoe kingdom is Boston, with the outlying principalities of Lynn, Brockton, Haverhill and several other cities. There are also great factories at New York, Philadelphia, St. Louis, Chicago and many other cities. There are over nineteen hundred independent factories, employing over two hundred thousand people, and making, approximately, 250,000,000 pairs of shoes every year.

Export of American Made Shoes.—Since the consolidation of the various machinery companies, ten years ago, the commercial rating of the shoe manufactures of the United States has doubled. In proportion to the amount of capital employed the value of the product exceeds that of any other industry. The foreign demand for American shoes has practically been created since that time, as a dozen years ago the export of boots and shoes from the United States was insignificant. During the past ten years there has been an advance of 531%



SECTION GOODYEAR WELT SHOE

in the value of exports, those for 1913 amounting to $200,000,000. American shoes can now be bought in every capital in Europe, and they are rapidly replacing European makes in the centers of fashion. This condition is due largely to the fact that the royalty system of leasing machines has relieved the manufacturer of carrying a large investment, and has given him freedom to extend his vision over the world-wide field of trade.

Manufacturers in the United States have not suffered by the sale of machinery abroad. The system of machinery has also been a boon to labor. Wages in shoe factories are higher today than ever before and the conditions under which the laborers are employed are radically changed. Safety, comfort, and cleanliness in factories have supplanted dirt, danger and inconvenience. Strikes are infrequent, and the relations between employer and employed were never before so cordial as they are at the present time.

Shoes today are the only article of general wear made in the United States on an absolutely free-trade basis, as there is no duty on shoes whatever, and the duty on hides was removed several years ago.

FOR RESEARCH

1. Why does leather have such a wide field of usefulness?

2. When did the tanning of leather assume commercial importance in this country?

3. What do you know of the Hudson Bay Company, the Northwest Fur Company and similar organizations?

4. Write two hundred words descriptive of the fur industry in the United States.

5. What is "patent" leather? Raw hide? Split leather? Parchment? Levant Morocco?

6. If possible visit a tanning and a shoe factory and follow the process of manufacture from start to finish.

7. From the United Shoe Machinery Company, Boston, Mass., secure literature describing the Goodyear Welt process of manufacturing shoes and be able to recite upon the effect this invention has had upon the industry.

CHAPTER XXIV

THE SALMON CANNING INDUSTRY

One of the great industries of this country is the canning and preservation of food in hermetically sealed packages. The principal articles canned in the United States are: Tomatoes, corn, milk, oysters, corned beef, salmon, sardines, peaches, pears, beans, apples, and peas, —and they are relatively important in the order named.

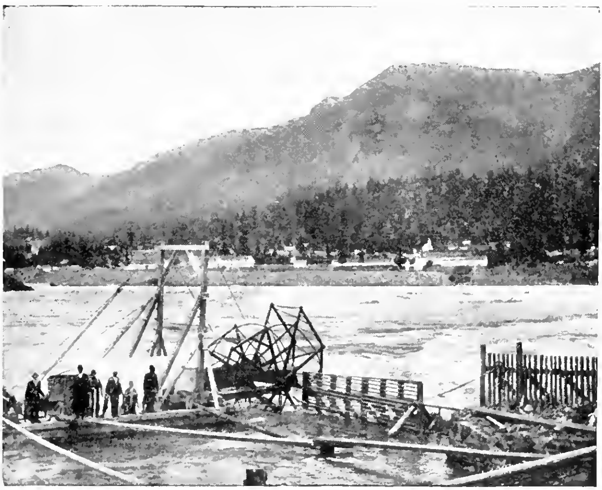
The canneries are intimately connected with several other industries; to the lumber industry, by annually using over thirty million packing boxes, to the tin plate industry by using two million boxes of tin plate, to the printing industry by using over two hundred and fifty million labels.

Nearly half a million people are annually employed in the canning industry, directly or indirectly. The canneries are of vast advantage to the farmers, as they use such enormous quantities of their products, thus changing the relation of many foods to the seasons. What was formerly used in only one season may now be used throughout the year.

Salmon Canning Centers.—Perhaps the most interesting branch of this industry is the catching and canning of salmon, the most important of the fisheries. The principal salmon canneries are located in Washington and Oregon,—in the Puget Sound country, across the Canadian border in the vicinity of Vancouver, and in Alaska. The largest salmon canneries in the world are at Bellingham and Blaine, Washington.

Of all edible fish, the salmon is certainly king. From a piscatorial standpoint it carries the honor of being chief provider for its country, and it needs not to be pampered, propagated or protected. It "just grows,"—no one knows just where,—and, yearly, at the psychological moment, obligingly swims up to its finish, at the very door of the cannery.

Five varieties of salmon are taken in these waters. Of these the "Spring" or "Chinook" is the largest and most plentiful, attaining a weight of from twenty to one hundred pounds, but its pale, whitish color is not desired.



Courtesy O. W. Ry. & Nav. Co.

FISH WHEEL—COLUMBIA RIVER

The principal market, London, is conservative, and the tradition of the fathers is that the meat must be deep pink. Luckily, the nimble and plentiful "Sockeye" salmon meets this demand, its flesh being firm, toothsome and of orthodox hue. A less desirable but equally plentiful variety is called the "Hump-back."

The Fishing Fleet.—Fancy a fleet of some two thousand smacks, with crimson and tawny and silver sails, manned by Japs, Greeks, Siwashes, Scandinavians and

Britons, drifting lazily seaward towards the orange-red sun, dropping behind the snow-veiled parapet of the magnificent Olympics. So still is the ensuing twilight that you can hear the polyglot jargon of this flotsam and jetsam of the nations, as boat hails boat, and prophets proclaim the outlook for the night's catch. Then, with the heaving flood-tide, from the far, cold depths of the sea, comes the racing, leaping, shimmering, tumbling mass of salmon making for home, goaded by Nature's primeval instinct of propagation.

One school may be a mile long, and the "run" will continue for several days. However, there is need for haste, for the packing season, for each variety, is only six weeks long, and every boat must do its utmost. The "Springs" come first, followed by the "Sockeyes" for a season of equal duration, the "Hump-backs" completing the season in the early fall. In the morning the catch is deposited upon the cannery wharves, and the packing begins. Lest the enormous kill should, in time, decrease the supply, six hatcheries are now maintained, and millions of young salmon are annually distributed in these waters, to take the place of their predecessors.

Fish Traps.—As the canneries will no longer buy speared fish, they are caught chiefly in traps and gill nets. The trap is a mystifying arrangement of piling, wire netting and ropes. A row of piles, sometimes over a hundred feet in length, are set from ten to fifteen feet apart, starting from the shore and running diagonally from the incoming tide to deep water. The wire netting is secured to these posts and held down by stones or other weights. This is called the "lead," and, according to law, must not be over 2,500 feet long.

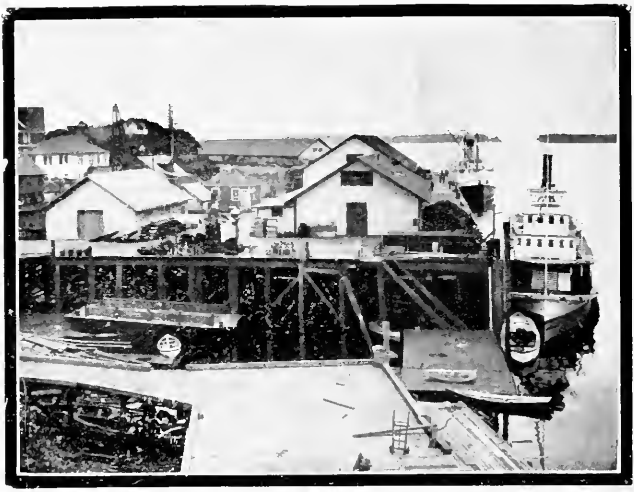
The law also regulates the mesh of the wire and nets used. At the outer end of this "lead" is the "pot" in deep water, but not deeper than sixty-five feet at low tide. Flanging the mouth of the pot are short rows of piles, strung with netting in such a way that when the schools of fish strike the lead, and follow it to deep water, they are turned toward the mouth of the "funnel" of the pot by the flanges, called "hearts." The pot is suspended on piles like a huge dip-net forty feet square. The funnel is a hole about ten feet in diameter, so arranged that when fish are once in they are almost certain to remain until the trap is full, when they are turned into an extra yard of netting called a "spiller," and are loaded into scows to be taken to the canneries.

This operation is a wonderful sight, particularly so when there are from twenty to seventy thousand salmon in the pot. It is estimated that the fish have but one chance in ten thousand to escape, when once within the trap! A floating trap has been patented recently, and promises to be very successful, as the cost is only about one-third as much as the driven ones.

Another method, carried on in a smaller scale, is called reef or bar fishing. One end of the web is fastened on the shore, and the other end is given to a man in a gasoline-driven boat, who runs out and around the school of fish, playing out the web as he goes. The web has large iron rings in the lower edge, and a rope runs through these. When the fish are surrounded, the ends of the rope are drawn up and the "purse" of salmon is pulled ashore. These webs are usually 1,500 feet long, 125 feet deep and cost $700.

Along the Columbia, and other rivers of the Northwest, the fish wheel is a common sight, purse seining being forbidden by law. In most of these rivers the waters become literally alive with the silvery "Chinook" and, as they flow towards the sea, their current revolves the huge framework, upon each arm of which is swung a basket of wire netting. The fish hug the shore while going up-stream, jumping over obstacles along the way, and in attempting to jump over the wheel are caught and thrown into a larger net often by the hundreds. There are single days when one salmon wheel will take out over five hundred dollars worth of fish.

Competition is as great in the fish-canning business as in any other, and most of the canneries keep buyers in the "field," going from boat to boat and buying all they can get. Some of these boats will carry in twenty thousand fish to the cannery. Upon arrival they are unloaded in a unique manner. As they must not be speared or cut, each of the unloading crew uses an implement



Courtesy O. W. Ry. & Nav. Co.

SALMON CANNERY—BELLINGHAM, WASH.

which consists of a single steel prong, or hook, set in the end of a five-foot handle. This prong is dexterously caught in the gills of the fish and they are unloaded, one at a time.

Preparing the Fish.—Until recent years all of the canning companies contracted with a "Boss" Chinaman at San Francisco, to send the required number of "Chinks" to do the work, as they were found to be more faithful workers than white men.

However, this plan has been largely superseded by the use of a machine called the "Iron Chink," which does the work more rapidly and much better,—almost without waste. The fish are fed into it as corn is fed into a sheller, and it cuts off the head, tail and fins, scrapes off the scales and opens and cleans the fish at one turn of the wheel, and it runs as rapidly as men can feed it. The saving in meat alone will soon pay for a machine.

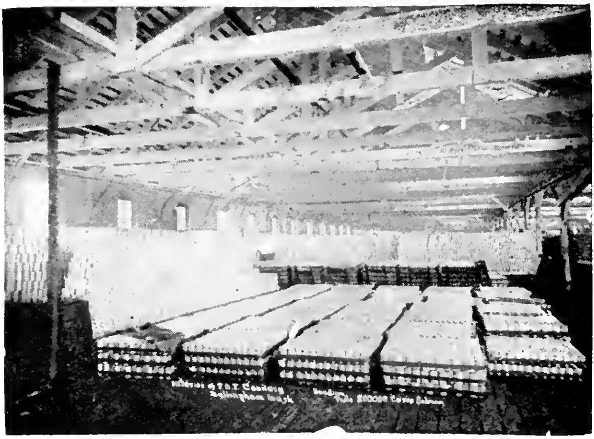
Courtesy O. W. Ry. & Nav. Co.

INTERIOR, SALMON CANNERY

Canning Machinery.—When cleaned, the fish are placed in the buckets of a belt conveyor and carried up against a series of circular knives, which cut the fish into pieces as long as the cans are tall. These pieces are automatically carried to tables, where girls place them in cans. These then go to another table where a piece of tin is placed on the meat to catch the drop of solder which might, otherwise, reach it. One turn around the machine and the tops are crimped on. The tilted cans are now rolled through a bath of acid, to remove the grease, and then through one of solder.

After the small opening in the top of the can has been sealed, and the cans tested, they are placed in the cookers and kept at boiling temperatures for twenty minutes. A hole is punched in the top of each can to allow the surplus steam to escape, and then sealed.

The second cooking follows, an hour at 248 degrees. After a lye bath, to remove the grease, the cans go to the warehouse, which contained, when the accompanying view was taken, 200,000 cases of four dozen cans each.



Courtesy O. W. Ry. & Nav. Co.

CANS READY FOR SHIPMENT

The final process is the labeling, but it is none the less interesting. The cans roll down an incline, over a paste brush, the next turn picks up one end of the label, the next the other end, the next passes it under a pressure band, and the work is done.

Throughout the process the salmon is never touched with the bare hands, and infinite pains are taken to keep the meat clean. Live steam is turned on the machines and tables at the close of each day's work. There is nothing in the can but a teaspoonful of salt and the fish.

A steamer may be on one side of the cannery, loading for Europe, while a train, on the other side, will carry a load to any part of the United States.

While this industry seems interesting and picturesque to the layman, with it is connected much labor, expense and infinite care. To avoid damage from the toredo, all piling must be removed as soon as the season is over in the early fall, and all vessels must be taken from the water. The web must all be cleaned, repaired, and tarred, to preserve it until the season opens the following spring. It is nothing uncommon to see from ten to twenty acres of drying racks. One company alone spends $175,000 annually before taking a fish. Each trap costs from $7,500 to $10,000 to build. No one should visit the Northwest without inspecting a cannery and following the interesting processes through which the fish pass "from river to can."

FOR RESEARCH

1. How many kinds of fresh-water fish can you name? How many kinds of salt-water fish?

2. Make a map, showing the coast-line from Baltimore to St. Johns, Newfoundland, and shade the fishing banks. Locate Portland, Gloucester, Boston, Providence, Norfolk.

3. Where are lobsters obtained? Oysters? Cod? Herring? Clams?

4. How are cod-fish caught? How are they prepared for the market? What cities are important curing points? What international difficulties have arisen concerning this industry?

5. What are sardines? Where are they obtained? What are most of the sardines on the market, in reality? How may the genuine be known?

6. What is a game-fish? Name several varieties? Do salmon belong to this class?

7. What varieties of fish are obtained from the Great Lakes? Where are the most valuable fishing grounds? Where are they prepared for the market?

8. What is the United States Fish Commission? What is its work? What action have different states taken along this line?

9. Trace a shipment of salmon from Bellingham, Washington, to London, by steamship. From Vancouver to Toronto, by rail. From Seattle to New York. What lines would be used and where would transfers be made?

10. What is halibut? What is the peculiarity of this fish? How is it sold?

11. Where are salmon obtained from the Atlantic Ocean? Are they canned, as is the custom on the Pacific? How do they compare in quality with the Pacific product?

12. How does the Columbia River compare, in size, with other inland bodies of water? Make a map showing Puget Sound and the Alaskan Coast line.

CHAPTER XXV

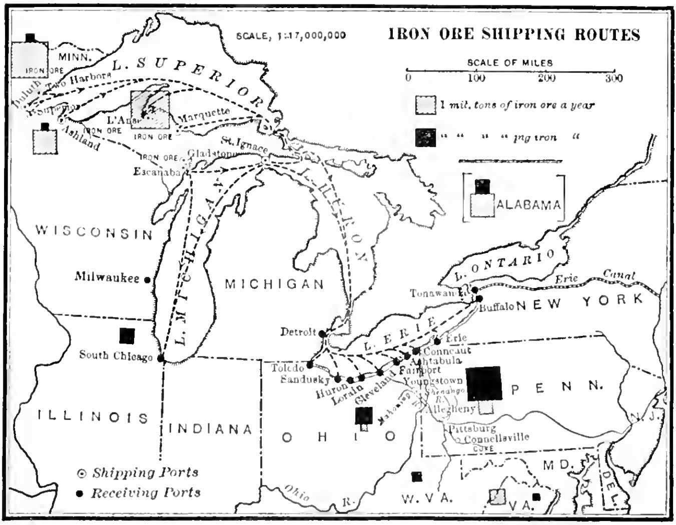
IRON AND STEEL

From the commercial point of view, the development of the iron industry is the greatest wonder of the age. Destinies of nations are influenced by it, for iron is the foundation of civilization. Iron transformed into steel by adding a few tenths of one per cent. of carbon made possible the cheap railroad and thousand-foot steamship. Steel is the main element in the construction of the machinery that does the drudgery of enlightened nations. Steel is revolutionizing the architecture of our cities, as, by combining strength and lightness to the highest degree, it has made possible the fireproof building forty or more stories high.

No other cause has contributed more to the cheapening of freights than the building of railroads of steel instead of iron. The all-steel train can go farther and quicker, and with greater safety, than ever would have been possible before its invention. Steel freight cars carry heavier loads, in proportion to their weight, than wooden cars. A train now carries three times as much freight as it did twenty years ago, and at a greatly reduced cost. Great bridges, all over the world, are built of American steel, and it has other uses without number. It is gratifying to know that this country leads the world, in this, the basis of all manufacturing industries.

Iron Ore is found in twenty-five of the states and territories, but nearly all that is manufactured comes from the Lake Superior region or from the Alabama district. The mines of the lake region are found in Northern Minnesota, Northern Wisconsin and the Michigan Peninsula. These states produce three-fourths of all the iron ore mined in the United States. The Alabama district is at the Southern end of the Appalachian Mountains, near the city of Birmingham.

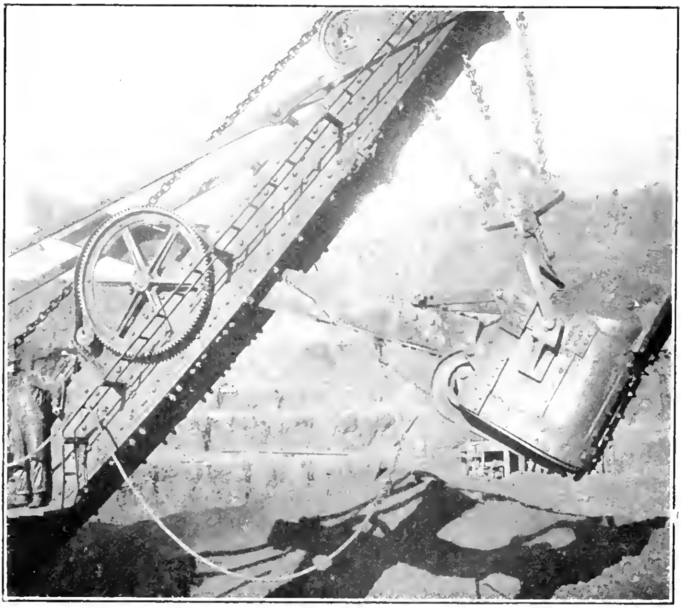
Mining Iron Ore.—If the ore lies near the surface, the earth is first removed by use of steam shovels, and hauled away, then the shovels are used to load the ore upon cars. This is called "open pit" mining. If the ore



IRON ORE SHIPPING ROUTES

is deep down beneath the surface, a shaft is sunk, and the ore is taken out as coal or any other mineral is mined. This is called "shaft" mining. This is a more expensive process than the "open pit" method, but it is necessary, as about seventy per cent. of the ore is obtained in this manner. The shaft mines may be operated during the entire year, while the open mines cannot be worked during the winter months in cold climates.

The discovery of the Mesabi Range, at the head of Lake Superior, was the greatest single factor in placing this country in its exalted position, for here is not only a deposit producing more than any four others in the world, but also the greatest reserve supply to be found on earth. Besides many others, here are the five greatest iron mines in the world, the Adams, the Mountain Iron, the Fayal, the Mahoning and the Stevenson.



Courtesy Duluth Mesabi & Northern Ry.

STEAM SHOVEL LOADING ORE

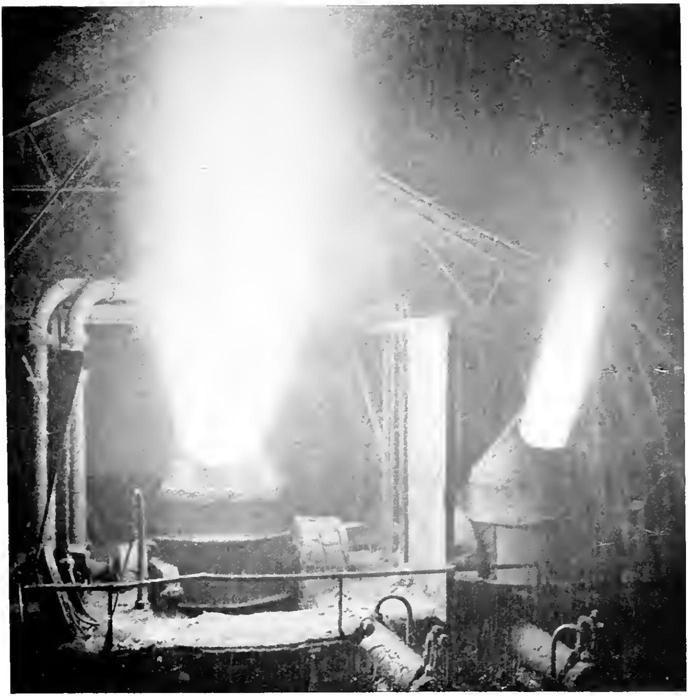
These mines have been worked to a depth of from fifty to two hundred feet, and their greatest area of ore still remains uncovered at the surface. Three of these mines produce more ore than the entire state of Alabama, or than the sixty-odd mines of the Marquette range. The state of Minnesota produces more ore than any entire country, except Germany, and, when the demand calls for the working of all of the mines, those of Germany will sink into insignificance.

Manganese Iron Beds.—The discovery of the new Cayuna Range, west of Duluth, means much to the industry, for here is manganese ore, indispensable in the manufacture of steel. This ore is worth nearly four times as much as hematite, because of the effect of the manganese in freeing the rolls. Manganese steel is used for rails on railroad curves, for plowshares, cogwheels, dredge teeth, and burglar-proof safes. Most of the American supply has been imported from Brazil, India, Cuba, Spain and Germany. The addition of manganese ores in unlimited supply, to this country's list of raw materials, gives the United States leadership in every branch of the iron and steel industry.

The Lake Superior Region.—There is no summer trip more interesting and full of information, than that to the Lake Superior region. From Duluth, a short ride to Hibbing, lands us in the heart of the Mesabi "Range," which was discovered in 1890 and first worked in 1892. One-sixth of all the iron in the world is shipped from this point. Here, instead of mines deep down into the earth, we find an open field of from forty to a hundred acres. The ore, instead of standing vertically, as in most mines, and running down to great depths in a narrow vein, spreads out near the surface in great horizontal beds. Instead of blocks of hard iron ore, we see many acres of what appears to be black, yellow and red dust, but it is high-grade iron ore.

Here are no miners with pick and shovel and drill, groping around a thousand feet underground, but a steam engine, on the surface, under the control of one man, scoops up the ore with a shovel that lifts five tons and drops it in a car alongside. One of these shovels, in an hour, does as much work as five hundred men could do in a day in an underground mine.

Here is the real secret of American supremacy. Every steam shovel keeps two or three engines busy switching cars onto the main track and making up trains. One shovel will load a fifty-ton car in three minutes. The cost of loading is only a few cents per ton for labor and fuel, but the operation is fascinating in the extreme.



Courtesy Burr McIntosh, N. Y.

BESSEMER CONVERTERS AT WORK

The engineer touches the lever, a great steel support, carrying the shovel, drops on the ore, the engine puffs sharply, and the shovel bites into the ore and swings it over into the car. In three hours a fifty-car train is made up, ready to carry its 2,500 tons of ore to the docks seventy-five miles away. Along the terraces of the Mahoning mine a hundred steam shovels may be seen at work at the same time, and the switching scheme, which enables the dozens of trains to pull in and out without delay, blockade or accident, is a wonder.

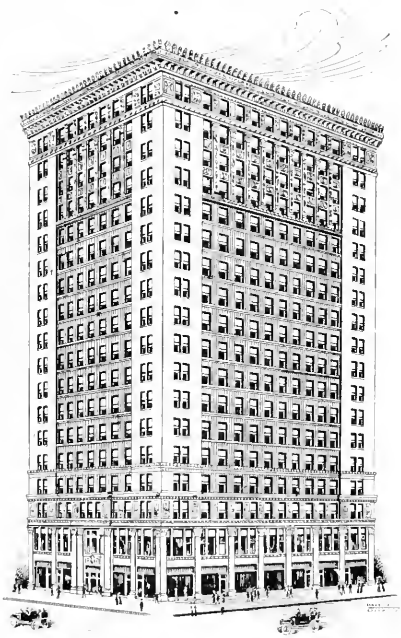
Steel Plant at Duluth.—On a 1700-acre site, ten miles west of Duluth, Minn., is being erected one of the greatest steel plants in the world. Along a two-mile water front are the docks at which the product will find shipment to lake ports. Here the coal for the blast furnaces will be loaded. While this seems a long way to haul coal, this very item was the deciding economic argument

Courtesy Burr McIntosh, N. Y.

A PITTSBURGH NIGHT SCENE

for the building of this plant, as the vessels carrying ore east can carry coal on the return trip at a very low rate, as over one-half of the lake vessels have been returning with water ballast.

The World's Greatest Ore Docks.—From the Mesabi Range, ore can be laid down at the Duluth-Superior and Two Harbors docks at a little over a dollar per ton. The great shipment of ore from these points has led to the erection here of the world's greatest ore docks, and has built up the densest traffic in the world. One of these docks is over two thousand feet long. The mines of this section furnish the greater part of the cargo that keeps in operation a fleet of nearly eight hundred vessels during the "open" season of seven months, carrying the ore to the vicinity of the furnaces, the greatest being at Pittsburgh, Cleveland, South Chicago and Gary, Indiana. The tonnage passing through the "Soo" canal is more than five times as great as that of the Suez canal. It exceeds that of New York, London, Liverpool and Ham-



Courtesy Woodmen of the World, Omaha

A FINISHED PRODUCT

burg, during the time it is possible for vessels to operate. The trade is so masterful and supreme on the great lakes that it has even dictated the type of ships to be used, and the design of shipping and receiving docks. Special ships have been built and special machinery designed to care for it, the like of which can be found nowhere else in the world.

How Ore Is Shipped.—The early shipment of ore from the Lake Superior region was attended with much toil and difficulty. All of the ore had to be hauled in sleds to the shore of the lake, where it was loaded, by means of wheel-barrows and gang-planks, upon little schooners and taken to Sault Ste Marie, unloaded and hauled around the falls, and loaded again upon similar ships.

All of the vessels then engaged in the industry, with their cargo, could now be easily stored in the hold of one of the great lake steamers. The method of unloading was equally primitive, a block and tackle being attached to the ship's mast and to the dock, which accommodated a rope attached to a bucket, to carry the ore. A horse on shore pulled the bucket to the dock, and to get it to the hold again, he backed up. Later, "donkey" engines took the place of the horse, and these were used until the invention of the unloading machine in 1880, by use of which the system of loading and unloading has reached perfection. The steamer *George W. Perkins* loaded 10,514 tons of ore in eighty minutes and unloaded it in two hours and forty minutes.

The unloading is done by use of great cranes, operated by machinery, which carry self-filling buckets capable of grabbing from the vessel's hold from ten to twelve tons of ore at a time, which is quickly swung into open cars, in much the same manner as it was first loaded by the steam shovel. The greatest unloading docks are at Ashtabula and Conneaut, Ohio.

Kinds of Iron.—The three forms of iron in general use are "pig" or cast iron, wrought iron—which is cast iron treated in a "puddler" to make it weldable and tougher—and steel, which is cast iron wrought to the highest degree of quality. To obtain "pig" iron the ore must be smelted in a blast furnace. This mammoth furnace resembles a lamp chimney in shape and is constructed of steel and lined with a water jacket of fire-brick or some other substance that will protect it from the great heat. It is charged from the top, with alternate layers of ore, limestone and coke, while at the bottom is introduced a strong current of air. The chemical reactions which take place, when the currents formed by the mixing of hot gases and solid substances meet, result in the production of molten cast iron, which, when drawn off and moulded into bricks called "pigs," is ready for the converters.

The Bessemer Process.—The most noted method used in the manufacture of steel is the Bessemer process. This consists in charging molten pig iron into a jug-shaped steel vessel called a converter, and forcing a blast of air through it until the silicon, manganese and carbon are burned out, and then restoring a small portion of the manganese and carbon by adding some form of re-carburizing material. The converter is so mounted that it can be rotated from a vertical to a horizontal position. The molten pig iron is charged into it when horizontal, then, when raised to its vertical position, the blast, which maintains a pressure of from twenty-five to thirty pounds per square inch, is automatically turned on from the bottom. The blowing continues from five to eight minutes, when the converter is turned to a horizontal position again and the re-carburizing material added, and the charge is then ready for casting into ingots.

The open-hearth process is also used extensively in the manufacture of steel, and consists in exposing the pig iron to the direct action of a greater volume of flame than is possible in the Bessemer process. This is accomplished in what is called a regenerative gas furnace, and the product is very much like that obtained by any other process.

Pittsburgh is known the world over as the "Smoky City," for, over the valley where it is located, has hung, since the birth of the industry, a great mass of fumous clouds, and under them the great converters paint the skies of the night with a living fire. All along the river the black stacks of the furnaces direct a pyrotechnic display without parallel. The scene is beautiful beyond description and interesting as it is spectacular.

A Rolling Mill.—To manufacture from iron and steel, special machinery has been invented to conform to the great weight. Pneumatic trip-hammers were called for and rollers large enough to press out a fifty-ton piece of armor plate or shafting. In many of the mills the motive power is electricity, by use of which one man may turn a switch, causing a great crane to pick up a ten-ton ingot and lift it into a car, which is to haul it to the rolling mill, with apparently as much ease as the man turned on the switch. At the rolling mill, automatic tables pull and push the mass back and forth, between the rollers and under the trip-hammers, until reduced to the desired shape. Next, giant shears, operated by hydraulic pressure, cut and trim a two-inch sheet as easily as a seamstress cuts cloth.

If we were to use no iron we should be obliged to return to very primitive ways of life. We need only to think of the many articles in daily use to understand how much the iron and steel industry means to us. We could not dispense with iron in the construction of our houses, and farming could not be done without the many labor-saving implements made from iron and steel. The railroad traffic of to-day would be impossible without iron and steel for the rails, engines and cars. The wooden boats have been largely displaced by vessels of steel, and steel framework is the support of all large buildings. Large, strong and lasting bridges are possible because steel enters almost entirely into their construction. Iron is the most useful and important of all metals.

FOR RESEARCH

1. Make a map of the Great Lakes, locate the iron ranges, and trace a shipment of ore to the steel mills. Indicate the location of these mills upon the map.

2. Why is it more economical to ship the ore to the coal than it would be to ship the coal to the ore?

3. Distinguish between: Pig iron, malleable iron and steel. What is the difference between forged steel and Bessemer steel? Which is used for cutlery? Which for armor plate?

4. What changes in farming would take place if iron and steel were not to be obtained? What changes about the household?

5. Why is a canal being constructed from Lake Erie to the vicinity of Pittsburgh? Name the principal cities connected with the iron and steel industry.

6. What substances, manufactured by the use of iron, are used for clothing, food or other purposes?

7. Obtain specimens of brown hematite, red hematite, magnetite, carbonate and pyrites and note the color and character of each. Which variety is found in the greatest quantities?

8. What has made this country the leading nation in the manufacture of iron and steel? What men have been largely responsible for the development of the industry?

9. Where are the greatest shipyards in this country? The greatest locomotive works? The greatest stove manufacturing plants? The greatest lake shipyards?

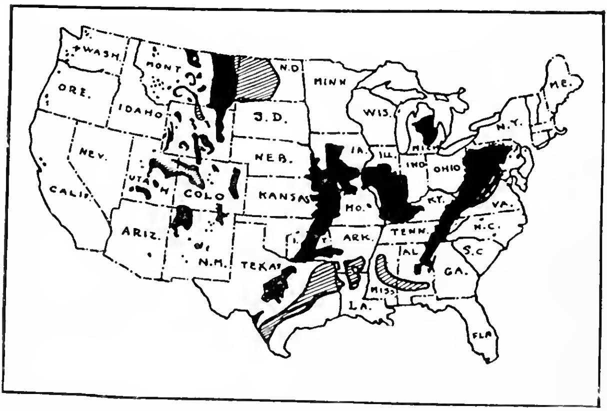
10. How does the production of iron and steel in this country compare with that of other countries? Name the other countries in order of their importance.

11. Andrew Carnegie characterized a skyscraper as "A bridge stood on end." What comparison can you make concerning the construction of each?

CHAPTER XXVI

THE COAL SUPPLY

The action of Ex-president Roosevelt in withdrawing from sale and entry over seventy million acres of land, which are underlaid with coal deposits, and the reversal of this order by the succeeding administration,



THE COAL REGIONS OF THE UNITED STATES.
The black areas are anthracite and bituminous; the shaded areas are lignite.

was largely responsible for the wholesale discussion of the conservation movement. It became a question of national importance. The movement toward this conservation was probably prompted by the fact that experts claim that, at the present rate of consumption, all the anthracite coal in this country will be exhausted in fifty years, and the bituminous supply in twice that time. The German government long ago bought back all of its coal lands and the mines of that country are operated under its control. The Canadian Government has done likewise. The advantages obtained by proper mining methods will be apparent, when it is understood that it has always been the custom in this country,—and the custom still prevails,—to mine only the principal vein in a locality; this mine afterwards caves in and the settling of the ground ruins all other veins for future use, a method as wasteful as that of the lumbermen who cut only the choicest trees, allowing the growing supply to be broken down and burned in the forest.

Pennsylvania is the greatest coal-mining state in the Union, having a monopoly of the anthracite-bearing area, the only other sections being in Colorado and New Mexico.

The bituminous areas are scattered widely over the United States, the most productive sections being in the States of Pennsylvania, Ohio, Maryland, Virginia, West Virginia, Tennessee, Kentucky, Illinois, Missouri, Iowa and Montana. These states comprise a coal-producing area five times as great as that of all Western Europe combined.

The distinction between the two principal kinds of coal is that the anthracite contains 84 per cent. or more, of fixed carbon, and very little ash, sulphur and moisture, while bituminous coal contains only from 50 to 75 per cent. of fixed carbon, the remainder being waste matter.

Anthracite coal is a staple, the price of which fluctuates very little and varies only in proportion to the distance it is hauled to the retail market. There is no competition at present in the coal trade; eighty-three per cent. of all the hard coal in the United States, and ninety-eight per cent. of the entire coal output of the country is controlled by the Philadelphia and Reading Railroad Co., which owns sixty-three per cent. of the coal lands. This road practically controls the coal business of seven other roads, doing business in Pennsylvania. By owning the coal lands and mines, hauling all the coal and eliminating the middleman, the roads make *three* profits grow where only *one* grew before! It is a noticeable fact that all dealers charge the same prices for the same grades of coal in the principal cities. It is claimed that they are under contract with the producers to maintain a certain price or forfeit their future supply.

Coal Production.—The earliest record of anthracite coal production in the United States was in 1814, when

Courtesy Gt. Northern Ry. Co.

COAL OUTCROPPING—WYOMING

twenty-two tons were mined in Pennsylvania. It is said that it was sold to the owner of an iron furnace, who became disgusted with his bargain when it apparently refused to burn, and left his post to find the man who had defrauded him. Upon giving up his search and returning to his furnace he found the doors melted off! In Missouri and Iowa the mining of bituminous coal began about 1840 and coal was first discovered in the West, in what is now the State of Washington, in 1852.

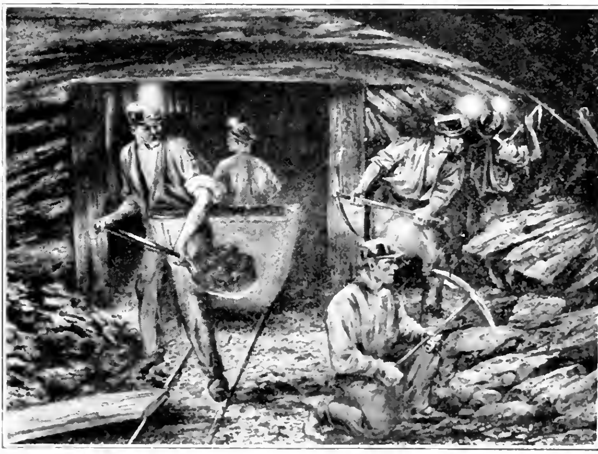
Over four hundred million tons of coal are mined in this country every year, giving employment to over six hundred thousand men and boys. A coal-mining town is different from any other mining town, from the fact that the supply is not exhausted so frequently, the great shafts and drifts running deeper into the earth year after year.

The coal miner becomes a fixture, working many years in the same mine, the boys following in the footsteps of their fathers, becoming old in the same town, where their own sons will perhaps follow them in the same business. At the age of eight or ten the boys are sent to the breakers to pick the slate from the coal, at fifteen they become laborers about the mine, later, after having acquired skill they become miner's helpers and afterwards full-fledged miners. Then, as age comes on, or when they become crippled in the mines, they begin the backward trip, first as miner's helpers, then mine laborers, and finally breaker boys, at the same wages they received when eight years old.

Mines in this country may be divided into two general classes, the horizontal, where the shaft is tunneled into the mountains, and shaft mining, where shafts must be sunk perpendicularly until the vein of coal is found. Over the shafts are buildings for housing the machinery for hoisting and lowering the men and coal. The deepest shaft in America is at Wilkes-Barre, Pennsylvania. It is 1,060 feet deep, 12 x 52 feet in diameter and has five compartments.

The subterranean passages of a coal mine are laid out with the utmost precision, rivaling the most regularly planned streets of a city. The main thoroughfare is generally seven or eight feet high and twice as wide, with double tracks for the passage of the coal cars. At right angles the side-streets are tunneled from both sides, forming the workrooms of the miners.

The modern coal mine possesses a mechanical equipment of no mean proportions. First there must be a fanning system for ventilation, then there are sanitation, draining and electric lighting systems, telephones, electric conveyors, and a fire department of which many an incorporated city would be proud. The introduction of improved machinery has changed the whole aspect of these subterranean communities within the past few years.



From an old print

OLD METHOD, MINING COAL

Formerly, the coal was mined by men with picks and shovels, and hauled to the surface by horses or mules. Now mighty electric or compressed air cutters, with their endless belts of glittering teeth, gnaw rapidly into the black strata of the mine, and trolley cars pull the coal to the elevators. Mechanical drills pound out the holes for the cartridges of black powder.

As the coal comes from the mines, it is in all varieties of sizes and shapes, and must go immediately to the breakers, where it is first dumped onto a screen made of bars six inches apart. The coal passes through these spaces, then goes over lower bars with three and one-half inch spaces, the coal passing over both of these being handpicked to remove the impurities. From the bars the lump coal passes to a series of rolls for a first breaking down, and thence, after picking, to the second rolls, which crush it into "broken" size and under.

The transportation of coal, from the place of mining to all parts of the country, for final use, is a business of great magnitude. In its accomplishment there is brought into play not only the executive genius of the heads of the great railroad and steamship companies, but also the inventive talent of the engineers who have devised labor-saving and speed-increasing appliances. Six thousand tons of coal were loaded upon a steamer in six hours recently, and it can be unloaded in about the same time.

Coal is transported by water at a comparatively low price, the Great Lakes rate being about thirty cents a ton, per thousand miles, and some of the large boats will carry 8,000 tons. Railroad cars, loaded with forty tons, are lifted bodily by great cranes and their contents dumped into the vessels. From Pittsburgh to New Orleans the rate is about fifty cents a ton, the coal being loaded upon barges, and several of them are fastened together in the form of a raft and floated down the rivers. Some of the principal distributing points are, in order of their importance,—Pittsburgh, New York, Philadelphia, Chicago, Buffalo, Cleveland, Toledo, Duluth, Superior, St. Louis, Cincinnati, Boston and Milwaukee.

Coal a Great National Asset.—The transfer of commercial and industrial supremacy from Great Britain to the United States has been coincident with this nation's passing of the former as a producer of coal. As machinery plays its increasing rôle in the workshops of production, the nation which possesses the largest supply of coal will dictate the economic policy of the world. This country not only possesses the greatest coal areas, but, by the employment of the newest labor-saving devices in the mines, obtains its product at a price greatly below that of any other country.

Alaskan Coal Fields.—As coal is the material energy of industry, the manufacturing advantage which the United States possesses, in its comparatively cheap supply, will influence enormously the future commercial development of the world. It is even probable, on ac-

COMPRESSED AIR MACHINE DRILL AT WORK IN A COAL MINE

count of the rapid exhaustion of the European mines, that this country will eventually control the coal markets of Europe, as it has, for many years, the market for cereals, but the prices will never be any lower unless the business is regulated by legislative enactment. The only chance we have had to decrease the price of coal by increasing the supply, lay in the development of our coal fields in Alaska, but that chance seems to have about passed from us, although, perhaps, no fields in the world equal those in richness. There are billions of dollars worth of coal there, in veins rising with the hills, very near the surface and sometimes actually exposed.

The coal may be easily mined, it is not far from the sea, and railroads can be built to tidewater over practically level ground. But, unless quick action is taken, this will soon all pass into the hands of a monopoly which will outrival the one now controlling the supply and we will have to buy back, at a high price, the coal that is really our own!

The most satisfactory plan would be for the Government to own the mines, and lease them to the mining companies under a definite contract, allowing them a reasonable profit.

FOR RESEARCH

1. Obtain specimens of as many varieties of coal as possible. From what localities were they obtained?

2. What are the peculiarities of lignite coal? Where is it obtained? What is cannel coal? For what is it used? What is peat?

3. What is a coaling station? How do ships receive their coal?

4. How is coke obtained? Why is it used instead of coal in the manufacture of iron and steel? What are the principal by-products of coal?

5. What variety of coal is used in the manufacture of illuminating gas? What is a "fat" coal?

6. Make an outline map, showing the areas of coal production. What other countries produce great quantities of coal?

7. Locate, upon your outline map, the coal-carrying railroads and indicate the location of the principal markets.

8. Why is coal cheaper at Duluth than at Omaha? Trace a trainload of coal from Scranton, Pennsylvania, to Wichita, Kansas. What railroad lines would be used?

9. What is meant by long ton? Short ton? Is there an ordinance in your city governing weights and measures?

10. Why do we sometimes find the prints of leaves and ferns upon pieces of coal? Examine a piece of coal under a strong magnifying glass.

11. What effect has the use of coal had upon civilization? Why is wood burned in some localities instead of coal?

12. Discuss the relative value of different grades of soft coal, hard coal and coke as fuel in your own home.

13. What is peat? In Nebraska and other Western states there are large deposits. For what used?

CHAPTER XXVII

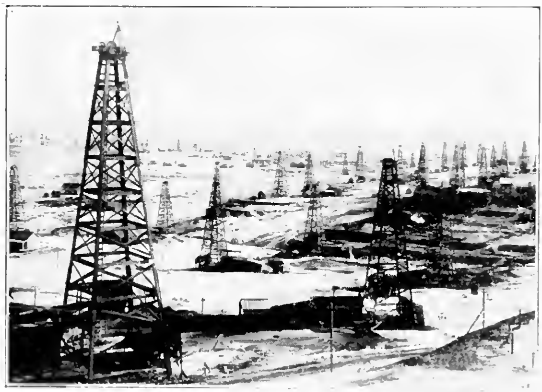
PETROLEUM AND ITS PRODUCTS

Crude petroleum is the most valuable liquid on earth, next to water. Great reservoirs of it underlie many of the states and it is found in almost all countries. It is usually found in the vicinity of coal fields and is the product of a continuous distillation which transpires in the formation of coal, a process which has been in progress for countless ages. In its crude state it is a heavy liquid, varying in color from a dark greenish tint to steel gray.

American Oil Lights the World.—The product from American fields is carried wherever a wheel rolls or a camel's foot can be planted. Across the Desert of Sahara the caravans go laden with astral oil. It burns before altars in India and in many heathen lands the natives sat in darkness until the oil merchant came. In the most remote parts of China a case of kerosene is a familiar sight to men who have never heard of America. It has dispelled gloom in the huts of the Arctic explorers and brings cheer to the herder's dug-out in Australia and South America.

American Oil Beds.—As early as 1819 petroleum was discovered in Kentucky. Salt wells were abandoned as useless on account of the presence of a dark oil floating on the surface of the brine. Similar experiences were encountered in Pennsylvania, and no use was made of the oil, until an enterprising Yankee bottled it and sold it as a "cure-all" for sprains and almost every other ailment. Woolen blankets were spread over the oil, which floated on the surface of the water, and when fully saturated with the oil they were wrung dry and the process repeated. The first oil well drilled for the purpose of obtaining oil was sunk by Edwin Drake near Titusville, Penn., in 1859. The venture was successful and others followed in quick succession, as soon as methods for refining and using the oil came into use.

The center of the oil industry has always been at Pittsburgh, and it is through its oil trade that Western Pennsylvania is best known throughout the world. The district includes eight refineries and has supplied in one



Courtesy M. K. & T. Ry. Co.

OIL WELLS—EASTERN KANSAS

year as high as thirty-five million barrels; however, this quantity has recently been exceeded by California, with a production of over sixty million barrels in one year.

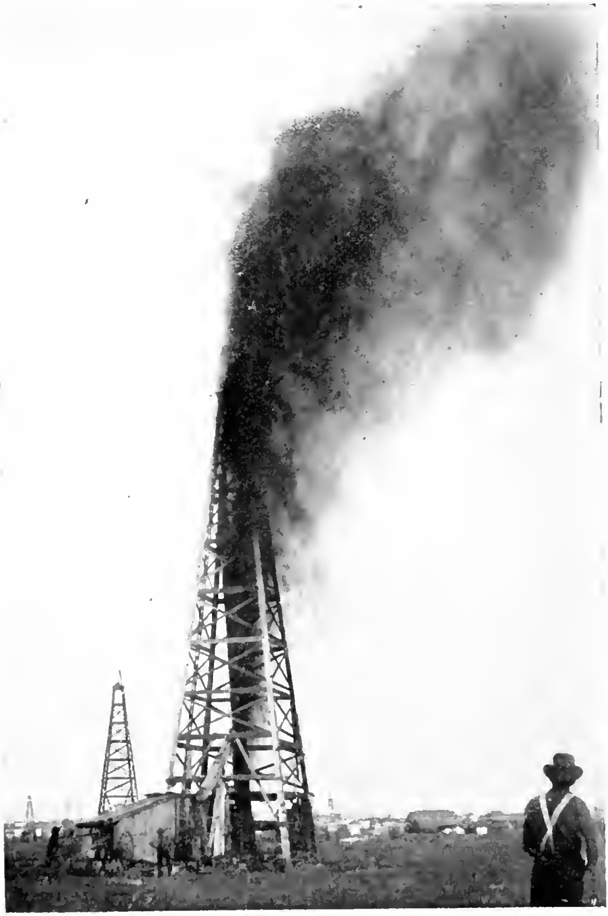
The California oil boom began in 1892, when a well was drilled in the suburbs of Los Angeles. Scores of wells have since been sunk there and in other parts of the state, and the enormous yield has been the result. Oil is king in California today, for ten thousand derricks uphold its throne. It was worth thirty million dollars to the state last year, exclusive of increased land values.

This far exceeded the entire gold output of the state and surpassed, by three millions, the value of all citrus fruits placed upon the market.

Rich California Oil Wells.—The richest strike in the history of oil was the Lakeview gusher, near Bakersfield, California, as it has produced more oil than the aggregate of all the greatest gushers ever known in the world. Many have produced more at the start than the daily output of the Lakeview, but none of these kept up the performance much longer than a month. When two and one-half months had passed the Lakeview had produced two and one-half million barrels of oil, and the flow had increased to sixty-one thousand barrels a day.

The Texas oil field, at Beaumont, is noted for its enormous yield, as four of its greatest gushers alone produce twice as much oil as all of the wells in Pennsylvania. If the California and Texas oil were of the same grade as that produced in the Eastern and Kansas-Oklahoma regions, the sudden uncovering of such a supply would paralyze the oil industry. However, the California and Texas oils are of a much heavier grade than that produced in the Eastern regions. They have an asphalt instead of a paraffine base, and refining gives only twenty per cent. of illuminating oil as against seventy per cent. from the older fields. The heavy residuum of the Southern and Western oils, after refining, furnishes a fuel of even greater heat-producing power than coal, and it is in this field that its future lies. It is already successfully used on the locomotives of the Western lines of the Santa Fé and Southern Pacific Railroads and gives perfect satisfaction, as it is cheaper than coal and produces no smoke or dust. Sprinkled along the right-of-way it kills the weeds, prevents dust and preserves the ties. It is burned successfully in stoves, furnaces, factories and on steamships, and roads sprinkled with it become almost equal to those covered with asphalt.

A well is sunk for oil in very much the same manner



Courtesy M. K. & T. Ry. Co.

A "GUSHER"—OKLAHOMA

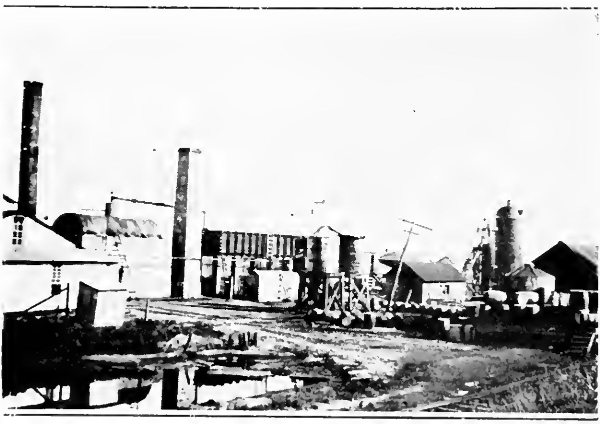
that we drill for water, except that the operation is upon a larger scale. When the well has reached the oil-bearing strata, at a depth of from eight hundred to fifteen hundred feet, a torpedo, containing from one to twenty-five gallons of nitro-glycerine, is carefully lowered to the bottom and discharged by dropping an iron weight upon it.

The operation is called "shooting" the well, the explosion suddenly driving away the oil and creating a chamber into which it soon returns, and then forces its way to the surface with more or less violence. In one Texas well the flow came with such force that the derrick was demolished and several hundred feet of iron pipe, four inches in diameter, weighing upwards of six tons, was thrown a distance of about three hundred feet in the air. The oil geyser afterwards settled down to a steady flow, rising to a height of one hundred and fifty feet, falling in a spray. The oil came out of this well at the rate of fifty thousand barrels a day, and it was nine days before the well could be capped and the waste stopped.

United States Oil Production.—When the first well was drilled in Pennsylvania the entire output of petroleum was only eighty-four thousand gallons a year. To-day the United States alone produces over six billion gallons per year. The entire history of the industry reads like a romance. It seems almost incredible that it was first regarded as worthless, then sold in small bottles as a medicine, until a process for refining was discovered and the kerosene of commerce made its appearance. While the new oil was superior to whale oil, lard oil or tallow candles, which had been used for illuminating up to this time, it was not wholly satisfactory on account of its liability to explode from heat. But chemists found the cause of the trouble to be naphtha, which they then found a way to remove.

In the earlier days the residuum after refining was discarded as worthless, but this was afterwards discovered to contain many valuable substances. At present over two hundred different chemicals and other preparations are made from it.

The by-products are as valuable, if not more valuable, than the refined oil itself. They include gasoline, rhigolene, benzine, naphtha, paraffine, lubricating oils, petrolatum, roofing pitch, coke, aniline dyes and a large number of medical preparations. Paraffine is used extensively in making chewing gum, waterproof paper, candles, for covering fruit and jelly jars and countless other purposes. Twelve million pounds of petrolatum, the basis



Courtesy M. K. & T. Ry. Co.

OIL REFINERY—TEXAS

of vaseline, are produced annually by the Standard Oil Company alone. Lubricating oils, adapted to all kinds of machinery, are manufactured annually by this company to the amount of four million barrels. From the Western oil asphaltum is derived, which is used in the manufacture of paving blocks, roofing, insulating and waterproofing materials and for road oil. The cake residuum furnishes the carbon points used in arc lamps, and then there are pharmaceutical preparations almost without number. The utilization of these various by-products has required the greatest specialization of methods, the constant encouragement of invention and an immense amount of capital.

Oil Refineries.—Most of the refineries are located near great bodies of water. The product of the Pennsylvania region is refined at New York, Philadelphia, Baltimore, Chicago, Buffalo and Cleveland. That from the Kansas-Oklahoma field is refined at Independence, Mo., and Chicago; that from the Texas field at Galveston, and the product of the California region at Los Angeles and San Francisco. At first the oil was conveyed in casks, but that was soon found to be too expensive, and the tank car and pipe line were devised, for use on land, and the tank ship soon appeared upon lake and ocean.

The first pipe line, laid in 1862, was four miles in length. At the present time there are nearly one hundred thousand miles of pipe line, most of it being the property of the Standard Oil Company, carrying the oil from the wells to the refineries and markets. This pipe would reach around the earth almost four times! The company also owns over ten thousand tank cars, enough for a train reaching from New York to Philadelphia—also an enormous fleet of one hundred and twenty steamers and sailing vessels, which transports petroleum and its products to the far corners of the earth.

Export of Crude Oil.—Most of the crude oil which is exported goes to France and Spain, where it is treated in local refineries, the duty on refined oil to these countries being almost prohibitive. For the Oriental trade the oil is shipped in cases of five gallons each, two cans strapped together being called a "case." Five cargo steamers are devoted to this trade on the Pacific, while twelve more steamers attend to the coast trade. The largest tank-ships contain about two million, five hundred thousand gallons, and so powerful are the pumps by which they are controlled that such a cargo can be taken on board or delivered in six hours.

The hull of the ship is divided into many air-tight compartments, which are kept hermetically sealed from port to port, as a precaution against fire. Occasionally these ships take fire, as a result of leaks, and can only be saved by sinking them. As the compartments are water-tight there is no loss of oil in those remaining intact, but the cost of raising the vessel to the surface is enormous.

The Standard Oil Company, organized in 1882, is the most conspicuous of the world's oil refineries. It is our largest American exporter and is the greatest and most powerful organization in the world, excepting the United States Steel Corporation. It has an authorized capital of $110,000,000, but this does not represent all of its capitalization. It owns property in every civilized country, controls twenty-six plants, and is the largest employer of labor in the world. Seventy thousand people are required to carry on the extensive operation of this company, the occupations represented include nearly all of the trades in which men are engaged. Among them are one thousand boiler and tank makers, and fifteen hundred ship builders. Thirteen thousand men are engaged in operating the pipe lines—eight thousand five hundred in producing, purchasing and measuring the oil, twenty thousand in refining and handling it, twelve thousand in distributing and marketing in this country, and twelve thousand in the foreign trade, also twelve hundred in the general administration of affairs.

The perfect organization of this company makes it possible for it to sell oil in European countries, with as extensive fields as ours, if it were not kept out by a high tariff. Persia, Bulgaria, Burma, Ceylon, Russia, Australia and parts of South America have immense undeveloped fields, but individual effort largely prevails there and the fields are undeveloped. The Russian oil fields are as extensive as ours, yet the largest corporation there in the oil business has a capitalization of one million dollars. In Italy, Spain and Egypt wells are yet drilled by hand, and the pumps are operated in the same way. The use of the "grasshopper connection-rod," which pumps a dozen or more wells by one engine, was recently prohibited in Turkey because each would throw forty men out of work! It seems that for many years to come the United States will furnish oil to the greater part of the world. The Standard Oil Company is an organization intensely American. Much of its success has come from its selection of men, as it has searched the civilized world for talent and skill. Even the elevator boys in the general offices are selected with an idea to their development.

FOR RESEARCH

1. Obtain as many petroleum products as possible for study.

2. Indicate the principal oil regions on an outline map. Show how these areas are connected with the cities where refineries are located.

3. Why has the petroleum industry grown so rapidly?

4. What other country rivals the United States in the production of petroleum? Why has the industry not advanced there as rapidly as in this country?

5. Discuss the influence of petroleum and its products upon our social and economic life. What effect has it had upon the industrial arts?

6. What is the connection between the petroleum industry and the supply of natural gas? Why are these products the most economical and satisfactory fuel for use in the manufacture of glass?

7. Whale oil, pitch, tallow, paraffine, kerosene, gas and electricity have each been used in turn for the purpose of illumination. Discuss the relative value of each.

8. Obtain the proper medium for burning a portion of each of the first six and experiment with the same.

9. How has the petroleum industry influenced the manufacture of automobiles and gasoline tractors?

10. Why are prices of petroleum products higher now than they were several years ago when refining had not reached its present state of perfection?

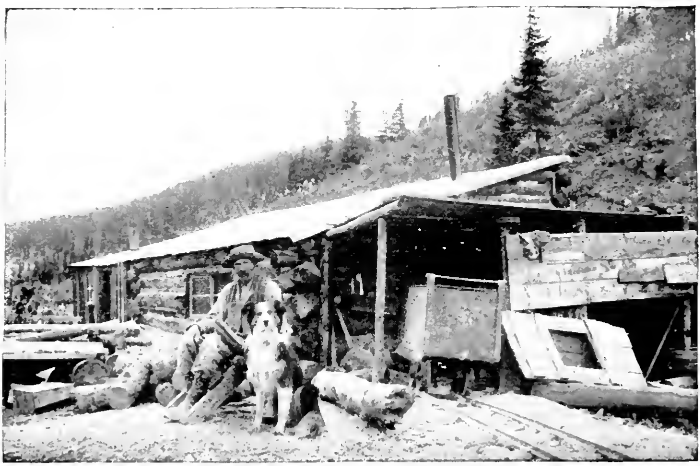
CHAPTER XXVIII

GOLD—FROM MINE TO MINT

The great financial panic of 1857, the greatest in the history of this country, rendered the National treasury, as well as the greatest commercial and industrial enterprises, practically bankrupt. At that time we were mining some gold in Georgia, North Carolina and California, but all of our silver was obtained from Mexico. The Civil War was about to begin at the very moment, when, in 1859, two of the greatest discoveries in the history of this country were made, that of oil in Pennsylvania and of gold in Colorado. In less than ninety days over twenty thousand men spread over the territory tributary to Clear Creek, Colorado, where they washed great quantities of gold from the banks and beds of the streams. Millions were taken then, and hundreds of millions have since been extracted, from the quartz veins that rib the mountain sides, from which the gold originally found in the valleys was eroded by the storms and tempests of the ages. Such, in brief, was the inception of civilization in the Rocky Mountains.

Science Aiding Mining.—This has become the age of metals. The evolution has been great. The mining overseer has given way to the mining engineer, who makes accessible the material for our progress. In the early days the world did not need so much ore as at the present time, and a sufficient amount was easily accessible. Now, scientific means are required to reach the treasure and bring it to the surface. This is done by the use of the most modern appliances for securing and delivering the ore at the mills and refineries. The largest mine in the world today, the Homestake, at Lead, South Dakota, which in thirty years has produced almost one hundred million dollars' worth of gold, would be valueless had not the mining engineer found a way to handle its vast product of low-grade ore.

The miner is the one individual who refuses to recognize the impossible. He is always willing to stop anywhere, under any circumstances, to talk about mines, and he is always hopeful, joyous and buoyant. No matter if he never made a dollar from a mine in his life, he is always certain that he will "strike it rich" soon.



Courtesy Colo. Southern Ry. Co.

A PROSPECTOR'S CABIN AND MINE

Placer Gold Mining.—The first discoveries were called "placer" gold: nuggets or grains washed to the surface. The most primitive utensil used by the early miners was the pan, which they partially filled with dirt thought to contain gold, then filled it to the rim with water, causing the sand to settle to the bottom as the pan was gently rocked, after which the water and mud were poured off, leaving the particles of gold alone remaining in a spoonful of sand. After the pan came the rocker, by the use of which more dirt could be treated with the same operation. This was followed by the sluice-box or trench, a wooden ditch, with riffle-bars or blocks set across the bottom. A stream of water is diverted from its course through this sluice and the dirt is thrown in with shovels. As it washes over the obstructions at the bottom, the gold, being heavier, is caught in the crevices and the refuse is carried away by the water. When the water is shut off the gold is gathered from between the blocks.

Hydraulic Mining.—The most elaborate of all the means of working placers is the hydraulic monitor. By this method a stream is dammed, somewhere above the working, and the water carried down through great pipes, usually twenty-two inches in diameter. This water is delivered into an iron monitor, which directs a stream against the bank of earth to be washed, through a nozzle from six to nine inches in diameter, with a rending power that is terrific, tearing down the very mountain-side. This gravel is washed through sluices and the metal recovered as in the other processes, and the miner must then search below the surface.

The first process of underground mining is called "blocking out," by which the dirt and stone surrounding the ore is removed, exposing the ore to view. The side-walls are heavily timbered, to prevent their falling in, and the miners begin drilling with great air-pressure drills to prepare for the charge of powder which will "shoot" out the ore. This ore is then hauled in a tram-car to the main shaft, where it is elevated to the surface. As the particles of gold are usually found in veins of stone, it is not accessible until these are crushed, and this is done by the use of a stamp, which resembles a trip-hammer, and they are usually arranged in groups of five, some mills using as many as a thousand stamps. They weigh about five hundred pounds each, and rise and fall about fifteen inches every second, crushing the lumps of quartz and releasing the small particles of gold, making it resemble placer gold. Water is run into this crushed stone and the mixture is expelled through a screen over a copper apron, which has been amalgamated. As gold has a great affinity for quicksilver, this amalgam coat readily absorbs the particles of gold, after which it is scraped off the copper plate and the mercury removed by heat in a retort, leaving the residue, which is gold.

Courtesy Colo. Southern Ry. Co.

WHERE GOLD WAS FIRST DISCOVERED IN COLORADO

Smelting Ore.—Some classes of ore will not respond to this process, and must be smelted, by being placed in a mammoth furnace, with layers of coke, lime and ore, each in the proper proportion, or the mass, when melted, will clog the furnace. The heat required is intense, necessitating the use of water jackets or fire-clay lining, around the furnaces to prevent their melting along with the ore. After the charge has been melted, the sulphur burnt out and carried in fumes, the metals, being heavier, now sink to the bottom and are drawn off and sent to the refinery, where the gold and silver are separated from the "base" or predominant metal. If this is lead, the mass is called "bullion"; if it is copper it is called "matte." It may be interesting to know that since the fires were first lighted, under the furnaces of the first smelter, in 1868, the smelter has been in constant operation night and day ever since. The principal smelters are at Denver, Leadville, and Cripple Creek, Colorado and Tucson, Arizona, and refineries are located at Omaha, Neb., Chicago, Ill., and Perth Amboy, N. J.

Ores are usually spoken of as "free-milling" or "refractory." When the refractory ores are not smelted they are treated by the cyanide process, which consists in first running the ore through crushers, which reduce it fine enough to run through a 20-mesh screen. This is then taken by automatic carriers to large iron tanks. A weak solution of cyanide of potassium is held in other tanks higher up, and is turned in from the bottom of the ore tank. The solution percolates up through the ore until the top is covered to a depth of one or two inches, and is allowed to stand from forty to seventy-two hours, by which time all of the gold is dissolved and held in solution by the cyanide. The solution is then drawn off from the bottom, and, as it comes out of the ore tank, runs through a box of fine zinc shavings. This contact causes an instant precipitation of all the gold carried, and it drops to the bottom of the box. After the first solution is drawn off the tanks are filled with clear water, which, passing through the boxes containing zinc shavings, saves all the gold that may remain in the sand, the process being called "washing out." The zinc shavings and gold are now taken to the retort room, where the zinc is eliminated by heat, and the gold molded into bars or "bricks." These bricks are larger than building bricks, and are about twice as heavy as the same amount of lead. They are worth from five to seven thousand dollars each.

In treating the ores during the early history of the industry, the amount of metal lost by ignorance of proper means nearly equaled the amount saved. The smelter reduced this loss materially, but this was unsatisfactory, until pushed to the present state of perfection. To the eleven hundred and forty-seven millions of dollars, which have been produced from Colorado mines, should be added twenty to thirty per cent. that has been wasted in the dumps or the mines, the tailings from mills that spread along some of the streams for miles, and the slag piles at the smelters. A portion of these losses are now being recovered by working over this refuse, and good profits are often realized.

Courtesy Colo. Southern Ry. Co.

HYDRAULIC MINING

Electric Dredging.—The greatest marvel of modern mining is the electric dredge. This monster was invented by a genius who dug a hole in a dump of refuse from an old mine, and built a barge, upon which he placed powerful pumps and dredging apparatus. Then he ran in enough water to float the barge, and the machinery began eating into the earth, bringing up great quantities of dirt and gravel. This is dumped upon the barge and washed through numerous screens, the refuse filling up the lake at the rear, as the machine and water work forward. Amalgam plates collect the gold so effectually that less than one-tenth of one per cent. is lost. If a ton of dirt contains only ten cents worth of gold, it is a paying operation.

Cripple Creek.—The richest six miles on earth is the Cripple Creek district. Here, away down in the granite's deep embrace, is the treasure for which human beings, all over the earth, are toiling, dying, selling their souls and bodies. The most famous mines there are the Independence, which transformed W. S. Stratton from a poor prospector to a multi-millionaire, and which he after-

Courtesy Colo. Southern Ry. Co.

A SMELTER—LEADVILLE, COLORADO

wards sold for ten millions more. Another of his mines, the Portland, has paid over eight millions in dividends, and there are countless others dotting every hill. But this gold is far beyond the simple appliances of the old-time miner, as enormous capital is now required to penetrate the great depths.

If one has a sufficient amount of courage—and life insurance—he may step into an iron cage, with the permission of the Superintendent, and drop with lightning speed, down, say a thousand feet, there getting into an electric tram which moves out horizontally with equal velocity. The trolley wire flashes a few feet overhead, and a stream of water trickles along the track. It is not advisable to reach up—and down—at the same time! If this is a *real* mine—not one exploited to catch visitors—for a working mine does not solicit visitors, the trip is one of rare attractiveness. The descent to the depths, where the men are working, reveals the great pneumatic drill, operated by six men, which penetrates the quartz vein sufficiently for a charge of dynamite to be planted, the explosion of which makes the mountain quiver. Then great quantities of the ore are loaded upon the ore-cars and taken to the surface, to be shipped to the smelters or stamp mills.

The Colorado Silver Mines.—The highest average grades of silver ores are produced about Georgetown and Silver Plume, Colorado. Those at the latter place alone have produced fifty millions in silver. Here, as in almost every other district, the mountains are literally covered with mines. The records at Georgetown show that nearly 23,000 claims have been recorded there, and about 1,300 have obtained United States Patents. There are also many rich silver mines at Leadville.

After seeing the ore mined, it should be followed to the smelter, or stamp mills, to witness further evidence of the amount of capital, scientific effort and labor required to finish the process. Those who visit Colorado will be able to follow all of these steps without great difficulty, finally visiting the United States Mint at Denver, where may be seen the most wonderful transformation, the reduction of great bars of precious metal into coin of all denominations.

The discoveries of gold, in all parts of the world, have furnished stories of endurance and daring that have never been equalled. No matter how forbidding the prospect has been, men have risked their lives, and experienced every form of misery and danger for the yellow metal, which they expected to bring them an equal portion of happiness.

> "'Tis gold
> Which buys admittance; oft it doth; yea, and makes
> Diana's rangers false themselves, yield up
> Their deer to stand o' the stealer; and 'tis gold
> Which makes the true man kill'd and saves the thief;
> Nay, sometimes hangs both thief and true man: What
> Can it not do, and undo?"
>
> SHAKESPEARE: CYMBELINE.

FOR RESEARCH

1. Where are the United States Mints located? Why do coins contain alloy?

2. When was gold discovered in the Yukon District? Locate this district upon a map of North America and trace a shipment of ore from Dawson City to Seattle, naming the bodies of water and railroad lines that would be used.

3. Where is Leadville? How did it derive its name? Locate Tucson, Lead and Deadwood.

4. In what other countries are gold and silver obtained? Where do we obtain quicksilver? For what is it used in addition to its use in the reduction of gold from the ore?

5. Australia, the Transvaal, Guinea, California, Venezuela, Alaska, Colorado, and the Black Hills, have each at some time, stood in the front rank in the production of gold. What is their relative rank to-day?

6. For what purposes are gold and silver used? What is the fiat value of an ounce of gold? Of an ounce of silver? What ratio is this?

7. Where was the "Comstock Lode"? Is the mine in operation to-day? What can you learn about the Sutro tunnel? Where is Goldfield? Carson City? Virginia City?

8. Where are the smelters and refineries located? Who owns them?

9. Describe the underground workings of a mine. If possible, obtain specimens of gold and silver ore for examination.

10. Trace a shipment of ore from Cripple Creek, Colo., to the smelter at Denver, thence follow the bullion to Perth Amboy, N. J., where it may be refined. What railroads might carry the shipment?

11. How does a miner "stake" his claim? What are his rights? What is a "lead" of ore? How far may it be followed? What is a drift? A vein?

CHAPTER XXIX

A MODEL COPPER MINE

For many centuries the chase after gold stirred the hearts of adventurous men, while the baser metals have been sought and found in a more prosaic fashion. Yet copper and iron have done more to make this country great than all the gold that was ever mined.

About fifty years ago copper was the lure that led men to explore a wilderness in the upper peninsula of Michigan and reveal a magnificent storehouse of treasure on the shores of Lake Superior. Prior to that time that region was considered a hopeless wilderness, fit only for Indians, fur traders and trappers. It had been known for many years that the region was rich in minerals, the Jesuits having found copper there, and the Indians mined it in a crude fashion. But even these were not the pioneer miners, for there is ample evidence that some prehistoric race discovered and operated them without the aid of a promotion syndicate or an issue of watered stock.

While many people, representing several nations, passed these rich deposits by, in their search for western homes, a young American geologist, Douglas Houghton, awoke his countrymen to the realization of these riches. In 1841 he submitted a report to the state government of Michigan, and there immediately began a rush of treasure-seekers into a country that was then more inaccessible than any mining camp of today. England had long held a monopoly of copper production of the world, as this was long before the discovery of the great deposits in Montana, which have yielded fabulous wealth for the copper kings of Butte, Anaconda and Helena.

The Lake Superior Copper region has never become notorious by a war of greed such as has made the Western copper mines a by-word for political trickery and corruption. Its history is a clean story of American commercial success and the development of the mines is typified in the record of the famous Calumet and Hecla.

Copper has become such a king among metals, since

PLUNGING A MILE UNDER THE SURFACE

the beginning of the age of electricity, that it adds over six hundred million dollars to the wealth of the world every year, and its reign has probably only begun. While the Calumet and Hecla property has never gained any spectacular notoriety, its product has paid more in dividends than any other mining corporation in the world. Over one hundred million dollars have been paid to the stockholders, in dividends, in the past forty years, on a total capitalization of two and one-half millions. In the past five years the mine has paid nearly thirty millions in dividends. It is no wonder that the owners have kept out of the "copper war."

The Calumet and Hecla is an impressive object lesson, showing how a great corporation can look after the welfare of its properties and employees without impairing its dividends.

Upon making a trip to this region, coming up Lake Superior by steamer, one is impressed by the fact that there is little devastation, such as is found in other mineral camps. Back of the city of Houghton there is a row of hills covered with a second growth of timber. Against the sky-line looms a red shaft-house or two and along the crest of the hill trails a long train of ore-laden cars. The scattered towns, through which the electric cars run to Calumet, have little of that ugliness found in most mining towns. The landscape is far more attractive than that which is seen in the wake of the iron miner. The tall red shaft-houses are about the only signs of the wonderful activity that toils underground throughout the entire night and day.

There are a dozen different villages, all part of the one vast mining camp,—Hecla and Calumet, Laurim, Osceola, Yellow Jacket, Blue Jacket, Red Jacket, Wolverine and Tamarack, containing about fifty thousand people who are dependent upon copper for their living. Five thousand men work for the Calumet and Hecla company, and over half of them labor under ground. There are more miles of streets underground than in the towns on the surface.

Two hundred miles of shafts, drifts and cross-cuts honeycomb the earth a mile from the surface. To support this system of underground highways this company uses thirty million feet of timber every year. It is clearing the country of timber for five hundred miles and is using up the forests faster than are the lumber interests. The company has its own logging crews and mills and owns its own forests, this one feature being a great industry alone.

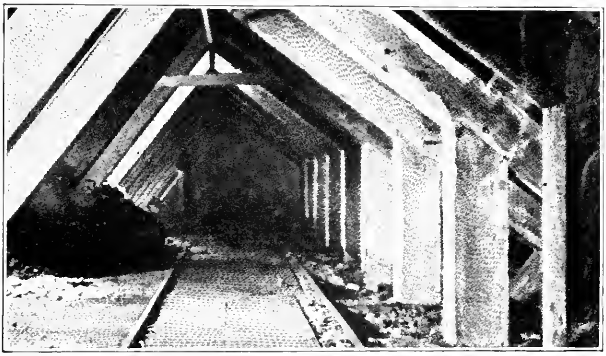
There are sawmills and carpenter shops, smithies greater than those found anywhere else except in the works of the most extensive manufacturers of machinery. Fifty tons of steel drills have to be sharpened every day.

COMPRESSED AIR DRILL

There are warehouses and supply stations, a private railroad operating twenty miles of main track, a fleet of steamboats, all of which are kept in motion by the copper ore that is hoisted from a thousand feet beneath the surface.

Among the workmen the native-born American is in the small minority. The Cornwall and Finnish miners lead in numbers and there are Irish, Scotch, Welsh, German, Danish, Scandinavian, Bohemians, Austrians and many others, but this polyglot community is so law-abiding that there is no municipal police force in the district. The towns are incorporated and controlled by the company and are under the supervision of a few constables and watchmen, employed by the company, which also maintains a metropolitan fire department and a municipal theatre which cost a hundred thousand dollars.

The company has solved the immigration problem by treating its employees as human beings. It owns about twelve hundred dwelling houses which are rented to employees at a cost of 6 per cent. on the investment



From an etching

MUCH TIMBER IS USED IN MINES

and maintenance. Over a thousand of the miners have purchased similar houses on small payments. The company has built about thirty churches and sold them to the congregations, and maintains eight school houses, where twenty-five nationalities are fused in one great melting pot to become American citizens.

There are also fine libraries, club houses with gymnasiums, bath rooms, bowling alleys, etc., furnished in the same way. A fine hospital with a full corps of physicians and nurses is always ready to attend the call of any miner who needs such assistance. There is a miners benefit fund, founded by the company, which pays death and disability benefits. Each miner pays fifty cents per month toward this fund, and the company donates a sum equal to the amount thus contributed.

At the Red Jacket shaft is the most powerful hoisting machinery in the world, huge engines of eight thousand horse power which reel and unreel a mile and a quarter of wire cable. They hoist ten-ton cars of ore from the bottom to the surface in ninety seconds! This is the deepest mining shaft in the world, and it is claimed the effect of the earth's revolution may be detected here, as it is impossible to drop anything to the bottom of the shaft, all such substances having always caught on the west side of the wall.

These mines are the greatest fire risk in the world. They are protected from fire by a water-main and underground telephone system, pumping stations and electric alarm systems. In 1890 this system was thoroughly tested, but the fire had gained fearful headway. The burning area was shut off by closing a system of fireproof doors, the surface opening was sealed by covering it with earth, yet the fire raged for three weeks. Such fires elsewhere have burned for years, as there is more timber in those vast labyrinths under the earth than in all the buildings of a pretentious city. Visitors are not admitted unless personally endorsed by the manager, as there have been fires that were thought to have been of incendiary origin, and the company will not risk such piratical methods of curtailing the supply of copper.

A Typical Copper Smelter.—A trip to the copper country should end with a trip to the smelter, near Houghton, where the dull ore may be seen transformed into something beautiful. The long ore trains come trailing over the hills from the stamp mills, which have ground the ore into a powder that looks like coarse brown sugar. From the cars it is dumped into elevated bins, which shoot it over to the great furnaces, whose heat is twenty-three hundred degrees. Here it is purified as it melts, and the refiner dumps cordwood into the glowing caldron and blows air through the mass to clear away the dross. At the proper time a gate is opened and the liquid copper flows out like a dazzling stream of gold. With a wonderful play of colored flames the liquid travels on to the ingot molds, which are set around the edge of a great wheel.

LOADING COPPER INGOTS ON STEAMER

On the hub of the wheel sits a man who rides his chariot of fire with amazing skill and indifference to his incandescent surroundings. On the outer rim of the wheel another man pries the ingots loose, pure commercial copper, made while you wait, each ingot weighing forty-six pounds and worth six dollars in the metal market. They are dumped into running water, to cool them, and then shot down an incline onto a platform, where two men pile them onto cars carrying 30,000 pounds each.

A queer little locomotive pulls a train of these cars, carrying $4,500 worth of copper, which has been transformed from the ore to its present state in a few minutes. Only half a dozen men have been engaged in this last process, yet in a day they will turn out two hundred thousand pounds of copper ingots, which are worth thirty thousand dollars. The daily charge of two hundred thousand pounds is smelted in five or six hours. It is a most fascinating mining exhibit, without noise, dirt or discomfort.

The Michigan copper miner earns from sixty to seventy-five dollars per month, with work the year around, with which he is enabled to have a home, pay his bills and educate his children, and he is the average immigrant at that. The difference is in his environment. His employers believe there is something more due him than the right to live and toil. They give him a chance to live like a man, and when he looks around and sees a thousand homes owned by miners who have begun just as he is beginning, he is inspired to do the same. Is it any wonder then that there are few labor troubles in Calumet? The miners say they are satisfied with their wages and conditions and prefer to work the whole year around.

While the profits of this great mine are so dazzling and enviable, nobody will begrudge them so long as these communities of mining folk, up among the woods and fields of Michigan, are being made good Americans, through the efforts of the company, by dealing out fair play and honest appreciation of the bonds between capital and labor.

FOR RESEARCH

1. Why is copper one of our most useful metals? For what is it used?

2. Locate the Rocky Mountain region, the Lake Superior region, the Andean region, the Iberian region and the Hartz Mountain region. In what countries are each of these regions situated?

3. What city is the headquarters of the great copper-mining companies of this country?

4. Why has the price of copper decreased materially during the past few years?

5. How do the mines in Montana and Arizona compare with the Michigan mines, in amount of copper produced?

6. What was the cause of the "Copper War" in Montana? What men have been most prominent in the development of the industry in this state?

7. What metal is mixed with copper to form brass? What is that metal used for?

8. What is the extent of our export trade in copper? To what country is most of our surplus sold?

9. Trace a shipment of copper from Butte, Montana, by rail to Baltimore, Maryland, thence across the ocean to the Netherlands. Trace another shipment from Phoenix, Arizona, by rail to San Pedro, California, and thence across the ocean to Hamburg.

10. What effect do the fumes from the copper smelters have upon vegetation? Upon animal life in streams of water?

11. What is copper "matte"? How is copperas, or vitriol, obtained? For what is it used?

CHAPTER XXX

POTTERY AND CLAY-WORKING INDUSTRIES

The word "pottery," in its widest sense, includes all objects made of clay, molded into form while in a moist, plastic state, and then hardened by fire. Clay is the most widely spread and abundant of all mineral substances and exists in many forms, the white kaolin clays, used in the manufacture of porcelain, being the purest. The making of pottery depends upon the chemical changes that take place when the clay is heated in the fire.

The art of making pottery is one of the most extreme antiquity, being known and practised by all known prehistoric races. The Egyptians and the Greeks have long been famous for their pottery and porcelain. The highest grade was originated in China, copied by the Japanese, and later by European countries. The wares of Germany, England and France have long led those of all the world as to quality. One of the most famous brands in the world is that manufactured by Haviland & Co., at Limoges, France, and, like all wares of high quality, it has been largely copied, and is sold under names of similar pronunciation.

The most famous wares of Germany come from the potteries at Meissen, near Dresden, the product being hard transparent porcelain resembling that of China and Japan. Many of the English brands are world-famous, among them being Wedgewood, Royal Doulton, Winton, and Coalport; English Bone China is the most expensive chinaware in the world.

Indian Pottery.—Among the Indians of the Southwest pottery has been an important industry since prehistoric times. Whatever the shape of the vessel, it was built by coiling upon itself a long, thin strip of clay. After the desired height and shape had been reached it was either baked unpainted, or the markings of the coil were eliminated and the color applied. This coloring is generally of a geometric nature, although they sometimes represent birds, animal forms, masked personages and cosmic symbols.

The manufacture of stoneware, pottery, tile and china has been established in the United States for many years, and is now conducted on the most extensive scale in the East and in some portions of the West—notably in New Jersey, New York, Ohio, West Virginia and Illinois, their lines of production grading from the ordinary to the best grades of vitrified china.

Clay Products.—Every state in the Union manufactures the coarser clay products—brick, tile, terra-cotta, electrical conduits, stove and furnace fittings, etc., to some extent, and in several states, notably in Pennsylvania, New York, Illinois and Iowa the industry has assumed gigantic proportions. The increased proportion of steel-framed buildings has created a demand for terra-cotta, and the demand for clay products is rapidly increasing. The plastic character of clay allows it to be moulded into attractive and novel designs. Modern architecture also calls for a variety of grades of brick, and we have vitrified, waterproof, enameled, and other grades in all colors and finishes. A kiln of brick can be dug from clay, carried through the machinery of the factory and burned ready for the builder in about six days. Ninety per cent. of all the tiling used in this country is now made here.

With the exception of the finest English and French china, American manufacturers are producing all varieties of articles in clay, equal in quality to the finest foreign products, from the coarsest and least expensive to those of the most artistic finish. The first porcelain bath tubs were manufactured in this country fifteen years ago, and great quantities of wares of this class are annually exported, as the quality is superior to that manufactured abroad. These are not porcelain in reality, but steel covered with a translucent porcelain layer.

The process of manufacture of crockery ware is long and tedious, being attended with many risks of failure.

Courtesy A. T. & S. F. Ry. Co.

SOUTHWEST INDIANS MAKING POTTERY

Each piece has to pass through many hands, from the day it is started until it is finished and ready for shipment. An average of about six weeks is required to bring a given quantity of ware through the kilns, and the risk in firing is great. Absolute loss of the entire quantity may result from variation in raw materials, a mistake in the kilns, an error in judgment as to the amount of heat required, or some other cause, which can only be obviated by careful training and long experience.

Centers of Pottery Making.—The greatest quantity of white table ware is manufactured in this country at East Liverpool, Ohio and Trenton, New Jersey. While Trenton is the leading pottery producing city, Ohio is the leading state in this line of manufacture. The value of Ohio's product is forty-three per cent. of the total for the whole country, and there are more than a hundred potteries in the state. New Jersey is second, with a product worth twenty-six per cent. of the product of the entire country. New Jersey is the largest producer of bath-tubs and sanitary ware. The annual product of these two states is worth fifteen million dollars.

The introduction of the electric light demanded porcelain insulators, these now being a staple product of the potteries, some of them confining their operations to this one article alone. One factory in Ohio makes common playing marbles exclusively and turns out an average of one hundred thousand per day.

Most of the employees of the potteries work on the piece-work system. Many women are employed to do the lighter work and the decorating. Very little machinery is used, the pieces being fashioned by hand upon the potter's wheel, by a method technically known as "throwing." This process is illustrated in records thousands of years old, and is essentially the same to-day. The work begins in the clay bins on the ground floor, where the materials are weighed, mixed, reduced to a liquid, and, after the removal of impurities, they are returned to the solid state and then kneaded. The clay can then be kept indefinitely, if a proper degree of moisture is retained, and the quality improves with age. It is claimed that the Chinese bury their clay after it has been prepared, and allow it to remain in the earth for years, one generation using the clay mixed by their fathers and preparing that to be used by their sons.

The Potter at Work.—No art is more truly creative, and it is very interesting to see a piece rise into shape

1. Milkweed. 2. Grape. 3. Pine cones. 4. Teazel. 5. Lily. 6. Blackberry blossom. 7. Cherry blossoms.

SOME REPRESENTATIVE PATTERNS OF ROOKWOOD POTTERY under the potter's hand upon the wheel. The workman throws the ball of clay upon the center of the rapidly-revolving disc and, with both hands, presses it in the form of a cone. As the disc revolves he inserts one thumb into the center of the cone, allowing the clay to flow between it and the other fingers. As these squeeze the clay between them it seeks relief from the pressure by flowing continually higher and thinner, and forms the walls of the article desired. The hands do everything, and upon the delicacy and firmness of their touch the whole operation depends. Practically all cheaper grades are moulded, in whole or in parts. Except in stoneware potteries, throwing is a lost art, as all china is now made by jiggering or casting.

There are three sets of kilns, for firing biscuit, glazed and decorated ware. The green ware is first fired in cases called saggers, made of clay. It is then dipped in glaze and fired again. If decoration is to be applied, it is then usually fired again, but this painting is sometimes done on the biscuit under the glaze.

A new class of art is made at Zanesville, Ohio. It is called Feroza faience and has more the appearance of having been made of metal than of clay. The process which produces the rich, bronze-like appearance, characteristic of this ware, is a secret. The shapes in which the ware is manufactured are artistic and unique, as they are uneven and have the appearance of having been hammered out, thus resembling the Japanese metal ware.

Rookwood Pottery.—While studying the work of our potteries one must be attracted by the most beautiful of all faience—the Rookwood, known and admired the world over, and pronounced the most artistic as well as the most valuable of our products. This pottery was founded in 1880 by Mrs. Maria Longworth Storer. It is managed on lines unique in the prevailing factory system, as the effort is to attain a higher art rather than cheaper processes. No printing patterns are used and no two pieces are ever made alike. Each piece is marked, dated and signed by the artist. The decorators comprise men and women mainly from the Academy of Art at Cincinnati, and a spirit of freedom and liberality has always prevailed, in order to cultivate individual artistic feeling among the workers.

The decorations are placed upon the moist clay before any firing, the colors being mixed with clay and forming part of the ware itself. The pieces, after decoration, are fired into biscuit, and the various glazes are applied in subsequent firings. The clays used are entirely American and largely come from the Ohio Valley. These native clays, from the start, inclined the color quality toward yellows, browns and reds, and the decorative medium lent itself to a rather luxuriant style of ornament, all of which the transparent glazes merge into deep, mellow tones. As the command of a material has strengthened, the beauty of the ware has steadily gained in a harmony of all of the elements which compose it, until form, color, decoration and glaze combine to produce those things of beauty which elude all attempts to imitate, and thus make this a complete novelty in the world's ceramics.

A vase made at Rookwood, under the conditions existing there, is as much an object of art as a painted canvas or sculpture in marble or bronze. An object of art is immeasurably more precious when its owner knows that there is no other just like it, and that the artistic conception expressed there will never be found exactly the same.

FOR RESEARCH

1. What is meant by the term "pottery"?

2. Why has the making of pottery been an industry of all nations, even in prehistoric times?

3. On an outline map, shade the states most noted for the manufacture of pottery products.

4. How is the glaze produced on chinaware and other products?

5. How much time is required for a merchant to order and receive a shipment of ware from England and France? What is the duty on china? How is the importer protected against breakage?

6. Write the Rookwood Potteries, Cincinnati, Ohio, for illustrated printed matter describing fine pottery.

7. Have you ever seen a genuine piece of Indian Pottery? Describe it.

8. Trace a shipment of pottery from Limoges, France, to your own city, naming steamship and railroad lines that would probably carry it.

9. Have you a piece of "Haviland" in your home? If so, examine the trade-mark on the bottom and determine whether or not you have the genuine "Haviland & Co., Limoges."

10. Why is good china pottery expensive? Name the elements that enter into its production, in order of importance.

11. What kind of fuel is used in firing clay products?

CHAPTER XXXI

CONSERVATION

The word "conservation" is used in connection with the popular crusade, the object of which is to insure the use of our natural resources wisely and judiciously—for the benefit of the whole people, and not merely for the profit of the few.

Courtesy San Pedro Route

CONSERVATION OF WATER IN CALIFORNIA HAS TRANSFORMED A DESERT

The past few years have witnessed the establishment of well-defined movements, which are making rapid headway toward having many of their principles put into practical effect. The conservationists advocate practical and definite measures for the prompt and vigorous development of our natural resources and for their fullest utilization in the interest of all, without waste and without monopoly.

The field of conservation is very broad. It embraces the forests, the waters, the lands and the minerals of the country, Alaska and our island possessions. The relation of all these factors to the health of the American people is embraced, and so also is our wild life—animal, bird and fisheries. While seeking to preserve all these various sources of health and wealth, the conservationists have specialized in some subjects which have already been brought prominently before the public. This has been particularly apparent in connection with the utilization of the water power of the country. This movement has been in progress for a number of years.

It is a matter of the utmost importance that the rights and interests of the people should be amply protected, in connection with all federal or state grants or franchises, and the efforts of the supporters of this movement have helped to bring the matter prominently before the people. Through legislation which has recently led to the establishment of the Appalachian Forest Reserve, and other similar actions of our law-making bodies, practical benefits are already being realized.

Forest Fire Protection.—The prevention and control of forest fires is another means of conserving our natural resources which is receiving much attention, but certainly not more than it deserves, when we stop to consider what appalling destruction of life and property results from every extensive forest fire. The remedy proposed is better patrol systems and equipment for fire fighting, combined with more stringent regulations. Better results will also be secured through the cooperation of national and state governments on the one hand and the private corporations and individual owners on the other.

Pure Water.—Another subject of great concern is the prevention of the pollution of the rivers and streams of the country in order that better and purer water may be had for domestic and industrial use. Another is for the protection and improvement of navigable rivers by forest conservation on their watersheds, through the purchase or control by the nation, of the necessary land, in cooperation with state and private action to the same end. Equally important is the preparation of a comprehensive plan for inland waterway improvement, extending to all the uses of the waters and covering all sections of the country.

Extent of the Public Domain.—Originally our public domain amounted to, approximately, 1,400,000,000 acres.

WHAT IRRIGATION HAS DONE

Of this nearly all that is adapted to agriculture, and the greater part of our mineral wealth, outside of Alaska, has been disposed of, over 7,000,000 acres in all. Of this vast domain corporations and individuals have acquired 571,000,000 acres, only 115,000,000 acres of which have been settled upon by homesteaders. The railroads and other corporations have had bestowed upon them, by congressional grants, directly, and also through state grants, 190,000,000 acres of land, as much as the combined area of Illinois, Indiana, Ohio, Wisconsin, Missouri and Iowa. There has also been sold by the government, at merely nominal prices, 182,000,000 acres. A leading statistician claims that had the policy of leasing, which was abandoned in 1845, been continued, and applied to our coal, iron and copper lands, and lands containing precious metals, with suitable provision for control, the revenue from that source alone would to-day be sufficient to defray all the expenses of the national government.

Regulation of Timber Lands.—A project that requires legislative action is the public regulation of timber cutting on all forest lands whose conservation is essential to the general welfare, no matter whether the land be government property or privately owned; the taxation of the timber crop of the country on the basis of yield, separate from the land on which it grows; and the support and extension of practical forestry by whatever means may be decided upon as most practical. Another plan seeks the conservation and control of the unappropriated public grazing lands by the government in the interest of the stockmen, but subject at all times to homestead entry by bona-fide settlers.

Safeguarding Human Life.—Along with these specific aims are purposes, in a general way, to diminish sickness, prevent accidents, preserve the fertility of the soil in order that the future food supply of the people may be protected, enforce stringent fish and game laws and, finally, to prolong our coal, oil and natural gas supply by reducing the waste in mining, incidentally bringing about a better safeguarding of human life in and about the mines.

A Look Ahead.—It is estimated that, by the middle of the present century, our population will be one hundred and fifty million people. Therefore, we should realize our responsibility to the coming generations, as in wasting our resources to-day we are committing a great

Courtesy Union Pacific Ry., Omaha

A NEW HOME IN THE NORTHWEST

wrong. It is contended that the waste of our mineral resources alone, at the present time, amounts to nearly three hundred million dollars per year, aside from the hundreds of lives that, under present conditions, are lost annually in mine accidents, such as would not be tolerated in European mines. In natural gas alone—the most perfect known fuel—it is estimated that there is a daily waste sufficient to supply all the large cities in the country, while in the case of coal the mine waste averages half the amount saved. Of course this indicates a great improvement in mining methods, for in the early days of the industry in the United States two or three times as much coal was abandoned in the mines as was taken out and used.

Fire Protection.—The need of better fire protection has long been an urgent one, as our direct and indirect losses from fire reach the appalling total of nearly half the value of the new buildings erected in this country. The experts claim that if we did as well as European countries in guarding against fire we could reduce our losses four-fifths, and thus save a million dollars a day.

The Problem of Increasing Production.—Our farmers, also, might with advantage become converts to conservation, for they average only half as many bushels of wheat per acre as they do in Germany or England, where soil fertility must be maintained by scientific methods. During the past few years there has been much progress along this line, prompted by the activity of the agricultural colleges toward educating the farmers in seed selection and breeding, the study of soils and proper cultivation, yet, with the most fertile soil in the world, we should produce more bushels to the acre than any other country.

The "abandoned farm" is another evil of our system which conservation will aim to correct, just as it will try to repair the damage done to the country at large by the virtual extermination of many valuable species of wild birds, game and fur-bearing animals, such as the buffalo,—a tragedy that has almost been duplicated in this generation in the case of the precious fur seals, though their salvation may yet be secured through the efforts of an international conference recently held at Washington.

The Use and Abuse of Forests.—Another argument in favor of conservation is the fact that there is taken from our forests every year, not counting the loss by fire, three and one-half times as much timber as is grown in the same period. And, further, we consume, per capita, ten times as much timber as do the people of France, who are famous for their foresight, thrift and good judgment. In all other countries there are laws requiring lumbermen to plant a certain number of trees in place of everyone cut down, and they are also required to prevent all unnecessary waste by felling trees where they will not injure others and clear up all waste, thereby preventing fires, yet we have no provisions of that kind in our laws.

Conservation of Health.—Probably very few people, who have not looked into the subject carefully, realize that one of the objects of the conservation movement is to wage war against the great white plague. Experts declare that in the case of the half million consumptives in this country, fully three-fourths of the loss of life may be prevented by teaching the people the proper use of fresh air and sunshine! It is claimed that by reducing the loss of life from this and other preventable diseases the average length of life in this country would be increased more than fifteen years! Proper supervision of the water supply would practically stamp out the dread disease of typhoid!

As a means to the end of lengthening and strengthening life the conservators urge home, school and factory hygiene, the restricting of labor by women and children and the improvement of the public health service, municipal, state and national.

Public Knowledge of Conditions Necessary.—Taxes are increasing, the cost of living is rapidly going higher. There is dissatisfaction in the ranks of the laboring men who as yet have not discovered the real cause or remedy. It is time that we hear the alarm cry of conservation of all of our resources. Legislation will do nothing to check the lack of development or destruction of our resources, unless the people are trained to look after their interests and demand what is due them.

The Duty of the Schools.—A million people are pouring into this country every year, in addition to our natural increase. There may be room for all, so long as those in front move forward, but we have reached the end of our domains and the West will eventually be as crowded as the East. Within the next quarter of a century every tillable acre of land must produce twice what it now produces, and this can be done only through scientific farming, which must be taught in the schools.

Vocational Guidance.—Our public schools need the touch of conservation, in order that the great majority who do not attend college or enter the professions may be better fitted to battle with the problems of life. Conservation is a principle that may be well applied wherever there is need of *economy* or demand for greater *results*. Vocational guidance under the direction of the schools will ultimately help many a student to find his proper place in the great industrial world. A proper knowledge of what the world needs will help advance the efficiency of the race.

FOR RESEARCH

1. What was the immediate cause of the Conservation movement?

2. How often does the Conservation Congress meet? Who may become members of this organization?

3. Locate the "Timber Reserves" of the United States. Where are the National Parks? What is included in each that should be preserved for the people?

4. What laws have been enacted by all states relative to the preservation of fish and game? What is the law in your state?

5. In what way do the provisions of the Pure Food Law harmonize with the conservation movement?

6. What is a forest "ranger"? How many are in the employ of the Government? How effective is their work?

7. What concerted action has been taken toward increasing the yield of all field crops? With what successes?

8. What is the connection between the Reclamation service and Conservation? How can the proper direction of the Forest service benefit both?

9. What have the leading cities done toward establishing vocational schools? Why should trades be taught at public expense?

10. Why should the Government assume control of Niagara Falls? In what other places should National reserves be established?

REFERENCE BOOKS FOR RESEARCH WORK

Romance of Steel.................H. N. Casson
Practical Agriculture.............J. W. Wilkinson
From Cotton Field to Cotton Mill.Holland Thompson
Coal and Coal Mines..............Homer Greene
Romance of the Reaper...........H. N. Casson
Story of the Mine................C. H. Shinn
Workers of the Nation...........Gilson Willets
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