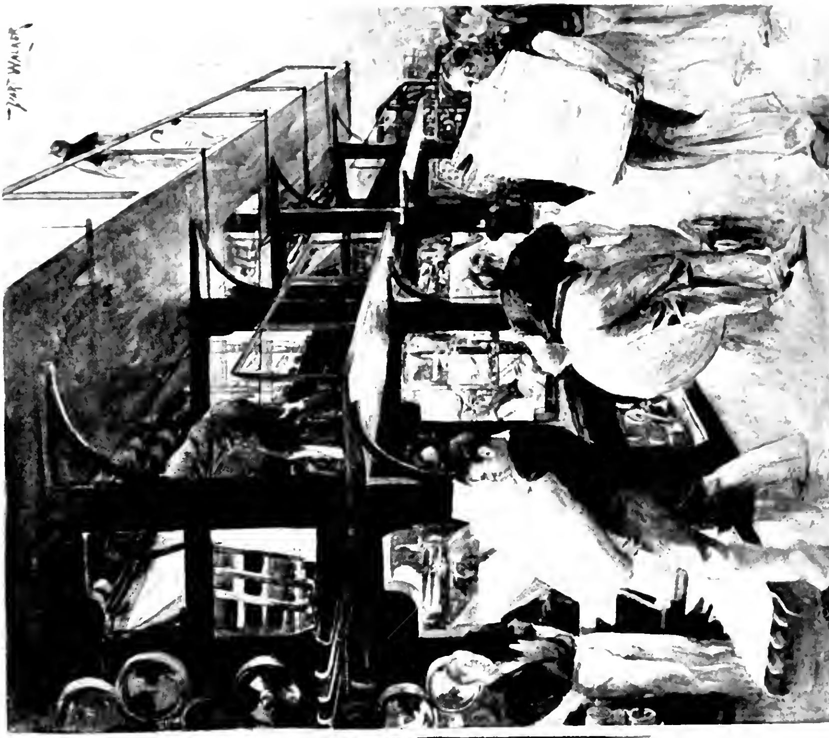

TORIAL AND PRESS ROOMS OF A DAILY NEWSPAPER

DRAWN BY T. DART WALKER

AN ENCYCLOPEDIA OF THE OCCUPATIONS OF THE AMERICAN PEOPLE AND A RECORD OF BUSINESS, PROFESSIONAL AND INDUSTRIAL ACHIEVEMENT AT THE BEGINNING OF THE TWENTIETH CENTURY

BY

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ILLUSTRATED WITH EIGHT FULL PAGES IN COLOR BY FREDERIC REMINGTON, H. REUTERDAHL, W. R. LEIGH, C. M. RELYEA, AND THIRTY-TWO FULL-PAGE HALF-TONES

IN TWO VOLUMES—VOLUME ONE

NEW YORK

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LIST OF ILLUSTRATIONS

VOLUME ONE

COLORED PLATES

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PREFACE

AMERICA is a nation of workers; but the story of their manifold activities has never been set forth until the publication of the present volumes. Our mines, soil, forests and waterways have been developed to a point that has made them the natural wonders of industry; our manufacturing and business enterprises have amazed commercial nations already alarmed by the rapid expansion of our foreign trade; our professional genius has accomplished the apparently impossible; the American artisan has surpassed those of all other countries by attaining the highest standard of skill; but hitherto the record of these achievements could be obtained only by tiresome search through a great number of government and private reports. The need, therefore, was for a complete story, in a single work, of business, industrial and professional achievement in the United States at the beginning of the Twentieth Century. In an attempt to fill this gap on our library shelves, the present work was prepared. It is dedicated to the thirty million persons in this country—including five million women and half a million children—who are engaged in gainful occupations. For these are the "workers of the nation."

It is hoped that this popular description of the manifold activities which are developing the nation will stimulate interest in the marvellous mechanism of our labor, and foster pride in the success of the American workman, be his capacity industrial or professional. Moreover, this story of work may help to remove the isolation of the specialist, the technician, and the plodder in routine. These may now obtain a broader conception of what their fellow workman is doing and come to a higher appreciation of his skill, energy and achievements. Perhaps there will follow a corresponding abolition of the notion that one's own occupation is all-sufficient to promote the welfare of humanity, and the awakening of a desire to co-operate with one's fellow workers in advancing the true interest of the American nation and the world at large.

Though industry and labor will continue to be the subjects of greatest public interest throughout the present decade, yet every effort was made to issue this work in 1901. Effort in this direction, however, was futile; for the amount of labor involved proved far beyond the expectations of the publisher who conceived the work, and of the author who undertook to produce it. An epitome of actual facts and existing conditions of to-day, free from theories and arguments, was achieved only after a process of elimination and condensation lasting a year and a half.

In merely gathering the data, many months were consumed. It was necessary to write more than 6,000 personal letters to officers or representatives of the departments and bureaus of the Federal Government; the State bureaus of labor, manufactures, agriculture, mining and statistics; the national and international organizations of labor; the industrial combinations; the 1,200 companies comprising the National Association of Manufacturers; the Board of Trade or Chamber of Commerce in each city; the various national societies representing the professions and the mining and agricultural industries; the public and private employment agencies; insurance, telegraph and telephone companies, and a great number of mercantile houses; the colleges, universities, and trade and technical schools; the trade and technical papers and class publications. Grateful acknowledgments are due to all of the foregoing, for courteous responses containing the required facts.

The preparation of a work of this character naturally necessitated the assistance of a large number of specialists and experts. Among these were James E. Homans, A.M., author of "A B C of the Telephone," "Self-Propelled Vehicles," and other books; and Mr. C. C. Starkweather, A.B., LL.B., translator of several volumes of "World's Great Classics" and other works, to both of whom special credit is due for much practical and valuable assistance in the preparation of "technical copy."

The distinguished "workers" whose names appear on the title page as the Board of Editors are in no sense responsible for any statement whatsoever contained in the following pages. Such responsibility, owing to the nature of the work, can be assumed only by the author, who alone undertook the task of reducing the vast panorama of a nation at work to a canvas of convenient size.

GILSON WILLETS.

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PART I

MANUFACTURING AND MECHANICAL INDUSTRIES

CHAPTER I

THE MANUFACTURER

Achievements of the American Manufacturer—The United States the Greatest Manufacturing Nation—Getting the Start as a Manufacturer—Learning a Business from the Bottom—The Plant—Factory Employés—The Localization of Industries—The Foreign Commerce of the United States—Our Import Trade—The Manufacturer as an Exporter

THE world has been immeasurably bettered in recent years, as a consequence of changes, social and industrial. The cause of this great advance is no mere plant-like tendency to grow toward a higher stage of development, but is found rather in the adoption of new methods and more earnest efforts in the carrying on of all labor. Enterprise and energy in every calling have striven untiringly to master nature's forces, drawing upon her limitless treasures, and applying her vast resources to thousandfold use. The imaginative qualities, also, have been of service to the advance of civilization: genius in scientific discovery, intuition in mechanical invention, daring in commerce, originality in manufacturing. All these processes have been supplemented by the unsparing zeal of the human toiler, without whose labors the plans of others must have come to naught.

Events of the first years of the twentieth century in the world of commerce and finance seem to prophesy very great things for the United States before the new century shall have grown gray. The marvellous progress of the country in every regard during the past century, which so nearly spans our national existence, is a mere hint of what we are likely to accomplish in the future. We have shown an unlimited capacity for assimilating new ideas; and we have more than held our place in the general onward movement of the nations. It is, therefore, natural if Americans sometimes indulge in superlatives when speaking of their country.

American inventiveness and energy are conquering the markets of the world, and have placed us in a position, which, if maintained, will logically make America, first of all, the world's banker. Every day new victories in the marketing of American manufactures are reported from every quarter of the globe, and this circumstance, together with our vast resources and steadily increasing national wealth, must, in the end, make the metropolis of this country the financial centre of the world: the Mexican, British, German and Swedish loans, recently placed in the New York market, are simply rungs of the ladder of consummation. Moreover, the ease with which these transactions were completed, without the slightest disturbance of our money markets, attests remarkable financial strength.

Our commercial growth has apparently been largely fostered by modern trade combinations. We hear a great deal in condemnation of these, but to many of the foremost men of the time they seem to be serving a much larger purpose in the progress of the world than would be acknowledged by their critics. While chargeable with serious faults, which, however, are remediable, they may be regarded as distinct factors toward industrial co-operation, which in the end—maybe not many years hence—will be recognized as the true solution of the differences that in the past have worked great injury to both labor and capital. Under such economic conditions as must follow from the adoption of this principle, the possibilities for the industrial development of our country seem quite boundless. The conquests of science in the nineteenth century were so wonderful that one hesitates to predict what science will do in the twentieth. But the keen intellectual competition of modern times in both industrial and professional life promises still greater achievements.

Each worker in the different fields of activity has played his part well in bringing about the present material conditions of civilization. If we desire, however, to make acquaintance with the actors of the great drama, Commercial Industry, we shall find our attention claimed by the manufacturer as first in importance.

Achievements of the American Manufacturer

In the first year of the Republic of the United States of America, the envoys and ministers plenipotentiary sent to us from the courts of Europe patronizingly proceeded to take the measure of the new nation. One of them wrote home: "Every inhabitant of the thirteen States, excepting a man named Benjamin Franklin, appears to be engaged in agriculture." To-day, in the third year of the twentieth century, the representatives of foreign governments are writing home: "The United States has become a nation of manufacturers. Women of New England, children of the South, men of every section, are producing manufactured articles of greater aggregate value than those of any other country. The home market is not sufficient for the products of the American factories. The manufacturers export more than they import. Napoleons of industry are forming billion-dollar combinations to invade and conquer the industrial world."

The manufacturer, meantime, is foremost among the magicians of commerce. At Homestead, Pennsylvania, where steed is made, he has so contrived things that, when a valve is turned, the molten metal runs into iron cars, and the engine attached to them speeds away, conveying the liquid steel to other parts of the plant. See the handling of lard at Chicago! The fluid lard is first loaded into a tank-car, then it is sent to the seaboard in a solid state, melted there by passing steam through pipe-coils contained in the tanks, and drawn out again in liquid form—all this to save cooperage and the freight on "merchandise in barrels." The manufacturer even liquefies wood and runs it into molds. He makes use of the X-ray to probe flesh, has his circulars set on type-casting machines; builds hundred-ton locomotives, and constructs steamship engines capable of developing thirty thousand horsepower.

The manufacturer belongs to that modest but powerful body of men, wholly unknown to the readers of romances, the National Association of Manufacturers, which has a membership of twelve hundred, representing all the leading industries of the country. It is not a political organization, concerns itself not with theoretic relations of capital and labor, but has, as one of its chief aims, the acquisition of new foreign markets—a determination which the captains of industry who comprise the association announced at their convention in 1901. It was as a result of that announcement that the foreign diplomats at Washington sent letters of warning to their respective governments, thus bidding the nations of Europe beware lest their formidable western rival secure control of the markets of the world, and advising a concert of European powers to the end that measures offensive and defensive might be adopted to prevent such a monopoly by the United States.

The United States the Greatest Manufacturing Nation

This commanding position in the world's commerce will certainly be retained by the United States. Her power of production shows no signs of abatement; indeed, we may reasonably expect the march of science and invention and the application of American ingenuity to lower the cost of both production and transportation. Our high standing as an exporting nation will be welcomed by the commercial world rather than evoke hostility, as has been intimated and feared in certain quarters. The commercial world buys the products of our fields and factories because it requires them for daily use, and because it can obtain them more readily and cheaply from the United States than elsewhere. Suggestions for the exclusion of the fruits of said field or factory seem scarcely likely to be realized. The effect of the refusal of Europe to purchase from the United States any of the great staples of which we furnish so large a proportion of the world's supply would be to cause an advance in the price of those articles in other parts of the globe. The United States furnishes one-fifth of the wheat entering into international commerce, three-fourths of the cotton, and practically all of the corn, while our contribution of meat to Europe is also large. To eliminate our output from the world's supply of these necessities of daily life would be to create increased prices of the limited quantities which could be obtained from other countries. Hence, in these natural products, it may be expected that the demand upon us will continue indefinitely, and the fact that the United States in 1902 sold to Europe alone more manufactures than she had ever sold to the entire world in any year prior to 1895 shows plainly what American manufacturers have done toward capturing European industrial markets.

The causes of this wonderful expansion in exports are to be found in the fact that the United States is the earth's master merchant of the principal commodities of daily life. The chief requirements of man are food, clothing, heat, light, and the very large variety of things made by machinery classed as "manufactures." Of all these the United States is the world's largest producer. The main articles of food are breadstuffs and meats; of wheat the United States brings forth more than any other country, and of corn more than all other countries combined; while of meats the United States is also the world's largest producer. For clothing the article of prime necessity is cotton, and of this the United States grows more than three-fourths of the world's total. For heat, coal is the greatest requirement; of this fuel the United States now takes out of the ground a larger quantity than any other country. As for light, our petroleum wells furnish more refined illuminating oil than those of any other nation. In manufactures, above all, the United States is undisputed monarch, the value of our products being nearly double that of the United Kingdom, and nearly equal to that of France, Germany and Russia combined.

Roughly stated, the sources of our national wealth are agriculture, mining, and manufacturing. Of the whole, manufacturing contributes about seventy-five per cent, farming twenty, and mining five. According to the actual number of persons employed, agriculture ranks first, with 10,000,000 wage earners, while manufacturing, with over half a million establishments, employs about 6,000,000 persons, and mining about 1,000,000. Rated according to value of production, manufactures head the list with $13,000,000,000; in agriculture the three principal cereal crops of corn, wheat, and oats alone are valued at nearly $300,000,000; $1,600,000,000 represents the value of our minerals. In addition, the sum of $12,500,000,000 is invested in the railroads of the United States, which employ about 1,000,000 men.

Getting the Start as a Manufacturer

Every industry holds up a beckoning finger. It is for each young man to show the ability that will cause the beckoning finger to summon *him*. Thus it summoned Charles M. Schwab, Andrew Carnegie, Henry C. Frick and hundreds of others who are now captains of industry.

American business enterprise has so broadened and industries have so multiplied as to increase the young man's opportunities to a remarkable extent. In the great cities there is an especially large demand for young men of brains. New ventures are started every day. There are now many flourishing branches of business unexploited or unknown twenty years ago. In the fields of electricity and chemistry alone the new lines of activity are astonishingly numerous. In the old days there was, in each establishment, a proprietor, or there were partners, with two or three high-salaried clerks, and few employés. Now there are huge firms with many partners or stockholders, and a large staff of managers who earn good incomes, much larger in fact than a good many proprietors formerly made. The number of these trained employés must, of course, increase as the business grows, and promotions are made from among those young men who have proved themselves most capable.

Learning a Business from the Bottom

Occasionally the industrial world is startled by the failure of an old-established house. In many cases the reason for this is very simple. The younger men, just out of college, were not content to begin at the bottom, and learn the business thoroughly in every detail as their fathers did. The various departments were thus left to the management of superintendents, with no one to check their errors or assist their methods and decisions. Lack of unanimity, waste of energy through friction, and the want of competent direction would ultimately seal the doom of the house.

From the student's gown to the overalls may not be a pleasant step. But the young man who is not manly enough to take it, if necessary, will not succeed in business. Energy, application and willingness to begin at the bottom are requisite. How helpless and really ridiculous is the position of the head of a great house who is obliged to rely upon some underling for advice in elementary matters pertaining to his own business. Imagine the predicament of the chief of a leather manufacturing establishment, for instance, who could not judge of the qualities of leather. His buyer would rule him, if he did not ruin him, which, through carelessness or incompetency, he might conceivably do.

There is not a process in the manufacture of any commodity with which the owner of the plant should not be practically familiar. Then he can "pull up" the remiss operator, localize the difficulty, and remedy it by advice or substitution. Defects in machinery he can also discover, and devise improvements. The margin of profit is in our day so small, and competition so great, that fractions of a cent in prices control the market. The savings now necessary in the cost of manufacturing make it absolutely imperative that a man should know his business thoroughly. Business, to-day, is a science, and the scientifically equipped man is the most likely to succeed.

The Plant

The first consideration of the manufacturer is capital. We will suppose that he has not enough money himself to make the start. He must then join what money or ability he has with the capital of others.

Since all staple things must be sold at the lowest possible figure, there very naturally must be large sales to counterbalance the small profit. In most industries the larger the plant the cheaper the product. It does not matter much in what industry the manufacturer invests his capital, as the rate of profit, in the long run, is about the same in all. Perhaps the profits of iron and steel manufactures, in particular, are to be envied, but in other lines—leather goods, lumber, clothing, paper, flour, carriages, railroad cars, stoves, hardware, silks—the profits cannot be said to differ very materially. The average manufacturer is content with six per cent net profit on his capital. The profit of the cotton or woollen cloth manufacturer is seldom more than one-half cent a yard—and this in dividend-paying mills. The shoe manufacturer makes only a few cents on each pair of shoes that retails for two dollars. Yet his, too, is a paying trade. The calico manufacturer is content with a quarter of a cent a yard, the sugar refiner with a like amount of profit on each pound, and the paper-maker counts on a yield of no more than five per cent on his capital. Yet in all these fields manufacturers grow rich.

The site once being settled upon and duly secured, the establishment of the machinery is next in order. One secret of the supremacy of the American manufacturer is the fact that as soon as a new machine is placed on the market, and is found to work better than the old one, the inferior machine gives way to the improved.

Although his grandfather never heard of the telephone, the telegraph or the electric light, the young manufacturer makes free use of electricity and since human hands are needed to operate that power, new sources of employment are opened to numbers of men and women. Is he a shoe manufacturer? He must have the most approved machines, which turn out a pair of shoes, complete, every twenty minutes. If a match manufacturer, he will save thousands of dollars a year by using the machine that pastes the labels on the boxes at the rate of a thousand a minute, instead of the quick hands of a girl who yet can paste only twenty thousand labels a day. As a manufacturer of cotton, he must have the spindle that has saved the country $100,000,000 since it was invented thirty years ago—the Rabbeth spindle that makes ten thousand revolutions a minute. Is he a chair manufacturer? He must have the machines which can turn out complete chairs, at the rate of one in every forty minutes.

Suppose him a manufacturer of pins. He buys twelve machines which can be tended by one man, and in a day a million pins are produced. A nail manufacturer can buy machinery from which nails will pour in a steady stream—a complete nail every second. The manufacturer wishes to send out a vast quantity of circulars? An automatic addressing machine does it much faster than a girl with a pen. Is he a canner of fruit, of meat, or food of any kind? Not once need the food be touched by the hand of an operative. Clean machinery will do it all. With full allowance for wear and tear, the average machine will last twenty years, unless it is in the meantime supplanted by one more efficient.

Factory Employes

But besides the soulless machinery there is the human operative. The better the operative, the better the article produced. To the manufacturer each operative represents a certain amount of invested capital, and so even the lowest paid operative must be responsible for a certain return in cash profit. Hence in many great factories it is the invariable and inexorable rule to discharge every man who has passed the age of usefulness or whose energy has begun to wane. In some cases these men are provided for by the employers. They are discarded, however, on a business principle, as worn-out machinery.

Fitness alone keeps a man at work in establishments thus managed. In factories where small profits are made on cheap things, such as matches, pins and needles, calicoes, buttons, every movement of the operative counts. In a cotton mill the subdivision of labor is so fine that the girl who adjusts a certain movement of the spindle with her left hand accomplishes the same amount of work in less time than her neighbor who uses the right hand. In five thousand repetitions of the left-hand movement only one second of time is gained, but since thousands of girls do the same thing, and since the left hand is thus used millions of times, the aggregate of time gained in a year amounts to days. Again, watch the girl who stands at the end of a frame of a hundred spindles. She is apparently idle. But her eyes sees every thread in the hundred spindles, somewhat as a practised eye can take in the entire contents of a store window in a single glance. Suddenly a thread breaks, the girl darts forward and, with a lightning-like movements, joins it. Here is marvellous expertness rewarded with only eight dollars a week. For delicacy and dexterity of touch, furthermore, let the needle manufacturer show you how an operative can cut the eye in a needle. That girl could pierce a human hair in the same way, so deft is her hand. The match manufacturer, too, will point out a girl who can pick up the exact number of matches necessary to fill a box. She never counts them, but there is never a single match over or under the necessary number for a particular box. There's a fortune in that operative's touch—and she earns six dollars a week.

Indeed for wonderful sights a European trip is not necessary. He who would write a book of marvels need only make a tour of the great mills and factories of the United States. There he will find material for a volume, not on seven ancient and lifeless prodigies, but on the seven hundred modern human wonders of the world.

The extraordinary efficiency of the American artisan is proved by an examination of figures:

Over one-third of all manufactured goods of the world comes from the United States. Great Britain's share is fifteen per cent, that of Germany is twelve per cent, and that of France is eleven per cent. We manufacture seven times as many wares as should be called for from our people in proportion to the part they form of the earth's population. The average gross manufactured product per individual in the United States is valued at $1,900 per annum. The French artisan produces goods to the value of $650; the English artisan, $485; and the German, $450. We may attribute this enormous superiority in efficiency largely to the general use here of the most modern machinery and methods. It enables us to compete successfully with home markets of other countries.

The Localization of Industries

After the manufacturer has considered all the points above mentioned in connection with capital, plant and operatives, he finds that a question of prime importance is that of locality. The elaborate care devoted to localization is one of the striking features of modern industrial life. Its principle, however, is not new. It is almost as old as industry itself, for nothing was more natural than that workers in certain trades and crafts should congregate in towns and localities where they might labor to the best advantage. Yet the subject of localization has so greatly developed in our own day, and has had so tremendous an influence upon our industrial life, that it may fitly be called a modern idea. Localization is, indeed, at the bottom of two other great trade principles—centralization and combination.

The ancient idea of localization was that a trade could be best followed, either at the spot where the raw material was found, or else where there was the greatest demand for the finished product. But this notion is now superannuated. In modern, and especially in very recent, times, localization generally refers simply to the place where the industry is more or less centralized; and this centralization depends upon purely economic conditions. Cotton mills, for instance, used to be built near cotton fields, or in great cities where this article would be readily sold. But it is now known that such mills do the best work under peculiar climatic conditions, such like those prevailing, for example, in England and in sections of New England, and thus it is that precisely in old England and New England numerous cotton mills exist to-day. It is partly this attention to localization that has caused the incomparable industrial progress of the United States. The system has made it possible to manufacture with the greatest economy the best quality of goods, and to distribute the production in the most advantageous manner.

Localization is by no means confined to this country, where it has been most successfully exploited. Even in so unindustrial a country as Russia importance is attached to it. More than five hundred villages of that empire are devoted to various branches of woodwork, different communities applying themselves to certain specialized occupations. One village manufactures only the wheels of vehicles, while another makes the bodies. But it is only in the foremost industrial countries that the principle is thoroughly developed, and it is in the United States that it is carried to its furthest limit.

The principal determinants of localization are: 1, nearness to materials; 2, nearness to markets; 3, waterpower; 4, favorable climate; 5, a supply of labor; 6, capital available for investment in manufactures; 7, the momentum of an early start. The exact place, or centre of localization, is often the result of chance. When once established, a trade will tend to remain in a certain locality and grow there rather than shift its position upon a chance of better success elsewhere. Certain industries, of course, go at once to localities that are naturally best fitted for them, as the mill goes to a watercourse, and nearly all industries in their beginnings start in or near the field of supply of their raw material. It is only later that other considerations—and it is these that are now the controlling ones—such as climatic conditions, greatest economy in production, nearness to markets, transportation facilities are influential in a closer localization and centralization of industries.

The principle of locating an industry near the source of raw materials is illustrated in the establishment of the paper mill near the spruce and poplar forests; potteries near the clay beds; and furniture factories within reach of timber areas. A remarkable example of natural localization is found in the canning of oysters in Baltimore, which does sixty-four per cent of this country's entire oyster canning.

The advantage of being near the principal market for the article manufactured has always been of great moment in the locating of industries. It is not now so necessary to be very close to the market, as transportation facilities have shortened distances and time. Sometimes, also, remoter localities, where ground rent is low, are chosen for manufacturing purposes, since the saving in this respect offsets the cost of transportation. But the advantage of reasonable accessibility has placed very nearly fifty per cent of the manufacturing of the whole country in Massachusetts, Connecticut, Rhode Island, New York, New Jersey, and Pennsylvania. Manufactures are maintained in these States, not that the soil there yields the most copious raw materials, but chiefly because of the great markets created by the large populations of New York, Boston, Philadelphia, and Baltimore. Nearness to market practically means quick and cheap access to market.

Formerly waterpower was a controlling consideration, and it is still largely in use in certain industries. Its influence upon localization of industries is not, however, nearly so great as it was before the days of steam. Cotton mills were formerly driven entirely by water, and even now water supplies thirty-one per cent of the power used in this industry.

The climate affects both the workers and the material. An invigorating climate is very favorable to industry, and is responsible in a large measure for the localization of manufacturing in the Northern States. It has been found that a moist climate is most favorable to the manufacture of cotton; and for this reason the New England States, up to the present time, have been able to overmatch the many advantages of the Southern States in point of nearness to the source of supply, cheapness of labor, and the lower cost of living.

A good supply of labor is as necessary to industry as capital itself. Manufacturing industries tend, therefore, to become localized in sections where the labor supply is constant and the worker efficient. This has been to the great advantage of the New England towns which are surrounded by exhausted farms, and possess, therefore, a surplus of reliable labor. But in the West, where agriculture has remained in a more flourishing state, and has continued to attract workmen, manufacturing has been slower to advance. As most of the industrial enterprises are financed from the great money centres, it is essential that industries should be localized at points easily accessible to capitalists. It is equally essential, however, that there should be a quantity of local capital, to furnish means for supplying the wants of the industrial population, as well as banking facilities for handling capital. A prosperous town is, therefore, a favorable locality for great concentration of industries: Pittsburg is one of the best illustrations. When whaling declined at New Bedford, about the middle of the last century, the local capital, thus set free, was invested in cotton mills, and the city became one of the great centres of that industry.

The Foreign Commerce of the United States

All nations give close attention to their foreign commerce, both because of its relation to the prosperity of the people and also because of its relation to the revenues of the country. One of the easiest and surest ways of raising funds for carrying on a government is by the collection of taxes in money on articles imported or exported. In a large proportion of cases this collection is confined to imports, though a few countries still impose an export duty on certain commodities. The said effect of commerce upon the prosperity of the people and the funds of the government leads to a constant and careful supervision of the imports and exports by all governments. It is possible to determine what are the imports and exports of almost any nation, and by a little more arithmetic the total international commerce of the world can be approximately estimated. The world's total commerce, then, is set down by statisticians at about twenty-one billions of dollars. Of this, exports come to about ten billions, and imports to about eleven billions. It is plain why imports should exceed exports. Every article exported from a country becomes an import when it reaches another country, and when the cost of transportation and handling is added to its value on leaving the country of its origin, it is natural that the import value should be a little higher than the export value. In many countries, especially those of Europe where most of the home production is required for the home population, exports are less than imports. In the countries having a large producing area and adequate means of carrying their natural products to the water's edge for transportation abroad, the exports generally exceed imports.

It is by the comparison of the figures of the different countries, as issued in their official reports, that we are able to compare the commerce of the United States with that of other nations. By a study of the conditions of production, consumption and manufacture at home and the demand for our products abroad we are able to determine not only the relative standing of the United States as a commercial nation, but also its prospect for retaining its present proud rank as the greatest exporting nation of the world.

The rapid expansion of the foreign commerce of the United States is the natural consequence of the extraordinary impetus given to production by railway construction in the closing quarter of the nineteenth century.

Following the establishment of the transcontinental line, which was completed in 1869, came the extension of other lines, through the great Mississippi valley and the South, and this resulted in the opening of the great agricultural, forest and mineral areas whose natural supplies have made this the greatest producing country of the world; while the multiplication of railways facilitated the assembling of natural products for manufacturing purposes. Thus our agricultural output has, we may say, doubled, the total value of American farm products having increased from less than two and a half billions of dollars in 1870 to five in 1902.

In other branches the increase has been more phenomenal still. The production of coal, a prime necessity in manufacturing, grew from 33 million tons in 1870 to 290 million tons in 1901; pig iron, from less than 2 million tons to over 13 millions; and steel, from less than 70,000 tons to over 10 million tons. Meantime the railways had grown from 52,000 miles in 1870 to nearly 200,000 miles at the present time, and rates for rail transportation have fallen to about one-third the rates of 1870. The result of all this is that the United States has become the greatest exporting nation in the world, having risen from fourth place in 1870 to first place in 1902. The value of our exports during that time has practically quadrupled.

Our Import Trade

Turning to the imports, it may be expected that they will continue to grow. In 1902 they exceeded those of any earlier year in our history, and the reasons for continuous augmentation are coincident with our rise in manufacturing. While the United States is the world's biggest shop for the chief elements required in manufacturing, it does not produce certain articles of tropical and subtropical growth of which the manufacturers are requiring constantly increasing quantities, such as raw silk, fibres, Egyptian cotton, India rubber, and sundry other things. Add to this the food staples of tropical origin, such as coffee, cocoa, tea and such sugar and fruits as are not grown at home, and it is apparent that the importations must increase, especially from the tropics. The value of tropical and subtropical products imported grew from 143 million dollars in 1870 to over 400 million in 1902, and the share which they form in our imports from 31 per cent in 1870 to nearly 50 per cent in 1902. And this proportion seems likely to increase. While our population goes on growing in numbers, or while its wants continue to grow—as those of every civilized nation do—we must draw more and more upon the hot belt. This means a perpetual swelling of our importations from that source alone, and our recent acquisitions of territory have not only given us a stimulus to buy goods from tropic lands, but have opened new fields for the American exporter.

The Manufacturer as an Exporter

Meantime, the American manufacturer, like the American missionary, claims that he is the great torch-bearer of civilization; for into all the corners of all the countries of the earth he sends, as an exporter, his typewriters, phonographs, sewing machines, bicycles, automobiles, cameras, clothing, oil, locomotives, steel rails, electric street cars, even bridges of steel, and ten thousand other useful things. This great American manufacturer receives orders for barbed wire, calico, shoes, or tons of biscuit, from places on the other side of the globe. New Guinea, the Caroline Islands, Peru, and Greenland send to him for sewing machines. From Europe and Asia come demands for that handmaiden of commerce, the typewriter, with an "export keyboard," in Russian, Hebrew, Greek, Armenian, or Arabian characters. Since the day the United States army carried the typewriter into Manila, we have filled orders from Filipinos for thousands of writing machines. Again, that the Asiatic may sweeten his everlasting tea, immense quantities of condensed milk are shipped to Thibet, Manchuria, and Mongolia. From the Moors and the Persians come orders for bicycles, while Abyssinia wants American cameras. The world also calls for our steel in vast quantities. An American bridge company is building viaducts for the Uganda Railway. The great Atbara bridge on the Soudan Railway came from an American steel plant. A locomotive plant at Richmond, Virginia, sends twelve huge iron steeds to Finland; a Philadelphia locomotive concern sends twenty-two to New Zealand; a Pittsburg locomotive company twenty-eight to India. An American corporation receives an order from Spain for eleven passenger coaches, twenty-two freight cars, and 4,000 tons of steel rails. Other American companies secure contracts from Norway for 20,000 tons of steel rails. Far Australia calls for 20,000 tons of steel rails from Illinois. A steel car company in Pittsburg is asked to rush one hundred pressed steel cars to equip the Paris-Lyons Railway. A tool shop in Sandusky fills an order from China for 12,000 planes. Java calls for a whole shipload of American wire fencing, and Japan absorbs everything American, from a Rochester lamp to a complete railway. Jerusalem orders Edison talking machines and Kentucky whiskies and Pittsburg stogies. To the shores of the River Jordan itself the American manufacturer sends his agricultural machinery. All these things are matters of record; they prove that the exporter is the great civilizer of to-day.

CHAPTER II

INDUSTRIAL COMBINATIONS

Summary of Statistics—Charles M. Schwab's Views—John D. Rockefeller's Views—Henry O. Havemeyer's Views—How Organized—Management—The World's Greatest Industrial Combination—Opportunities for Employés of Combinations

THE tendency of the American people toward centralization has for a generation been noted in the affairs of the body politic, where certain well-defined forces have been steadily tending toward a firmly-intrenched federal government, as opposed to a distribution of regulative powers widely scattered in local seats of authority. Thus we have come to behold a strongly centralized government at Washington.

When we turn, on the other hand, toward another division of our affairs, to the sphere of economics, we find that there exists the same tendency toward centralization. The great industries which are contributing to aggrandize American wealth and prestige are upholding the principle of a wise division of labor and the abandonment of old-time wasteful methods.

What constitutes an industrial combination? In gathering data, the Director of the Twelfth Census found it necessary, in order to obtain a uniform basis of tabulation, to fix a definition which should determine the corporations to be included, thus:

> No aggregation of mills is to be considered an industrial combination unless it consists of a number of formerly independent mills which have been brought together into one company under a charter obtained for that purpose. The word "trust" was avoided in this definition, because, while it may have come to convey to the popular mind a certain significance, it stands technically for a form of organization under which the stockholders of each of the separate companies assign their stock to a certain number of trustees, giving to them an irrevocable power of attorney to vote the stock as they see fit, which form of organization has been declared illegal.

Summary of Statistics

Of the one hundred and eighty-three principal industrial combinations in the United States, reported by the Census, three, viz., the Standard Oil Company, the Continental Tobacco Company, and the United States Leather Company, have a capitalization exceeding $100,000,000 each, the United States Steel Corporation not having been organized at the time of the report. The 183 combinations control 2,203 plants. The total of the authorized capital is about $3,500,000,000. But if all the combinations known to the business world were included, the total capitalization of "industrials" in the United States would reach 6,500,000,000. Large as the total is, it ceases to impress one when compared with the railroad capitalization, which is $12,500,000,000. Even this enormous amount becomes insignificant when compared with the total wealth of the United States, which is now close to $100,000,000,000. So, when we recall the fact that the United States has become one of the greatest manufacturing nations, while formerly agriculture was the chief pursuit of the people, the capitalization of six and one-half per cent of the entire wealth of the country in this industrial development is not excessive.

Charles M. Schwab's Views

From the authoritative statement of a great Captain of Industry, Mr. Charles M. Schwab, the president of the greatest industrial combination in the world, we are helped to form a judgment on the nature and objects of modern industrial combinations. He says:

> Combinations have gone on in nature forever, and they will go on in politics and business. You might as well try to dam the Mississippi or sweep back the tides as to stop the natural consolidation of business interests. The old trust idea was just as fallacious as anything could well be. In the first place, it was founded upon the principle of restricting the output or increasing the prices, or in some other artificial way regulating the business. That is doomed to failure. The proper business consolidation is one that is formed with exactly the opposite views. It is formed with the view of encouraging trade, of enlarging trade, and, above all, of cheapening the production of the article of which it becomes the manufacturer, and in that way increasing the trade.
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> The great business enterprises of the past have been built up by the individual interest and individual efforts of certain individuals. Look back over the great businesses that have been built up, you will find that they have been the result of some one great mind, who has had all his interest in that business. The result of that individualism was great progress, great extensions, great economies and great successes. The difficulty with these great combinations of capital will be to get people to manage them—people who will put the same individual effort into them as the individual did into his own property. I believe that difficulty can be met, and the way we intend to try to meet it is this: It is the intention of the United States Steel Organization to put every man in charge of a little branch of the business, not on a salary, but on a percentage on the profits, which will be paid to him in cash, and which he can invest in the securities if he wishes, and in that way get his individual result upon his individual work. We don't believe that we can get that from salaries, but we do believe that we can come as near making a man a partner in that direction as in any other way that has yet been devised, and it is our intention to operate every one of our great departments on that basis.

John D. Rockefeller's Views

Few personages of note in our industrial history have been listened to by all thoughtful citizens with more interest than Mr. John D. Rockefeller, president of the Standard Oil Company, when before the Industrial Commission he championed the merits and public services of his gigantic corporation:

> I ascribe the success of the Standard Oil Company to its consistent policy to make the volume of its business large through the merits and cheapness of its products. It has spared no expense in finding, securing, utilizing the best and cheapest methods of manufacture. It has sought for the best superintendents and workmen and paid the best wages.

It has not hesitated to sacrifice old machinery and old plants for new and better ones. It has placed its manufactories at the points where they could supply markets at the least expense. It has not only sought markets for its principal products, but for all possible by-products, sparing no expense in introducing them to the public. It has not hesitated to invest millions of dollars in methods for cheapening the gathering and distribution of oils by pipe lines, special cars, tank steamers, and tank wagons. It has erected tank stations at every important railroad station to cheapen the storage and delivery of its products. It has spared no expense in forcing its products into the markets of the world among people civilized and uncivilized. It has had faith in American oil, and has brought together millions of money for the purpose of making it what it is, and holding its markets against the competition of Russia and all the many countries which are producers of oil and competitors against American oil.

The chief advantage of an industrial combination is that it has all the advantages which can be derived from a co-operation of persons and aggregation of capital. Much that one man can not do alone, two can do together; and once admit the fact that the co-operation, or, what is the same thing, combination, is necessary on a small scale, the limit depends solely upon the necessities of the business. Two persons in partnership may be a sufficiently large combination for a small business, but if the business grows or can be made to grow, more persons and more capital must be taken in.

The business may grow so large that a partnership ceases to be a proper instrumentality for its purposes, and then a corporation becomes a necessity. In most countries, as in England, this form of industrial combination is sufficient for a business coextensive with the parent country, but it is not so in this country. Our Federal form of government, making every corporation created by a State foreign to every other State, renders it necessary for persons doing business through corporate agency to organize corporations in some or many of the different States in which their business is located.

Instead of doing business through the agency of one corporation, they must do business through the agency of several corporations. If the business is extended to foreign countries, and Americans are not to-day satisfied with home markets alone, it will be found helpful and possibly necessary to organize corporations in such countries, for Europeans are prejudice against foreign corporations as are the people of many of our States.

These different corporations thus become co-operating agencies in the same business and are held together by common ownership of their stocks. It is too late to argue about advantages of industrial combinations. They are a necessity. And if Americans are to have the privileges of extending their business in all the States of the Union, and into foreign countries as well, they are a necessity on a large scale, and require the agency of more than one corporation. Their chief advantages are:

1. Command of necessary capital.
2. Extension of limits of business.
3. Increase of number of persons interested in the business.
4. Economy in the business.
5. Improvements and economies which are derived from knowledge of many interested persons of wide experience.
6. Power to give the public improved products at less prices and still make a profit for stockholders.
7. Permanent work and good wages for laborers.

I speak from experience in the business with which I have been intimately connected for about forty years. Our first combination was a partnership, and afterward a corporation in Ohio. That was sufficient for a local refining business. But dependent solely upon local business, we should have failed years ago. We were forced to extend our markets and to seek for export trade. This latter made the seaboard cities a necessary place of business, and we soon discovered that manufacturing for export could be more economically carried on at the seaboard, hence refineries at Brooklyn, at Bayonne, at Philadelphia, and necessary corporations in New York, New Jersey, and Pennsylvania.

We soon discovered, as the business grew, that the primary method of transporting oil in barrels could not last. The package often cost more than the contents, and the forests of the country were not sufficient to supply the necessary material for an extended length of time. Hence we devoted attention to other methods of transportation, adopted the pipe-line system, and found capital for pipe-line construction equal to the necessities of the business.

To operate pipe lines required franchises from the States in which they were located, and consequently corporations in those States, just as railroads running through different States are forced to operate under separate State charters. To perfect the pipe-line system of transportation required in the neighborhood of fifty millions of capital. This could not be obtained without industrial combination. The entire oil business is dependent upon the pipe-line system. Without it, every well would shut down and every foreign market would be closed to us.

The pipe-line system required other improvements, such as tank cars upon railways, and finally the tank steamer. Capital had to be furnished for them and corporations created to own and operate them.

Every step taken was necessary in the business if it was to be properly developed, and only through such successive steps and by such an industrial combination is America to-day enabled to utilize the bounty which its land pours forth, and to furnish the world with the best and cheapest light ever known, receiving in return therefor from foreign lands nearly $50,000,000 per year, most of which is distributed in payment to American labor.

Henry O. Havemeyer's Views

A sensation at the time was caused by the frank avowal of opinion concerning the question most agitating the industrial world, which was uttered by Mr. Henry O. Havemeyer, President of the American Sugar Refining Company, before the Industrial Commission:

The mother of all "trusts" is the customs tariff bill. The existing bill and the preceding ones have been the occasion for the formation of all the large "trusts," with very few exceptions, inasmuch as they provide for an inordinate protection of all the interests of the country, sugar refining excepted. Economic advantages incident to the consolidation of large interests in the same line of business are a great incentive to their formation, but these bear a very insignificant proportion to the advantages granted in the way of protection under the customs tariff.

There probably is not an industry that requires a protection of more than ten per cent ad valorem, and it is to obtain what is provided over such percentage in the tariff that leads to the formation of what are commonly spoken of as "trusts."

With a protection to an industry not exceeding ten per cent, all menace to the community from "trusts" would cease. This ten per cent would represent the difference in cost of production, and likewise act as a protection against surplus products of foreign countries being dumped in our local markets, thereby interfering with the regular and economic working of our industries. Any advantage that might then accrue to such combinations they would be fully entitled to, and the public would not be damaged thereby, as any expansion of price would be met by foreign competition and relief.

Corporations, whether directly such or in the form of trusts, are an expedient for uniting the interests of a large number of persons of smaller means into a large aggregation of capital. Attack upon them is, therefore, an attack upon their stockholders. In the case of many well conducted corporations these stockholders are very numerous and are often persons of moderate means, dependent upon their income for their support.

In the absence of all disturbing causes, the direct tendency of a combination of capital is to promote economy, reduce expenses, and diminish price. This does not mean that a person having anything to sell will not get for it the largest price that he can. It means that with the abundance of capital ready for investment, the only way to prevent competition is to keep prices below the competitive point.

Great public improvements, factories, and other enterprises requiring large capital either are impossible unless through the instrumentality of corporations, or are possible only through the action of individuals themselves possessed of unlimited capital. It is easy to see what in the latter case would happen to the community.

How a Great Combination is Organized

The methods by which a combination is organized and financed are numerous. The following description of the organization of the American

Smelting and Refining Company illustrates the general method of forming combinations. Desiring to reduce expenses and eliminate competition, the various smelting interests saw that the only course to be pursued was a consolidation, and in the first place, options upon the various plants and businesses were obtained at the lowest price possible, upon a cash basis. The owners, or vendors, were given the right to subscribe for such proportion of the capital stock of the new company as they saw fit, upon the same basis as cash subscriptions were made. The options were then taken over by the bankers who were financing the scheme, and who undertook to organize a syndicate for the raising of the capital necessary to purchase the properties. This syndicate was organized under a subscription agreement. A contract was entered into for the actual purchase of the properties. The syndicate managers called on subscribers for the payment of their subscriptions. The amount was deposited with a Trust Company. A corporation was organized under the laws of the State of New Jersey, and, in the case of the American Smelting and Refining Company, $27,400,000 of seven per cent cumulative preferred stock was issued, together with $27,400,000 of common stock. With this issue of stock the company acquired all of the property. When the preliminary work had been completed, a day was set on which occurred what is technically known as a "round-up." The parties making the contract with the new company for the transfer of the various properties, together with the bankers or syndicate managers, were present, so that it would not be possible for lack of proper legal proceedings to prevent the entire consummation of all the transactions. The officers of the new corporation were also present, and transferred to the party making the contracts all the stock of the corporation to which he became entitled under his contracts, and took over the deeds and conveyances from the various vendors. The vendors received checks for the entire amount of their purchase money, and immediately handed checks to the syndicate managers for whatever amounts they had subscribed for upon the same basis as the other subscribers. The transaction being thus completed, the officers of the new company proceeded to record their deeds as soon as possible, and to take possession of the property.

There are various other plans, promoters sometimes receiving specified sums of money for their services, and bankers almost always having to take for their services a percentage of the stock or the surplus left over. Promoters' profits generally depend on their expense accounts, and upon their skill in making purchases.

In financing industrial combinations conservatism prevails. The capitalist advancing the money to buy the various plants is, often, taking considerable risk, for which he expects high pay. His judgment as to the probable development of the business of the combination of course determines the extent of his remuneration. Whether he holds the securities or sells them from time to time, his returns depend on the earning capacity of the establishments. Private bankers are now taking an active part in floating large business corporations. Notable among these men is Mr. J. Pierpont Morgan.

Management

What the men responsible for the new methods have to say for themselves is always of value in enabling us to derive an impression at first hand. Mr. Chas. R. Flint, the organizer of the rubber and several other great combinations, says that a combination of muscle is a labor organization; a combination of money a bank; a combination of intelligence a university; but that an industrial combination is a union of the three—muscle, money, and intelligence—and that none of them can be successful without benefiting the component parts. Speaking as a witness before the Industrial Commission, Mr. Flint said:

> In general I think that a centralized management is the most desirable, if there are men of sufficient intellectual ability to administer an extended business, and there are not a great many intellectual giants that have the ability to run ten or more large businesses. In my judgment, one of the dangers to the success of industrials is that parties, without being intellectual giants, are liable to attempt to centralize too much. Taking men as they are, I think that in business where high-class ability is required at many places, and where the business is not of such a character that its conduct can be reduced to rules, and where its success depends on local ability and local judgment, and where the efficiency of the selling department is involved with long-time personal relations, such a business it may be very dangerous to suddenly centralize.
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> It is far wiser, I think, in a case of that kind, to sustain the independence and individuality of the separate concerns. In that way you have the advantage of the organizations that have created those concerns, and by an adjustment of compensation, based somewhat upon the earnings of those individual concerns, you sustain the individual interest that is essential to success. At the same time your central organization has the advantages of comparative accounting and comparative administration, and is able to hold the separate concerns to a strict accountability, or, by appealing to their pride, to promote a healthy spirit of rivalry.
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> In many cases, the pride which a man, knowing that his work is being compared with others', has in handling his business successfully, together with the incentive given him by reason of an interest in the profits of the business he is managing, keeps up that individual interest that exists where the person possesses a large ownership. But in many cases it does not. The fact is that one of the fundamental difficulties of the management of these corporations lies in the fact that the managers have a smaller percentage of interest in the operations that they are conducting under the plan of an industrial combination than they had when it was an individual property or when they had a large interest in a small corporation.
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> The best way to meet this condition is through an accurate system of comparative accounting, and in that accounting it is advisable not only to compare general results, but to compare details so as to find the cost of different parts of the process. At the same time it is advisable to have the managers interested in the profits of the business. That comes as near as possible to solving the difficulty. On the other hand, there are lines of business of such a character that they can be all handled from a central office. Such a business can be reduced to a very accurate system. For example, the manufacture of metals can probably be reduced to a more accurate system than the manufacture of rubber goods, since in the former there is no way in which you can utilize the chemist to any extent.
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> You cannot lay down any positive rules as to chemical combinations, because those materials are constantly fluctuating, and there is such great variety of conditions to meet that the business of manufacturing rubber goods must largely depend on local intelligence, and that necessitates high-class ability in the local management. In the case of the Rubber Goods Manufacturing Company, the salaries of the chief executive officers are very small as compared with the salaries of local managers. The salaries of the local managers will average three times the salaries paid to the chief officials of the corporation.

The World's Greatest Industrial Combination

The greatest of all industrial combination is the billion dollar aggregation whose organization aroused more excitement in the business world than an international convulsion which might change the map of the world. Its privy council meets regularly in the Empire—the appropriate name of a "skyscraper" near Wall Street; it is here that the directors of the United States Steel Corporation hold their monthly meetings. Take the express elevator to the eighteenth floor, and find that board in session—the council of the Empire of Steel. Twenty-four men are seated, like King Arthur and his knights, at a round table. They are all comparatively young men, Charles M. Schwab being the youngest. Only one is foreign-born. Fourteen came up from the ranks—farmers' boys, clerks, workmen, self-educated, self-made. Less than half are graduates of universities. Four were formerly lawyers or judges; six are bankers; seven were "born and raised" in the midst of the coal and iron fields of Pennsylvania; five were christened in the heart of the steel region of the Middle West. These twenty-four men rule the great American Empire of Steel, with its several hundred thousand workmen, its billion dollars of capital, and its dependent or partially dependent population which equals in number the combined population of Connecticut, Colorado, and Florida. The names of several of the magnates who are privileged to gather at the council table of the corporation are familiar to business men in every part of the globe where steel is used: J. Pierpont Morgan, John D. Rockefeller; William E. Dodge, a controlling influence in the American copper industry; P. A. B. Widener, master of many enormous webs of street-car lines in the United States; Clement A. Griscom, head of the greatest line of steamships carrying the American flag, and an associate manager of the most important single railroad system in the world; Marshall Field, who began life as a dry goods clerk, now the foremost dry goods merchant of the world; Henry C. Frick, starting as a "hand" in a flour mill, now the Coke King of the world; and finally Charles M. Schwab, twenty years ago a stake driver for day wages, now the president of the largest corporation the world has ever known. Andrew Carnegie does not attend the meetings of the council, but is represented through the Carnegie Steel Co., by Mr. Schwab. Other names might be mentioned, including those of the presidents of the subsidiary companies, but enough have been named to show that the influence brought by twenty-four men to this colossal enterprise reaches out into nearly every one of the three hundred and fifty great industries in America.

Just as Bismarck, the iron chancellor, welded the States of Germany into the compact unity of the German Empire, so has Mr. Morgan, the Bismarck of finance, "squeezed" together a set of competitors hitherto warring for supremacy. The list of the constituent companies absorbed by the United States Steel Corporation, with the amount of their authorized capitalization at the time of their absorption, is as follows:

UNITED STATES STEEL CORPORATION: CONSTITUENT COMPANIES

Company	*Capital*
The Carnegie Company	$160,000,000
American Bridge Company	70,000,000
Lake Superior Consolidated Iron Mines	30,000,000
Federal Steel Company	200,000,000
American Steel and Wire Company of New Jersey	90,000,000
National Tube Company	80,000,000
National Steel Company	63,434,000
American Sheet Steel Company	53,000,000
American Tin Plate Company	50,000,000
American Steel Hoop Company	33,000,000
Total for constituent companies	$829,434,000
United States Steel Corporation	$1,404,000,000

Previous to the formation of the United States Steel Corporation, the Federal Steel Company, itself representing a combination of six great corporations with subsidiary coal, iron, and railroad companies, was the world's greatest corporation. It brought to the new steel corporation the control of the steel business in Chicago, Milwaukee and elsewhere. Beginning in New York, at headquarters, and ending at Duluth, Minnesota, a complete inventory of the steel corporation's properties would fill a large volume. The coal lands alone, in this Steel Empire, comprise 75,000 acres worth $1,200 an acre. Then there are nearly 100,000 acres of leased natural gas lands, and 30,000 acres classed as "other lands and quarries." On these lands are eighty blast furnaces, over 18,000 coke ovens, and finally 150 steel plants. The system of plants is connected by six great railroads and several smaller ones, all owned or controlled by the combination.

The blast furnaces of the company produce nearly 10,000,000 tons of pig iron annually, and the steel plants, 7,000,000 tons of steel or two-thirds of all the steel made in the United States. The remaining third of the total production of steel comes from the plants of about thirty competitors of the great corporation. The coke ovens make it the greatest coke concern in the world. A clearer idea of the relative importance of the United States Steel Corporation in steel production may be conveyed by the following approximate figures for 1902:

	TONS
Produced by the United States Steel Corporation	7,000,000
Produced by independent companies	3,000,000
Total for United States	10,000,000
Total for Great Britain	5,000,000
Total for Germany	6,000,000
Total for all other countries	6,000,000
Total for the world	27,000,000

An exhaustive description of the organization and operation of the United States Steel Corporation would require all the remaining pages in these volumes. It can only be said, briefly, that the work is so thoroughly systematized and subdivided that only the most important matters reach the president in his New York office. The ten heads of the ten plants send written reports to Mr. Schwab from time to time. Like the commonwealths of a federal state, each company retains its individuality, each transacts business with the other as though absolutely independent, and each splits the very last dollar in driving bargains with the others. The presidents of the various companies, like the Board of Directors, meet at least once a month in New York to discuss points of mutual interest. All executive authority, however, is vested in President Schwab, and in the Executive Committee, appointed by the Directors. The net revenues, or earnings of this mighty industrial world-power average $10,000,000 a month. Such are the domain, resources, organization, production and revenues of the world's greatest combination.

Opportunities for Employés of Combinations

Has a young man entering the employ of a trust, without influence or favor, a fair chance to win a good position for himself in life, and to make a fortune? Are the young employés shut out from advancement? Investigation shows that modern consolidation has actually increased rather than curtailed the chances for young men. With the exception of a few of the older combinations, such as the Standard Oil Company, the Leather Trust and the Sugar Trust, the great consolidations encourage the independent advancement of their employés. From the nature of things, the combination must depend very largely upon expert servants. The old "trust" system, which had for its basic principles the restriction of output, the increase of price, and the throttling of competition by absorbing and closing opposition concerns, was declared illegal. The trusts then were reorganized to comply with the new statutes. It was hard to shake off old methods, however, and nepotism and favoritism seemed still to rule the management. In the Standard Oil Company, for instance, the important positions are generally filled by members and followers of the Rockefeller, Pratt, Flagler, Rogers, Payne and Wardwell families, which owned the original refineries making the combination.

But this system of nepotism is fast disappearing. In the new combinations, other ideas prevail. Consolidations are now generally effected by underwriting syndicates, which take over the properties, organizing a company, and putting its securities on the open market for public subscription. Thus the control is necessarily divided and the number of stockholders vastly increased.

Under the sway of this modern idea of consolidation and combination, in contradistinction from the old trusts which were found illegal, the president and other high officers of these great enterprises are very generally men who have worked up from the ranks. The big concerns are continually shifting their employés, constantly on the lookout for new material of the right sort. To every promising lad opportunities are given, and, if found worthy, he is quickly promoted, without regard to antecedents.

A noteworthy example of this sifting process may be observed in the methods of the United States Steel Corporation. The Carnegie Steel Company, one of its constituent concerns, had worked out this scheme of systematic promotion, and had employed it with the best results. For years the company had filled its controlling offices with brilliant experts, who had been promoted in proportion to their talents. Mr. Charles M. Schwab, the president of the corporation, a shining example of the success of this method, has introduced the same system into all the companies now combined in the greater concern. On this subject Mr. Schwab says:

> The personal element is one of the most important requisites for success in business. Consolidation must find some method to neutralize the loss occasioned by eliminating the individual. High salaries will not suffice. The personal element can be maintained only by providing for an interest in the results, the profits, among the workers in high positions.
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> Under the old individual business scheme the skilled worker had only limited opportunity for increased pay, and practically no opportunity for a partnership participation. Business enterprises, with a few notable exceptions, were held as close family corporations. Outsiders were rarely admitted. No matter how expert these outsiders were, they were held all their lives on a salary. The concerns where this rule did not apply expanded much more rapidly than their competitors, but the example so set was apparently not sufficiently attractive to induce its general application. It remained for the system of combination to make this scheme general, and to open up for young men of brains opportunities that heretofore have been closed to them. There was never a greater opportunity than now. The opportunities for any man, workingman, or manager, or any man who has to use his brains, were never so great as they are to-day. Never has there been such a scarcity of the special men that great manufacturing concerns and capitalists desire. I think the man with exceptional ability to-day has a better opportunity of becoming a large owner or a director in one of these companies than ever before.

Upon the pay rolls of the United States Steel Corporation are the names of a quarter of a million men and boys. In every plant and department there are weekly meetings of foremen and managers, at which new ideas are suggested, and the names of bright men and boys are mentioned, records being kept and copies being sent to the president of the company including this particular plant. So, likewise, there are regular meetings of heads of departments and superintendents, called by the presidents. In this way merit or talent is quickly discovered and rapidly rewarded, the system proving a drag-net for the discovery of aptness and genius for business. Even the usual jealousies and the workings of "office-politics" do not serve to hinder its beneficent action. The discovery—bound to come—that a man has been unjustly "held back" by a superior so redounds to the credit of the abused employé that he is pushed forward all the more rapidly afterward.

Looking at the workings of the so-called Tobacco Trust, we find that its success has been due to the fact that it has recognized in substantial form the services of its employés. Mr. Duke, elected to the presidency of the consolidation, chose superintendents of factories, heads of departments, and other high officers from the ranks, following the methods he had so successfully employed in his own company, and thus speedily achieving such enormously beneficial results in the consolidation that it was enabled to invade Europe with its ramifications. In this consolidation the employés are under close observation, and the indication of talent secures promotion. This is well illustrated by the course pursued in the recent establishment of a new department, involving enormous expenditures. The fact that merit and not "pull" prevails was shown by the selection for its head of the superintendent of a comparatively obscure factory who had shown extraordinary capacity in his own field. Directors' sons and nephews were passed by, and this employé was placed in the coveted position. This concern positively discriminates in favor of young men.

Looking at the methods in vogue in the International Paper Company, we see a similar plan prevailing. As the original officers retire their places are recruited from the ranks, most of the old plants now being under the control of managers who were merely factory superintendents or foremen before the consolidation. The policy of the new company is not to go outside of its own employés in filling new positions, no matter how high. Directors' sons take their chances with all the rest. The heads of the various departments have all been selected on account of their special fitness for the positions. This system has been so perfected that the managers claim that they always have, among their twelve thousand employés, men competent to fill all the positions, from the lowest to the top.

A cursory glance at the conditions of these consolidations show, therefore, that they are beneficial to the best interests of the young man of today who has ability and is willing to work hard.

One effect of the consolidation system in business is that concentration of effort is requisite in the rising young man. The day of the all-around man is past. The Jack-of-all-trades is more than ever master of none. A man must be able to do one thing and do that preëminently well. The future will be dominated by specialists. Industries have been re-arranged so that now they are separated into departments, at the head of which are wanted men who know all about that special branch, and who are trained specialists. Such men may command salaries ranging from $5,000 to $15,000 a year. These high salaries are not only not begrudged, but are paid with willingness to the right men. In the rubber combination headed by Mr. Chas. R. Flint, there are 300 partners sharing in the earnings of the establishment. One annual dividend of profits shared among the heads of departments in the concern was $150,000, and $60,000 worth of stock is owned among the clerks. All the developments of the new system are of course beneficial to the corporation, in the additional interest taken by the employés in their work. As the real object of consolidation is to produce goods at lower prices, scientific supervision is necessary. Young men must therefore perceive that there is thus opened a continual demand for experts and specialists.

CHAPTER III

TRADES UNIONS AND LABOR CONDITIONS

Labor Organizations—The American Federation and the Knights of Labor—Labor Unions and Employers

Labor Organizations

THE organizations among the workers of the United States for the safeguarding of their interests are of three types—the local, the national, and the international. The local union is usually made up of members who live and are employed in one town, and its business is done by vote of all the members. The national and international unions represent the same idea—the union of the workers of a trade in a large territory or in several countries brought about by united action of many local bodies. The great majority of the national trade organizations are bound together in the American Federation of Labor. There are other cases of alliances among organizations with related interests, as the International Typographical Union, the pressmen, and the bookbinders.

No complete statistical statement for the labor organizations of the whole country has ever been made, and it is not possible to give an accurate estimate of the number of active members. Here is a rough estimate of the membership at the present time:

Organizations	Membership
Unions affiliated with the American Federation of Labor	950,000
Custom clothing makers	3,800
Lithographers	2,100
Bricklayers	39,000
Plasterers	7,000
Stonecutters	10,000
Box makers	5,500
Piano workers	7,700
Engineers, marine	6,000
Engineers, locomotive	37,000
Firemen, locomotive	39,000
Conductors, railway	25,800
Trainmen, railway	46,000
Switchmen	15,000
Letter carriers	15,000
Knights of Labor and unenumerated organizations	191,100
Total	1,400,000

In a review of the national and international labor organizations having general offices in the United States, the Commissioner of Labor of Iowa gives the names of eighty-nine such organizations from which he was able to secure information, and the number of their members as 1,550,247. The earliest of these unions dates from 1851, but seventy-three of them were established within twenty years, and of these fifty-one had their beginning during the last decade.

These organizations, it will be observed, represent but a small percentage of all the workmen of the country, for about six million persons are engaged in manufactures alone, while the membership of 1,550,247 given here includes a number of large unions, and some of them very important organizations, such as the railway employés and the miners, which are engaged in transportation and in mining. These unions, however, may be considered as representing the laboring interests of the whole country. They include all of the most important industries and occupations, the greater part of those occupations not organized being in the smaller industries where but a few persons are employed in single establishments. These unions, too, are the regular army of labor and fix the standard for all the others. And as will be seen later on, unorganized labor to a large extent participates in the victories won in the way of shorter hours, higher wages, and improved conditions.

Colored men, even in the Southern States, are often admitted to the unions, but separate unions are encouraged. The social color line is drawn, and although the white men are willing enough to work with the colored people, yet they do not always like to meet them at the union meetings. But they will back them up in labor troubles. This loyalty to their colored brothers caused the largest strike that ever occurred in New Orleans, a few years ago. The draymen and teamsters, who were colored men, formed a union. They sent a committee to the employers to have the agreements signed. The employers refused to receive them. Then the whole organized labor of New Orleans went on strike, including machinists, printers, gasmen, bakers, and others. Of course, under such circumstances, the workmen gained a speedy victory.

The American Federation and the Knights of Labor

The plan of the American Federation of Labor and the plan of the Knights of Labor are not exactly similar. The former is a federation of the organizations representing many distinct trades. The local unions have no direct relation to the Federation. The expenses of the Federation are covered by the national bodies, which may secede at will. On the other hand, the idea of the Knights of Labor is more the union of all workers, each local assembly being in direct relation with the central body. Each trade controls its own affairs, no higher authority intervening, save on request.

The American Federation of Labor has, it is true, organized mixed local bodies, made up of members of various crafts, with the name of federal labor unions, but they are preliminary to the organization of trade unions as soon as there are enough representatives of the various trades in the place to warrant it. There are more than seventy national and international unions, the term international applying only to the American continent. Attached to these national and international unions there are about eleven thousand five hundred local unions. The state branches are ten in number, with more than eighty central bodies. Known by different technical names, there are also many central labor unions and more than six hundred local unions, with no national or international unions, but directly attached by charter to the American Federation of Labor.

Labor Unions and Employers

Labor organizations have proved their power in many fields by securing union labor generally pay about the union rates. Thus even the non-union men often get higher wages than non-union men, yet employers of non-union labor generally pay about the union rates. Thus even the non-union man is benefited by the union. Take the builders of Boston, for example, and we find that the minimum union rate of wages is in vogue even among employers who hire non-union men.

One very important point in favor of union men is that they never apply for relief from the public authorities in time of depression. Their unions look out for their needs. In Chicago, for instance, after the panic of 1893, there were thousands of unemployed workmen. Among those who applied for charitable relief there was not one member of a labor organization in good standing. Furthermore, the unions exert a favorable influence upon business in general by increasing wages. This elevates the standard of living, and enables the masses to consume more goods. Their influence upon the intellectual and moral condition of their members is also excellent. The members hear discussions of economic and social subjects, and are thus led to read and think, and to become better citizens. The unions also encourage steadiness and sobriety.

One argument in favor of unions is that the single wage-earner has no liberty of contract. Liberty, it is claimed, only becomes possible through combination. The relation of the member to the union is like that of the citizen to the republic; it maintains his rights. He substitutes the majority and vote of his union for the dictation of the employer. Among employers there is some difference of opinion as to the effect of labor unions upon their interests. The president of one large company is on record as saying that it would be well if unions could make wages uniform in all competing plants. But some employers think that unions are injurious in their education of workmen, teaching them that employers are generally unjust, and inculcating the fallacy that capital is their enemy. It is said by these men that the prosperity of some towns is seriously menaced by the labor unions, notably Birmingham, Alabama. The opinion of Mr. Charles M. Schwab, the President of the Steel Trust, is of general interest. He says: "If I were a working man—as I was—if I were a working man now, in one of these mills, especially if managed under the broad policy under which I hope the steel manufacture is administered, I would not want to belong to a labor organization. It puts all men, no matter what their ability, in the same class of work, on exactly the same level. If I were a better workman, quicker, smarter than the other men, I would want to reap the benefit. I would not want to be put into the same class with the poorer man. If we have 500 men employed at the same class of labor the wages paid must be the same paid to the same class. The level is that of the poorest man in that department. As a working man I would not advance, and I would not be able to show superior ability over any other, if I were in an organization."

It is specially asserted against the unions that they stir up strife, and cause strikes. It is admitted that when a union is first formed, many strikes are likely to occur. The men possess an exaggerated idea of the power of the union. On the other hand, employers unaccustomed to dealing with unions, resent the interference of "committees." But when a union becomes established in a given locality it is claimed that it diminishes rather than increases strikes. In fact, a record kept in Indiana for two years showed that more than one-half of the strikes in that State were among unorganized men. The Labor Commissioner of Indiana estimates that eighty per cent of the labor troubles in his State are "with unorganized workingmen or men newly organized, not disciplined along the line of organization." Of 22,793 strikes reported by the United States Department of Labor, from 1881 to 1900 only sixty-three per cent were ordered by labor organizations.

Employers and a representative of non-union labor complain that the unions are blameworthy in trying to exclude non-union men from employment, by refusing to work with them, and in influencing legislative and executive action in case of public work, declaring this policy to be tyrannical, despotic, undemocratic, and a direct interference with the rights of the non-union men. On the other hand it is alleged that it is not the purpose of the unions to prevent non-union men from working, but simply to induce them to come into the union, this policy being necessary to the union's welfare. In order to meet the employer on equal terms, the union must represent all his workmen, or at least all that class of workmen of which it is composed.

Formal agreements exist between labor organizations and employers on many subjects, such as wages, hours of labor, etc. Sometimes an agreement contains a clause to the effect that the employer, when in need of labor, shall apply to the labor-bureau of the union for workmen. Again, the agreement may be a mere stipulation that the employer shall employ members of the union, hiring them as he wills. The bakers, barbers, the brewers and some other trades have adopted the plan of requiring the employer to apply to the union for help. This cuts out the employment agencies, to whom the men are forced to pay a bonus. It often occurs that the employment agency is a saloon, and the best spenders are the first to be recommended for a place, thus putting a premium on drinking.

The "minimum scale" is not generally understood by the public at large.

It permits the superior and better qualified workman to receive a higher wage than the ordinary workman. For example, take the printing trade. The union "minimum scale" is, perhaps, eighteen dollars per week. But many skilled compositors get more than this, on account of the excellence of their work. Such is the state of affairs with proofreaders, also, some earning much more than others. And it is the same with the iron-molders, the hatters and the furniture workers, in fact, in all industries in which day-labor is employed. For example, the bricklayers have a "minimum scale" of four dollars, and yet many of them get $4.50 and $5 a day. In these and similar trades, where there is a difference between ordinary and excellent work, there is a marked contrast between the "minimum scale" and the higher one.

Concerning "walking delegates" a false notion generally prevails. They are not agitators, acting irresponsibly. Nor are they, as a rule, trade union leaders. They are merely agents, or servants, exacting payments of dues, bringing in new members and making settlements. These walking delegates, or business agents, are necessary in dealing with employers, as a committee of the working men of the establishment, whether the demand was granted or not, would thereafter be in disfavor with the owners and would soon be discharged.

Very few of the trade unions in the United States are incorporated. In the State of New York about three hundred are incorporated out of a total of sixteen hundred. Opinions differ in reference to the advisability of incorporation. Some favor incorporation because it enables the unions to enforce their contracts with employers, and makes them responsible organizations so that employers are more willing to deal with them. The President of the Brotherhood of Electrical Workers is in favor of incorporation, with the inseparable addition of compulsory arbitration. But many representatives of the unions are strongly against incorporation. They allege that the courts have a tendency to favor employers. President Gompers, of the Federation of Labor, prefers to keep the union funds safe from the interference of the State, and does not think that there would be any gain in giving legal validity to contracts between employers and unions. A union, it is asserted, which does not keep faith can not succeed. Many of the labor troubles arise from the breaking of the contracts by employers. If these contracts were legalized, it is claimed that the employers would readily find means of evasion. The contracts can be enforced by the workmen only through the power of the workmen to make evasion more expensive than compliance. The conclusion is that the power of the unions as fighting bodies would be weakened by incorporation. Funds might be tied up in time of strike by injunction, either by the employers or a minority of the union members.

The use of labels as a means of encouraging the public to patronize union shops is favored both by the Federation of Labor and the Knights of Labor. The first union label was adopted by the Cigarmakers' International

Union, in 1880. Since then many national and international unions have adopted labels. The purpose of the label is to guarantee to the purchaser that the labelled goods have been made by union members, and that they are thus made under the proper sanitary conditions. The label also is a means by which organized workers help the manufacturers who pay them well and treat them properly. Certain States have enacted laws for the protection of union labels, severely punishing any person detected in counterfeiting them.

There is general complaint concerning the ownership of stores by industrial and mining establishments. When employers maintain such stores in good faith for the benefit of the employés they are of course valuable to the workmen. But it is alleged that workmen can buy usually from ten to fifty per cent cheaper at other places; and that although there is no open compulsion, yet there is a discrimination made in the matter of employment against workmen who do not trade at the company stores. One result of the system is that workmen are kept in debt to the stores, receiving hardly any of their wages in money. And it is averred that in times of strikes the stores aid in enforcing submission by the threat of stopping credit.

In reference to company tenements similar complaints are made. It is asserted that these houses are inferior structures, and are rented at exorbitant rates. In some New England factory towns, however, company houses are superior to those owned by private individuals. It is certain that the proper housing of the poorer working people is one of the serious problems in the industrial world to-day.

An interesting feature of labor organizations is the business of insuring against liability for accidents. Ten companies have written nearly a billion dollars of this class of insurance. Many labor organizations have a death benefit feature, about forty per cent of the national unions paying such benefits from their funds. In certain labor organizations the insurance is a separate feature. In some instances there is a benefit in case of sickness, in others, a benefit in case of disability, loss of work and loss of tools. Several large employers have established benefit and insurance funds, and others pay part or full wages to injured employés. Benefit and insurance features have been maintained for some time on several of the large railroad systems, and are extending to other roads.

CHAPTER IV

INDUSTRIAL BETTERMENT AND EDUCATION

Industrial Betterment—Special Responsibilities of Employers—Mr. Carnegie and His Employés—Industrial and Business Education—Apprentices

Industrial Betterment

IN the manufacturing industries the improvement in the condition of the workers has followed closely upon the evolution of the factory system growing out of the remarkable developments of machinery. For many years every new marvel in machinery was looked upon as a new enemy to take the bread from the mouths of the hand workers. But the working people have, from many examples, come to see that the temporary displacement of labor is speedily followed by an expansion of industry—a lowering of cost, an increased consumption, and ten or more factories in operation where formerly one was sufficient. With the growth of the factory system and the coming together of large numbers of workers with a common interest, labor organizations were formed to safeguard the interests of all. The new problems which resulted from the introduction of machinery and the building of great factories were not met at once. Grave evils were for a time suffered by the workers, but gradually, with the systematizing of factory management and as a result of the demands of organized labor, industrial betterment has become a fact. Many of the things that a few years back would have been looked on as admirable efforts in the line of industrial betterment are now regarded as conditions essential to economic production.

Improved shop conditions have not been the direct demand of organized labor to as great an extent as better wages and a shorter working day. Statistics of strikes in the United States for twenty years show that nearly one-half of all the strikes had to do with the subject of wages, while not less than one-fourth in some way related to the matter of hours of labor. In somewhere about one-half of these contests the workmen were successful in gaining their demands. It can therefore be seen that there must have been a marked tendency in favor of labor in the form of higher wages and shorter hours.

The economic changes which have followed each other with such rapidity during the last few years, says the President of the National Association of Manufacturers, have created many new problems which manufacturers and other large employers of labor find themselves compelled to consider. Organized capital is confronted by organized labor, and it is exceedingly gratifying to note that instead of more determined antagonism there is a larger disposition to consider the points at issue with calm deliberation and intelligent judgment. To those who are appreciative of the humanitarian aspects of industrial life it must be exceedingly gratifying that so many representative manufacturers are devoting much attention to problems affecting the conditions under which their operatives live and labor.

There are many members of the Manufacturers' Association who have devoted much thought and study to problems of this character, and who have applied advanced ideas with much success within their own establishments. There is an economic value in such ideas in addition to the interest which attaches to them from the humanitariam standpoint, and profit can be derived in many ways from study of factory life and conditions as found in those modern establishments where progressive ideas have been applied in full force. Employers generally would derive much satisfaction and benefit from the study and discussion among themselves of what are often termed "industrial betterment ideas." The increasing recognition of the fact that employers have some obligations toward their operatives other than the mere payment of wages is one of the very encouraging signs of the times.

The various measures for industrial betterment (described in detail in succeeding chapters), all in successful operation in the United States, may be summarized as follows:

1. Club organizations in which employés are banded together for social, educational, recreative, and other purposes incident to such associations. A Young Women's Progress Club connected with a Dayton, Ohio, establishment, originated through the efforts of a lady who visited the factory daily at the noon hour and read to the young women. The members of the Club pay a small fee, or assessment, for books, and meetings are held daily, forty-five minutes at noontime being granted for this purpose by the company. The effect of the organization upon the employés has been elevating, morally and intellectually.

2. The encouragement of physical culture by means of gymnasiums, calisthenics, baseball, bicycle, and similar clubs. In a large manufacturing establishment in Dayton, Ohio, where a great many women are employed, the experienced force was constanly being depleted on account of sudden illness and fainting spells among the women, sometimes as many as seven or eight a day being compelled to quit work. Physicians were summoned to examine the factory, pronounced the sanitary conditions perfect, and suggested that the trouble was caused by too close application on the part of the women to their work, and that a brief rest in the forenoons and afternoons would be found beneficial. The suggestion was acted upon, and an informal calisthenics club was formed under a competent instructor employed by the company. The female employés are now given fifteen minutes' recess each morning and afternoon, all the women joining in light gymnastic exercises. The effect has been very marked upon the health and efficiency of the women.

3. The improvement of intellectual conditions by means of free lectures, libraries, kindergartens, and educational classes.

4. The increasing of industrial efficiency through industrial schools and manual-training classes.

5. The advancement of spiritual life by means of Sunday-schools and general religious work.

We have established the policy, says a certain manufacturer, of breaking down the wicked idea of social distinction; first by little parties, excursions, and so on; then by an occasional word of counsel, a Washington Birthday letter or a Christmas letter; the opening of a small park and playground for the children adjoining the factory, and of a comfortable hall upstairs over the shop—park and hall each bearing the name of "Golden Rule;" arranging for meetings and music in the park on Sundays in the summer, and in the hall during the winter time. Progressive people in the neighborhood are conducting an ethical Sunday-school in the hall every Sunday afternoon. The meetings in both places are religious in the best sense of the word, though broadly catholic. The subjects discussed and studied are the Golden Rule, brotherhood, patriotism, the wage question, and various phases of the social problem. In addition, the men have organized among themselves a club for the study of social problems; also a German social club, and a singing club. The company created an insurance fund to provide for injuries, sickness, etc. The men deposit one per cent of their wages to the credit of the fund and a like amount is deposited by the company. The fund is under the direct control of the men. We lay no claim to having done anything from a charitable motive; the whole aim has been to strive toward an ideal of justice. There is little of what is known as the "boss" idea about the place—none at all, indeed, except the necessary direction—and with the disappearance of the "boss" idea I believe the alleged necessity for bosses will go also. The company, furthermore, distributes annually a portion of its profits among the workmen, each receiving a sum proportional to the amount of his earnings during the year.

6. The cultivation of musical taste and ability by means of concerts and musical entertainments for employés, and the encouragement of musical clubs and organizations among them.

7. The promotion of improved social conditions by means of social gatherings, summer outings, meeting places, and game-rooms for employés, banquets, dances, etc.

8. The promotion of employés' personal interest in the successful conduct of the business by encouraging and assisting them to purchase shares in it, thus, in effect, taking them into partnership.

9. The improvement of domestic conditions by means of improved dwellings, instruction in sewing, cooking, and housekeeping, and in landscape and kitchen gardening, and the exterior and interior decoration of homes.

10. The care of employés' health and comfort by means of bathing facilities, dining and lunch rooms, the furnishing of hot lunches to female employés, and by improved sanitary construction and appliances.

11. The care of sick and disabled employés and their families by means of free insurance, free medical attendance or hospital facilities, and by the encouragement of beneficial organizations.

12. The cultivation of thrift through savings bank facilities, building associations, or provident organizations, and by the giving of prizes for valuable suggestions of employés, and rewards for faithful service or the manifestation of zeal and interest in their employment.

13. The rendering of financial aid to employés in cases of hardship or distress.

14. The manifestation of interest in the personal affairs of individual employés, the cultivation of cordial and even confidential relations with them, and the promotion of their welfare in all possible ways. At Cleveland, Ohio, the Chamber of Commerce has taken up the betterment of the

conditions surrounding the workers in the factories and stores of the city, and has appointed an industrial committee to have charge of the matter. The committee began its labors by gathering data, including a collection of photographs and stereopticon slides, illustrative of the work already in progress in several factories and wholesale houses. Much attention has been given to the formulation of rules and by-laws for beneficial associations for employés; questions of equipment of shop restaurants, with costs, menus, methods and management; the starting of reading-rooms and libraries, and the installation of shower baths and other washing facilities. Co-operation has been given, with other associations, looking to the encouragement of shop evening classes and other forms of educational work.

Special Responsibilities of Employers

Though there are laws in force in each State which regulate and define the liabilities of employers, the responsibilities of employers extend beyond and above the law. These responsibilities may be classed under the general head of the ethical relations between employer and employé, embracing such matters as the influence of the employer; the recognition on his part of the rights of employés aside from those rights which are given a legal status; a personal interest in those who work for him; a reasonable amount of commendation of good work in the form of promotion; and a recognition of the identity of interests which exists between employer and employé.

The buying of an employé's labor is something more than a mere business transaction. He who takes the greatest interest in the personal welfare of those under him will achieve better results and those more quickly, than he who likens himself to a slave driver and a bargain driver when the commodities are the services of men and women. Mr. Carnegie says that one of the chief reasons for his success was that the men in his mills were paid better wages than the men in other steel mills. Mr. Wanamaker declares that the success of his stores was and is founded not upon the number of customers, but upon a consideration of the comforts and rights and health and personal welfare of his employés. Another employer declares that contentment, fidelity, willingness, good health and cheerfulness on the part of his employés are so many assets and should be guarded as such. It may therefore be accepted as a fact that the most profitable investment an employer can make is the taking of measures, and the constant devising of plans far the improvement of the conditions surrounding the workers in his establishment. The employé who considers that he is looked upon as a partner does not think so much of the clock. If he is shown that he is regarded in the light of something better than a mere machine, he takes a personal interest in the conduct of the business; he is thus induced to devise ways to avoid waste of material, time, or energy, to study the business and to suggest plans for improvement. Many mills and stores have adopted the "merit system," whereby the employés are assured either of promotion or advancement in wages or salary for exceptional ability.

It is necessary that the sub-employer as well as the employer should be a born leader of men. He must be master in his department, not only in knowledge but in skill. He must be able to do any thing that any man under him is required to do. This is especially true of foremen. If the head of the shop, the mill, the composing-room, is a natural leader of men and is able to show, as well as to tell, the men what to do, the success of his department is assured. It is well said that workmen cannot be forced to do right or to produce their best; they must be influenced to do so, and only a good man can influence men for good. The foreman who is required to handle a large number of men of various temperaments, and who attempts to work them to their utmost capacity and bring the largest output without regard to the quality of the work or the manhood of the men, will fail. The best foreman knows that to achieve the best results, he must not lose sight of the rights or the happiness of the men. This applies as well to the superintendent, or manager, or the head of any department of any business establishment. It sometimes happens that clerks or operatives are sensitive to their surroundings, such as noise, temperature, light, and so on. The sub-employer who gives attention even to these details is of greater value to the capitalist than he who tries to save the firm's money by ignoring them.

Mr. Carnegie and His Employes

Andrew Carnegie's personal ideas of the responsibilities of an employer are summed up in the most practical manner in the following letter, written in March, 1901, after his retirement from active business, and addressed to the president and managers of the Carnegie Company:

Gentlemen—I make this first use of surplus wealth upon retiring from business as an acknowledgment of the deep debt which I owe to the workmen who have contributed so greatly to my success. I hope the cordial relations which exist between employers and employed throughout all the Carnegie Company works may never be disturbed; both employers and employed remembering what I said in my last speech to the men at Homestead: "Labor, capital, and business ability are the three legs of a three-legged stool; neither is first, neither is second; neither is third; there is no precedence, all being equally necessary. He who would sow discord among the three is an enemy of all." My cashier will hand over to you, upon your acceptance of the trust, $5,000,000 of the Carnegie Company bonds in trust for the following purposes:

The income of $1,000,000 to be spent in maintaining the libraries built by me in Braddock, Homestead, and Duquesne. I have been giving the interest of $250,000 to each of these libraries hitherto, and this will give a revenue of $50,000 hereafter for the three.

The income of the other $4,000,000 is to be applied:

First, to provide for employes of the Carnegie Company in all its works, mines, railways, shops, etc., injured in its services, and for those dependent upon such employes as are killed.

Second, to provide small pensions or aids to such employes as, after a long and creditable service, through exceptional circumstances need such help in their old age, and who make a good use of it.

Should these uses not require all the revenue and a surplus of $200,000 be left after ten years' operation, then for all over this workmen in mills other than the Carnegie Company in Allegheny county shall become eligible for participation in the fund, the mills nearest the works of the Carnegie Steel Company being first embraced.

This fund is not intended to be used as a substitute for what the company has been in the habit of doing in such cases. It is intended to go still further and give to the injured or their families or to the employes who are needy in old age through no fault of their own, some provision against want as long as needed, or until young children can become self-supporting.

Each superintendent will report to the president such cases in his department as he thinks worthy of aid from the fund, and the president will in turn report to the directors with his recommendation for action.

A report to be made at the end of each year giving account of the fund and its distribution, shall be published in two papers in Pittsburg, and copies posted freely at the several works that every employe may know what is being done. Publicity in this manner will, I am sure, have a beneficial effect.

Industrial and Business Education

The strenuous competition for the world's trade, stimulated to an unusual degree at the present time by the victories which we have been winning in the very strongholds of our warmest rivals, has led to much discussion of the best methods of reaching industrial supremacy in other fields. The wonderful feats of the bridge builders on the Atbara bridge and the Gotheik viaduct contracts, of the electrical companies on the Glasgow and London railway contracts, of the locomotive builders in equipping the express trains in France, in England, in Australia even, and the well-known position abroad of such products as the Rookwood pottery and the Tiffany glass, have brought leaders in other industries to ask, "Why may not we, too, as well, by educating the workmen, win as great victories? Have not our men the same capacity to develop skill, taste, and rapidity?" As a solution of this problem many manufacturers are advocating an education of the workmen in the scientific principles on which the industries are based and a broader training which shall give familiarity not in the single, narrow operations, but in the whole of the trade.

The facilities for industrial education in America have not kept pace with industrial progress. The system of apprenticeship by which efficient all-round machinists were formerly developed has practically disappeared. The vast majority of so-called machinists to-day are in reality machine attendants, being confined to the operation of some single piece of mechanism, and, in fact, little more than automatons. Such operatives may be easily found. But the enormous expansion of our manufacturing interests has occasioned an increasing demand for highly skilled artisans fitted to be foremen, superintendents and managers, and this demand is beyond the supply. A knowledge of fundamental scientific principles, as well as of the routine of shop-work, should be possessed by these men. Experience has shown that the graduates of the higher technical schools can not be depended upon for such positions. They lack knowledge of shop practice and traditions, and are often disinclined to make the temporary sacrifice of serving as underlings. Besides, such is the power of the labor unions, that these opportunities are not easily obtained. And, again, the demand for these young men is so great that their number is wholly inadequate for the purpose.

The graduates of the manual training schools are more available. But even among these lads there is a disinclination to the manual labor required at the outset. The manual school, of course, has taken a permanent place, and is everywhere expanding and increasing in usefulness. But it is not a trade school. The impulse for the establishment of manual training schools came from the Centennial Exposition, shortly after which was opened the first school devoted to the teaching of art in its application to to the industries. In 1884 the textile school was added. This branch of education has rapidly extended, mostly from the generosity of private citizens.

In Philadelphia are the Textile School and the Williamson School, and in New York are the Cooper Union and the Auchmuty Schools. There are also a few in other communities—merely a beginning, however, when the necessities of the case are considered. The Cooper Union has given instruction, in its forty years of existence, to about one hundred thousand persons in its night classes. Through the generosity of Andrew Carnegie, day-classes were added. But there is always an increasing demand for such instruction. In the case of the Williamson School, for instance, the applications exceed its capacity sixfold. Correspondence schools, developed since 1890, are a further proof of this demand. Their largest patronage comes from men employed in shops and factories. One school of this sort claims nearly half a million students, an increase of six hundred per cent in two years. In the night schools hundreds of young men are striving to get an education. In those of the Young Men's Christian Association alone 25,000 young men, including more than 4,000 mechanics, are securing instruction at a nominal charge. These, however, are mere auxiliaries to the regular trade schools.

The views of the employer on this question may be illustrated by the resolutions recently passed by the Pittsburg Foundrymen's Association, which were as follows:

> *Resolved,* That the foundry industry has arrived at a point where there is a demand for managers properly trained in the principles of scientific and commercial founding;
>
> That a representative body, such as the American Foundrymen's Association, be requested to draw the attention of the institutions of learning to this fact, and urge them to take the necessary steps to supply the demand.

Resolutions were passed, at a subsequent meeting of the American Foundrymen's Association, in favor of the establishment of special schools for teaching the science and art of founding.

Very evident is the gap in our educational system on the mechanical side. On the artistic side it is even more glaring. European countries completely outclass us in the application of the arts to the industries. Excepting in the carpet industry, almost all of our artistic designers are men of foreign birth and training. Our native workmen seem unable to compete with them in filling positions where artistic originality is demanded and artistic methods required. It is impossible to rely upon inspiration alone, however great the talent in the individual may be. Systematic instruction is indispensable as well.

In the matter of foreign competition, European nations, especially Germany, have for years been developing industrial schools in every little community. Great has been their reward. Much of our raw material is exported only to be manufactured abroad and sent back to us. In many other lines much of our importation is due to the lack of symmetrical industrial development here. There is no greater necessity, then, for our national welfare, than the spreading and fostering of industrial education.

In securing a business education there is a course midway between the office or shop, and the university. Reference is made to the business college. Great advances have been made in late years not only in the number but also in the methods of such institutions. They were formerly too theoretical. They are now quite practical. Not so much attention is paid to textbooks. Practical knowledge is given to the student in the ways of transacting business. There is in the business college a bank, with its officers and clerks, a jobbing house, a commission firm, and offices for the business of real estate and insurance. The student in his course of training must act as paying-teller, receiving-teller, discount clerk, shipping clerk, salesman, bookkeeper, and cashier. He buys and sells, makes deposits, draws checks, and goes through the regular forms of business transactions. He learns the methods of work in real estate and insurance offices. All this is made as thoroughly practical as possible, so that business men employing the young graduate may find him acquainted with business forms and customs. Thus the prejudice against business colleges has been removed. Some of the regular colleges of the country have fallen into line with the spirit of the times, and have opened what are virtually business schools. The increased complexities of industrial development, the specialization in many departments, making them truly scientific pursuits, the accumulations of capital devoted to specific enterprises, and the opening of stock issues to purchasers of moderate means—all this has caused a widespread and increasing demand for thorough technical training. Although not meant entirely to supplant apprenticeship in business, yet, by following these courses the graduate will be enabled greatly to shorten the probationary period, and will be fit for rapid promotion. Business is practical, but its principles are scientific, and may be studied. Men cannot take at once the larger leadership of the whole and the small oversight of details. They must be trained to see which are the large things to attend to, to understand organization, the division of labor, the opportunities which lie before them, and the selection of those for which they are best fitted.

In mercantile and financial business appear the twin tendencies of modern industry, which are toward extreme specialization for the average worker, on one hand, and toward increasing the advantage of the thoroughly equipped expert on the other. In either case, there is an imperative demand for careful and thorough training, both to meet the requirements of employers, and also to subserve the interests and facilitate the advancement of employés. In addition to colleges, an even larger field of usefulness, in business training as well as in numerous other industrial branches, is filled by the correspondence schools, which form a new, although evidently permanent, feature in American education. These institutions offer such facilities in instruction by correspondence with their students that the busiest worker can avail himself of the advantages they offer, in the way of increasing his knowledge in his own branch; thus adding to his chances of promotion and advanced salary. Their greatest work, however, is accomplished by affording opportunities for unskilled workers to raise themselves by their own efforts and industry, so that hitherto unprecedented opportunities are opened to the humblest toiler to make his first steps in the direction of success and ultimate prosperity. Thus it happens that in an industrial order, which constantly tends to force the worker into narrower fields of specialization, the opportunity to acquire the training for higher and better paid positions is constantly afforded.

Apprentices

There is a good deal of the dead letter about apprentice laws. In most of the States there are statutes upon the subject, but they are not enforced, and, in fact, have dropped into complete disuse. In States in which the sway of these laws would be of the greatest benefit, the regulations of the labor unions have interfered with their enforcement. The excuse alleged by the labor unions for this interference is that some employers hire boys, not for the purpose of teaching them a trade, but to supplant men and to cut wages. This course throws men out of work, while boys fill their places for less pay. The boys, it is stated, are not really taught trades, but are kept in narrow lines of work, the most profitable to the employer. The regulations of the unions, on the contrary, aim to give every boy in a shop the chance to obtain a real knowledge of the trade. They protect both the men and the boys. They prevent the premature transference of the boys from school to the shop, and also tend to afford real instruction to the boys instead of letting them be made use of by employers and taught little of their trade.

In this connection it may be proper to refer to the novel system of apprenticeship recently inaugurated in at least two great machine shops, for in both cases the system seems to have come out of the same need as the schools—the lack of a chance for apprentices to properly learn a trade. These establishments are the Baldwin Locomotive Works, of Philadelphia, and the machine shop of Brown & Sharpe, of Providence, Rhode Island. The system in use in the Baldwin Works is described in the following paragraphs, and the Brown & Sharpe Company follow substantially the same plan. The essential features are shop work, under the charge of a superintendent of apprentices, the employer agreeing to change the work of the apprentice so as to give familiarity with all the operations of the shop, and at the same time technical instruction in evening classes either in a school or by the correspondence method.

It was observed at the Baldwin Locomotive Works, where 12,000 men are employed, that the apprentice wanted something in the way of a certificate or diploma indicating his efficiency, just as college boys desire their "sheep skins." And he is entitled to it. It was seen that systematic education of apprentices was of absolute necessity, not only in the mere handicraft of the various processes, but in the acquiring of a certain amount of technical knowledge also. In the State of Pennsylvania the law forbids the employment of any boy under sixteen and over thirteen except when the parents obtain a permit from a magistrate. So that boys of this class, generally the sons of widows, are taken as messengers and kept along until they can be put to a trade. With this establishment there are three grades of apprentices. First, the boys of the masses, of ordinary education, who remain with the company four years. They are required to take one year's course in some night school, in elementary geometry and algebra. During the second and third years they must attend drawing-school, taking a two years' course, outside of the workshops. At the end of the four years a bonus is given to these boys, and their indenture is virtually a diploma. With the high-school boy, the preliminary course in elementary algebra and geometry is omitted, but he must attend for two years a night school for mechanical drawing, to perfect himself in this. From him only three years of service are required. He receives a bonus of $100, instead of the $125 given to his more unskilled companions. The third class is composed of university graduates. The apprentice in this class begins with the hardest work in the shop. He has plenty of technical knowledge, but he does not know how to use it. As he is a man, he can not be indentured. But a contract is made with him for two years, and he receives a small salary—thirteen cents per hour for the first year and sixteen cents per hour for the second year. He also receives a certificate when his term of service is finished. These latter positions have in all cases proved most beneficial to the holders, who are placed at once in more remunerative positions and are in the direct line for further promotion.

The young men who leave the concern at the end of their apprenticeship serve as an advertising medium for the establishment wherein they gained their expert knowledge. In those who remain, the concern has a body of men in its own workshops who are invaluable, and from whom the important positions are recruited. Thus, considered merely as an investment, the system is of great value to the establishment. The manufacturer imparts the commercial side of the business, in connection with the incidental technical training. The strictly technical education of the apprentices should be obtained outside, at the night schools, or otherwise, as has been remarked. As the average foreman is apt to keep a boy at a certain stage of work indefinitely, there ought to be a superintendent of apprentices, a man who will look after the apprentices, not only in the shop, but out of it, and see that they are not "held back" by the foreman, but are pushed ahead according to their capabilities and allowed to get all they can out of the course.

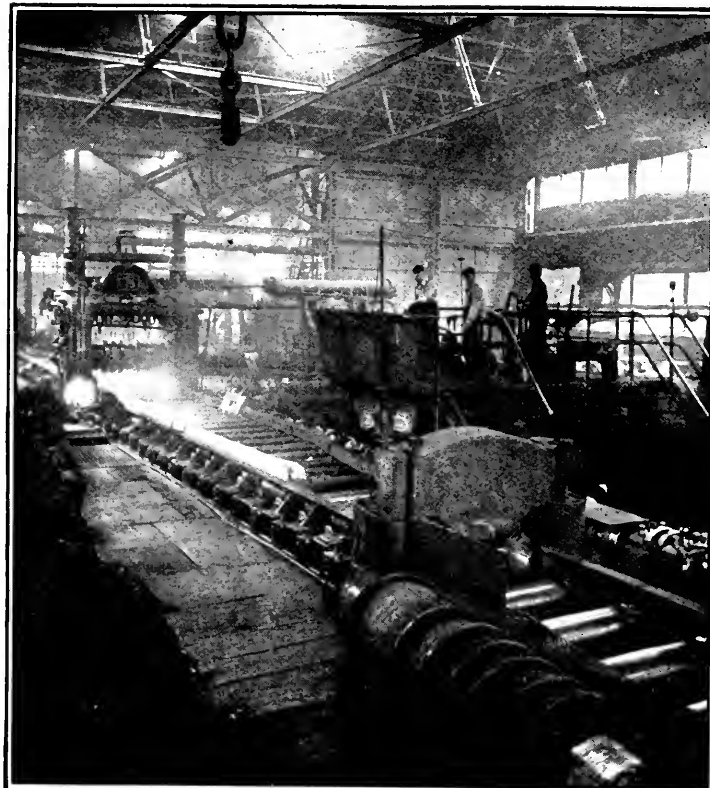
CHAPTER V

METAL INDUSTRIES AND TRADES

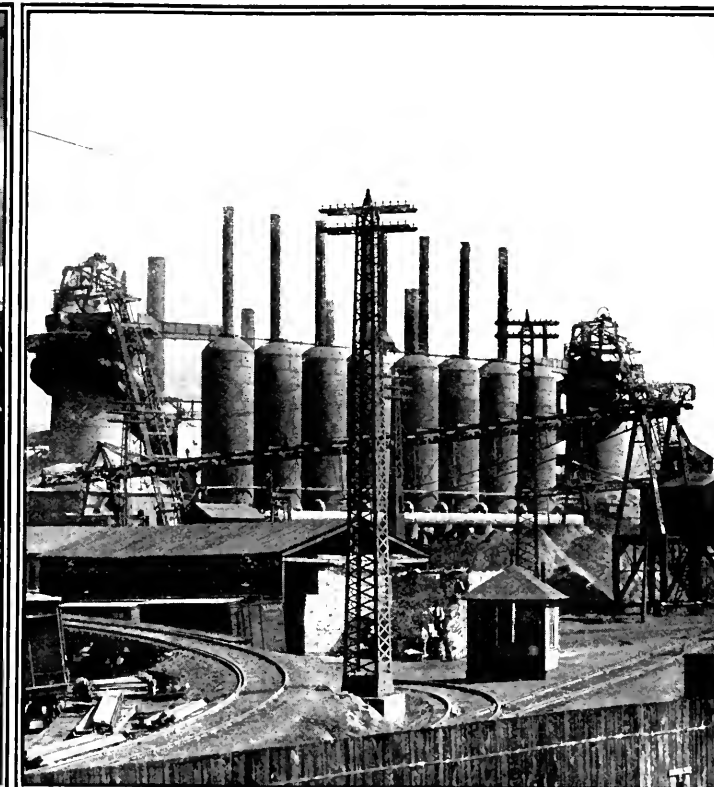
The Iron and Steel Industry—Pig Iron Manufacture—Bessemer Steel—Open-Hearth Steel—Gun Forgings—Armor Plate—Tin and Terne Plate—The Copper and Brass Manufacturing Industries—Aluminium—Iron, Steel, and Tin Workers—Sheet Metal Trades—Metal Polishers

THAT the American people hold the leading place among manufacturing nations is largely due to our success in the manipulation of metals, which, in its turn, depends upon our possession of almost fabulous wealth in natural mineral resources. The readiness of our men of action to avail themselves of every natural opportunity is nowhere more abundantly shown than in their celerity in putting these gifts of kind Mother Earth to practical use in advancing our industrial growth. In the field of American enterprise, metals and metal products so preponderate that they quite rise to some fifty great industries in which vast sums have been invested, myriads of wage-earners supported, and immense profits realized. In the matter of American iron and steel alone, so great a tide of prosperity has set in that the ingenuity of the statistician is overtaxed to render it adequate representation. The processes in treating iron ore in the great furnaces of the steel-making region give play for the skill of able chemists, for the ability of masterful managers and for the zeal of devoted workingmen.

In the great groups of manufacturing industries of the United States, iron and steel stand third, all other metals tenth, while the combination of the two branches places metals at the top of the list. This fact of the relative importance of the great groups of industries is determined, of course, by the value of their products. The figures in this case are: for iron and steel and their almost infinite variety of products, $1,790,000,000; for metals other than iron and steel and their products, $750,000,000; total for all metals and their products, $2,540,000,000. This sum is a quarter of a billion dollars in excess of the total value of food products, which form the second great group of manufactures. Iron and steel products include pig iron, iron and steel ingots, billets, rails, structural iron and steel, machinery, locomotives, tools, hardware, and an almost countless group of subsidiary products, mention of all of which falls within the scope of this work, and will be treated in separate chapters.



INTERIOR OF A LARGE STEEL MILL



BLAST FURNACES—CARNEGIE STEEL COMPANY

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The Iron and Steel Industry

Iron is unquestionably the basis of all manufacturing industry. So important has the iron and steel industry become that to-day it is looked upon as a barometer of trade and national progress. The production of steel, especially, has come to be considered the most accurate gauge of the position of a people in the scale of civilization. As far back as 1791, Alexander Hamilton, then Secretary of the Treasury, reported that "manufactures of iron constitute, in whole or in part, the implements or materials, or both, of almost every useful occupation."

The blast furnaces, rolling mills, steel works, forges, and bloomeries are reported to be in a state of activity unprecedented in the history of the country, and yet it is impossible to supply the demands for their products with a fair degree of promptness. The three forms of iron are pig or cast iron, wrought iron, and steel. Pig iron is made directly from the ore—mixed with fuel, limestone, oyster shells, etc.—in a blast furnace. It was named in honor of a humble animal, because of the shape of the mold into which it is run in its molten state from the furnace. The shape referred to is that of a litter of pigs suckling. Wrought iron is cast iron treated by the puddler in such a way as to make it weldable, ductile, fusible at high temperature, and susceptible of being bent as man wills. Steel is cast iron subjected to a furnace treatment of a kind which makes it capable of being bent without breaking, and yet stronger than wrought iron.

The Bessemer, open hearth, crucible and other processes of producing steel have made this metal so cheap that manufacturers constantly seek suggestions for applying it to some new use. Meanwhile it already enters into the being of a myriad things, from a watch-spring or a nail, to a battleship, an East River bridge or a modern "sky-scraper."

In the installation of machinery in all the rolling mills and steel works, decided advances have been made in the last decade, especially in labor-saving equipment, and in appliances for reducing labor cost. To manipulate masses of iron and steel of necessarily tremendous weight, special machinery had to be invented. Great hammers were made, large and strong enough to pound a fifty-ton armor plate or shafting into being. One of the largest hammers of the kind, capable of striking a 250-ton blow, may be seen at a shipyard in Quincy, Massachusetts, pounding away with a force which would crush the armor plate of the original "ironclad," the *Monitor*, to dust. In some mills the motive power is electricity, by which 10,000-pound weights are handled as easily as a porter handles a trunk. A boy can do the work, if necessary, the operation merely requiring the turning of a valve, whereupon a great crane, like the arm of a Colossus, picks up the five-ton ingot and sets it down in a car in which it is hauled, by a small locomotive, to the rolling mill. Here a second crane lifts the ingot out of the car and feeds it to the furnace. When it is heated to the required degree, the crane once more lifts out the iron mass and passes it on to the rolling machinery. Tables that work automatically now pull and shove this five-ton weight back and forth through the roll until it is reduced to the desired dimensions. It is next carried to the shears, which do their work by hydraulic power. Here the steel plate, which is perhaps two inches thick, is sheared as easily as cloth is cut by the tailor. It is then ready for shipment.

Coexistent with the wonderful growth of the iron and steel industry during the last thirty years, there has been a great reduction in the cost to consumers of all iron and steel products. This decrease in the price of finished materials can be traced directly to the advantages resulting, first, from the consolidation of iron and steel establishments; second, to installation of the latest labor-saving machinery; third, to the employment of highly skilled managers and workmen; and last and above all, to the constantly increasing demand for iron and steel products. Although the improved machinery has displaced thousands of workmen who would otherwise have been employed at blast furnaces in handling ore, coal, coke, and pig iron, still the number of wage-earners in the iron and steel industry is greater to-day by more than 50,000 than it was ten years ago. Of the 222,000 wage-earners employed at the blast furnaces, forges, bloomeries and mills, 183,000 earn their livelihood in the rolling mills and steel works; and among the latter are more than 1,000 women and nearly 2,000 children.

The following table shows the increase in the various classes of wage-earners in the iron and steel industry between 1890 and 1900:

		NUMBER OF WAGE EARNERS.			
	Year.	Total.	Men.	Woman.	Children, under 16 years.
Total	1900	222,607	219,635	1,071	1,901
	1890	171,181	168,943	58	2,180
Blast furnaces	1900	39,358	39,261	6	91
	1890	33,415	33,341	....	74
Rolling mills and steel work	1900	183,023	180,148	1,065	1,810
	1890	137,295	135,134	58	2,103
Forges and bloomeries	1900	226	226	....	....
	1890	471	468	....	....

The total production of all kinds of iron and steel products in the years mentioned was as follows:

	TONS
Products of blast furnaces	14,452,234
Products of rolling mills and steel works	15,040,129
Products of forges and bloomeries	15,497
Total	29,507,860

Pig Iron Manufacture

Pig iron is the name given to blocks of iron run out of a blast furnace into molds preparatory to working into steel, or for the various manufacturing industries. It is made, as previously stated, from the ore, mixed with limestone, dolomite, oyster shells and other substances, all the ingredients being melted together in the blast furnace, with the result that the pure molten metal is liberated. Pig iron is generally classified according to the variety of fuel used in firing the furnace; as, for example, bituminous iron made from pure bituminous coal, with coke, or with mixtures of bituminous coal and coke. Similarly, anthracite iron is made with pure anthracite coal, or with a mixture of hard coal and coke; charcoal iron is made from charcoal fires; and coke iron, from coke, or from coke and charcoal fires. It is also classified according to its destined purpose, as Bessemer, basic, foundry, forge, and other varieties of pig. The total production of all kinds of pig iron in 1900, including spiegeleisen, ferromanganese and blast-furnace castings, amounted to nearly 14,500,000 gross tons, valued at over $206,000,000; representing the output of 224 establishments in twenty-one States, employing nearly 30,000 wage-earners. Of this amount, Pennsylvania produced nearly 7,000,000 tons, or not quite one-half, at about fifty per cent of the total value. Ohio ranked second, with a little over one-fifth the amount and value, and Illinois third, with less than 1,500,000 tons. No other State reached 1,000,000 tons, while seven out of the twenty-one yielded only about 335,000 tons among them. Pennsylvania also ranked first in the number of wage-earners employed, claiming over forty per cent of the total number in the country and 43.5 per cent of the total of wages paid. In addition to the amount of foreign and domestic ores consumed in 1900, over 1,600,000 tons of waste materials from other industrial operations were used, including mill cinder, rolling mill scale and zinc residuum from the smelting of franklinite. The total pig iron production, being estimated at about fifty-seven per cent of the total, must have been about 1,000,000 tons. The total for all ores and waste materials consumed in the year is, therefore, nearly 27,000,000 tons. The average price per ton for all grades of pig iron, calculated on the returns from the entire country, was $14.29, the lowest average being $10.23 for Illinois, and the highest, nearly $18.00 for Massachusetts. Of the various grades of pig iron, the following are the more important: Bessemer pig iron, containing below 0.10 per cent of phosphorus; low phosphorus pig, less than 0.04 per cent of phosphorus; foundry pig, containing three or four per cent of carbon, 1.50 to 3 per cent of silicon, 0.50 to 1 per cent of phosphorus, and from 0.20 to 1.50 per cent of manganese; forge or mill iron, which is largely purified; white and mottled pig, having widely varying composition, and used both for puddling furnace and foundry; ferrosilicon, containing from 10 to 20 per cent silicon; spiegeleisen, containing from 9 to 21 per cent of manganese; and ferromanganese, containing from 45 to 82 per cent manganese. The three latter varieties are used extensively in the manufacture of steel. In the production of Bessemer and basic pig iron Pennsylvania ranked first in 1900, with nearly 55 per cent of the total output for the former and over 71 per cent of the latter. It also claims over 24 per cent of the foundry iron; about 42 per cent of the forge iron; 24 per cent of the white, mottled and miscellaneous grades; 28 per cent of the ferrosilicon; nearly 46 per cent of the spiegeleisen; about 61 per cent of the direct castings, and practically all the ferromanganese. Ohio ranked second in the production of Bessemer and basic pig iron and first in point of ferrosilicon (53 per cent), while Illinois ranked third in the production of Bessemer and second with spiegeleisen. Alabama was fourth in point of total quantities of all varieties of pig iron, producing nearly four times the total output of the State following on the list.

Curiously enough, while the total production of all grades of pig iron had increased in 1900 nearly one hundred per cent on the figures for 1890—being 14,500,000 tons as against 8,800,000—the number of blast furnaces in the country had decreased from 681 to 399. This loss, however, was due mostly to the fact that numerous furnaces reported in 1890 were still in existence, although inactive, while more modern plants, in various parts of the Union, represented the actual working centres. By 1900 most of these had been abandoned and dismantled. The number of wage-earners in pig iron manufacture was somewhat over 33,000 in 1890 and over 39,000 in 1900, although the total output had so increased in the latter year as to give an average of about 367 tons per worker as against 265 tons per worker in 1890.

Late in 1901, according to government reports, a furnace at Rankin, Pennsylvania, operated by the Carnegie Steel Company, made in twenty-four hours 790 tons of Bessemer pig iron. This was considered a phenomenal production, and until that time had never been equalled by any blast furnace in the world. This record, however, which it was thought could not be surpassed, was eclipsed on December 10, 1901, by a furnace of the National Steel Company at Youngstown, Ohio, which produced that day 806 tons of Bessemer pig iron. This record was again beaten by a Carnegie furnace at Bessemer, Pennsylvania, which produced in a single day, in June, 1902, 901 gross tons of pig iron.

Bessemer Steel

Steel is the name applied to a number of alloys of iron, with other metals and elements, principally carbon, silicon and manganese; the general physical properties depending most largely on the varying percentages of carbon, which is the substance causing the hardening and tempering of the several varieties. The term steel is also given to certain alloys of iron, which, principally from their carbon percentage, are neither cast nor wrought iron of any grades. The varieties of steel are distinguished according to the degree of carbonization, as hard, or ingot, steel, medium and mild steel; each of which differs from the others in its suitability for certain purposes, in the facility of welding, forging and tempering, and in its ability to endure given strains or stresses. As to manufacture, two varieties of steel are distinguished—Bessemer and open-hearth; each of them having its own advantages in point of producing certain desired grades and properties in the finished product.

Briefly described, the Bessemer process consists in melting pig iron in a cupola, or shaft furnace, and running it into a pear-shaped reservoir, known as a "converter." Through the bottom of the converter air is blown under high pressure, being caused to rise through the molten mass, and thus burning out part of the carbon contained in alloy. Theoretically speaking, this process, if continued, should result in the elimination of all the carbon: practically, the process may be so regulated as to produce any desired quality of steel. Since the operation of eliminating the carbon and silicon frequently demands other things than regulation of the air-supply, it is customary to add to the molten mass certain definite quantities of spiegeleisen, a variety of white cast iron containing known percentages of carbon, manganese and ferromanganese. The effect of the manganese is to liberate the oxygen injected with the air blast. The converter is then tipped on trunnions and the steel run into molds for future working. Since the introduction of the Bessemer process in the United States in 1867 it has been used principally in the manufacture of steel rails, the percentage of the product devoted to this industry in 1890 being 51 per cent of the whole. At that time there were 51 Bessemer steel plants in the country, located in Massachusetts, New York, Pennsylvania, Virginia, West Virginia, Ohio, Illinois, Indiana, Michigan, Missouri and Colorado. Since 1880 there have been four varieties of the original process introduced in the United States; namely, the Clapp-Griffiths and the Tropenas, from England, and the Robert-Bessemer and Walrand-Legenisel from France. In all of these the decarbonization and desiliconization of the molten metal is conducted on the same general principles, the prominent differences being in the construction and capacity of the converters and in the manner of blowing the air through or across the metal. Thus the Tropenas process is mostly used in the manufacture of steel castings. In 1900 the Clapp-Griffiths process, introduced here in 1884, and counting six establishments in 1890, with a total output of over 69,000 tons, had been practically abandoned; the Robert-Bessemer process, numbering five plants in 1890, with a total output of castings of over 4,000 tons, had only one plant, with two converters and a total output of 2,300 tons; the Walrand-Legenisel process as conducted for two years (1895-97) was discontinued; while the Tropenas process numbered five establishments, with a total output of 897 tons. All of these improvements share the objections made to the original Bessemer process, that the molten mass is not uniformly affected by the passage of air through it, thus yielding various qualities in the same batch of steel.

Open-Hearth Steel

The open-hearth process of steel manufacture consists in melting pig iron and steel scrap, or other highly refined material, in a shallow furnace, where the molten material has a broad surface exposed to passing currents of air and gases, which serve to burn out the contained carbon, with the result that a much more uniform mixture may be obtained than by passing air currents through a deep converter filled with molten metal. The reduction of the carbon can also be more accurately adjusted to any desired percentage, and the batch can constantly be tested by removing samples on a ladle. The pig iron and scrap is usually melted by fire from natural or artificial gas, and is dipped from the furnace, to be run into ingots or castings, by a ladle, by which also desired quantities of spiegeleisen or ferromanganese may be added. There are two general types of furnace, distinguished as acid and basic; in the former the slag contains forty-five per cent and upward of silica, in the latter, less than twenty per cent.

The open-hearth process was first introduced in the United States in 1868, but was abandoned after about two years of experimental work, although producing a considerable quantity of steel. The difficulty was that the steel could be rolled only at an extremely high temperature. In 1869-70 a second furnace was erected at South Boston, Mass., where a high quality of product was produced from the start. The product was first used for steel heads on iron rails, showing perfect capacity for welding with the iron. Later, it was rolled into plates for use in boilers and fire boxes. During 1871-72 furnaces were erected at Nashua, N. H., and Pittsburg, Pa., the former producing quantities of forgings for marine and railroad, the latter, mild steel plates for boilers and fire boxes. This marked the beginning of the great industry in America, which has steadily increased to the present day. In 1900 reports showed that over seventy per cent of the steel manufactured in the United States was made by the basic process, while the average capacity of the furnaces had increased from twenty to thirty tons at a heat in 1890, to between fifty and seventy-five tons. In the same year also the total product by both acid and basic processes amounted to something over 3,000,000 tons, an increase of 700 per cent over 1890, the average value per ton being $23.60, representing a total value of over $7,000,000,000, for the whole United States.

Gun Forgings

The construction of heavy guns involves a multitude of details of interest. Those turned out at the Watervliet Arsenal, where is located the biggest single shop building in the United States (140 acres in area), are known as the built-up, forged steel type. They are composed of a main inner tube which constitutes the wall of the bore, extending from breech to muzzle, superposed by a jacket and forged steel hoops, varying in number with the size and type of the gun. In the make-up of the modern 12-inch breech-loading steel rifle cannon is a main inner tube, a jacket and nine steel hoops, and the trunnion band. The main tube is surrounded at the breech by the jacket and two rows of hoops. Toward the muzzle of the gun the number of hoops diminishes to one. The big steel jacket, weighing 35,000 pounds, is expanded by being inclosed in an iron cylinder which is placed in a fire-brick furnace, and kept there for about thirty hours, at a temperature of about 700 degrees Fahrenheit. When the jacket is expanded to exactly the required diameter it is raised by a huge crane and lowered over the tube to the exact position indicated, a most delicate operation. The tube and jacket remain in the "shrinkage pit" under a stream of cold water for about fifty hours. They are then removed, placed in a lathe and turned down to receive the hoops, which are heated and shrunk on in the same manner, only now the gun is horizontal. The various hoops are hooked together by the shoulders to prevent displacement. Then comes the slow and delicate process of rifling. The breech mechanism is then attached and the gun is finished.

The casting and forging of the part of the gun called, in steel-master's parlance, the "tube," is intrusted to contractors, and by the time it is assembled at the arsenal it has earned many American dollars for many American workmen. The gun casting is of open-hearth steel. The molten metal is drawn from a travelling tank, and thence into the mold. At last the mold is full; but the gases must be expelled from the metal. So the steel-master puts it into a hydraulic press, where, by a mighty pressure from below, the ingot is made homogeneous and all the impurities are brought to the two ends of the casting, which, as soon as the mass cools, are cut off. By means of wondrous machinery the steel-master next bores a hole through the ingot, just where the bore of the gun will be. The casting is now made ready for forging, by bringing it to a high temperature. This forging takes place in another hydraulic press by a kind of kneading process. Through the bore the workman runs a round steel bar or mandrel, and is thus pressed out to a larger diameter and a decreased thickness. When the casting has been squeezed to the correct size, it is again heated, then tempered in a bath of oil, then heated once more, this time in a wood furnace, for annealing. When it is again cool the forging is complete.

The tube of a sixteen-inch gun is in eleven sections, and each section is forged in the manner just described. These eleven parts weigh forty-two tons, and are carried from the furnace to the arsenal in three specially constructed freight cars. More than two years are required to make one of these sixteen-inch guns. For a gun of half the bore, an "eight-inch," seven months are necessary; for a ten-inch gun, ten months; and for a twelve-inch gun, a year and a quarter.

A few facts may be given in reference to the work done by these huge guns. In the first place they are not good for more than 500 shots. With the exception of the new monitor sixteen-inch gun, the largest of our great coast-defence guns used by the army is 32 feet in length and weighs 127,680 pounds. This gun can hurl a steel projectile of 1,000 pounds weight a distance of ten miles. To do this it demands a charge of 480 pounds of powder, producing at explosion a pressure of 32,000 pounds to the square inch. The projectile is made of the finest forged steel. It leaves the gun at a velocity of 2,100 feet per second, and would pass entirely through a battleship at a range of four miles. At eight miles a steel shell filled with eighty pounds of high explosives would do incalculable injury upon striking a ship. It is an entire misconception of the truth to imagine that these great guns are not accurate in their aim. On the contrary so very accurate are they that a good gunner can send successive projectiles through the same identical hole made by the first ball, at a range of about two miles. While much depends upon "the man behind the gun," yet the gun itself is true and sure. These guns are generally mounted upon the United States disappearing carriage, which holds the world's record for speed of firing, or about forty rounds per hour. After firing the gun instantly disappears behind the emplacement for reloading.

Turning to another instrument of destruction, we find that the twelve-inch breechloading steel mortar fires a shell weighing from 1,000 to 1,200 pounds, containing from 80 to 100 pounds of the most powerful explosive. This is called the deck-piercing shell. The mortar's range is about six miles. It requires for each charge 108 pounds of powder, and is very accurate. These coast-defence guns are superior to ships for purposes of defence, although, of course, battleships are indispensable for offensive purposes.

Armor Plate

American steel-masters are now even supplying armor plate for foreign navies. The profit on armor plate is placed as high as twenty-three per cent. The large profits are justified on the grounds, first, that an immense outlay of money is necessary in order to build an armor plant; second, that the business is not continuous; third, that the manufacturer must stand the risk and the loss of rejection. The specifications under which armor plate is made for the United States Government are more severe than those prescribed by any foreign government. Moreover, when tests of armor plate are made by the government the separate pieces are not tested, but the whole lot is accepted or rejected according to the results of two shots; hence if the plate fails to stand the test the loss is great.

The production of steel armor plate and gun forgings, reported by the census for 1900 amounted to 15,302 tons, valued at $7,526,479. The total production was reported by the State of Pennsylvania. Homogeneous steel armor plate was first made in the United States in 1890, at Bethlehem, Pa. In 1891 steel armor plate was also produced at Pittsburg, Pa. American armor plate, which enjoys a world-wide reputation for its many points of excellence, is now manufactured by immense hydraulic presses, at least one of which has an energy of 15,000 tons. A few years ago the plates were formed into shape by heavy rolls or were forged under hammers. The thickness of the plate varies from 3 to 18 inches for Harvey armor and from 3 to 12 inches for Krupp armor. The dimensions of the heaviest plate ever made in this country, which was used on the port turret of the warship *Wisconsin*, of the United States Navy, are as follows: Finished weight, 112,586 pounds; length, 249½ inches; width, 135 inches; thickness, 14 inches. This plate was made in 1898 at South Bethlehem, Pa. During the same year a barbette plate for the warship *Alabama* was produced at the same place. It weighed 104,340 pounds, was 15 inches thick, 239 inches long, and 104¾ inches wide. The heaviest side armor plate ever made in the United States was produced at Pittsburg, Pa., in 1895, and weighed, when finished, 97,520 pounds. It was used on the United States warship *Oregon*. This plate was 255 inches long, 90 inches wide, and 18 inches thick.

Tin and Terne Plate

Tin and terne plate manufacture in the United States is a comparatively new industry, a development of the last decade of the nineteenth century. Tin plates are thin sheets of iron or steel which have been coated by being dipped in molten tin. They are used chiefly in the making of household utensils and cans for preserving food products. Terne plates also are sheets of iron or steel, coated in a bath containing an alloy of tin and lead, instead of in molten tin alone. Terne plates are often called roofing plates, as they are used chiefly, if not wholly, for roofing purposes. Black plates are the iron or steel sheets from which tin and terne plates are made. Many of the mills which manufacture tin or terne plates also operate rolling mills equipped for the production of black plates, thus combining in one establishment two great industries, namely: the tin and terne dipping industry, and the black plate industry. Both of these branches of manufacture promise to become of great importance and magnitude. Though their growth has been confined to a single decade, they are included to-day among the most vigorous and progressive branches of the iron and steel industry. As new uses are discovered and developed, year by year, the demand for these products will increase. A number of new black plate and tin dipping plants have been built in the United States in recent years, and with the increase of the productive capacity of such plants, tin and terne plates will become important features of our export trade. Indeed, the exports of these products in 1901 amounted to 1,360,000 pounds valued at $66,500. As an illustration of the wonderful growth of this industry in the United States, it should be added that the total production of plates in 1890 was less than 3,000,000 pounds, while in 1900 it amounted to nearly 850,000,000 pounds.

In the manufacture of tin plate at the present day two important facts are to be considered: first, that steel plates are almost universally used; second, that most of the work is performed by machinery, electricity being the usual motive power. At the introduction of the industry in 1873 iron plates were exclusively used; whence the terms "coke" and "charcoal" plate, formerly indicative of the quality of the iron, but now referring merely to the thickness of the coating, since the thicker deposit of terne was put upon the better quality of iron plate. At present, the practical distinctions are between the Bessemer and the Siemens, or open-hearth, steel plates. The steel intended for tinning is first formed into billets, which are first rolled into bars, and then into black plates. For this purpose, the billets are subjected to welding heat, after which they are rolled on grooved rolls into long flat bars, 6, 7, 8, 10 or 12 inches wide, and from three-eighths inch to one inch thick, according to requirements; sections then being cut off about the width of plate to be rolled out. After several alternate rollings and heatings, generally four, in course of which several thicknesses of plate are superpassed in the press, the "packs" are rolled out to the required size, the several layers, generally eight, composing each one, being then separated and trimmed. After separation the plates are carried by an electric travelling crane to the pickling-room, where a number of them are placed in a cradle and immersed in a heated bath of dilute sulphuric acid, a specially-arranged machine alternately raising and lowering the cradle, so as to cause the acid to rush between the plates, clearing them of all scale and oxide formed during heating and rolling. The pickling bath is followed by another in pure water, by which all traces of acid are washed away, leaving the plates bright and clean. They are then packed in cast or wrought-iron pans and heated to red heat in the first annealing furnace, and, after cooling, are cold rolled between three successive pairs of rollers; plates with turned or pinched edges being ejected after each rolling by an attendant operating a hand lever. To finally prepare them for tinning, they are again "pickled," washed, annealed and rolled; unclean spots are scoured with sand and hemp; and the entire batch is placed in a wheeled trough of perfectly clean water, until the tinman is ready to work them.

There are two distinct processes of tinning, the "acid" and the "palm oil," the former being the most recent and also the most usual. In the oil process the batch of plates is boiled in palm oil for about 20 minutes, thus evaporating all water and acid that may adhere to their surfaces, and are then placed in a pot containing melted tin and lead—this is called "terne"—and having a layer of oil floating upon it. After a brief immersion in this pot, they are removed to a second, also containing molten metal, where they soak for some time; being then laid upon the "bob," or receiving table, where they are cooled and cleansed with hemp to remove all dross, preparatory to the third potting in extra pure metal. In the acid process a single metal pot is used, which, however, is divided into two compartments, one having a very thin layer of muriate of zinc on the surface of the metal, the other of oil. Rollers inside the pot draw the plate through the flux of zinc muriate on the one side and pass them up through the oil on the other, the thickness of tin layer depending upon the speed at which the rollers move and their relative adjustment, and not upon repeated dippings in molten metal, as in the oil process. After tinning the plates are passed through the branning, dusting and polishing machines, which remove all oil by treating the surface with bran or middlings. The various machines used in the process are driven by separate electric motors, which produce particularly effective operation in the doubling and slitting shears, as well as in the travelling cranes, each of which has three motors, and are useful in saving the labor of men whose only duty was to carry the plates from one department to another.

Copper and Brass Manufacturing Industries

A great increase in the uses of copper during the last ten years has been a marked feature of this industry. Within the time mentioned the uses of copper have been quadrupled, one of the chief causes being the great demand for copper wires for the constantly increasing number of street railways in all parts of the country. New uses for copper have also been found in the manufacture of electrical apparatus and supplies. So vast are our home supplies of raw copper that American manufacturers are able not only to supply the domestic demand for all kinds of articles, but to send great quantities of manufactured copper abroad. The production of this metal in the

United States in 1899 was the largest in the history of the industry—270,000 tons. The smelting and refining of copper forms practically two distinct branches of work, each being conducted by independent plants, although the products of the smelters are largely sold to the refineries as raw material.

The brass manufacturing industries in this country were built up by the metal-button business, which led to brass making on a large scale.

The States lying between Butte, Montana, and the Naugatuck Valley in Connecticut, represent the distance between the principal copper mining centre and the chief brass rolling centre of the United States. To the valley of the Naugatuck every year is brought over 50,000 tons of copper, or about one-sixth of all the copper produced in the United States. Spelter also is used in the manufacture of brass; and the railroads bring hundreds of carloads of spelter to Connecticut, from Missouri and Kansas, the bases of supply for this metal. In the Naugatuck district is made three-fourths of all the rolled brass manufactured in the United States. An interesting additional fact is that nearly all the brass mills operating in other States than Connecticut, were built and are conducted by men who once worked or lived in the Naugatuck Valley. It seems that the continuous manufacture of articles in this alloy, employing the young men of the valley through successive generations at the same work, has created a race of brass-workers whose skill as a body is not equalled elsewhere. Skill in mixing, rolling, and manipulating brass has been transmitted from father to son, until the removal of the brass mills to another State would deprive a large percentage of the men of the valley of a livelihood. The corporations carrying on the great manufacturing industry in this locality are constantly increasing their plants, thus putting them on a more permanent basis and indicating that the establishments are there to stay.

Any one who visits the valley can learn the general labor conditions there without asking a question. Each town is an open book, telling of thrift and prosperity, and the cottages of the workingmen are its pages. As an example of the work required of a rollerman, here is one making what is called an eyelet metal. It must be rolled to a width of six inches, and in gauge it must not vary one two-thousandth of an inch. With the aid of a micrometer, which registers infinitesimal fractions, the rollerman makes his eyelet metal meet requirements. The skilled worker in brass can find ready employment in any of the brass-making towns in Connecticut, and there also the novice can learn the trade.

Brass foundries, where articles of cast brass are manufactured, constitute another important branch of the brass and copper industry. The principal foundries are in Bridgeport, Cincinnati, Baltimore, New York, Boston, Erie, Pennsylvania, and Dayton, Ohio.

Closely allied to brass-rolling is copper-rolling, though not nearly so much skill is required of workmen in copper. The principal copper mills are in Michigan, New York, Massachusetts, New Jersey, Pennsylvania, and

Illinois. The principal product of the mills, besides rolled brass, is brass and copper wire, for the latter of which telegraph, telephone, and electric light companies furnish an ever-increasing market. Most of the brass mills remanufacture their product, and some turn out sheet copper in addition to work in brass.

Aluminium

This metal has done much to keep the famous America's Cup safe in our country. The deck-beams and fittings of several American Cup yachts were of this metal. In a great deal of marine work it is supplanting wood, being used for the construction of torpedo boats in several European navies. The commercial use of aluminium became possible only after the development of the electric furnace. Its manufacture may yet be vastly profitable. The manufacture of aluminium for use in the arts began in the United States in 1883. Since then the uses found for this metal have constantly increased. The price of it has been so lowered by improved methods of production that it can now be employed for many purposes, from which it was formerly excluded by its excessive cost. The production increased from eighty-three pounds in 1883 to about six million pounds in 1900, and the price per pound has been reduced from sixteen dollars to thirty-two cents. It was at first claimed that aluminium was to replace nearly all the other metals for manufacturing and building purposes, and many costly efforts have been made to employ it in uses for which it is entirely unfit. There are many ways in which it can be advantageously used, especially, for example, in the manufacture of culinary utensils. The demand is increasing for these, as they have all the advantages of copper utensils, are much lighter, are less affected by the air, and are better conductors of heat. Aluminium kettles and pans produce no poisonous salts or oxides when used in the cooking of vegetables, and they are easily kept bright and clean. Aluminium may eventually take the place of brass in railroad cars for fittings and trimmings. It is both cheaper and lighter than brass. The military authorities are experimenting in the use of aluminium in the manufacture of articles for the infantry. Its availability for horse-shoes, as well as nails and tacks, is also being tested. Considerable success has rewarded these efforts. There is a long list of articles made of aluminium. Among these may be mentioned hairpins, thimbles, ferrules, and ornamental bands for canes and umbrellas, combs, backs for brushes, mirror frames, and many other toilet and fancy articles. As aluminium can be rolled into very thin sheets and then beaten out into leaf, it is taking the place of silver leaf in decorating. With the further reduction probable in its price, aluminium will find many other uses.

Iron, Steel, and Tin Workers

The majority of iron, steel, and tin workers are members of the Amalgamated Association, the union of the workers mentioned. Founded in 1876, in Pittsburg, this association was designed to render uniform the work, conditions, and earnings of those who became its members. This was made difficult in the first place by the location of plants, some of which were in places where fuel, transportation, labor, and other items of producing cost were more favorable to the owners than in other places. Another obstacle was the difference in productive capacity, it being conceded by all interested that a large output of manufactured commodities was decidedly advantageous to the workmen, by facility of operation, and to the manufacturer by ability to control the market through securing large orders which the smaller producer could not cover in a restricted term. As employés in this industry work by the ton, the above conditions resulted in such disparities of daily earnings that dissatisfaction arose and complaints proceeded from both sides, necessitating conventions of the men and conferences with the manufacturers, eventuating in the following agreement: When improved machinery is introduced, or new methods of operation are employed, which shall reduce the work of the men and increase the output of the mill, there shall be a reconstruction of the wage scale. As these scales are annual contracts, the conservatism of the association is evidenced by the provision just recited, and the progressiveness of the American mill worker is differentiated from the tardiness or reluctance of the foreign workman, who always makes a grievance of an attempt to introduce invention, improvement, and specialization.

A review of the conditions prevailing in the iron, steel, and tin plate trades shows an interesting feature of the comparative results of immigration. These trades employ skilled labor, immigrating workmen in this field coming from Western Europe. Much more serious is the effect upon unskilled trades of the immigration from southern and eastern Europe. The machinists coming from Great Britain or Sweden are generally already members of unions, and naturally enter the unions here. It is said that the iron, steel, and tin workers have been badly affected by evasions of the alien contract-labor laws, most of the immigrants in these fields coming from Belgium and Alsace-Lorraine, a considerable reduction of wages having been thus brought about. Immigration has certainly had one effect on the iron and steel industry. It has caused an increase of output. The old restrictions imposed by the unions limited the amount of work which a team of men should be permitted to do in eight hours. But the immigrants would not endure this restriction, and, by their influence, the output has been doubled in seven years. But as regards the skilled workman of the iron and steel trades the introduction of new machinery is vastly more serious. By this means low-grade labor has been largely introduced from southern and eastern Europe. The general growth of the industry has, up to the present time, been so rapid that, although skilled workmen are proportionally smaller in numbers, yet their absolute number is increasing, and they have thus been able to maintain the standard of earning, in spite of immigrants and new machinery.

Sheet Metal Trades

In the several trades summed under the general head of sheet-metal working—this includes tinsmithing, coppersmithing, aluminium, sheet iron, and architectural metal working, each with its peculiar processes and principles—there is an increasing demand for skilled and well-equipped labor, to fill the ever-enlarging and varying fields into which the industry is being extended. To the present time, also, it is curiously true that, despite their increasing industrial significance, none of these trades is over-crowded; while in all of them the rate of wages is high.

In addition to the common productions in tin and copper for household and industrial utensils, sheet metal is becoming increasingly popular for architectural purposes—cornices, ornaments, skylights, even building fronts —in many cases taking the place of woodwork. This is particularly true in the case of cornices, which are frequently made of galvanized iron or copper, for the primary purpose of combining structural durability with such lightness as will not render the wall topheavy. The framing for skylights is now generally made of sheet metal, shaped into form, rather than with metal castings or with wood. The manifold forms of ventilators, chimney tops, air and heat conduits are other applications of the sheet metal worker's skill to building purposes.

The up-to-date workman in all these crafts must have such superior knowledge of the general principles of his calling as shall enable him, not only to cut and shape the various products required in his work, but also to draft the patterns, upon which the several parts are to be appropriately shaped. This branch of the work often requires considerable thought and study, as well as long and complicated calculations; as, for example, in making some vessel of new or peculiar shape, such as a copper sphere, or one in which a definite cubic capacity must be combined with a required contour. In cornice work, also, there is a wide field for the expert, who knows, not only how to fit and piece the sections of a machine-made cornice, but, equally well, to deal with the numerous constructional problems involved; such things as no machine can ever be devised to do.

The practical metal worker is frequently required to make pipes or flues of certain capacities, or for the conduction of particular liquids and gases, which work requires some little mathematical facility in calculating proportions, etc., also, a thoroughly practical knowledge of the properties of metals and the action of various fluids upon them. Adequate mathematical knowledge is also demanded in the manufacture of vessels of new and peculiar shapes; here again setting a premium upon a high degree of technical training in the practical worker. Briefly, there are few industrial callings in which the duties of the trained craftsman can be more readily and profitably combined with those of the draughtsman, engineer, mathematician, and other technical experts. Naturally these desirable qualifications are not always imparted during apprenticeship, or even by years of practical experience, which fact furnishes a telling argument for the usefulness of the modern school of correspondence, in which busy workers and apprentices may gain full instruction in all desirable branches, with the least possible expenditure of money and time. As may be readily learned in many a shop and factory, the graduates of these institutions frequently hold the highest positions and command the highest pay.

Metal Polishers

Metal polishers who have reached the age of forty often look like old men. There can hardly be found a trade more deleterious to health, say those who follow it. Among the harmful conditions may be mentioned the liability of the workmen to get their lungs full of flying and impalpable dust which is composed of metal, minerals and cotton fibre. They are also, in many cases, deprived of the proper supply of light, and great injury to the eyes thus arises. It is not easy to wear goggles or glasses, as the operator's sight must be of the keenest, in order to detect blemishes.

There are laws for the protection of this class of workmen, but they are too seldom employed. New York statutes require that at each polishing lathe there shall be an exhaust fan to carry off the dust, that each operative shall have two hundred and fifty square feet of air to breathe, and plenty of light. It has been claimed that not in five per cent of the shops do these desirable provisions prevail. A buffing-wheel, making 2,500 revolutions per minute, has wrecked many constitutions. From it, as the polisher applies the metal, a cloud of dust arises, made of particles of cloth and metal, and that is what the operator breathes. Generally the windows are hermetically sealed. Often the walls and floors are covered with the accumulation of years. In the process of brightening silver plated material there is given forth by the wheel a cloud of dust of which crocus is a large constituent, while from the plating-room come fumes of nitric acid. In the process of polishing chandeliers there is much dust set free, which is composed of particles of brass, and permeates the air of the shop. Metal polishers often do not care to complain, because their wages are high. Here is a good field for activity among the factory inspectors, who should force employers to maintain proper conditions in the shops.

CHAPTER VI

MACHINERY, TOOLS, AND THE MACHINE TRADES

Machine Work *vs.* Hand Work—Metal-Working Machinery—Pneumatic Tools and Appliances—Motive Power Appliances: Steam Engines and Boilers—Steam Turbines—Gas Engines—Turbine Water Wheels—Machine Shop Practice—Training for the Machine Trades—Machine Shop Employés—Foundrywork, Blacksmithing, and Forging—Pattern Makers

TO THE superiority of American mechanical invention belongs the credit of having advanced our people to the front rank among the manufacturing nations. In the stress of modern competition, victory in the contest for supremacy in the mechanic arts depends, not upon the artisan, but upon the superior quality of the tool which the successful competitor happens to be using. Thus a manufacturing machine of the latest improved type puts under the control of the American workman not merely a tool or combination of tools, of the highest excellence, but seems literally to give him an increased number of hands, correspondingly enhancing the power and efficiency which he is able to bring to his daily toil. The machine is virtually at the foundation of our great factory system. This is true to such an extent that in this volume most of the descriptions of the leading manufacturing industries treat, at the same time, of the machinery in use in each branch.

The making of machinery for use in manufacturing has itself developed into a leading industry. The typical product of American enterprise may be said to be labor-saving machinery. The success in attaining the end designed may be noted in the increased speed with which an article can be turned out, even five hundred times as fast as before, and in some cases much more rapidly.

Machine Work *vs.* Hand Work

The chief interest in machinery manufacture lies in the story of the wonderful achievements of the machines thus produced. One giant pair of tongs, operated by machinery, can lift a ten-wheel locomotive as if it were a toy. Another weight-lifting machine swings a ponderous bridge-beam into place. Still another hoists tons of rocks up a mountain side as easily as a man would pull up so many pebbles in his dinner pail. Then here is the wonderful lifting magnet. Do you remember the little horseshoe magnet you owned as a boy? It lifted a tack or a shoe-button—how proud you were! This great magnet of commerce is simply that little horseshoe of

yours enlarged to a size by which tons of iron bars and steel plates are lifted and carried from place to place in the great iron works. This great magnet loads a train with steel, two tons at a time, or lifts a cargo of steel out of a ship.

Further achievements of modern manufacturing machinery may be understood by a few comparisons drawn from several trades. In the hand manufacture of matches a thoroughly competent workman can cut, on an average, 1,000 sticks per hour, or 8,000 in a working day, which is sufficient for about 150 pocket boxes of ordinary size. The match-making machine can cut and dip 17,000,000 matches per day, a number sufficient to fill 300,-000 boxes, which represents a ratio of about 6,400 to 3 as between the output of machine and hand. Stripped pine logs are fed direct to this machine, which gives them a rotative movement; while cutting a continuous shaving, or veneer, from circumference to centre. These strips are again cut, by properly disposed knives, into splints of the required length and thickness of a match—the entire work being accomplished at the rate already mentioned.

The simple and efficient brick-making machine will mold and cut 30,000 bricks in a day of ten hours, as against the average of 3,000 formerly produced by a skilled hand workman in the same time. The mechanical candle-dipper can turn out 7,000 complete candles, as against the average record of 1,000 for a skilled chandler dipping by hand. In this machine about 100 molds are connected to a trough filled with melted wax composition, which is poured in as required, wick lengths being automatically drawn into each mold from reels. By machinery, also, paper-covered cigarettes can be filled and rolled at the rate of 500 per minute, giving an average of 30,000 per hour and 240,000 in a day of eight hours, as against the best hand-work record of 150 per hour or 1,200 per day. This represents a ratio of 200 to 1. This machine cuts the paper roll into leaves of the required size, measures the exact amount of tobacco for each cigarette, rolls and gums every one perfectly, and all entirely automatically.

Similarly, any one of the several varieties of mechanical "typesetters" can in a given time do the work of six expert hand compositors, producing, also, perfectly spaced lines, as is difficult with hand work. Such machines are, therefore, largely used, particularly in the composition of magazines and papers, the slugs being able to endure "long runs," thus saving the cost of electrotyping or stereotyping. The hand manufacture of nails formerly furnished occupation for hosts of people, who could produce them at the rate of 200 or 300 per hour at greatest, earning thereby scarcely sufficient money for necessities. Now, by mechanical devices, at least 60,000 nails, either steel-wire or cut, can be produced in an hour, which gives an average of nearly 500,000 per day, greatly reducing the cost of this necessary article.

Turning from the realm of manufacture to that of travel, we have similarly large comparative figures. By modern means of locomotion, railroads, automobiles, steamships, the greatest average speed of a human being, fifty miles per day of ten hours, has been increased by at least 400 to 600 per cent by modern improvements. Supposing that one could move around the world at the average rate of fifty miles per day, he would complete the journey in about 480 days, which figure is reduced to seventy days with the use of modern means of land travel, which, in fact, can also compensate the lower speed average of water-borne traffic. Thus it appears that the size of the world is virtually reduced for human travel, as the ratio of 7 to 48.

In a thousand other ways, in hundreds of industries—in agriculture and mining, as well as in manufacturing and transportation—machinery has wrought marvellous changes.

Metal-Working Machinery

Distinct types of tools and machinery are manufactured for working metals, forming a separate group of manufactures. As here used, the term metal-working machinery is meant to embrace power-operated machines for working metals in the forms of bars, rods, wire, plates, and sheets or castings. The list of machines in this class includes many types and kinds—from "trip" hammers to pneumatic hand tools. In machine tools, especially, very decided progress has been made for more than a decade. Some of the older shops in which machine tools are made still produce all the different kinds of tools required to equip a new shop. The trend of manufacture, however, has long been toward specialization, so that now nearly all the newer shops produce only one particular type or class of tool. In some establishments engine lathes, only, are made. In others, planers or milling machines are a specialty. Cincinnati has more shops devoted exclusively to special metal-working machinery than any other city in the Union. Philadelphia, Providence and Hartford are the next largest centres; only in the last-named cities the industry is diversified, while in Cincinnati it is highly specialized. The object of specialization has been to make more efficient, rather than cheaper, machine tools. It is understood, however, that the greater the tool's efficiency the more economical it is. The differentiation of processes in various industries have from time to time made necessary special machines, each to perform a single operation. In the bicycle industry, for example, the chainless wheel called for a machine to cut small bevel gears with rapidity as well as with accuracy and economy. The Twelfth Census report gives the following as the significant features of recent progress in machine tools and machine shop practice:

1. The automatic and semi-automatic principles have been extended to new and larger classes of work than before.
2. The forming tool has become a recognized shop appliance.
3. The "oil-tube drill" has been developed from an exceptional to a regularly used tool.
4. Compressed-air portable tools have been developed substantially *de novo.*
5. The application of the power press has been greatly extended.
6. Electrical driving has come into general use.

7. The system of heavy portable machine tools in conjunction with a massive iron floor-plate has been originated.
8. The grinding machine has been largely increased in size, power, and extent of use.
9. The development of travelling cranes.
10. The origin of high-speed steels for cutting tools.

Pneumatic Tools and Appliances

It is possible here to discuss only one or two of the lines of development mentioned in the above list. The most interesting, perhaps, are the pneumatic tools, which are justly regarded as the most important development in the tool branch of machine industry. These include the pneumatic hammer now indispensable not only in the machine shop and in stonecutting, but also in shipbuilding and in the erection of steel-frame buildings. Among compressed-air tools, the wonderful rotary drill is most important.

There is a steady tendency in nearly every important branch of industry to the use of automatic, or self-driving, tools, appliances and machines. The most important application of this independent motor principle in machine-shop work is found in the automatic "magazine-feed" turret lathe, which rapidly machines and finishes castings and drop forgings entirely by power, as well as removing the completed parts and inserting new, rough castings. Another important development is the multiple spindle lathe, which so reduces the cost of work as to allow the making of brass screws and other small articles, with no other compensation than the chips and shavings cut off in the process. Automatic forming tools, as recently perfected, enable the rapid production of heavy metal pressings, such as bicycle hubs, while, by the use of the oil tube drill, having a constant supply of oil fed during its operation, by means of a tube or channel leading to its point, deep drilling, as in gun barrels, hollow spindles, and various machine parts may be easily and rapidly accomplished, without danger of overheating. Power presses, for punching the disks of laminated dynamo armatures, and other patterns, have permitted a degree of exactitude and rapidity of work impossible by any other means. The electric motor has furnished nearly the most important element in the development of automatic shop tools and small machines, enabling the transmission of power without the use of heavy and cumbersome line shafting, belts and pulleys. Motors are attached either to each individual tool, or else to a group of tools, driving them all through a special line shaft. The individual-motor tool is, however, increasing in use and importance. Thus, the many departments of an establishment may be supplied with power from a single plant, while, without the use of heavy machinery, the separate tools and machines may be situated at considerable distances apart. The separate motor principle has found its most conspicuous application in the development of the electric travelling crane, which is already a highly important adjunct in a variety of industries, such as steel-making, shipbuilding, tin-plate manufacture, bridge-building, etc.

The separate-motor tool reaches nearly the highest point in the development of combined lightness and efficiency in the already numerous pneumatic appliances used in shipbuilding, steel-construction work for bridges and office structures; in boiler-making, in stonecutting and drilling, and in a large number of other industrial uses. These machines, which are as fully efficient as and much lighter than any electrical appliances, have been developed almost entirely within the last decade. Among the most remarkable applications of compressed-air power in tools is the pneumatic hammer, very much resembling a clumsy pistol in appearance, which can strike from 800 to 1,500 blows per minute, and can be so exactly regulated as to vary the force of the blow between a sledge and a tack hammer. Its greatest use is found in riveting boiler plates or structural iron work, it being able to drive home and head a rivet of one and one-half inches in diameter in about five seconds, as against three minutes required by two expert hand riveters with heavy hammers. Several makes of pneumatic hand tools are so constructed as to allow a hammer, saw, chisel or other tool to be fitted into a common stock, and to perform a given piece of work many times more rapidly than the most experienced workman with hand tools. Similarly efficient are the pneumatic drills, used for boring iron and steel plates, or in larger sizes for rock drilling. In the latter field they have already demonstrated their superiority for both speed and efficiency to even the steam drill. For propelling all such appliances and apparatus the air is carried in flexible tubes from the reservoir or compressor, so that they may be moved from place to place almost as readily as the less efficient hand drill, saw, or hammer, while almost as readily handled and separated by the workman. This renders their efficient use possible on lofty steel structures one hundred feet and more above the ground. Among other applications of the wonderful power of compressed air is the paint spraying machine, which, by atomizing a quantity of paint held in a reservoir near the nozzle, can distribute it evenly over a wall or other surface, ensuring the penetration of cracks and crevices much more thoroughly than is possible with brush work. Cleaning is another eminent field of usefulness, as yet applied principally to carpets and upholstery, but showing a much wider range of possibilities. Air at a pressure of from eighty to one hundred pounds pressure per square inch is driven through a small hose terminating in a metal nozzle, with a very fine slit just under its extreme end. This nozzle, passed rapidly over the fabric to be cleaned, can completely remove all dust and dirt to the minutest particle. This method is now used by many carpet cleaning establishments.

Toolmaking is a distinct branch of machine-shop work, involving a wide knowledge of shop appliances, their construction and operation, also an understanding of their possibilities and limitations. This knowledge gives particular aptitude for performance of the operations necessary in the tool-room, rendering the practical toolmaker, in fact, the highest exponent of the machine trade.

Motive Power Appliances—Steam Engines and Boilers

By the term motive power appliances, as here used, is meant all kinds of devices for the generation of power; or, in technical terms, "the common types of primary powers." These include principally steam boilers, all forms of steam and gas engines, and all kinds of water wheels, including the turbine. In these manufactures nearly 1,200 establishments are engaged, the total annual value of their products reaching the enormous sum of $172,000,000. Pennsylvania, as might be expected, leads in this industry with 159 establishments and a yearly product valued at nearly $41,000,000.

As for steam boilers, improvements are constantly being made in structural details and design. Water-tube boilers are in special favor, as a result of their proved efficiency. The vertical tube style is used in the larger installations of blast furnaces and steel works. Mechanical stokers are used wherever possible, because they save fuel, fire more evenly, and accomplish more thorough combustion of coal; also because of city ordinances calling for smokeless fires. Another device adopted by the steam plants in connection with the great central electric light stations, street railway power houses and great industrial plants is the "mechanical conveyor" for the handling of enormous quantities of coal and ashes. In every large plant, in fact, attention is given more and more to improvements even in the smallest details, always with a view to economizing space, labor, time or money.

In steam engines of all kinds the same progress has been made, in late years, as in steam boilers, the compound engine, in particular, being now in popular use. Prof. R. H. Thurston, in a paper presented before the American Society of Mechanical Engineers, thus summarized the present position of the steam engine:

> The end of the nineteenth century was that of one which will always remain preeminent in history as the age in which the steam engine took shape in the hands of Watt and Sickles, and Corliss and Greene, of Porter, and their successors, and thus brought in the factory system and all our modern methods, of production, in the improvement of the condition of the people, and in all the material advancement in the industrial arts, which made the century distinctively one of supremacy of the mechanic. arts. The close of the century found the steam engine, though threatened with displacement by other motors, in the view of many writers, nevertheless the great motor of the age. Substantially all of the power employed by the civilized world is supplied by this great invention—congeries of inventions, rather—the product of a series of improvements, of an evolution effected during the hundred years or more just past. The limit to be possibly attained in its development and perfection will always remain a subject of intense interest.

Steam Turbines

Another wonderful invention, to which an entire volume might be profitably devoted, is that of the steam turbine. This "primary motive power," which has proven commercially practical, is said to form the most important advance step in steam engineering of the nineteenth century. A description of all the advantages of the turbine would prove interesting.

It is possible here to state only that one of these advantages lies in economy of space "as compared with the reciprocating engine." The largest steam turbine in the United States, in the power house of an electric light company, at Hartford, Conn., occupies, with the generator to which it is directly connected, a floor space of only 33 feet by 8 feet. It is of 3,000 horsepower and weighs 28,000 pounds. Another advantage is that friction is reduced to the minimum, and vibration so far neutralized that the simplest foundations will suffice, making it safe to place turbines even on the upper floors of a factory. This remarkable appliance is largely used to drive electrical generators, pumps, and ventilating fans. Its use is even more general abroad, especially in Germany and England. The largest turbines in the world are those of the London (England) Electric Traction Company, "embracing four units of 10,000 horsepower each." In England, also, the turbine has been successfully applied to the propulsion of ships. The results obtained have been eminently satisfactory, or, it would be better to say, remarkable, particularly in the matter of speed. The "Turbinia," the first vessel thus equipped, attained a speed of thirty-four knots. The "Viper," a torpedo-boat destroyer, made thirty-six knots. Altogether, the attention of inventors of three great countries is centred on the turbine for suggestions in the development of a more efficient form of motor than has yet been tried.

Gas Engines

One of the most significant improvements of modern times is to be found in the internal combustion motor, or gas engine, which, within the short period of twenty years as a practical producer of power, has come to the front in nearly every branch of industry, except railroading. This form of power generator is variously known as internal-combustion, or explosive, motor, from the fact that the driving energy is derived from the sudden combustion or explosion of an inflammable gas behind the piston. This gas, which may be the ordinary illuminant taken from the street mains, the carbonated vapor of gasoline or alcohol, or the spray of kerosene, is properly mixed with air and introduced into the cylinder, being there greatly compressed by the instroke of the piston and exploded in any one of several ways.

The early types of Otto engine, run by illuminating gas and ignited by a naked flame, could, on account of several obvious deficiencies in construction and operation, develop only a tithe of the speed and power now realized with the high-speed, high-compression engines, ignited by hot tube or electric spark. Taking these facts as typical of the improvements made in the last ten years we can readily understand that the maximum of thirty-five horsepower, realized by an engine at the Columbian Exposition in 1893, has been raised as high as one thousand horsepower, which is the average output of the great motor exhibited at Paris in 1900. Undoubtedly one of the most important factors in the development of this type of heat engine has been the growth of the motor vehicle industry, based on the inventions of Daimler and others, making possible the use of gas and spray from oil, gasoline and other oils and mineral spirits. Such motors are also coming into more general use for yachts, and even vessels of larger size.

As demonstrated by the experiments of numerous authorities, the power efficiency of an internal-combustion engine is about twice that of a steam engine, even under the most favorable circumstances; for, whereas about seventy per cent of the heat of combustion is realized in the steam, and about ten per cent as power, eighty per cent of the heat is realized by exploding the gas in an internal-combustion cylinder, with nearly twenty per cent turned into power. Also, in using such engines to drive the blowers of blast furnaces, as is being done with increasing frequency, the explosive gas being supplied from the furnace itself, it has been found that one brake horsepower per hour may be realized with the consumption of between 105 and 110 cubic feet of gas, as against an average of 400 cubic feet for the same output, with the best steam engines. A further advantage found in the use of gas engines is that their superior compactness and smaller weight—doing away altogether with cumbrous boilers and troublesome furnaces—renders them available for almost every condition in which a power plant is required.

Turbine Water Wheels

The development of the various manufacturing industries in the United States has led to a wide use of turbine water wheels, which, as a consequence, have been greatly improved in design and efficiency. Among important innovations may be mentioned the practice of using horizontal wheels, to the almost complete exclusion of the original vertical type. These are also designed to operate under much higher heads of water than were formerly considered feasible, also attaining a greater power of efficiency, with a larger number of revolutions. Among the advantages derived from the horizontal design are the possibility of direct connection, instead of the use of bevel gears to change the direction of motion: thus several wheels may be "connected up," according to the demands for increased power. The wheel may also be placed above the higher level of the water in the tailrace, where all connections are readily accessible for examination and repairs, and a draught tube may be used for carrying away the tail water. A further advantage is involved in the latter construction; since the pressure of the water, emerging from the turbine into the draught tube, is practically equal to that of the same flow of water above it, with a consequent saving in efficiency. The adaptation of turbine wheels to the requirements of operating under a high head of water, varying from 100 to 1,200 feet, has produced interesting and important improvements in the type known as "impact," "tangential," or "jet" wheel, which operate on the principle of the impact of a small but powerful jet against a series of buckets on the periphery of a small wheel. The design and construction of wheels of this type have been greatly modified, for the purpose of securing higher efficiency in the arrangement of the buckets, and neutralizing troublesome eddy currents. They are largely used in the far West, where high heads of water are the rule.

Machine Shop Practice

Closely allied with every branch of present day manufacturing in factory and mill are the foundries and machine shops producing those marvels of machinery that have made possible the great development of American manufactures and commerce. For, as previously inferred, it is due to our superiority in machinery, perhaps, more than to any other one thing—unless it be the adaptability of the American workmen to the use of speed machinery—that we are able to produce so many classes of manufactured goods, at smaller cost than our foreign competitors, although paying much higher wages.

The positive necessity of some degree of technical, or theoretical, knowledge in the practical machinist is no better exemplified than in operating such devices as the milling machine. It is not sufficient that an all-around machinist can successfully run this machine in the production of some certain class of work, since that fact involves no surety that he can set or adjust it, to the requirements of other lines. Thus many expert machinists are, in fact, only a part of the machines they tend, having no knowledge of such processes, for example, as indexing and spiral work, and no ability to make the necessary calculations required to properly adjust the machine for such purposes. Furthermore, in the work of assembling and erecting machinery, the machinist must exercise a degree of ingenuity and judgment that can be derived only from a long and varied experience, or else, from thorough and conscientious study in the lines of his calling. In these particulars, the exigencies of modern machine shop practice are rapidly bringing the standard of the skilled craftsman nearer to that of the technical graduate.

One machinery manufacturer refers to the restrictions placed upon his workmen's output by their union:

> Our shop is what would be called a union shop, although there are some departments where non-union men are employed. We believe in keeping in close touch with our employés and in maintaining friendly relations with the union. We have found the heads of the unions as a rule to be very fair, honest men, who are quite willing to look at our side of a question as well as at their own. We believe in paying a large wage, and the only thing about which we are at odds with the union is when they propose to lessen the output. When this proposition is made we consider it a great wrong not only to ourselves but to labor and a proposition which must always and under every circumstance be fought.

Training for the Machine Trades

The educational system of the country is incomplete in the training given to youth for the machine trades. At the same time, experts declare that the future of the United States will depend largely on the mechanical training of its young men, and that consequently, when our youth have left their schools, there should be a well-defined system of training provided in all trades and industries. The old system of indenture should be revived and improved, in order to meet the needs of the various grades of boys seeking places. The grammar school boy should receive more attention than those who have had more schooling. The time he has lost at school will be more than made up by his better knowledge of shop practice. Indentures should ensure a regular and uniform progress in the methods of the desired trade, machinist's, boiler-maker's, blacksmith's, or other. There are some claims that the numerous manual training schools of the country are sufficient, and that they are well adapted to the education and training of a class of skilled workmen. But it is a fact that these schools are lamentably behind the times in all that touches the various trades as practiced in America. To be a successful teacher in this branch of education it is necessary to be in constant contact with the practical work of the workshops, and to have at command all the latest improvements in the way of labor-saving appliances and perfected methods of operation, so that the student, at graduation, may be abreast of the times, and equipped for practical work. But here arises the financial difficulty, causing regrettable deficiency in the matter of machinery and appliances in the workshops connected with many of our educational institutions. The money thus spent would be better used in providing for a thorough teaching of algebra, geometry, mensuration, mechanical drawing, higher mathematics, and the chemistry of metals. If the workshops of the nation were organized as manual training schools, these schools would turn out young men not only trained from a mechanical point of view, but so thoroughly trained on the commercial side of the profession as to make them a financial as well as a mechanical success.

Most manufacturers prefer a grammar-school or high-school boy to a graduate of a training school, if they can have the mechanical education of such boys themselves. Hardly any educational establishment in the country offers any encouragement to young men in learning the trades of blacksmith, boiler-maker, or molder. Yet these trades offer a most desirable future for our youth, and in them the financial as well as the professional reward seems the greatest. Manufacturers feel that their businesses will prosper if handed down to competent workmen and managers educated in their own establishments.

Machine Shop Employes

The working conditions in machine shops have rendered necessary such extreme degrees of specialization that it is frequently difficult for a practical machinist to master every branch of his trade. The old system by which a man was bound apprentice in one shop, and, after learning the necessary rudiments, became a "journeyman," going from place to place, in search of wider and more various experience, is now largely supplanted by the system necessarily involved, both by the immense number and variety of appliances and the practice of devoting whole establishments to the manufacture of some special article. Consequently, an expert in some one line or other may be quite ignorant of the methods and processes of other lines, and, even in course of acquiring his proficiency must depend, to a large extent, on his own efforts; the foreman, of necessity, being otherwise engaged. To be sure, a man thus trained may be a good worker, and enjoy such advantages as come from the peculiar knowledge he possesses, but, unless by his own efforts and ambition he extends the sphere of his knowledge by working in a variety of shops, or takes some specially-prepared course of reading or study, such as is offered by several of the leading correspondence schools of the country, he cannot hope to qualify as an all-around machinist or be fully capable of filling the position of foreman or superintendent in any important shop or establishment.

In no line of work more than in that of the machine shop is the happy, though rare, combination of practical and theoretical knowledge more desirable. A man taking position as superintendent or foreman, whether he be a graduate of some technical school, or one promoted from the practical work of the shop, is largely handicapped by the inevitable limitations of his knowledge; the former, by the fact that his acquaintance with underlying theories is largely unmixed with practical experience; the latter, by the fact that his eminently practical experience is hopelessly specialized, with little or no knowledge of principles or practices outside of his own sphere. In either case, the marked unfitness of the applicant for the position is apparent. It seems, therefore, very nearly a necessity that a man of either class should supplement the deficiencies of his present knowledge by some thorough course of study or observation.

Foundrywork, Blacksmithing, and Forging

Foundrywork, or founding, including the work of molders, coremakers, cupolamen, etc., has within recent years taken a proper place as a division of manufacturing. Scientific, modern and practical methods have supplanted the old guesswork and rule of thumb methods. As a result the best positions in these trades are occupied by those who are not content with the methods learned years ago but who seek to keep well informed concerning the latest methods. The "founder" who now earns the highest wages is one who not only can produce molds from patterns, and from part patterns and sweeps, but who can do this work scientifically, and by the newest approved methods. This is true as well of such work as the production of dry sand or core molds and of loam molds, the founding and casting of metals, the mixing of iron and the arrangement and handling of cupola, coremaking and brass founding. Foundry workers should ever study the best modern practice and latest information concerning the details of coremaking; mixtures; the founding, arrangement, dying and handling of cores; the scientific running of cupolas; the mixing of iron by analysis. The three principal divisions of molding for iron casting are green-sand, dry-sand, and loam molding, and the best paid foundry workers are those who have a technical as well as practical knowledge of processes in these divisions.

In blacksmithing and forging, the workers who hold the most lucrative positions are those who have acquired a technical training. These workers understand physical and other characteristics of iron and steel; they possess expert knowledge of shop equipment, fire, fuel, forges, best methods of producing the blast, the handling of auxiliary and fire tools, heating and its effects; the most difficult forging, such as rod straps and rocker arm with cranks; the different classes of welds; the working of tool steel, which includes annealing, hardening, and tempering; forging machines, including hammers, presses, and bulldozers, and the various forms of furnaces; riveting and a knowledge of the weight of irons and metals; and finally, soldering, brazing, sweating, and the bending of copper and brass tubing.

There used to be a touch of mystery about the hardening and tempering of steel. There was formerly much talk about colors, dull red, straw, cherry red, etc. The work was done in a dimly-lighted shop so that the gradations and shades of color might the better be distinguished. The picturesque blacksmith of former days never could exactly explain his processes. He worked by intuition or guess, and he was not an adept at teaching his knack to others. A figure of the past is this old blacksmith. Exact methods have supplanted his guesswork. Science has stepped in and regulated appliances, and conditions, and processes. The furnace can be kept at any required degree of heat, and the pyrometre gives a constant record of the temperature for the guidance of the artisan. Results may now be reduplicated indefinitely. The accidental destruction of costly dies has been eliminated. The tempering of steel has, in fact, become an exact science.

In the practical work of blacksmithing a wide variety of facts and processes is necessarily included, much of it quite outside the sphere of common trade experience, on account of the universal present-day tendency to specialization. A fully-equipped worker at this calling, however, must be thoroughly capable of forging any required article in iron or steel, and also, of making any form of weld. It frequently happens that he is called upon to work in steel in the making of similarly various objects, which necessitates an understanding of the several classes of steel; the processes by which they are produced, and the methods of tempering and case-hardening. In the matter of tempering, also, certain physical facts come into use; such as the "temper colors" and the several degrees of temperature corresponding to them. These are nearly the only sure indicants that the desired temper has been obtained. In addition to the necessary practical—frequently peculiarly technical—knowledge of metals and their properties, the blacksmith must of course understand the object and use of the large variety of tools at his disposal, involving a commensurate skill in readily producing the numerous objects of iron work that he may be called on to furnish.

Pattern Makers

Pattern-making is an important branch of foundry work; having to do with preparing models for the molds. Patterns are usually made of wood, although, on rare occasions, also of metal or plaster. The pattern-maker must, therefore, be an experienced wood-worker; thoroughly capable of producing the various required shapes, and knowing when and how to piece together such patterns as cannot be made whole. There are, of course, a variety of methods in use for making each separate type of pattern; some of the more difficult constructions, such as core boxes, being produced in a variety of ways.

The pattern-making trade is one that comes into close relationship with that of the iron molder and the machinist, the product of the foundry and machine shop representing largely the handiwork of the pattern-maker, as the pattern-maker first shapes the product or article of wood, and which is after molded and cast by the molder and finished by the machinist. It is a trade that requires a high grade of skill, a fair mathematical education, and a natural inclination to mechanics. A competent pattern-maker must be able to read and understand thoroughly mechanical drawings, and oftentimes act as draughtsman also. As a result of the high grade of skill required, the craft enjoys somewhat better conditions than the general run of trades, the average of wages being about three dollars per day, and ranging as high as four dollars, the best wages and conditions being in localities where their organization has a foothold.

The representative organization of the pattern-makers is the Pattern-Maker's League, which has the same aims and objects as other trade unions, namely, to secure the best conditions possible in wages and hours, to elevate the standard of manhood, citizenship, and mechanical ability of its membership, and to protect them from any injustice at the hands of the employing class. It looks with favor upon the tendency toward the settlement of all disputes between capital and labor by arbitration and conciliation, believing that the organization of labor is purely a business proposition, as much so as that of any organization of capital, and that it is only the part of common sense to take up all differences, as one business organization should with another, and adjust them with due consideration to the rights of each. The organization is necessarily small numerically, as the proportion of the trade to that of kindred trades, the molders, for instance, is about one in ten. All told there are not more than six or seven thousand pattern-makers in the United States, of which about one-half are members of the league; of the other half a large percentage are scattered among the smaller cities and towns of the country in insufficient numbers to form local unions.

CHAPTER VII

SPECIAL MACHINE SHOP AND FOUNDRY PRODUCTS

Agricultural Machinery and Implements—Operatives in Farm Machinery Mills—Manufacture of Sewing Machines—Development of Sewing Machines—Manufacture of Typewriting Machines—Development of Typewriting Machines—Manufacture of Firearms—Safes and Vaults

Agricultural Machinery and Implements

IN NO department of American life or industry has machinery worked greater changes than in the field of agriculture. It has reduced almost to an incredible extent the amount of human labor required to produce a given quantity of crops or to cultivate given areas of land. Nearly all of this is the result of the great variety of new implements and wonderful machines that have come from the foundries and shops of the makers of agricultural machinery. In 1637 there were but thirty-seven plows in the whole colony of Massachusetts Bay. To-day we have sulky plows, gang plows, plows combined with harrow cultivators and seed drills, side-hill plows, vineyard plows, beet plows, subsoil plows, double landslide plows, and finally, what seems to be the end of plow invention, we have the steam gang plow, combined with a seeder and harrow. The plow is, of course, but one of the many wonderful implements which the manufacturer has devised. Corn planters, cultivators, and harrows in great variety, corn harvesters, huskers, and shellers, seeders, and, more wonderful than all, the combined reaper and thrasher, which, driven across the field of standing wheat, leaves the grain ready for delivery to the elevator or the mill. One of the agricultural implement establishments (the largest in the world) making various kinds of mowers, reapers, harvesters, etc., turns out 190,000 agricultural machines and implements a year, or an average of one in less than a minute for every working day in the year.

Next to water and sunshine, the greatest blessing enjoyed by the farmer of to-day is machinery. With the aid of modern agricultural machinery and implements, farming is no longer a matter of "the man with the hoe." Just as in photography we merely "press the button," so the farmer now simply presses a lever of this or that machine, and lo! his field is plowed, harrowed, sown, and the crop is reaped, bound, harvested, while he sits on a comfortable seat and drives and guides.

It is natural that the manufacture of farm implements should localize near the centre of agriculture, especially near the grain-producing section. Chicago, therefore, is pre-eminent in this industry, not only on account of its proximity to the grain fields, but also to the superior transportation facilities which have made it a great distributing centre. The establishments in this metropolis of the Great Lakes region turn out twenty-five per cent of all the farm machinery used in the United States.

One harvester firm in Chicago claims ownership of the largest plant of the kind in the world. It comprises eighty-five acres. Nine thousand persons are employed at the home plant, and, in addition, twelve thousand local agents are employed throughout the country. Two thousand clerks, accountants, and travelling men are required to look after the details of the business.

In agricultural machinery works, special machinery is used in manufacturing all the machines and implements. Automatic nut and bolt machines turn out thousands of bolts and nuts every day; molding machines are used for all gray metal castings, so that three hundred tons of metal per day can be poured; special machinery for manufacturing wheels and various other special machines make possible an output of over twelve hundred complete machines a day. In fact, almost all the work, except the assembling of parts, is done by special machinery designed for each particular branch of work.

Altogether the invention, development, and marketing of modern farm machinery comprises a distinct and vastly important industry. There are 715 establishments engaged, but, as in other manufacturing fields, the bulk of the output comes from a few great plants. The value of all the farm machinery and implements now in use on the farms of the country is at least half a billion dollars. Millions of dollars' worth of farming machinery are purchased every year in Fargo, Dakota, alone, this town being the trade centre of the great Northwest wheat country.

The leading State in the manufacture of all forms of farm implements is Illinois. One-third of all the wheeled cultivators manufactured in the United States in 1902 was made in Illinois. Of the total number of harrows produced in this country, Illinois makes one-half; of the whole number of plows, Illinois turns out one-fourth; of all the harvesters, combined harvesters and binders, three-fourths were made in Illinois.

Operatives in Farm Machinery Mills

A great number of different trades and occupations are included in the manufacture of the variety of products in this industry. A large establishment producing agricultural implements is really divided into a number of shops or factories, where perfectly distinct trades are carried on. There is the foundry, where the iron parts of the machine are cast, and the men working therein are foundry men, rather than makers of agricultural implements. There are carpenter shops, where the wooden parts are made and shaped by carpenters, who call themselves by this term and no other.

There are also machine shops, paint shops, etc., where the artisans employed are machinists or mechanics, or painters and varnishers, none of whom can be classed separately as implement makers. This industry is, indeed, very closely allied to foundry and machine shop work as well as to the group of manufactures that includes dairy machinery, farm vehicles, windmills, incubators, etc.

The measures for the betterment of the conditions surrounding the workers in the McCormick Harvesting Works are described by an official of the company, thus:

> We are seeking at every opportunity to reduce the chance of accident to our employés, and whenever an accident occurs, whether arising through the negligence of the employé or from other cause, we immediately devise some means of preventing a repetition of the accident, and of protecting the employé against his own negligence. Also a medical department with a physician and assistant in attendance. An emergency hospital where all cases of accident can receive immediate attention. A private ambulance for use in case of more serious accidents, and connected with the various hospitals of the city, where all such cases are taken and given proper attention, all at the expense of the company. We also have a department that keeps a record of all accidents occurring, and that follows up the injured and his family to see if they are in need, and to give them relief when investigation discloses the fact that such relief is justifiable.
>
> Our twine mill is provided with private sanitary lockers for all its employés. It has two parlors for the use of the girl employés, furnished with a piano with pianola attachment.
>
> We also have arrangements with the Public Library, whereby a daily delivery of books is made to the employés. There are two dining-rooms connected with the mill that supply daily lunches to about 250 of the girl, and 50 of the male, employés. The food is wholesome and supplied at a cost of from 7 to 11 cents per lunch, consisting of soup, two kinds of meat, potatoes, pastry, milk, tea, and coffee. A social club has been organized among the girl employés. We have a musical organization which gives operatic performances, the chorus being chosen from among those employés showing sufficient musical ability to ensure success. Lectures are given at intervals without cost to the employés. We also give an annual picnic, the first of which was held in the summer of 1901. Over 7,000 persons attended this outing, transportation being supplied by special trains at the company's expense.

Manufacture of Sewing Machines

Were some one to write a new "Song of the Shirt," the theme would not be the "Stitch, stitch, stitch" of needle and thread in the human hand. The song would describe the "Stitch, stitch, stitch" of a machine, hundreds of stitches a minute. In over eight hundred factories, to-day, 33,000 operators are engaged in stitching shirts to the song of the sewing machine. It is not only in the homes of the country that the sewing machine holds sway. It is used in as many as seventeen different industries, by nearly 700,000 operators. In a thousand book binderies, alone, sewing machines are used by at least twenty thousand workers. The sewing machine leads rather than follows the flag, forty establishments employing one thousand hands turning out annually over half a million dollars' worth of American flags and red, white and blue bunting. The sewing machine is used, too, by those who make our pocketbooks, who stitch our saddles, our harness, and our horse's clothing. Sewing machines are used in making the sails of our yachts; the awnings and tents that shade us; our hats, gloves, shoes—nine hundred pairs of shoes a day sewed on one machine. This is not to speak of the machines used by the tailors, dressmakers and milliners. And the housewife uses as many machines as are used in all these establishments combined.

Sewing machines for household use form a distinct class, in size and general design, varying only in the style of stitch used, and the manner in which it is executed. The lock stitch is the favorite; chain stitch machines, indeed, for household use are no longer manufactured. For factory use, however, the chain stitch machines are most popular, owing to the elasticity of the stitch, which makes it especially desirable for materials that stretch, such as knit goods. The greater number of sewing machines are now made in the Central States, rather than, as formerly, in the Atlantic States. The materials used in sewing machine manufacture are chiefly pig, bar and sheet iron, iron and steel wire, sheet steel, malleable iron, Japan varnish, power and machine supplies and woods for casing. The processes of manufacture include mills for the making of the cabinets and cases, foundries for casting the different iron parts, and machine shops for shaping and assembling the various pieces of mechanism which enter into the finished product. Only a very few establishments extend their operations over the whole range of work. Some are confined to the machine shop work and purchase the cast iron parts and woodwork; others engage only in the process of assembling the various parts, all of which are secured in a finished state from manufacturers.

Numerous new patents are granted every year on inventions covering the sewing machine and its attachments, as well as the machinery used in producing the various interchangeable parts. Every large factory maintains an experimental department, where inventors are given every facility for developing new ideas and putting the results to preliminary tests. With a view to doing away with the labor of operating machines by the ordinary foot treadle, many experiments were tried with water motors, air engines, steam engines, and springs and weights; but no effective motor was produced until the introduction of electricity for power. Electric sewing machine motors can now be used, even in connection with the ordinary household machine.

Certain leading manufacturers of sewing machines have established manufacturing plants abroad. These branch establishments are equipped with American tools and machinery, and frequently are of such a size as to equal the home plants in output. The number of American sewing machines sold abroad each year, including the American machines made in foreign countries, is about equal in number to those sold in the home market by all of the American companies.

Since 1860 the total value of the exports of American sewing machines approaches $90,000,000. The superiority of the American machine is thus demonstrated. The export trade has not been appreciably affected by the system of foreign manufacture.

Development of Sewing Machines

Much is due to Isaac M. Singer's improvement, patented in 1851, introducing the rigid overhanging arm to guide the vertical needle, in combination with a shuttle and a "wheel feed." A straight shaft in the overhanging arm imparted the motion to the needle, and the shuttle was driven by a mechanism deriving its motion from the shaft by means of gearing. The feed consisted of an iron wheel with a corrugated surface, the top of which was slightly elevated above the level surface of the table. By an intermittent motion the feed carried the cloth forward between the stitches, permitting the cloth to be turned in any direction. The material was held in place by a presser foot alongside the needle. This presser foot had a new feature, the yielding spring, permitting passage over seams, and adjusting itself automatically to any thickness of cloth. This machine serves as a model for a large proportion of the sewing machines of the world to-day. Mr. Singer, in addition, produced a sewing machine using the single chain-stitch, and also a double chain-stitch machine for ornamental work and embroidery. The sewing machine was now in perfected form, and its manufacture speedily became a great industry.

Bridgeport, Conn., Boston, and Elizabeth, N. J., hold the lead in the manufacture of sewing machines. Perhaps the development of the industry is more closely associated with Bridgeport than with any other city. New York City has always been the principal sales depot. Machines for stitching with waxed threads are used in the manufacture of boots and shoes, saddlery and harness. Heavy power machines are employed in the manufacture of awnings, tents, sails, and canvas belts. Specially constructed machines are used for stitching gloves, sewing carpets, and embroidering. There are also machines for working button-holes and sewing on buttons, which are very effective and great time savers.

Manufacture of Typewriting Machines

We in America have grown accustomed to rapid changes in business conditions. And so we are not surprised when we are told that, although it is somewhat less than thirty years since the typewriter first appeared, it now gives employment to about twenty thousand mechanics and 120,000 operators. One army of mechanics manufacture the machines, another army of young men and women operate them. The cperators earn an average of $8 a week, at least; some receive as high as $25 or even $50. One typewriter manufacturing firm has found positions during the last nineteen years for over 100,000 persons, principally young women, the company conducting a free employment bureau for the purpose.

No foreign nation has yet produced a machine good enough to keep out those made in America. King Edward has several American machines in Marlborough House. When the Shah of Persia visited Paris he bought a number of these writing machines. The Czarina uses one, as does also the Khedive of Egypt. Indeed, it is not unusual to read on the letter-heads of an American typewriter concern—"appointments from his Majesty," or "from his Royal Highness." The machine has found its way even into the sanctum of the Pope. Wherever writing has to be done for purposes of record or of correspondence, there the typewriter has taken its place. In every business, in every profession, in every government office it has become indispensable. Five thousand are in use in the government departments in Washington. In the United States laws have been passed legalizing the work of the typewriter; but in some foreign countries it has yet to make its way in places where handwriting is excessively reverenced. It cannot be doubted, however, that the several million dollars' worth of machines which we annually send abroad will speedily work there the same business revolution that has been wrought at home.

One of the first advantages in the use of the typewriting machine over hand labor lies in the speed with which copying may be accomplished. A typewriter and a copyist with a pen were each required to copy one thousand words of statute law; the typewriter accomplished the work in twenty minutes, while the penman required seventy-five minutes. The typewriter, too, has produced an industrial effect, not only in creating a new profession, but by greatly increasing the demand for skilled labor in manufacture.

Development of Typewriting Machines

Court stenographers were the first to realize the typewriter's worth. Lawyers took them up, and courts of law began to require their use in the preparation of legal documents. Then the large business establishments fell into line, and they soon became the fashion in the commercial world. Their advantages were seen by authors, newspaper men and telegraph companies, and at present there is no business or profession without them. Hundreds of patents have been issued, and there are several machines of about equal excellence upon the market. "Book-typewriters" have been perfected. Power typewriters will doubtless be greatly improved. There have been several patents issued for electrical typewriters.

The first machines put upon the market wrote only with capital letters. Strange as it may seem, the typewriter met with indifference and even opposition. But its work was its own best advocate, and it soon won its way into every branch of modern business. It has received the unqualified approval of commerce and the professions. It has been adopted by every civilized government in the world, a machine having recently been constructed with Siamese characters for use in Siam.

As the typewriter's popularity increased, inventors naturally turned their attention to it, and several hundred patents have been granted, in this country, for improved attachments and for new styles of machines. There are several different varieties on the market, all of which do very good work. The development of "book-typewriters" has rapidly progressed. Efforts are now being made to perfect the "power typewriter." In using these machines the operator has merely to touch a key, releasing latch mechanism, power from some external source completing the impression. In the case of electrical typewriters the "impression mechanism" is operated by magnets, the circuit being closed as the operator touches the key. In one of these there is a permutation system of type selecting, involving the use of fewer keys than ordinarily used. Inventors are now trying also to perfect long-distance typewriting machines.

Manufacture of Firearms

A million each of rifles, shotguns, and revolvers are turned out annually by the gunsmiths of the United States. At Ilion, N. Y., a single factory turns out enough rifles in a week to equip many regiments. The United States Armory at Springfield, Mass., founded in 1795, is the most important public arsenal in North America. The government was allowed to establish the armory within the city limits only after much consideration on the part of the residents, who feared that injury to the peace of the city would follow the settlement of so large a number of government employés. But the result has been that thousands of citizens have found lucrative employment in Springfield. Their wages have gone to build up the mercantile interests, and the skill acquired in the shops has made it possible for many private metal working concerns to secure valuable workmen. The unsurpassed facilities for the manufacture of firearms in this establishment made it possible to turn out four hundred rifles a day during the Spanish-American war, over two thousand men being employed night and day. A recent appropriation by Congress provides for extensive improvements, and the daily capacity of the arsenal will soon be raised to one thousand rifles. This is the largest manufactory of small arms in the United States and one of the largest in the world.

One of the largest plants in the country for the manufacture of rifles and small arms is situated at New Haven, Conn., within a mile of the Yale College campus. The buildings cover, in all, over thirty acres, and are filled with every conceivable improved device for the making of guns and parts. Here also are made cartridges for infantry rifles and small cannon. During the Spanish war this concern supplied many thousands of arms to the government; the contracts calling mostly for the Lee straight-pull magazine infantry rifle, which is a rapid-fire arm, to be loaded with five cartridges at a time on a removable "clip," and capable of discharging all without removal from the shoulder.

The principal stages in the manufacture of a modern rifle are the processes of making the barrel and the stock, both of which are extensive and complicated. The metal for the barrel is brought to the works in the form of ingots, which, in the drawing, rolling and annealing mill, are formed into round bars of the required shape, although somewhat larger than the finished products. This is done by passing plates of steel, about one foot in length at the start, and heated white hot, through three successive sets of rollers, which gradually increase its length to the required point, at the same time correspondingly reducing its diameter. The process of boring, next following, is performed with equal precision, being accomplished by securing the barrel blank in the frame of a lathe, and passing an augur through it from end to end. The hole thus made is considerably smaller in diameter than the bore intended for the gun, but, because the process must be accomplished in stages, it is necessary to use three successive augurs, of regularly increasing size, before the desired result is accomplished. The boring completed, the barrel is placed in another lathe, and turned down to the desired outside diameter and taper, after which its surface is ground on a revolving stone, in order to perfectly smooth the surface and remove all tool marks, due to the turning.

The firing test is accomplished by locking a number of barrels upon a specially prepared firing table and loading them with charges of powder and lead, at least twice the weight of any ordinary service cartridge of the same bore. The act of firing this unusual charge will result in straining or bursting any barrels having flaws or imperfections. Those that endure this test are removed to the rifling lathe, to receive the "twist," or rifle boring, which is another process requiring careful handling and accurately adjusted machinery. The twist of the rifling is gauged according to the weight of powder and lead to be fired in the gun, each separate standard weight of cartridge for the same calibre requiring a different twist, in order to ensure that the bullet is carried straight, end-on, and does not "tumble" or "keyhole," which is to say, be delivered side-on at its destination, with consequent loss of velocity and effect. The rifler is an iron tube, carrying at its end three cutters, narrow bars of steel, each carrying three diagonal protuberances ground to a sharp edge at the top. The tube, having been fixed upon a small iron rod, is slowly rotated and driven through the bore, cutting the grooves at the desired twist.

The various smaller pieces of a rifle are swaged separately into shape, so as to be fitted by screws or other attachments; only two of them, the sight and cone seat, being permanently attached to the barrel. After the gun has been completely assembled, it is fired in the shooting alley attached to the factory, in order to determine whether all parts are accurate. This work is performed by thoroughly proved experts, who test the piece, not only for accurate sight, but also for its firing qualities—depending on the correctness of the rifling and the trueness of the bore—any gun not meeting the requirements being condemned. The firing qualities of a gun depend upon the velocity with which it can project its bullet, with a given charge of powder. This is determined by an instrument known as a "chronograph" or "velocimeter," an accurately gauged clock, whose operation is checked by the closing of either of two electric circuits, including, respectively, the gun to be fired and the target.

The stocks of guns are made from black walnut, all the work of shaping, grooving and polishing being performed by accurate and complicated machines, with the exception of the preliminary work of cutting the rough outline from the timber piece, preparatory to setting it in the lathe.

Safes and Vaults

As wealth increases, so does the manufacture of safes and vaults—and the operations of burglars. The modern safe must always keep just a trifle ahead of the modern burglar, who is himself a machinist or mechanic, skilled not only in safe-destroying, but in safe-making. So, chiefly to checkmate the burglar, a small army of machinists, mechanics, draughtsmen and others are employed from January to December piecing chilled iron and steel together in such a way that locks cannot be picked nor plates rent with nitro-glycerine. The cashier of one of the largest city banks, while working "over time" suddenly found himself face to face with a masked man and the muzzle of a revolver. "Open the safe, or you're a dead man," said the burglar.

"Can't," said the cashier, coolly. "Permit me to tell you why," and he pointed to an ordinary clock on the wall. The burglar nodded submissively and vanished.

The cashier had made him understand that the safe was equipped with a time lock. No human force can open the ponderous doors of any safe provided with one of these time locks, called chronometers. On the other hand, a person cannot prevent the doors of a vault or safe thus equipped from unlocking at the moment at which the time combination has been set. Like an alarm clock, they do their work at the appointed time.

From Sussex County, New Jersey, comes an ore—Franklinite—which is harder than the finest tempered steel. When this metal is woven with wrought rods, and the burglar begins to drill, his tool pierces the soft metal faster than the hard metal, works sidewise, and snaps in two like a match. The modern safe is not only made fire-proof by the use of concrete materials and other devices, but is so strongly constructed that it will endure a fall from the top floor of a great office building to the cellar. Vaults, too, are made to withstand the crushing weight of falling walls and machinery. Thus the safety of hundreds of millions of dollars is assured by the cunning of our safe-makers. He who travels will perceive that the craft of the safe-makers is appreciated by foreign bankers. He will find American safes in Great Britain, and in fact in every country in Europe, in Australia and New Zealand and Java; in Morocco, Egypt, and South Africa; in India, China, Japan, and in Mexico. For thirty years the American safe has thus guarded treasure the world over. Some years ago the best English safe was pitted against one of American make. Our workmen opened the foreign safe in less than three hours; but the English mechanics toiled for more than six hours before they succeeded in opening the Yankee strong-box.

CHAPTER VIII

THE LUMBER AND WOODWORKING INDUSTRIES

Timber Regions and Trees—Logging Camps—Lumbermen of the West—Lumbermen of the East—Saw Mill and Planing Mill Products—Hard Woods—Cooperages—The Furniture Industry and Cabinet Makers

AMONG the great manufacturing groups the lumber industry holds the fourth rank. It is subdivided into three distinct branches. First, the logging industry, including the felling of timber, cutting it into lengths, and its transportation by rail or river to the mill. The raw material is the standing timber, and the finished product the logs delivered to the mill. This industry is largely carried on by men who own or operate saw mills.

Second, we have the saw mill industry. Here the raw material is the sawn logs, and the product is the rough lumber, including beams, joists, scantling, boards, shingles, laths, etc.

Third comes the planing mill industry, the raw material consisting of rough lumber and the finished product of planed lumber, with certain minor manufactures. Very often the planing mills are operated in connection with saw mills.

With all the billions of cubic feet of lumber in the United States, with the most expert axemen, loggers, drivers, and sawyers in the world, with the best known machinery and appliances, and a completely organized system for taking every advantage of the resources of our forests, it is still said that the supply of lumber cannot keep pace with the demand. For the annual consumption of wood in all shapes, per capita in this country, amounts to about three hundred and fifty cubic feet.

Timber Regions and Trees

The principal commercial timber is white pine, this king of the American forest furnishing fully twenty-five per cent of the output of all kinds of lumber. The supply of pine of different sorts comes from all parts of the Union, from both Northern and Southern States. Magnificent timber in the shape of redwood, sugar pine, and certain kinds of spruce and cedar are cut in enormous quantities in the Pacific Coast States. Many States produce hardwoods—oaks in a dozen marketable species, ash, the finest hard maple in the world, chestnut and hickory; of ornamental woods, a number of

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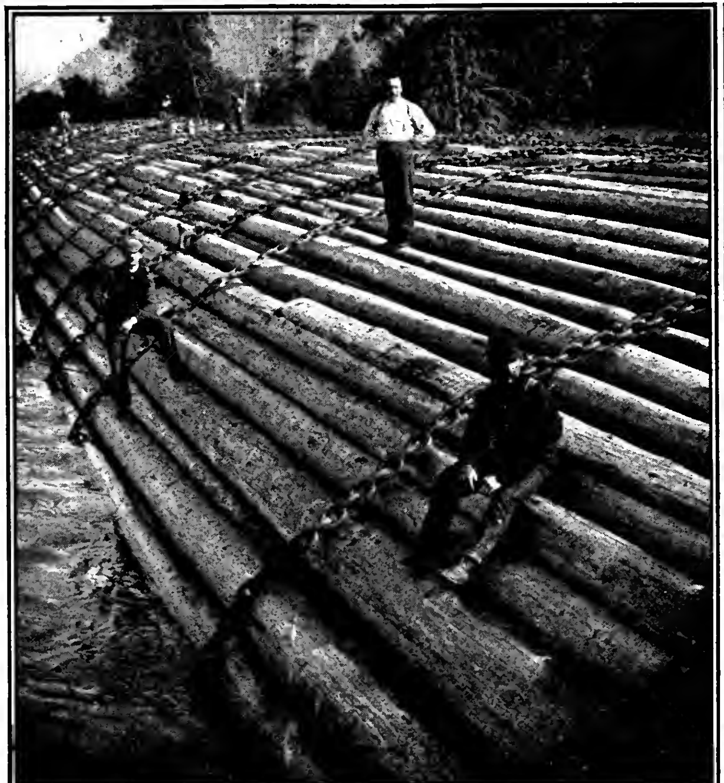
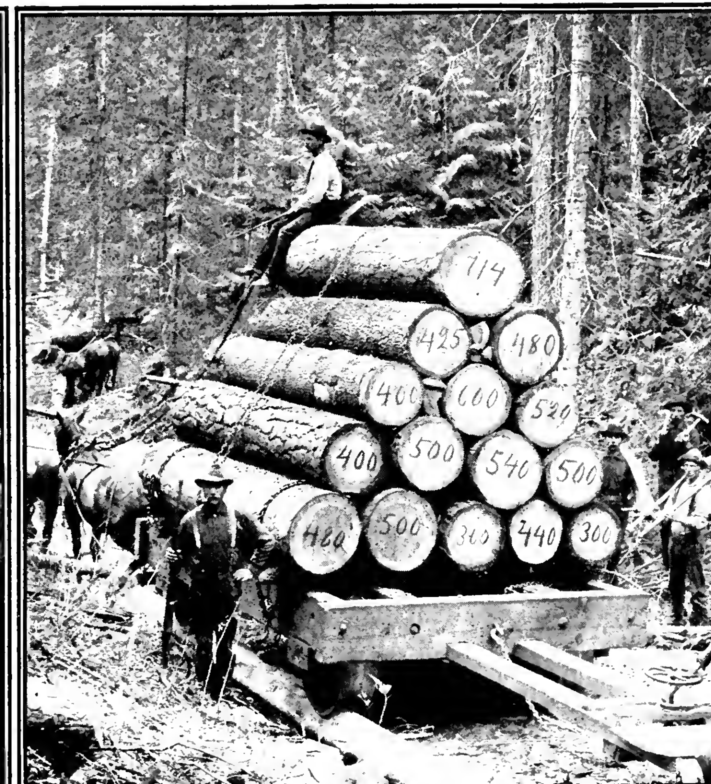


LOG RAFT, REPRESENTING A YEAR'S WORK OF A CAMP



TRANSPORTING LOGS IN IDAHO

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States furnish sycamore, elm, birch, walnut, and cherry. Pennsylvania and New York are rich in hemlock; Maine, New Hampshire and New York in spruce, and Louisiana in cypress.

The country may be divided in reference to timber into certain separate regions. First may be named the Northeastern States, including New England, New York, New Jersey and Pennsylvania. The northern part of this region is the home of conifers, mainly white pine, spruce and hemlock. In the southern part there is a mixture of hard woods with these, while in southern New Jersey there are many yellow pines. Second, we may mention the Southern States. These are characterized by a broad belt of yellow pine of several species, extending from southern New Jersey southwest and west to Texas and Indian Territory, while the lowlands of the coast and the Mississippi bottoms are covered with cypress and the mountain districts are plentiful in hard woods. Third, we note the Lake States, Michigan, Wisconsin and Minnesota, where, in the north, we find the white pine, which gives place to the hard woods in the southern districts. Fourth, we find a growth of hard woods in the Central States, mixed unevenly with conifers. Fifth, the Rocky Mountain region we observe to be filled with conifers, largely of yellow pine, the timber here being generally confined to the mountains. Sixth, we come to the Pacific Coast region, or those parts of Washington, Oregon, and California lying west of the Cascade Range and the Sierra Nevada. These forests are the heaviest in the United States, if not in the world. They consist almost entirely of conifers. In Washington and northern Oregon the prevalent tree is the red fir, with the addition of some cedar, spruce and hemlock. In the southern part of Oregon yellow and sugar pine appear, and these varieties increase toward the south. In California the predominating tree is the yellow pine, although there are some sugar pine, incense cedar, and several species of fir, with giant trees in small groves in the southern Sierra Nevada, redwood being found on the coast north of San Francisco Bay.

It is obvious, from the description just given, that the timber trees of the United States are of great variety, and that there is no State, except those in the arid regions, wherein there is not contained valuable timber. Although the ravages of the lumbermen have swept away thousands of miles of timber, the value of the standing forests in the country still constitute one of the most important resources of the nation. The principal timber trees, then, are the white pine, the spruce, the hemlock, the cypress, the Southern yellow pine, the Western yellow pine, the sugar pine, the red fir, and the redwood.

Logging Camps

Every lumber region has its own method of logging. These different methods of doing the same work are controlled largely by the different seasons in which logging operations are conducted, the varying nature of the forests and adjoining country, and the size of the timber. In the Northeastern States and in the Lake region the logging is done in the winter in order to utilize the snow for hauling the logs to the water or to the railway stations. The streams, filled by melting snow, are also brought into service for transporting the logs. Felling is usually done by saws, the tree being notched on the falling side with an axe, and then being sawed on the upper side. After it falls, the trunk is cut into desired lengths with the saw. Logs are moved about in the forest generally by horses or oxen, although, as in the Northwest, donkey engines are employed.

In the South, in the yellow pine and cypress and hard wood regions, logging is done throughout the year. The saw is less used there than in the East and West. In the Northwest, logging is also conducted throughout the year. Owing to the great size of the logs, machinery is used to a large extent in the handling of the timber, and cranes are employed for lifting the timbers on the cars. The largest logging camps are in Minnesota, where the lumbering industry is carried on on a more extensive scale than in any other State and the capital invested, measured by the number of establishments, is nearly twice as much as that of Wisconsin and California, which come next. The number of hands employed in Minnesota are double those of any other State, and the wages are twice as much as those paid in any other section of the Union, except in Arizona. The more recent the lumber region opened, the larger and better equipped are the logging camps. The later comers make use of the most improved machinery and methods, and operate upon a larger and, consequently, more economic basis.

Lumbermen of the West

The lumbering industry has steadily moved westward and northwestward, until it has reached the Pacific Coast, where it is now thoroughly established in the vast forests, principally of Washington. The yellow pine belt of the Southern States is almost exhausted, and the white pine belt of Michigan, Minnesota, and Wisconsin is fast approaching the end of its supply. The State of Washington, however, is hardly at the beginning of its lumbering industry, and it now has more timber than the entire yellow pine belt of the South, and the white pine section of Michigan and its adjoining States.

It is estimated that there are now standing in Washington 115,000,000,000 feet of (board measure) fine timber. More than one-third of the area of the State is covered with forests of fir and spruce. This timber is of wonderful growth, being frequently twelve and fifteen feet in diameter, with trees 250 feet high, and with clear straight trunks of one hundred feet. The yellow fir predominates, and it has been calculated that if all the cars bearing the lumber products of Washington (lumber, shingles, and logs) were to be made up into one train, it would reach from Seattle to Denver, a distance of over fifteen hundred miles. Again, if it were possible to imagine a building as large as the Pacific Coast Reserve, which contains Mount Rainier, its roof, which would cover an area of over two hundred and twelve square miles, could be shingled in first-class style by using the output of the shingle mills of the State of Washington for the single year 1902.

The quality of the Washington fir timber is as excellent as it is abundant. Its value is appreciated from Cape Nome in the Arctic to Cape Horn at the other end of the Western Hemisphere, and in Australia and in South Africa. A shaft of this wood upholds the British flag over Windsor Palace, and another shaft of it supports the Japanese flag over the palace in Tokio. The masts of the pleasure yacht of King Edward are of Washington fir, and masts are shipped all over the world, when length and strength combined are wanted for the great sail ships.

In the early days of logging in the West, the lumbermen worked as near the watercourses as possible, as it was more economical in handling the logs; but nearly all the most desirable timber has been cut from the river sections, and the work has been carried further into the forests, where railways and "skid" roads take the place of the streams. The ox team, which formerly dragged the great logs out of the forests to the river bank, have also been abandoned for the horses of enormous size, such as Clyde and Normans, and for the steam engine, which does the work far more rapidly and economically, wherever it can be employed. The engines are worked with wire cables, to which the logs are hitched, the bark having been first stripped from one side, and the cable is then wound about a drum, dragging the log over the skid roads to the desired point. When the logs are exhausted from a section known as a "yard," the cable is hitched to a stump, and, by winding the other end of the cable around the drum, the engine itself is pulled to another "yard." A logging crew works throughout the year. It will cut out some 40,000 feet of lumber a day, or about an average of 1,375 feet to the man. The wages paid are $2.17 a day. The present force of lumbermen in Washington is about 2,530. One of the most interesting features of the felling of the giant Douglas firs is the adroitness with which the tall trunk is made to fall in a certain direction, exactly calculated for purposes of handling the log and removing the cuts. A deep notch is cut into one side, not to fell the tree, but merely to guide it in its fall. As the saws cut into the trunk from the opposite side, iron wedges are driven into the channel or "kerf," as it is called, so as to keep the tree from settling and toppling over in the opposite direction. The direction of the fall can thus be calculated and regulated with great exactness.

Lumbermen of the East

Lumbering in the East is entirely different from lumbering in the West. In addition to the difference in the timber—from the giant Douglas firs to the small white birch trees of Maine—the methods of logging are entirely distinct. Instead of cutting trees into tall masts for merchantmen, as in the forests of Washington, the Maine birch tree is cut into spools. Yet the lumber industry of Maine is an extensive one, aggregating 600,000,000 feet in a year.

Most of the Maine lumber is cut in the valleys or regions of the two large rivers, Penobscot and Kennebec, the former region yielding about

180,000,000 feet a year, while the latter yields about 110,000,000 feet. The logging season is short, lasting about twenty-six weeks. It begins early in the autumn, so that the cutters may "yard" or collect their timber by the time there is sufficient snow on the ground to haul the logs to the river landings on sleds. Each year the loggers go deeper and deeper into the wilderness to reach better timber, and consequently the expenses increase with each season. Wages have also been advanced, owing to the greater hardships of the work; there is also sharp competition with Canada, and many of the best woodsmen are constantly going into the Dominion, so that the Maine lumbermen are frequently left with insufficient labor.

The work begins, or rather the preparations for it begins, early in August, when the loggers start on their journey to the forests around Moosehead Lake or up the river valleys. The loggers go by steamer or rail as far as possible, and then plunge into the forests. They generally walk, as the horses are used as pack animals or draw wagons loaded with provisions and tools. As soon as they reach the section that has been selected for operations, they clear and level roadways. The trees cut are generally pine, cedar, and spruce. The logs are taken to the yards and piled up and held in place by skids. The chopping continues until toward the end of January, when the loggers leave the forests and return down the rivers. After this the logs are hauled to the river landings. This work is finished by the first of April. When the ice goes out of the rivers, the driving crews roll the logs into the river and drive them down to the booms below. This ends the work in the forest for the season. Supplies have often to be carried into the forest for fifty miles or more, at a cost of about $11 a ton. As the supplies of a single camp amount frequently to more than 100 tons, the enormous cost of lumbering in the Maine forests may be imagined.

The average amount of timber cut by the Maine loggers is not so high as that of the loggers in Washington. This is due to the great size of the firs, which saw up into thousands of feet from one tree. A single company in Maine will often employ 500 cutters, who will cut 25,000,000 feet of logs during the season of twenty-six weeks.

Saw Mill and Planing Mill Products

The relative importance of saw mills and planing mills with respect to value of products may be seen in the following figures:

Grand total of products for all mills	$566,832,984
Saw mills	422,812,061
Planing mills	107,622,519
Independent timber camps	36,398,404

The principal timber products, after rough lumber, are shingles, cooperage materials, hoops, staves and headings, laths, bobbin and spool stock, furniture stock, agricultural implement stock, carriage and wagon stock, pickets and palings. Other very important timber products are telegraph poles, cross ties, and fence posts, hard wood and logs for export.

Saw mills in Maine handle the logs from the river, as water is the principal servant of the lumberman of that region. A chain carrier takes them to the band saws, which dispose of them at a tremendously rapid rate. From the saws, the lumber passes to the edgers, and if required to the planers, and then to the butting machines. The smaller stuff passes through the surfacer instead of the planer. From the time the log is hitched to the chain carrier in the river to the time it is placed on the cars, planed and ready for the market, everything is done by machinery. The economies effected by this elaborate system of machinery keep the Maine lumbering industry in condition to compete with the vast supplies of lumber in other sections of the country. Besides long lumber, the mills cut up clapboards and laths in great quantities. The mills are of large capacity, and 125,000 feet a day is not an excessive average for the milling season for one of these mills. This figure is often exceeded.

Hard Wood

White pine ornamented with a coat or two of paint no longer enjoys the monopoly for interior decoration of houses. Its place has been taken by hard wood, the use of which is generally prevalent, the custom having spread from the larger cities to the country at large. Few fine homes are now built anywhere in which hard woods are not used to some extent. Much of the education of the people in hard woods has been through ready-made mantels. The finishing in oak or ash is called the trim. It is turned out in city shops and shipped as ordered. In San Francisco there is a stock of 2,000,000 feet of the hard wood products of the Middle West.

Memphis is regarded as the largest hard wood market in the world. The amount invested in plants by Memphis firms aggregates one and a half million dollars. During the year 1902 300,000,000 feet was shipped, and the value of the business was upward of $7,000,000. There were employed 4,900 men, drawing annual wages of $1,410,000. This does not take into consideration a number of firms outside Memphis proper, who make this city their headquarters. Nor does this consider auxiliary trades, such as the manufacture of staves and headings, which find markets at home and in Europe, and sell for over $2,000,000 annually. The latter industry employs more than 1,700 men and requires about 8,000 cars for the transportation of its product.

Cooperages

If all the barrels that are made in a year by a single cooperage company in Brooklyn were laid on their sides, end to end, they would form a line 12,500 miles long, reaching from New York to Bangkok, Siam, via San Francisco. This company has its headquarters in Brooklyn, but it has also factories in Jersey City, Boston, New Orleans, and San Francisco. These factories turn out 40,000 barrels every working day of the year. Between the Atlantic and the Pacific there are about four thousand cooperages, which employ tweny-seven or twenty-eight thousand coopers and other workmen, paying them fifteen million dollars a year in wages. The total value of the barrels produced is over twenty million dollars. The barrels representing this great sum of money supply principally the needs of the flour millers, brewers, and fruit growers. Once there were vast forests of oak in Canada, but the coopers of the United States converted them into barrels. There were mighty forests of oak in certain Western States; but American coopers bought them all to make into barrels. Now the coopers are supplied by the oak of the Southern States.

Within the past fifteen years the introduction of improved methods in the manufacture of barrels has almost completely revolutionized the trade. Where there used to be a large number of cooper shops in every city and town, with numbers of hand coopers earning from $15 to $35 a week, the trade is now supplied almost exclusively by a few large machine shops located near the manufacturing centres. In the machine shops of to-day there are a few coopers employed as foremen, inspectors, etc., who learned the trade by hand (as the saying is, "from the ground up") in the early days, but the remainder of the help is, in most cases, boys, ranging in age from ten to eighteen years. There are, of course, a few exceptions in the way of common laborers who do the heavier work. A few hand shops still exist, but on account of competition with the machine shops they have only a small trade, consisting of a special class of cooperage. The wages paid by these hand shops are, on account of competition, very low.

Because of the great change in the way barrels are made, there has been very little inducement to young men to learn the trade as a hand cooper. As the old coopers die, the number of hand coopers naturally grows correspondingly less every year. Since the introduction of machinery in this field, however, there has been a great demand for hand coopers for the repairing and patching of machine-made barrels. By the old method of making barrels the material was dressed straight with the grain of the wood, but the machinery of to-day pursues a straight course, and if there is a crook in the wood, it must necessarily cut across the grain, which weakens the stave or head, and if it does not break in the process of bending it will leak or break soon after the barrel is used. Hand coopers must then be employed to repair it, and these are paid from $12 to $22 per week.

The Furniture Industry and Cabinet Makers

No more convincing testimony to the advance in the arts of luxury of the American people can be offered than the fact that the value of the annual output of furniture, including cabinet making and upholstering, in the United States averages $150,000,000. This means an average expenditure of nearly two dollars a year for each person in the land. Fifty millions of dollars, too, are paid to workmen for their share in turning out the products. The distinctive productions of American furniture makers are the folding-bed, the rocking-chair, the bureau, the chiffonniere, and many of the combination pieces designed to meet the needs of life in flats and other cramped quarters. All these articles, too, were first made in America. The rocking-chair is to be found in almost every home in the United States, but Europe has yet to learn its comforts. The American bureau is a space-saving improvement on the European dressing table. The great folding-bed era, pampered in its time by American bed-makers, is passing into history, and we are now in the metal bed epoch.

In furniture production, New York City leads with one-sixth of the entire output of the United States. The next largest producing city is Chicago, after which in importance are Philadelphia, Grand Rapids, Boston, Cincinnati, and St. Louis. Each of these cities produces over $5,000,000 worth of furniture a year; New York and Chicago about $15,000,000.

The thickly settled suburbs of large cities, with new householders ever increasing, create large markets for furniture of the cheaper grades. Manufacturers, however, say that the capacity of the mammoth furniture factories of the present day exceeds the demand, and that the industry is threatened with over-production unless American furniture soon finds a market in foreign countries.

Notwithstanding the fact that the largest cities are the greatest producers of furniture, Grand Rapids, a city of less than one hundred thousand inhabitants, has a reputation throughout the United States as the special centre of this industry. Some one has said of this city that it produces "furniture of the sort that proclaims it the mother of comfort," but it is as the chief wholesale market that Grand Rapids has risen to its distinguished place in the furniture industry. For years all the principal buyers in the country have visited this great market-place every January and every June. The custom has become so thoroughly established that even manufacturers in the large cities send their samples here for the regular semi-annual trade sales.

Many trades share in the work which the furniture industry provides, the material itself comes from many sources. The cabinet-maker would have nothing to do were it not for the labor of those who gather and prepare the mahogany, the oak, the curly birch, the maple, and the other wood stock. The upholsterer, also, would stand idle were it not for the workers in the textile trades.

The Industrial Commission reports that the enormous development in recent years of the factory product in the woodworking industry has been accompanied by a corresponding influx of immigrants. Work which the carpenter formerly executed at the place of building is now prepared beforehand in factories, and these factories are manned to the extent of fifty to seventy per cent by foreigners. The woodworking factory is essentially a machine industry with unskilled labor. The majority are located in Chicago, Michigan, and Wisconsin. In the furniture factory out of seventy-five men perhaps only five are skilled mechanics, the rest being only feeders. In this way a large number of immigrants are employed, and often children and women find places. In cabinet-making fifty per cent are Germans, who are considered the best men in the trade, and twenty-five per cent are foreigners of all other nationalities, and twenty-five per cent are native born. In furniture factories in country districts in Wisconsin the Germans have worked recently at as low as 50 cents a day, and their women were doing carpenter work at the bench.

CHAPTER IX

BUILDINGS, BRIDGES, AND BUILDING TRADES

Buildings—Fireproof Buildings and Materials—"Skyscrapers"—Elevators—The Construction of Buildings—The Building Trades—Plumbers and Fitters—Workers in Mid-air—Bridge Building—Bridgemen—The Caisson Process for Bridge Foundations

Buildings

THE number of men engaged in the actual construction of buildings in the United States would make an army larger than the host Napoleon led to Russia; and yet this army is outnumbered 10 to 1 by the workers engaged in the manufacture of building materials. In the supply of wood used in various forms in buildings alone, hundreds of thousands of joiners, carpenters and artisans are employed. Iron and steel buildings, fireproof structures, skyscrapers—these are familiar to the dweller in cities; but in all the vast region outside the great cities, eleven buildings in every twelve are of wood. It is estimated, indeed, that eleven million out of the dozen million dwelling houses in the United States are of the class popularly called "frame." Considering building operations the country over, wood is still the principal material used. Between the lumberman swinging the axe in the forest and the carpenter who fits the carved oak mantel into place in a new house, there lies a little world whose inhabitants get their bread and butter entirely from wood.

In all mills where building materials are made, machinery now performs in a day, as in other industries, an amount of work which the human hand could not accomplish in months. Still these mills employ thousands of men the year round manufacturing the materials that enter into our modern buildings. In iron and steel mills in Pennsylvania, Ohio, New York and elsewhere, men toil from morning to night turning out columns and girders; at quarries in New England, workmen level the hills, preparing stone that will again rise skyward in mammoth structures; at brick yards in New Jersey, in Philadelphia and Baltimore and along the Hudson, men mold clay into bricks—white, lemon, buff, mottled, etc.; still more workmen are engaged in making terra-cotta and Portland cement; in Pennsylvania thousands of workers are busy making glass for windows and skylights; woodmen in every timber State, from Georgia to Washington, make the forests resound with blow of axe and rasp of saw, sparing neither humble pine nor noble oak; thousands of wood-workers bend over lathes preparing mantels, doors, architraves, and general "trim." At the same time, in a thousand shops skilled laborers are employed turning out an endless rainbow of paint in order that buildings may be preserved. As we observe all these whose labors contribute materials for modern architecture, we must not forget the vast army of miners who delve in the bowels of the earth in order that others may live in dwellings of metal, safe from the peril of fire.

Fire-Proof Buildings and Materials

Absolute and total immunity from fire is not claimed for the so-called modern fire-proof building. A considerable amount of woodwork must still be used in the interiors, and the furniture and property of tenants remain to feed fire. All that is claimed is that the hazard is reduced to a minimum. To this end all the metal framework of the building is incased in material which is entirely incombustible and a slow heat conductor, namely, brick, hollow tiles, terra-cotta, and plaster applied in a special manner on iron laths. It is thus protected from the direct action of fire. The floors are arches of terra-cotta tiles or brick or other incombustible material. The best that can be done for the interior finish is to reduce the inflammable elements to a minimum, and to endeavor to confine the fire by means of fire-proof floors and partitions. A metal door has lately been introduced as a barrier against the spread of flames, and glass with silver or gilded wires imbedded in it is suggested for windows. Although elevator shafts and stairways are protected by fire-resisting walls, yet they serve to distribute smoke, and are thus a cause of danger. In the case of the burning of the Chicago Athletic Club Building, while in course of construction, in 1892, it was the opinion of experts that the metal parts of such a building, if protected by fire-proofing, will safely withstand any ordinary conflagration, the destruction in this instance being due to the vast quantity of flooring, scaffolding, trimmings, etc., collected in mass preparatory to use. The fire-proofing around the columns saved them from collapse, and the integrity of the building, as a whole, after the fire, was not questioned. The tile floor arches were not damaged.

In fact the development of the new type of building is very largely due to improvements in the manufacture of terra-cotta. This was first introduced as a building material in the United States in 1871, shortly after the great Chicago fire. It has many advantages, being recommended by its possibilities for reduction in weight, resistance to heat, adaptability to conditions of position and form, susceptibility to modelling, convenience for transportation, and for its great endurance. A late improvement proposed is enamelled terra-cotta, which can be readily cleansed.

"Skyscrapers"

Compared with some of the great office buildings in New York and Chicago, the Pyramids cease to hold first place as world wonders. The material in these tall buildings usually begins and ends with iron or steel —from the steel piers sunk to a natural rock-bed, upon which the main foundation of masonry is then built, to the frames of the skylights. The entire skeleton or framework of such a building is of steel. The stone or brick walls which cover this skeleton serve merely the purpose of keeping out the cold and the rain. Builders agree that, with the steel frame, a building can be carried to an indefinite height, with safety. During the last ten years, therefore, mills all over the country have been kept running fifty-two weeks in the year turning out steel columns and girders—the bones, as it were, forming the skeleton of fire-proof buildings. Thousands of hands also are employed in rolling-mills alone, turning out rolled beams for fire-proof floors.

Manhattan Island does not exactly resemble a bottle, in shape, and yet it seems possible to make such a simile when considering the limitations its shape imposes. Compared to a bottle, then, the lower part of the island is the neck, and it is on this neck that business locations are most desired. As a result, land in the downtown section has more than once been sold for $6,000,000 or $7,000,000 per acre. As it is impossible for buildings, on this strip of land, to spread out, increased space must be found toward the sky. Hence, the modern skyscraper. The tallest of buildings in New York, the tallest in the world, in fact, at the present time, is a skyscraper on Park Row, near the Post-Office. Those who occupy the offices on the top floor, the twenty-ninth story, are nearly 400 feet above the sidewalk. The exact height from the bottom of its concrete foundation to the tip of its flag-pole is 501 feet, which exceeds the height of the Great Pyramid of Gizeh by nearly fifty feet.

When the builder turned over this structure to the owners, complete, it weighed more than 20,000 tons. It has more than 1,000 rooms and a permanent population of 4,000, and nearly 30,000 persons pass in and out of its doors every day. Its elevators carry 60,000 passengers daily, which is more than can be said of many railway lines. In its entirety, this skyscraper is a city unto itself—like all the other skyscrapers which together form a mountain range of buildings at the lower end of Manhattan Island.

Elevators

Among the most important persons connected with the construction of the modern skyscraper is the "elevator man," or rather the manufacturer of elevators, who has made the modern business building of twenty-nine stories a possibility. To him falls the task of determining the number of cars necessary for a particular building, a problem solved by a study of the cubical dimensions of the structure and by an estimate of the number of passengers to be carried.

In the manufacture of steam, hydraulic and electric elevators, employment is given to many thousands of workmen, although only nine or ten firms control the bulk of the business. A great impetus has been given to

AN IRON WORKER IN MIDAIR

the industry by the erection of towering office buildings and apartment houses, and now even dwellers in private houses insist upon having an elevator to carry them from dining-room to bedchamber.

During the year 1900, 385 electric elevators, representing a total horsepower of 6,730, were manufactured in six States. This is only a small indication of the rapidly increasing use of the electric motor for lifting in large buildings, since the output for the succeeding two years certainly exceeded it by a good-sized percentage. At the present time the electric elevators are rapidly supplanting those operated by steam, compressed air or water, not only on account of the greater rapidity with which they may be run, but also from the greater flexibility of the power. One recently placed in the Washington Monument at Washington, D. C., traverses the entire vertical distance of 555 feet in five minutes, or 100 feet per minute, as against the record of ten minutes with a lift of different power. In the lofty Park Row Building in New York City there are fifteen electric elevators, five of which rise to the twenty-sixth floor, a vertical distance of 308 feet; another, intended for freight uses from the sub-basement to the top floor, a vertical distance of about 424 feet. Each elevator has its own separate motor and equipment; each motor having a vertical armature and mechanism for raising the car and regulating the counter-weights.

The Construction of Buildings

Modern office buildings, apartment houses, and hotels, are becoming the most important examples of the builder's art and craft. Before the first blast of rock is made for the foundation, the financier, the architect, the real estate expert, the engineer, the machinist, the contractor or builder, and the man who is to manage the finished building—all these—must come together and decide upon what kind of a building is best suited to the time and the neighborhood, what kind of an edifice on that particular spot will yield the highest interest on the investment. Consideration must be given to the value of the ground per square foot, the cost of the building per square foot, the cost of maintenance per square foot, and the annual rent per square foot. In using steel in place of masonry, the cost of construction has been reduced from five dollars per cubic foot to thirty-seven cents. In the Wall Street district of New York the total annual rental per square foot of floor space averages three dollars and a half. This acts as a suitable offset to the cost of land, some of which mounts up to $228 a square foot. But the most expensive factor in building is that of labor—seventy to eighty per cent of the cost of construction being paid out for wages. This includes the compensation of the brain workers, the professional men who confer with the financier.

The character of the building having been decided upon, the architect's plans are handed to the builder, and work begins. This builder is as much a captain of industry as the great manufacturers of whom he orders the iron, steel and stone. He has a trained office force, and a staff of experts for his particular branch of the work. Thousands of workmen are at his orders directly, or indirectly through the sub-contractors. Every detail must be calculated beforehand. He must work in a narrow crowded street, perhaps where there is no room to store materials. Hence the materials for the tenth story, for instance, must not arrive a single day before the ninth story is finished. The masons must follow as closely as possible after the steel workers. If one gang of men happen to be late at any stage of the operations, all the gangs following may be delayed. The builder must construct the huge edifice on schedule time, from story to story, just as a railroad train is run in a block system.

Men of many trades, meantime, have solved numerous problems, and are ready to begin work on the day appointed by the builder. The plumber and the gas-fitter have planned everything in accordance with the specifications of the sanitary engineer. The machinist has had hard work figuring out how he can build a large power plant in a small cellar. The steam-fitter has made a bargain with the machinist to use the exhaust steam from the power engines. The roofer and tiler, the hardware maker, the locksmith and the carpenter, are working in perfect harmony with all the others. "I did not realize there were so many trades in the world as I found I had to deal with when I undertook to finance this building," said the president of a corporation which had built a skyscraper. "But what amazed me most was the thought and forethought, as well as the cleverness, that go into even the smallest details of construction, and the complicated perfection to which everything has been brought."

In the actual processes of building, machinery now mixes the mortar and carries the hod; power derricks hoist the heavy stones, steel pillars and other materials; carts laden with bricks are lifted bodily, after the horse has been detached, to the topmost stories. Much of the riveting of connecting parts of steel is done with machine tools. This use of machinery in the building trades, and in the manufacture of what may be styled "ready-made" building materials, has served to lessen the cost of construction and lower the price of materials, and hence to increase production and extend the field of employment for workmen in all the building trades. Even stone is now planed and carved by machinery—and the stone carver himself is surprised to find that a machine is quicker and more accurate than his own skilled hands.

The public is no longer astonished by the rapidity with which the skeletons of the new buildings rise, when once the foundations have been laid. Two stories can generally be erected in six days of ten hours each. In the instance of the Unity Building, Chicago, the metal work for seventeen stories was put in place in nine weeks. In the construction of the New York Life Building, in Chicago, there were 671 separate columns used, and an average of twenty-five working hours was required to set the steel work for a complete story. As the exterior walls of these high buildings are supported wholly or in part by the metal framework, their construction can proceed simultaneously at several stories. Several gangs of workmen are frequently seen at different levels, constructing the exterior walls.

In twenty-story skyscrapers piers of solid masonry would take up too much room. The load carried by some of the metal columns is tremendous. Take, for example, the Shiller Theatre, Chicago. In this structure columns 92 feet 10 inches long were used to carry a weight of 25,000 pounds. Frequently 800 tons, or more, rest on a single column, having a sectional area of 158 square inches. Brick and terra-cotta have driven stone from the field in exterior walls for these lofty buildings. There is too much difficulty in properly anchoring stone, or attaching it to the metal framework. Wonderful are some of the foundations for skyscrapers. One development of foundation is called the "raft-footing," largely used in Chicago. On a bed of concrete a raft or grille of steel rails or iron beams is built in cross-wise layers, one for each column. In New York and other cities, pneumatic caissons have been employed to penetrate to bed-rock for the foundations. Great structures have, in some cases, been balanced on cantilevers, in order to distribute the enormous weight as generally as possible.

The Building Trades

Workers in the building trades are employed about one-third the number of working days in a given year, as these trades are largely influenced by the elements and by the supply of material. The working rules governing these trades in the larger Eastern cities provide that the hours of labor shall be eight per day, and fix the time of beginning and closing work, overtime to be worked only in case of emergency and to be paid at one and one-half times the regular rates, and holiday work at double rates. The minimum wages are in many cities fixed by agreement between employers and mechanics. The stone masons of Boston, for example, receive a minimum wage of forty-five cents an hour. Their agreement with their employers provides for regular payment of wages at or before five o'clock on pay day, and for payment of the amount due on demand to any one who is laid off. The regular wage rate of bricklayers in Washington is four dollars, but members of the union specially skilled sometimes receive as high as five dollars and a half, there being nothing to prevent payment above the minimum. In most cases, however, only those laying pressed brick receive extra pay.

The importance of plumbers and fitters to the communities in which they operate will be emphasized by giving some idea of the number of plumbing and gas-fitting supply establishments. The whole number of such establishments in the country is not far from 5,000, employing in all over 100,000 hands. In New York alone there are perhaps 800 such supply places, employing over 6,000 persons. The capital invested in the New York establishments is over $4,000,000, and the value of the product in a year over $13,000,000. In Philadelphia there are about 500 such supply establishments, which employ 3,500 hands and have an aggregate capital of $4,000,000 and an output valued at $7,000,000. Other cities support a proportionate number of men in these trades.

As recently as the days of the Civil War, the whole cost of the plumbing work in an ordinary first-class dwelling was not over three hundred dollars. To-day, two thousand dollars, or even three thousand or more, is not considered too much for the plumbing work in an ordinary dwelling. These sums pay only for the absolute necessaries and requirements of safety and comfort. As much more may be spent in adding luxuries. It is possible, for instance, to have a Dresden china bath-tub, costing by itself three thousand dollars. There are two such tubs in existence, one owned by one of the largest iron manufacturers in the United States, and the other by the Emperor of Germany. Or tubs of solid marble may be used, as in the mansions of certain very rich Americans.

The best preparation for the building trades can be obtained in training schools founded for that purpose, and teaching carpentering, bricklaying and plastering. Of course some additional practice is required in the world of affairs to supplement the trade school education. In many cases it has only taken from three months to a year for graduates of such a school to become entirely satisfactory journeymen. Their school training enables them to develop into superior workmen, who can take advantage of opportunities as they may arise. For instance, a carpenter's or bricklayer's ability to comprehend building or architectural drawings adds much to his value. Trade school graduates are enabled to take a large grasp of the various kinds of work in their line. Bricklayers can set boilers, line furnaces, set tile, etc.; and carpenters can work at shipbuilding and car-building, besides doing their regular work in their trades. If these graduates have business ability they stand a good chance eventually to become builders and contractors.

A well conducted building trade school has many advantages over the old-fashioned apprenticeship method. Instruction, and not construction, should be the aim of such a school, and yet it should offer a proper preparation for commercial methods. In these schools the pupils show great interest in instructional mechanical exercises, such as the departments of the building trades, bricklaying and carpentering, and the shop trades—machinist and pattern-making. These schools should remain in harmony with the reasonable desires of the working artisan, and should avoid competition with employed and employers. In a trade school constructing cheap furniture a boy was kept six months at making chair rounds, so that for him the school was a mere factory. In a properly conducted school he would have been moved along to learning other processes, in order to gain a general development, and not have been kept all the time at one thing.

In former days when it was said that a city was increasing in size the expansion referred to the extension of its boundaries. But at present, in addition to this old-fashioned growth, cities have grown taller. It is no exaggeration to say that certain sections of our large cities have doubled in height. A city has virtually been erected on top of another. The eight-story building has made way for the sixteen-story structure, whose tenants equal in number the population of a good-sized village.

This wonderful development of modern mercantile architecture is a factor in the growth and prosperity of the building trades. These trades are well organized. The constant demand for their work has enabled them to keep up wages in the cities. The different branches of the trade show varying effects of immigration. Among the carpenters of the interior cities wages are not affected much by immigration, but rather by country and suburban competition. An exception may be made in the conditions prevailing along the Canadian border, where the influx of immigrants tends to the establishment of a lower scale of wages. But this has been checked by a discriminatory initiation fee. One of the strongest organizations in the building trade is that of the bricklayers. They have a number of customs which tend very successfully to protect them against over-competition by immigrants. First, they require all their members to be citizens of the United States. This excludes those nomads who come here simply for the season. Secondly, they have a regulation which imposes the payment of a second initiation fee upon those who absent themselves from the locality for more than a month. As to the plumbers, they are well organized. Most of the competition in their branch of the trades comes from England and Scotland. In those countries trades unions have a firm foothold, and when the members emigrate they are very willing to accept the rules of the unions in the new country of their adoption. Hod carriers and building laborers are naturally affected by immigration. Still so close is their association with the other trades, and such is the effect of the influence of sympathetic strikes, that their wages are higher than those of common laborers.

Plumbers and Fitters

It is the custom of cartoonists and paragraphers to represent the plumber as a kind of highwayman who rifles pockets and gives a trifle of lead pipe in exchange. If, however, the actual value of the plumber to the public health were fully realized, he would receive honorable mention even in the comic papers. In the construction of every building there are four items, in providing for which economy is extravagance. These are the foundation, the roof, the heating apparatus, and the plumbing work. The plumber therefore is one of the four artisans whose skill is most important to safety and comfort in homes, offices, and public halls. The plumber is supposed to be the right arm of the sanitary engineer; but, in five cases out of ten, he is able to proceed without the aid of the logical chief of his trade. As to his charges—the physician charges five dollars a visit to heal; why begrudge the plumber five dollars a day to prevent? This is the light in which the health boards of all the large cities regard the situation, and hence it is that health officers have either taught or compelled citizens to recognize the economy of contracting bills with plumbers—that is to say, paying money for safeguards against infection.

The changed conditions of modern building, indeed, have considerably modified the calling of plumber, requiring a wider range and a higher standard of special knowledge than was ever attempted until within the last few years. Formerly the practical worker in household piping was expected to know little beyond the correct methods of wiping joints, connecting pipes and fixing sink traps, and expertness in these directions constituted him a fully-equipped plumber. Now, when, of necessity, far more complicated systems are required in the water supply and drain pipes of a building, it is essential that he understand something of the laws governing the circulation and pressure of water and of the theoretical principles of valves, traps, siphons, filters, pumps, cisterns, metres, and other operative appliances, and, as far as possible, be able to understand architects' drawings, so as to design systems of plumbing for any given building; having a thorough understanding of the necessary arrangement and connections of sinks, closets, basins, laundry tubs, etc., all of which details involve a greater degree of technical knowledge than the merely casual observer would suspect.

These new mechanical and operative conditions have made necessary a new class of practical man, the licensed plumber, who, on account of his adequate knowledge, holds government authorization to fit and remove metres and perform other functions requiring special skill and responsibility. They have also created a distinctly new profession, sanitary engineering, in which, on account of its growing importance, instruction is given in several prominent universities and technical schools. Among the subjects necessarily included in this line are the technical principles, upon which proper plumbing, heating, lighting and ventilating apparatus must be constructed; information enabling the proper preparation of plans and specifications, as well as the installation of such systems, and knowledge of defective constructions. The exigencies of the building trades, particularly in the smaller towns and cities, frequently require that plumbers do work on roofs, skylights, cornices, properly delegated to sheet metal workers, where these craftsmen can be secured. This is and must continue an increasingly important line of usefulness, in which the all-around plumber should, at least, be prepared to engage on demand. It is, therefore, essential that he know something of sheet metal working and the drafting of patterns. All these requirements greatly increase the field of the skilled worker in plumbing and household apparatus, and offer a higher rate of wages, with greater opportunities for advancement. It thus happens that the apprentice who avails himself of the courses of one of our great correspondence schools, not only fits himself for a greater degree of skill, but even shortens his apprenticeship.

The trade of gas-fitting has seen changes and advances similar to those experienced in other lines, which have raised the required standard above mere practical skill in connecting pipes and hanging fixtures into the realm of knowledge properly technical. In order to deal intelligently with constantly-recurring conditions of daily trade-experience, also, to fulfil the requirements in serviceable gas-supply systems, the up-to-date gas-fitter must understand the properties of gases, as also the advantages or disadvantages of the various descriptions of burners, pipes and fittings, and the best methods of using gas and gasoline in lighting, heating and cooking. In short, he must be thoroughly equipped to install the most suitable apparatus in every case, and to remedy defects in existing constructions. In addition, therefore, to being a skilled craftsman, he must have sufficient knowledge of the construction of buildings to enable him to overcome any structural difficulties, and to design systems of gas piping to meet all requirements.

Since the use of electric light is rapidly increasing, alike in public buildings, stores and dwellings, where it is often necessary to hang combination burners, the gas-fitter must have some knowledge of wire-hanging and connections, which should also enable him to wire call-bell systems and any other private electrical plants.

While the effect of modern methods and improvements in some trades and callings is to carry specialization to the greatest extreme, there are others in which the new conditions have ordained that several lines of work shall be included in one trade, because the objects sought in all are the same. Thus, one trade, as it were, overlaps another in numerous instances, where workmen are adequately skilful and properly informed. These facts are particularly evident in the several callings summed up under the general head of preparing and installing heating apparatus: the work on the several classes of heater being generally undertaken by the same persons. In general, hot air, hot-water and steam heaters involve similar problems of construction and operation, so far as concerns the conditions of providing sufficient drafts, requisite ventilation and fire-proof connections. At the present time all these matters are calculated with such mathematical accuracy that it is nearly obligatory that the practical steam-fitter and furnace man have some technical knowledge of the operative and sanitary bearings of his work. In considering the health and comfort of the inmates, as well as the adequacy of the plant to perform the work of heating a house, or the sufficiency of ventilating appliances, there can be no "approximate" calculations. Modern requirements are that the work should be done with the utmost possible exactitude. For these reasons alone the well-equipped steam-fitter or furnace man should have an intelligent understanding of the natural facts and principles involved in his work.

Thus it is apparent that in the construction of modern buildings, architects and builders reckon with the steam-fitter as well as with the mason, bricklayer, carpenter, and the plumber. Indeed, in great office buildings, hotels, factories, and other fire-proof structures, wood has been so largely superseded by steel that the carpenter has been relegated to the background, while the steam-fitter, with the ironworkers and other workers in fire-proof material, stands forward, a very important personage.

The membership of the United Association of Plumbers and Fitters numbers a little over 14,000. The association has 308 local organizations, which represents all the first and second class cities in the country, and the greater majority of cities whose inhabitants number as low as 8,000; and from nine to ten hours of labor are the rule. Where local unions are formed, the wages are usually raised within six months and the hours reduced. Working rules are changed, and, in fact, a uniform method of doing business is generally adopted after the formation of a union in any city.

Workers in Mid-Air

The steeple builder's calling was once classed as extraordinarily hazardous. Insurance companies considered him about as good a risk as a soldier in war time. Yet, steeple building, when compared to the conditions under which, or rather over which, men work on the modern skyscraper, becomes mere child's play. On the twentieth, twenty-fifth, twenty-ninth story, the bridgeman—as these toilers in mid-air are called—works face to face with eternity. One misstep, as he crosses on a steel beam from one steel pillar to another, and he would pitch down all the way to the foundation, as through an elevator shaft. For, as a rule, the men who rivet the steel frames together, work faster than masons, carpenters, bricklayers and others; hence, the stories are usually open most of the way down, the top of the steel frame often being completed before even the lower floors are laid. In such buildings only the most skilled workmen are employed, and as the frame grows higher, the number of bridgemen increases. By offers of steady employment, hundreds of bridgemen are induced to work thus over dry land instead of over water, as they do when at their regular work of bridge building. During the construction of some of New York's high buildings, bridgemen were brought from various parts of the country to finish the upper stories. Thus even the work on the towers of the new East River Bridge has been surpassed, in altitude and in point of danger, by that on New York's skyscrapers.

Oftentimes, after the buildings are finished, certain work of a dangerous character must be done. For this work volunteers are called. In the winter of 1901, the flagpole on a twenty-three story building needed repairing. A professional steeple-climber volunteered. Halyards had to be pulled through the top of the pole, the ball on which was 470 feet above the sidewalk. The climber ascended the pole by the use of spikes strapped to his boots, like those worn by telegraph linemen. He climbed sixty feet of smooth pole in less than fifteen minutes—then made himself a comfortable seat with a rope and board which he had taken up with him. In two hours his work was finished. Then, for the benefit of the spectators in the street below, who had watched his every movement, he climbed even to the top of the ball and balanced himself in a horizontal position, just to show what a man of nerve and health, but no imagination, can do. He received fifteen dollars for the job.

Stone masons, too, are obliged to perform dangerous tasks, in placing cap-stones on the towers of skyscrapers. They have frequently to stand on a ledge only a foot wide. Merely to balance one's self in such a place, at such an altitude, requires a level head, firm muscles and a good stomach; and to stoop down and lay a cap-stone, under such conditions—this is worth quintuple pay. Chimney climbing may also be classed among the most dangerous of modern callings. For this work two ladders are used. The climber ascends to the top round of the first ladder; then, as high up as he can reach, he drives an iron hook. On this hook he hangs ladder number two, climbs it, drives another hook—thus to the top. The most difficult part of the work consists in getting over the flaring rim of the chimney at the top. At this point in chimney climbing many lives have been lost. Sooner or later, bridgemen, "steeple-jacks," chimney "scalers," all who toil at great altitudes, lose their nerve. A few follow their hazardous calling perhaps for more than a decade, but the majority retire after the sixth or seventh year. The effect on the nervous system is such that oftentimes a workman succumbs suddenly, without warning, a pitiful wreck of his old self.

Bridge Building

Americans are accused by foreign manufacturers of building bridges and selling them "by the mile." Sixty thousand steel railroad bridges have been built in this country since 1880. The secret of the progress made in this industry lies in the use of steel. Many companies now take contracts to furnish a bridge complete, beginning the work with the ore as it comes from the mine, and turning the structure over to the owners on contract time ready for traffic. Seventeen years were required to build the first Brooklyn Bridge, ten years being spent in building the piers alone. This length of time was required because stone was used. The piers of the second East River Bridge, now building, being of steel, the completed structure will be ready for traffic probably by the end of 1905; the period of construction will last less than eight years instead of seventeen. In bridge building the parts are now duplicated in enormous quantities, owing largely to the machine processes which have replaced hand work.

The new East River Bridge, between New York and Brooklyn, is one of the greatest of bridges now under construction. Its centre or main span is a suspended structure, supported by four steel cables. These pass over steel towers, three hundred and thirty-five feet in height, and extend to masonry anchorages. The shore spans are of the truss type of construction, built in two lengths, with a central support. These shore spans are self-sustaining in every way, and are entirely unconnected with the cables, whose only duty is to carry the main or central span. The main span from centre to centre of towers measures sixteen hundred feet, and is one hundred and eighteen feet in width at the centre. The entire length of the bridge between the terminals is seventy-two hundred feet, and the minimum height of the bridge over mean high water for two hundred feet on either side of the centre of the main span is one hundred and thirty-five feet. The bridge furnishes two carriageways, each eighteen feet wide; four trolley tracks, each nine and one-half feet wide; two elevated railroad tracks, each eleven feet wide; two foot walks, each twelve feet wide, and two bicycle paths, each seven feet wide.

Bridgemen

The rapid increase in the demand for steel bridges has resulted in specializing the occupation of bridgemen. These workmen are trained in their perilous calling and follow no other. So expert do they become, so sure of foot and cool of head, that they seldom fall: and very proud they are of their skill. When being photographed, for example, they will take the greatest risks to show what a man can do when sitting on a beam two hundred feet above the water, with the wind blowing a gale. The "bridgeman" must be a good riveter and a fair mechanic. He is generally young, always sturdy and somewhat nomadic, as his work requires. To him a plank or a bar of steel is no narrower and no more dangerous to walk on three hundred feet in the air than on the ground. He handles ropes and rigging like a sailor, and climbs around in dangerous places, jumps from piece to piece, or slides down a rope or a ladder with the agility, quickness, and certainty of a monkey. Whether work is to be done on the ground or in the air is all one to him, and the rivet is driven home with a heavy sledge with as much facility and skill at the top of the tower as at its base. He is quick and sure of movement, and will toss and catch a red-hot rivet with the ease, and grace withal, of a baseball pitcher. He is a higher type of man and has more nerve than the "sand-hog," as the caisson worker in the river depths is called. The cat is no surer-footed.

There were an unusual number of high gales during the winter in which the towers of the new East River Bridge were completed. A gang of bridgemen was once caught in one of these gales on top of the Brooklyn tower. Now, no matter how mild it is on the ground it generally blows a gale on top of the towers, and on this occasion it blew at the rate of seventy miles an hour. Several loose planks of good size were blown to the ground like so many shavings. The men were there without any shelter, and braved out the storm, because it was the best, and indeed the only, thing to do. They clung to the cold steel at the risk of frozen hands, for the temperature was much below freezing. On the ground the storm was a heavy driving squall, with sufficient snow to fill the air and cover the pavement; up there it was little short of marvellous that those men could hold on as they did until the gale blew over. Not a soul grumbled or seemed to mind the frozen fingers; all were ready next day for another—if it should come. Some four or five of these brave bridgemen lost their lives by falling where to fall meant not merely to die, but to be mangled. A grand-nephew of Peter Cooper, a skilful and promising engineer and superintendent for the contractors for the towers and end spans, while directing the work, stepped backward to avoid a weight swinging from a derrick and fell vertically ninety feet to his death.

The bridgemen sometimes seem tediously slow in preparing to lash the material together or in preparing to handle great weights, but this is generally the slowness of security, and one feels greater confidence in work thus surely done when finally completed.

The Caisson Process for Bridge Foundations

The pneumatic, or caisson, process for sinking deep foundations was first used in this country in 1857, and has since been widely utilized, mostly for the foundations of great bridges and buildings. It is an extension of the methods used in the diving bell and the diving suit, and involves simple principles of physical science. A caisson is merely a box-cover resting on its edges with a load placed on its top sufficient to sink it, air being forced in to keep the water out and allow the men to work. The large caissons in this country are generally made of wood, for convenience in building and handling, and for economy. They are built on shore and launched like a flat boat; towed into position and weighed down with concrete or masonry to and into the bed of the river. The caissons of the new East River Bridge were sixty by seventy-six feet in area and were about twenty feet high when launched; a deck or roof near the middle of this height covered the working chamber for the men. At first the working chamber is filled with water; the air drives this out, the lower door of the lock is closed and men can enter through the upper door, which is then open. The men close the upper door on entering the lock and open a valve connecting the lock with the working chamber of the caisson; the air rushes into the lock and soon raises the pressure until it is equal to that in the chamber, when the lower door is opened to admit the men to the working chamber, while the upper door is held firmly shut by the pressure. This process is reversed in coming out.

The pressure must be equalized in the human body on entering as well as in coming out, and, of course, through the mouth, nostrils, and ears. The muscular effort of swallowing seems the best aid to this equalization by admitting air to the system more rapidly; holding the nose and blowing serves to distend the eardrums and tends to prevent their rupture, which sometimes occurs. Compressed air is stimulating and increases the respiration and the action of the heart. The air is heated by compression and is extremely moist; one perspires freely, and the clothing is frequently saturated, especially after exertion.

Some curious phenomena are observed. It is impossible to whistle at forty pounds pressure—should one fancy that amusement; one speaks through the nose and experiences difficulty in hearing; congestion of the lungs or brain sometimes occurs and sharp neuralgic pains are felt; accompanied often by vomiting and by bleeding at the nose, eyes, or ears; in extreme cases paralysis occurs. The effects are most felt in coming out, when the stimulation of the pressure is reduced, and the chill due to the expansion of the air and moist clothing reaches one's very bones. Those who suffer are generally relieved by going back again at once. The severity of the attacks increases with the amount of exposure and especially with the rapidity with which the pressure is applied or released. The ordinary precautions taken are to retard entrance and exit, the use of a warm wrap applied on reaching the outer air, and the avoidance of vigorous exercise or work at this time. Spare persons and those between the ages of eighteen and thirty endure the exposure best, while those with weak lungs or heart—especially the latter—or of intemperate habits, are most liable to suffer.

The "sand-hogs" (a name which the pressure men have given themselves) are sturdy, rough-and-tumble fellows, hardy, and generally inured to the work. They are nomadic, wandering over the country from one job to another, and are generally young and unmarried, and, too often, far from as temperate as the conditions of maximum efficiency require. Experience with this class of work and improvements in method have served to ameliorate the conditions under which it is done. With electric lights, it is no longer necessary to take the soot from increased combustion of lamps and candles into the lungs and stomach; the air is generally cooled to some extent artificially and the men pass rapidly, on emerging, to warm rooms, where they can have hot baths and dry clothes, with hot coffee as a valuable stimulant.

For reasons of economy, and to insure rapid completion, the work must be kept going continuously. The men never work more than eight hours in one day, three gangs being required for the full twenty-four hours. The time of working and rates of pay are determined by agreement with the men or with the "sand-hogs'" union. For depths of 55 feet or under they receive $2.50 for eight hours' work; from 55 to 70 feet, $2.75 for six hours' work; from 70 to 80 feet, $3.00 for two hours' work; from 80 to 90 feet, $3.25 for one and one-half hours' work; over 90 feet, $3.50 for one and one-half hours' work.

One seldom feels perfectly safe in compressed air, although conscious that everything possible has been done to make the caisson stanch. The machinery must be kept in order; the loading must be adequate; while the foremen, the men running the compressors, the lock-tenders, the "sand-hogs" themselves, must be assured men, faithful and vigilant. Accidents have occurred, and will occur, and the consciousness of this serves to make one cautious and, sometimes, nervous. But even with these drawbacks there are always brave and faithful men to be found ready to play their humble, though important, part in carrying these wonderful enterprises to successful completion.

TWISTING THE CABLES FOR THE NEW EAST RIVER BRIDGE

CHAPTER X

ELECTRICAL INDUSTRIES AND TRADES

General Conditions in the Electrical Industries—Electric Arc Lamps—Incandescent Electric Lights—Manufacture of Dynamos—Electric Motors—Storage Batteries—Talking Machines—Insulated Wires and Cables—Electrical Conduits—The Electrical Trades

General Conditions in the Electrical Industries

IT is becoming increasingly true that this is the age of electricity and electrical appliances in every branch of industry; not only in respect to the wonderful variety of devices being constantly produced, but also in the unprecedented rapidity of development in every branch. Scarcely twenty-five years ago, a noted electrician, speaking of the possibilities of electric motors, declared that they were unpractical, because sufficient current could not be generated commercially on a paying basis, and that they were "at least fifty times more expensive to maintain in action than the ordinary steam engine." At the present time such a statement is one of the curiosities of literature, since electrical motors are not only operated on an immensely more economical basis than steam engines, but their uses are practically unlimited in nearly every branch of industry. The same is true of electric lighting, telephony and a dozen other branches of electrical activity. A noted statistician, speaking of the development of telephony, says: "At the beginning of 1879-80 this business amounted to little or nothing; at the end of the year it represented one of the great interests of the country." The same statement, as has been often pointed out, is similarly true of the telegraph, of the dynamo generator, of electric lighting, of electric railway work, of electric power transmission, of the "storage," or secondary, battery, and of any one of the numerous minor contrivances in daily use. Also nearly every branch of manufacturing industry is being rapidly transformed by the use of electricity in one way or another; while the several concerns that make a specialty of producing electrical devices are among the strongest and most extensive in the country.

The annual production of wooden poles and crossarms for telegraph, telephone, power and electric lighting lines forms a large percentage of the lumber business of the United States, while the figures for iron and copper wire, iron and steel poles for trolley lines, and for glass and porcelain insulators and other electrical instruments, are similarly important factors in their several branches. Millions of pounds of bar iron and copper wire are used annually in electrical industries; most of it being in such diameters as render it useless for other purposes. An equally important product of the steel industry is the vast and increasing output of steel rails for trolley railway lines, the size and weight of which exceeds anything used on steam railroads; also, of the special frogs, switches, and rail bonds, designed to increase the conductivity at the joints, when serving as part of the return circuit. The total production of copper and steel parts, such as bars, rods, drop forgings, commutator segments, strips, etc., is immense, as is also that of insulated wire, from the finest diameters to the heaviest cables.

The departments of electro-metallurgy and electro-chemistry are rapidly coming to the front, and are literally transforming many independent industries. Practically all the copper mined in the United States, with the exception of a small portion from the Lake Superior region, is refined electrolytically.

The wonderful electrical production of aluminium is another important branch of the industry, which has resulted in vastly reducing the cost of this metal and opening up wider fields of usefulness. Aluminium wire, on account of its superior conductivity and smaller weight and cost, must eventually supplant copper as the leading form of electrical conductor. Electrolytically-produced aluminium reached as high a figure as 6,500,000 pounds in a recent year. Among the important electro-chemical products may be mentioned calcium carbide, the basic material for acetylene gas production; carborundum, a fusion of carbon and silicon, an artificial abrasive nearly equal to the diamond; and artificial graphite. The extent of these industries may be judged from the fact that about 35,000 horsepower at Niagara are used in electro-chemistry and electro-metallurgy; producing annually about 12,000 tons of calcium carbide and 1,400,000 pounds of artificial graphite, besides numerous other products of a more familiar nature.

To sum up briefly the present-day importance of electricity, it may be confidently asserted that it has invaded practically every branch of industry, except farming—although there, also, the near future will see a marked change, with the spread of facilities for current-transmission and the further perfection of simple motor appliances. Despite the fact, mentioned by several writers, that the ordinary citizen seldom purchases such familiar articles as electric light lamps and telephones—much less expects to own a trolley line of his own—the average annual income to the various branches of electrical industry and manufacture is seven dollars, of which an estimated expenditure of only seventy-five cents is for telephoning and about fifty cents for telegraphing. Of this high average fully seventy-five per cent goes for the purchase of articles which were impossible before the commercial perfection of the dynamo electrical generator, and would be still unattainable were the primary chemical battery still the sole source of current supply.

Up to 1902, more than 25,000 patents were issued on electrical contrivances in electric railways, motive power, lighting, telegraphy, telephony, signaling and generation. Thomas A. Edison heads the list of electrical inventors with 711 patents. Elihu Thomson follows with 394, Edward Weston with 274. Charles E. Scribner with 248, Charles J. Van Depoele with 244. Others exceeding one hundred patents each are: Rudolph M. Hunter, Rudolph Eickemeyer, Hiram S. Maxim and Sidney H. Short.

Although the output of the numerous manufacturers of electrical apparatus and supplies has reached a very large figure, it represents by no means the total of production. This is evidenced by the fact that the majority of corporations engaged in the numerous branches of electrical industry manufacture their own instruments and apparatus, as required. Thus telephone, electric lighting, power and transportation companies undertake to supply their own needs, and those of their customers, by maintaining large plants for the manufacture of necessary articles. Some other large concerns, those not primarily in any branch of electrical work, have successfully accomplished the task of producing their own plants complete, including dynamos, motors, cranes, travellers, and all necessary machinery, upon the installation of electricity in their establishments. Thus, a noted shipbuilding concern on the Pacific coast, which built the famous battleship "Oregon" and other United States men-of-war, recently equipped its yards with a complete electrical plant, using current for practically everything, from the propulsion of giant travelling cranes to the operation of hand tools, and made all appliances on the spot. Another evidence of the great activity of America in the field of electricity is that, while foreign nations have done excellent work both in inventing and producing all kinds of electrical contrivances, the importation of these articles is insignificant by the side of the constantly growing exports, which seem to be rapidly making our country the great electrical producer of the world. The total capital invested in electrical manufacturing and supply in the United States is at least $1,500,000,000.

Among the most recent developments in electric supply manufacture has been the establishment by several American companies of branch factories abroad. This is the outgrowth of large foreign business which seemed to demand a source of supply near at hand. These factories have been built and are run strictly on American ideas. The conversion of the London Metropolitan District Railway into a modern electric system with a complete outfit of American machinery first discovered to English eyes the American "invasion" of European markets. Glasgow, too, has in operation a complete electric railway plant with American-made equipment throughout. Electric street railways from American plants have gone, too, to South Africa, to Buenos Ayres, to Sydney, Australia, to Japan, and to Corea. American electricians have carried their lights to Hammerfest, in Norway, and to the lighthouse of the bleak coast of Punta Arentas, in Tierra del Fuego, the southermost continental point on the globe. They have lighted not only the depths of the Calumet and Hecla mines, but the heights as well of the Andes, 14,000 feet above the sea level.

Electric Arc Lamps

There are two varieties of electric lamps in common use—the arc lamp, operating generally on the principle of two pencils of carbon slightly separated, so as to permit a continuous electrical combustion, as the current jumps across the small break in the circuit, and incandescent lamps, in which a fine film of carbon or metal wire is heated to incandescence in a vacuum bulb. Of arc lights there are two familiar varieties, the open arc and the inclosed arc. The former represents the original type, as introduced by Brush, in which the current was supplied by direct-current dynamos to a series circuit. Previous to 1890 this type of lamp was operated by companies making it an exclusive specialty. But, with the growing use of the alternating dynamo, both arc and incandescent lamps came to be operated by the same companies on the same circuits, the superior range and flexibility of the current rendering combination of devices and consolidation of interests highly economical and practical. Among the difficulties attending the use of the various types of open-arc lamps, such as the Brush, was the great rapidity with which the carbons were consumed; the average for a 2,000 candlepower lamp being one inch per hour for the positive electrode and about one-half inch for the negative. Thus, particularly in the early period of their use, the expense for carbon supply and renewal was a very large one. The expedient of using narrow, flat carbons, so as to give the arc plenty of material to work upon, but little swing, was thus effected, while the difficulty from unsteadiness and flickering of the light was not obviated. Double carbon lamps were but little better than single. With the introduction of the alternating current, the end of economy in carbons was somewhat more closely approximated, on account of the fact that each pencil, being alternately positive or negative, was consumed more evenly and yielded a steadier light. However, the flickering still continued with currents having fewer than thirty-five periods or double reversals per second, while with seventy periods and over a disagreeable humming sound was produced. Consequently a frequency of sixty cycles was found most suitable under general conditions of service.

During the last decade the inclosed arc lamp has been introduced, and is steadily increasing in use and popularity, on account of the economy in the burning of carbon points, which with the older variety necessitated constant attention and renewal, also an enormous waste in half-burned carbon pencils. Indeed, the saving in these respects has been estimated as high as $12 or $15 per lamp per year. In this type of lamp the carbon points are housed in a small opalescent nearly air-tight globe, which, in turn, is inclosed in a tightly-fitting outer globe. The arc burns, therefore, in a rarefied and heated residual atmosphere of carbon monoxide and nitrogen, in which the consumption of the positive carbon is about one-twentieth inch, and of the negative about one-fiftieth inch per hour for a 2,000 candle-power lamp.

NAVAL CADETS AT PRACTICE—FIRING A TORPEDO

DRAWN BY H. REUTERDAHL

With the majority of inclosed arc lamps, also, alternating currents of high frequency are used, thus greatly promoting economy in the consumption of carbon. The alternating current is used with inclosed arc lamps in nearly 350 cities, while the direct current is limited to less than 75 cities. The inclosed arc has become practically universal.

Incandescent Electric Lights

Twenty-five or more factories in the United States turn out 90,000 incandescent lamps a day. The average life of an incandescent lamp is about 800 hours. Estimating that each lamp is used twelve hours a day, every lamp in the country has to be replaced at the end of every second month.

Incandescent electric lamps operate on a different principle from that embodied in the electric arc. Instead of involving the consumption of carbon, or any other substance in the atmosphere, the light is produced by passing the electric current through a filament of carbon or highly resistant metal suspended in a glass vacuum bulb. This theory involves further that smaller units may be employed than are possible with arc-light circuits—the average size of incandescent lamp being sixteen candlepower, while as small as one or two candlepower has been employed, and few above 100 or 150 candlepower. Lamps of 500 candlepower have been made, but their cost is greater in proportion than that of the arc lights, which average between 1,200 and 2,000 candlepower. By general understanding, the incandescent lamp finds its best use in furnishing small lights for domestic illumination of large halls, railroad stations, and factory buildings. Although most of the early incandescent lamp filaments were made of bamboo or paper carbon, specially prepared in a gas furnace, the prevalent method of manufacture at the present time is to squirt the pulp of the raw material into filamentary shape; then carefully carbonize it in a crucible, and finally "flash" it in a gasoline or other hydrocarbon vapor. In the course of the process graphitic carbon is deposited around the surface of the film, imparting the smooth and steely appearance, and developing sufficient resistance to produce the required candlepower of light, at the predetermined strength and pressure of current. The ends of the filament are joined to short lengths of platinum wire, which are sealed into the base of the bulb with plaster-of-Paris cement, so as to convey the current when brought into contact with the circuit terminals. The vacuum is produced within the bulb by a special form of pump, which, in connection with a chemical process, exhausts the air very rapidly, the time now required being only a few minutes, instead of several hours, as in former times. When the air has been exhausted and all "occluded" gases are worked out of the bulb and filament, the end of the bulb is "sealed off" under heat, leaving the familiar tip or point at its end.

The bulbs for incandescent lamps are blown in molds and are furnished to the lamp-maker direct from the glassworks. As at present produced, they are of approximately one shape, although there has been in the last few years some slight variation in both shape and size. They are made elongated, with an enlarged and rounded end, in order to allow for the familiar loops in the filament, which are intended to increase the light-giving brilliancy for a given size of bulb. A common form of filament is that looped up in the middle and "anchored" to the base of the bulb by a fine nickel wire, between the leading-in wires. In some lamps containing a double-looped filament, there are two anchor wires to the base. In lamps intended for illuminating street railway cars, or for use in other places where there is considerable vibration that might throw the incandescent filament against the glass, an anchor is inserted at the tip to hold it firmly in place. While the great majority of incandescent lamps are constructed to burn at a predetermined candlepower with a given strength of current, some of them are furnished with regulating devices, consisting of resistance steps arranged in the base, so as to control the strength of the current going on the filament. Others have two filaments, that may be thrown in or out of circuit alternately, thus permitting a regulation of the light by shifting the current from one on to the other. In the average run of lamps the proportion of light and current is about 4 watts to the candlepower, which is 64 watts to the ordinary lamp, and one electrical horsepower, or 746 watts, for every twelve lamps.

The usual sizes of lamps are the 4, 6, 8, 10, 16, 20, 32, 50, 100, and 150 candlepower, although out of about 25,000,000 lamps manufactured in 1902, over 21,000,000 were of the 16 candlepower size, leaving not quite 3,000,000 of lesser and about 1,200,000 of greater candlepower. The majority of the lamps of smaller power, which in recent years are being manufactured in increasingly large numbers, are of the minute sizes, used as call and circuit signals on telephone switchboards and also in surgical appliances for exploring the stomach and other cavities of the human body. The manufacture of the common types of incandescent lamps is conducted in ten of the United States. In 1902 New Jersey headed the list with an output of over 8,000,000, Ohio following with nearly 6,000,000. The manufacture of sockets, now mostly of the screw type, was conducted in four States, the total output reaching over 12,000,000, and representing a value of nearly $600,000. In addition to these figures, which represent the output for the common varieties of incandescent electric lamps, using a resistant filament or fine metal wire in a vacuum, there were manufactured in 1902 nearly 400,000 decorative miniature lamps, X-ray bulbs, vacuum tubes, etc., representing a total value little short of $73,000. Many of the latter kind of incandescent lamps have no filament, but obtain their illumination by virtue of the sparking across of the current between two metal plate terminals in a partial vacuum. Such are the familiar Geissler tubes, also the Crookes tubes used to produce the Roentgen rays. Other varieties have special gases to provide a material for illumination by the current.

In the Moore tube, liquid mercury inclosed in a vacuum forms the cathode, or negative pole, while the anode, or positive pole, is of iron, the vapor given forth from the mercury constituting a form of arc throughout the chamber, which may be several feet in length. Such tubes may be connected to either an alternating or direct current circuit. The final form of lamp, generally included in the incandescent series, is the Nernst, in which light is produced by passing the current through a small "glower" rod, composed of certain prepared earths. This rod is entirely non-conducting, when cold; its power to conduct current increasing with heat. Moreover it may be used virtually in the open air in an inclosed frosted globe. Ingenious devices are used to enable the current to pass until sufficient heat is produced to use the "glower," and the light has the advantage of being steady and remarkably pure and white. Such lamps are made in various sizes from 150 to 1,200 candlepower. The glower usually lasts through about 800 hours of steady service.

Manufacture of Dynamos

In the matter of dynamos the capacity for incandescent lighting in the United States is about 10,000,000 lamps of sixteen candlepower. All these lamps concentrated in one place would make a burning city seem a feeble light. Thousands of dynamos are turned out by the manufacturers annually, varying in capacity from the small dynamo of a few lamps to the great dynamos in central stations with a lamp capacity of twenty-five thousand.

During a recent year over 10,500 dynamo electrical generators, representing nearly 771,000 horsepower, were manufactured in twenty States of the Union; over 9,000 representing a total of nearly 429,000 horsepower, being of the direct or continuous-current type, and about 1,300 representing about 342,000 horsepower, being alternators. The total value represented was nearly $10,500,000, of which over sixty per cent was for direct current machines. According to these figures, the average total horsepower per dynamo was about 73, representing, however, averages of 245 horsepower for alternators, and about 47 horsepower for continuous current generators. The reason for this apparent discrepancy is that alternating-current dynamos represent the bulk of the larger electrical units from the reasons that their current is more flexible, hence better suited for most purposes, such as lighting and power transmission, and that, with the use of transformers, it can also be carried a far greater distance for power purposes than is possible with that from a direct-current dynamo.

The steady development of the alternating-current dynamo, since its commercial introduction in 1885, has been constantly raising the figures for quantity and pressure of current generated, also for the distances to which it may be conducted. In these respects the direct-current machine has long since reached the limit of its capacity, since, unlike the alternator, it may not be operated in connection with transformers for modifying the voltage. Furthermore, since the introduction of two-phase and three-phase currents, the superiority of the alternator is still further accentuated. In the vast power plant at Niagara Falls the great dynamos first installed were each of 5,000 horsepower capacity, generating a two-phase current at 2,200 volts, which may be "stepped up" to 11,000 or 22,000 volts, by the use of transformers, according to the length and other requirements of the line. Latterly, several 10,000 horsepower machines have been installed, which generate a current at a potential of 12,000 volts, entirely dispensing with the "raising" transformers, unless a higher voltage is desired. They also greatly contribute to saving the initial cost of the plant, lowering the average figure per horsepower from $14 to $7. Even the dynamos used on the Canadian side of the falls are made in the United States. With the development of dynamos has come a corresponding movement toward consolidation of interests and uniformity of plants and powers in the several branches of electrical industry. Thus the sharp rivalry between electric lighting companies using arc lamps and those using the incandescent type has been largely overcome.

Electric Motors

The electric motor is one of the most important factors in modern industry, not only because of the scientific and mechanical principles involved in its construction and operation, which vastly reduce the cost of power, but also because of the fact that it is rapidly revolutionizing numerous branches of manufacture, in which, heretofore, the problem of economical small power units and of shaft transmissions have been always present. Strangely enough, the electric motor was known in virtually the same form as we have it to-day, many years before electric current could be produced economically in sufficient quantity to operate it. Only within comparatively few years was the discovery made that it is "reversible"—that is to say, that by rotating its armature mechanically it can become a generator of the current that would cause operation, if introduced into its field windings from an external source. As a general rule, the difference between a motor and dynamo is that in the latter the armature brushes have a "backward lead," while in the former, they have a "forward lead"; the difference in operation depending principally on the position of the diameter of commutation, in relation to the vertical.

Storage Batteries

The electrical storage battery, also known as the secondary battery and accumulator, is one of the most indispensable apparatus in use at the present time. The objects for which it is employed are also numerous and varied. Strictly speaking, it is incorrect to describe this instrument as a storage battery, since, as is obvious, electrical energy, or any other form of power, may not be stored or boxed up like some material substance. The term "secondary battery" is the correct one, since it correctly describes the true operations involved, which consist, briefly, in so altering the chemical composition of two metal electrodes in an electrolytic liquid, by the passage of an electric current, that a difference of electrical potential is created between them, capable of producing a current so soon as the outside circuit is closed.

In the average sizes of storage cell there are as many as from fifteen to twenty-three plates in a single reservoir, one more negative than positive. The pressure at full charge is 2.2 volts, while close to the end of its working range, 1.8 volts. The output is measured in ampere-hours, the amperage being measured by the size and number of the contained plates. On account of the great weight of the lead-lead cells, various improvements have been devised and tried to a greater or less extent; among them being the lead-zinc, lead-copper, alkaline-zincate, iron-nickel, etc., although to the present time the lead-lead type holds the field practically undisputed. Storage batteries are used for supplying current to the motors of automobiles, electric launches and on some few electric street cars, as well as for special work, such as supplying "central energy," in modern telephone exchange stations. By far their greatest use, however, is in the large units for electric light and power stations, where they facilitate the work of supplying currents, also equalizing the load in cases of exceptional demand. In several railroad yards large storage batteries supply current for hauling passenger trains from the depot through tunnels or over bridges. One such battery consists of 320 cells of fifty-one plates each and has a constant capacity of 1,520 amperes at the hour rate of discharge. The total annual output of storage batteries in six States manufacturing them is over 11,000,000, representing a value of nearly $2,600,000.

Talking Machines

Machines for reproducing the sounds of the human voice, music, etc., are manufactured on a large scale, and enjoy considerable popularity. There are three types of machine in familiar use, which between them represent 353 patents: the phonograph, invented by Edison in 1877; the graphophone, invented by C. A. Bell and C. S. Tainter, of Washington, D. C.; and the gramophone, invented by Emil Berliner, famous for his work in telephone transmitters. Although operating on the same general principles, the three machines differ in some special details of construction and operation.

In the earlier forms of phonograph a rotating cylinder mounted on a screw-threaded shaft, so as to be shifted endwise as it turned, was covered with a sheet of tinfoil. Upon this foil sheet rested a stylus, whose movements were controlled by a diaphragm, like that on a telephone transmitter, so as to make impressions of varying size, shape, and depth, according to the spoken words or musical sounds striking upon the diaphragm. These could be reproduced by shifting the cylinder and turning it again in the same direction. Among the first improvements made in this instrument was the substitution of materials more suitable than tinfoil to retain the sound records. At the present time the instrument is far different from that originally exhibited.

In the matter of the graphophone the primary distinguishing feature lay in the sound records, which were impressed upon sheets of paper coated with a prepared mixture of wax and paraffine, and took the form of irregular and varied line forms corresponding to the sound waves striking upon the diaphragm. Another innovation consisted in a revolving disk, which could be used instead of the familiar cylinder, the records being traced in a continuous spiral line from centre to circumference. Another notable improvement was a cylinder holder with a ball joint at one end so as to permit it to be easily tipped for slipping the hollow wax cylinder on or off, thus introducing the principle of interchangeable cylinders. Two diaphragms were used, one for recording, the other for reproducing the sounds.

Berliner's gramophone, while resembling the other machines in many essential particulars, has the revolving disk as the only surface provided for recording the sound. This disk is made of zinc, and, when under the recording diaphragm, is covered with an extremely thin coating of wax upon which the sound records are traced by the point of the stylus. When the record is complete the disk is placed in an etching bath, so that the record is permanently impressed upon its surface by the action of acid; after which it may be used for reproducing the sounds, or an indefinite number of electrotype reproductions can be made from it. Gramophones are produced solely for exhibition purposes, hence all recording is done at the factories, and only the reproducing diaphragms are supplied with the machines sold to the public.

The earlier phonographs were operated by a hand crank at the end of the cylinder shaft. Later types of both phonograph and graphophones were operated by foot pedals or clock work. At the present time all talking machines intended for exhibition purposes run with electric motors, the current being supplied from small primary batteries concealed in the case. Some of them have large brass horns for intensifying and spreading the sound, others, simple ear pieces at the end of rubber tubes. They are also manufactured in a number of styles from the highly finished concert machine to the simple nickel-in-the-slot variety, so familiar in public places. Indeed, they have proved through the twenty-five years since the first appearance of the phonograph a constantly and increasingly popular source of public amusement. During a recent year 151,400 complete talking machines were manufactured in seven States of the Union, the total value represented being over $1,240,000. In the same year also nearly 3,000,000 complete interchangeable records, cylinders and disks, were manufactured, with a total value of nearly $540,000. All other accessories, such as horns, stands, etc., represented a total value above $446,000. In this business nearly $3,500,000 invested capital is represented, while an average of one thousand wage-earners are kept constantly employed in the work of manufacture.

Insulated Wires and Cables

In the modern uses of electricity insulation is an increasingly important consideration. There are various methods and substances employed, according to special requirements. Previous to 1859 the nearly universal method was to wind wires with silk or cotton, in the manner still followed with the smaller sizes. In that year was introduced the process of braiding on the insulated thread, as on the handle of a horsewhip, which method is still followed in wires intended for interior work. The process of covering wires with gutta percha is based on the invention of Professor Durant, introduced in 1848, which consisted in applying a solution of gutta percha and chloroform to the surface. This invention marked the first step in the direction of submarine cable work; the first such cable, laid across the Mississippi River at St. Louis in 1847, having been a gutta percha-covered wire inclosed in a lead sheath. In interior electric light wiring where flexible conductors are frequently required, the wires have been variously insulated with rubber coated tape and with balata gum, the latter being an American expedient. Thus was combined an effectual insulation with perfect assurance against fire from the passage of currents. In the earlier forms of underground cables, as designed by Mr. Edison for his incandescent lamp circuits, the conducting wires were run through pipes with viscous material, also with rope, in order to keep the different lines separate. At the present time, cables intended for underground telephone lines consist of a number of wires, each insulated with paper wrappings—the two wires of each circuit being generally stranded together—and inclosed in a lead sheath. The underground cables for electric light and power lines are similarly constructed with lead sheaths, although the insulating material is chosen according to the work. In 1902, the value represented in the output of insulated wire, generally of the braided or rubber covered varieties, was over $22,000,000, the manufacture being conducted in eleven States.

Electrical Conduits

Although in the early days of the telegraph electrical science had not advanced sufficiently to permit the wires to be successfully placed underground, thus making success dependent upon stringing them overhead on pole lines, the tendency at the present day in all branches of the industry is to the use of conduits and to the abolishment of poles. With the advances in the science of insulation, telegraph and telephone wires were readily placed in underground conduits, but electrical authorities contended for a long time that high potential light and power circuits could not be successfully buried in similar fashion. None the less this has been done in many of the larger cities of the Union, including New York, and it may be confidently predicted that within a few years practically no aerial lines will be seen in any city. As is well known, Mr. Edison contended from the first introduction of incandescent electric lighting that the wires should be put underground; and this plan has been universally followed by the Edison companies. His conduits are what are known as "solid," from the fact that the circuit wires are inclosed in tube lengths, with a surrounding viscous insulating material, in which they are embedded. The tube lengths, constituting the conduit, are joined at "junction boxes," where the inclosed wires are suitably connected to those in the succeeding section. Another type of underground conduit is constructed on the "drawing-in" principle; the telephone, telegraph, electric lighting or power wires being suitably insulated with prepared paper or other substance, and inclosed in a lead sheath. The "cables" thus formed are reeled on huge spools and drawn in through underground conduits of earthenware, concrete or iron tubes and suitably spliced in frequent manholes. This is the nearly universal method with telephone lines.

The Electrical Trades

That electricity offers one of the most profitable fields of labor to-day is an established fact. Twenty years ago incandescent and arc lamps were not invented, the dynamo was just being shown in Vienna as a scientific experiment, but no practical use was suggested for it; the telephone was shown for the first time at the Centennial, and many people wondered that so erudite a man as Sir William Thomson, now Lord Kelvin, should pronounce in favor of its commercial value. Of all the commercial applications of electricity, the telegraph alone was then before the world. What is the state of things now? Briefly this: More than $1,500,000,000 are employed in it to-day, and these figures are being increased by $100,000,000 annually. Within a decade a large percentage of the steamboating, railroading, canal hauling, illumination, domestic lighting, heating and cooking, factory operations of all kinds, mining and metallurgy will be done by electricity.

This means the employment of men, and the engagement of experts. In what field is there a better opening? Moreover, there are many applications of electricity yet in an undeveloped state worthy of attention that will abundantly repay any labor, study and time.

The advance of science and new methods in every branch of activity is so elevating the standard of intelligence in the general worker that, ere long, the great majority of "manual trades" will be entirely "skilled industries." In no connection is this fact more fully evident than in the domain of electrical science and its manifold practical applications, where it is rapidly becoming impossible for an unskilled mechanic to do aught but the most rudimentary work. It is not sufficient that the electrician understands that one wire, with an insulated winding of a certain color, must be attached to one terminal of a machine or transformer, while the other, wound with a different color, is secured to the other, or that he is sufficiently skilful to properly adjust the brushes of a dynamo, or to arrange the complicated wiring system of a power switchboard: he must have an intelligent understanding of constructional and operative theories of all devices employed in modern electrical work, so as to conduct their operation and remedy defects, as well as to keep abreast of the comet-like advance in all directions of electrical activity. Such requirements hold because every improvement in this line is in the direction of greater exactitude and more precise standards of measurement and regulation. The slipshod methods of former times are being utterly abandoned, and, each day, the movement is steadily in the direction of relegating even present achievements to the scrap heaps in view of the certain future attainment of still greater perfections. The increasing use of alternating and polyphase currents, together with the requirements of the modern power-house, with its highly-complicated generators and perfected engines, demands of the effective worker an exactitude of technical knowledge in his own branch, also a real expertness in steam engineering and general mechanics. Within scarcely more than twenty years the electrical motor has grown from a laboratory curiosity to a mighty factor in manufacture, travel and general industry; while with the electric light the experimental stage is already "prehistoric" in view of the immense variety and complexity of appliances employed.

To be more precise; the well-equipped electrician must have a knowledge of his apparatus that is, in some sense, commensurate with a physician's knowledge of the human body. The modern dynamo generator is, truly enough, the nearest approach to an organism that science has yet produced. The slightest inaccuracy in construction or the most minute disarrangement of parts impairs its effective operation, almost amazingly. It also has its "diseases," the causes of which only an expert can discover and remove. Dynamos and motors, like living things, cannot be tended and regulated on set rules—they require "sympathetic understanding." Furthermore, the various species of these machines, open-coil and closed-coil, series-wound or shunt-wound, direct-current, or alternating-current, represent so many distinct theories to be mastered and so many diverse constructions to be understood. The every-day duties in voltage and current-regulation present situations requiring trained judgment, even in manipulating mechanical switching devices and reading the records of mechanical gauges and metres. When the electrical worker has to deal with such matters as inductance, impedance, phase, frequency, or with such devices as transformers, converters, accumulators, fuses, and the various kinds of "coils" and circuit attachments, he must know what he is doing, also "why" and "when," or else learn by unfortunate and expensive experiences.

While every electrical worker must understand the general principles of construction and operation, he must needs specialize, according to the distinct trade or industry he is to follow—whether such be electric lighting, railroading, telephony or simple power-house work. Each one of these embodies a multitude of special and peculiar conditions and situations, which the competent operator must understand, or fail. In even the apparently simple operation of interior wiring, the mechanical details of connecting, attaching, insulating, etc., must be executed with reference to questions of safety from fire, as well as to the peculiar kind of apparatus to be supplied, or the strength of the current to be carried. In short, the steadily-increasing requirement, in every branch of the industry, is that even extensive technical knowledge shall be combined with practical expertness.

CHAPTER XI

LIGHT, POWER, AND HEATING APPARATUS

Electric Lighting—The Gas Industry—Power Employed in Manufactures—Steam Power—Gas Power—Water Power—Electric Power—Stoves and Heating Apparatus—Electric Heating

Electric Lighting

THE furnishing of electrical supplies for power and lighting purposes has become concentrated into the hands of a few companies. This is probably due, at least in part, to the extremely rapid development of the industry and to the fact that the swift changes in machines and apparatus often consign the wonders of yesterday to the scrap heap. The capital required is also larger, because of the fact that the supply companies have a by no means small financial interest in many of the light and power plants to which the supplies are furnished. Concerns like these are known as "parent" companies. In the matter of supplies for electric light establishments, America leads all countries. We have about 2,500 local electric light companies here, against less than two hundred in Great Britain. While only about thirty-five millions of dollars is invested across the water, nearly ten times that amount is invested in this country. New York companies alone carry a capital equal to the whole amount invested in the British Isles.

Among the principal "parent" companies engaged in electric light manufactures—arc and incandescent lamps—are the General Electric, Westinghouse, Fort Wayne, Excelsior, Brush, Standard, and Western Electric. The business of the General Electric furnishes an example of the magnitude of the operations in this field. This company has over one thousand central stations, supplying about one hundred and fifty thousand arc lights. Its capital is nearly $50,000,000, and its annual output has a value exceeding $15,000,000. The location of the principal offices and largest manufacturing plant of the company, at Schenectady, New York, was determined by a chance look from a car window. One of Mr. Edison's agents, in passing Schenectady in a train, noticed two large unoccupied factory buildings lying to the west of the New York Central tracks, which had been erected for a locomotive plant but never occupied. At that time the various electrical and mechanical companies in which Mr. Edison was the leading spirit were located in or near New York. As Mr. Edison and those associated with him in his various manufacturing enterprises were anxious to get out of the metropolis as quickly as possible, and as these buildings offered a chance for quick removal, the agent left the train at the next station, returned to Schenectady, and arranged for the purchase of the buildings. The plant at Schenectady now employs nearly eight thousand persons. The new iron foundry is the largest and best equipped gray-iron foundry in the United States, and contains over three acres of floor space, while the machine shop has over four acres. The present floor space of all the factory buildings of the company, including the great plants at Lynn, Massachusetts, and at Harrison, New Jersey, is approximately fifty-seven acres. In 1900 the company received orders for $27,969,541 worth of electrical apparatus and supplies. This covered orders for over 350,000 horsepower of alternating and direct current generators and more than 600,000 horsepower of electric motors and transformers for various uses. It also included orders for over 12,000,000 incandescent lamps, about one-half the present annual production of the United States. Sixteen years ago the sixteen-candlepower lamps sold for one dollar each; now they may be bought for twenty cents.

In addition to the parent electric light companies, there are a great number of local or suborganizations. Such is the Chicago Edison Company, with its many central stations. This company is, indeed, one of the largest companies supplying electric light and power in the world. The largest central electric lighting station in the world is the New York Edison Company, which generates 130,000 horsepower of electric current. The Electric and Manufacturing Company (part of the Westinghouse interests) is one of the leading concerns in the electric industry of America. At its plant in East Pittsburg, sixty-five hundred workmen are employed, and the output of this immense establishment is used in every country in the world. Many of the large electrical undertakings of the last few years were made possible by the fact that this company was in a position to construct and install the apparatus necessary to make such enterprises a success. Among these may be mentioned the great electric power transmission plant at Niagara Falls, for which this company furnished the largest electric generators that had ever been constructed.

An important division of the electric light business includes "isolated" or private plants, such as are used in great hotels, factories, mines, department stores, theatres, and docks. There are probably not less than ten thousand such plants in operation.

The building of motors and other apparatus for power is part of the work in every plant where lighting apparatus is manufactured.

The following table gives the total number of electric light plants in the United States, the total investment, and the value of product:

	ELECTRIC LIGHT PLANTS	
	Private	*Municipal*
Number in the United States	2,572	460
Total investment in all plants in the United States	$265,181,920	$12,902,677
Value of product in all plants in the United States	56,490,652	3,531,605

The Gas Industry

The gas man hath his victories no less than the electrician. The battles in this instance have been won with gas stoves, gas engines, gas radiators, patent burners, and other mechanical devices for the utilization of gaseous fuel. These saved the day for the gas men at the very hour when it seemed that a surrender to the electrician was inevitable. And so it comes to pass that gas plants have no fear of neighboring electric light plants, since they can sell fully fifty per cent of their product for fuel, a field which for electricity has been won only in part. It is said that the invention of Auer von Welsbach of Vienna has so reduced the cost of gas per unit of illumination that only the stars and the moon are cheaper. Figures furnish the proof that though electricity is now "the light of the world," in the dark and the cold corners of the country gas still finds a welcome. The inhabitants of the United States burn annually at least $75,000,000 worth of gas, this being about the amount paid to the gas companies throughout the country. In some cities, notably Philadelphia, Wheeling, West Virginia; Richmond and Charlottesville, Virginia; and Hamilton, Ohio, the gas plants are the property of the municipality. The number of premises throughout the country supplied with gas is about 2,000,000, including of course many premises, such as hotels and clubs, which use electricity, but have gas connections to use in time of trouble with the dynamo. It is a curious fact that in the whole State of Massachusetts there are fewer premises supplied with gas than in the single city of Philadelphia, the Bay State having about 140,000 gas-lighted premises and the Quaker City 150,000.

There is a tendency among gas men to combine, forming "parent" companies, which own and operate a number of plants in different cities. A capital of $567,000,000 is invested in the manufacture of gas in nearly 900 establishments in the United States. This sum represents the value of land, buildings, machinery, tools, and implements, and the live capital utilized, but does not include the capital stock of any of the manufacturing corporations engaged in this industry. The census shows an increase in the last ten years of eighteen per cent in the number of establishments. The increase in the number of cubic feet of gas consumed was 83 per cent. The average product per establishment has risen within the last ten years from 50,000,000 cubic feet to 76,000,000 cubic feet, an average increase of 55 per cent per establishment.

In the manufacture of gas, oil is the chief of the materials employed. Both crude and refined oil is used. Its cost represents thirty-nine per cent of the total outlay for materials. More than seventy-five per cent of the gas is water-gas. In the manufacture of this kind, hard coal, coke and oil are all employed, the water-gas plant having the advantage of a smaller expenditure for labor. The illuminating power of water-gas is higher than that of coal gas. The cost of transportation affects the price of coal and oil, and the qualities vary in different sections. The prices range from $0.832

per 1,000 cubic feet in Pennsylvania, under normal conditions, to $4.50 in Nevada. This represents the average prices of all manufactured gas, both fuel and illuminating. In Idaho, Indian Territory and Oklahoma gas is not manufactured. About twenty-seven per cent of the total quantity of gas sold in the United States is consumed in New York City. The amount used there is staggering, the figures being 18,180,821,125 cubic feet. The average price is $0.905 per 1,000 feet, making an aggregate expenditure of $16,457,822.

The development of the illuminating gas industry was slow. The introduction of this form of light was opposed on the ground that the erection of gas works and the distribution of the product endangered health. But the opposition was finally overcome and cities were lighted by gas. The first gas was made from coal with an illuminating value of fifteen to seventeen candle-power. Kerosene and improved lamps greatly retarded its general use. But the discovery of the production of gas from water solved the problem. The water-gas industry is purely American. This gas is manufactured according to the methods of Dumotay and Lowe, by a process in which hydrogen and the oxides of carbon produced by the action of steam upon carbon at a high temperature, are mixed and then combined with richly carburetted gases, usually from petroleum, thus producing the power of illumination.

The rivalry of electricity proved a blessing in disguise, for it forced the finding of other uses for gas than those of illumination. The introduction of gas stoves for cooking and heating, and the growth of the use of gas engines, have been of great benefit to gas production. The patent mantle enables gas to compete with electricity as an illuminant, and has acted as a great stimulus to the gas industry. In spite of electricity the consumption of gas is constantly increasing.

The following table gives the total number of gas plants in the United States, the total investment, and value of product:

	GAS WORKS	
	Private	*Municipal*
Number in the United States	877	14
Total investment in all plants in the United States	$567,000,000	$1,918,120
Value of product in all plants in the United States	75,716,000	487,355

Power Employed in Manufactures

The average yearly aggregate of motive power used in all manufacturing industries in the United States is not quite 12,000,000 horsepower. Of this nearly 9,000,000 horsepower is supplied by steam engines; about 2,000,000 horsepower by water wheels; over 300,000 horsepower by electric motors; almost 200,000 by gas, gasoline and other internal-combustion engines; and something over 50,000 by other forms of power, principally compressed air. In addition to these figures, which deal chiefly with the output of local power plants, may be mentioned a further 320,000 horsepower, included under the general head of "rented power," about 200,000 horsepower being electrical. Of course, as is well understood, the electric current transmitted from the power station to the numerous shops and factories where it is used must be generated by either steam engines or water wheels operating dynamos. The above figures, however, take this fact into account, classifying power according to the immediate sources of the supply in any given case. The increase in all items is extremely rapid, since the application of power to supplying electric light and street railway circuits is constantly growing: 1,500,000 horsepower for the one and 1,000,000 horsepower for the other are very low average figures. Indeed, the power output for these purposes will at no distant date exceed that used for distinctively manufacturing industries. Another growing field of power application to work outside of industrial uses is in the great office buildings, which have been built in large numbers in all parts of the country during the last twelve or fifteen years. In one of these structures in New York City, having sixteen stories and over five hundred offices, there are three steam engines of a hundred and fifty horsepower and one of seventy-five horsepower, used to drive dynamos for electric lighting, etc.; four small engines, aggregating about fifty horsepower, for driving the ventilating fans; five pumping engines for operating the hydraulic elevators, aggregating 440 horsepower, giving a total of over 900 horsepower, a figure which is doubled and trebled in some later buildings.

Interesting figures have been published from time to time by the government showing the relative importance of the various manufacturing industries as power users. Thus, out of over 500,000 establishments in the United States using power of some kind, the highest average is for the iron and steel industry, which is about 2,500 horsepower per establishment. The paper and wood pulp industry is second with an average of about 1,000 horsepower per establishment, although some of the larger works alone use many times this amount of power. The cotton goods industry averages about 840 horsepower per establishment; the worsted goods, about 526; and all others, less than 200; leaving a grand average of not quite 67 horsepower per establishment for the twelve largest consumers of power.

Steam Power

In spite of the great increase of water wheels, electricity and gas engines as primary sources of power in industrial lines, the steam engine still holds first place, with nearly 9,000,000 horsepower out of about 12,000,000 for motors of all classes. Estimating the industrial importance of the various States by the amount of steam power consumed, we find that Pennsylvania leads, with a total of over 1,600,000 horsepower of engines. Ohio comes second, with about 760,000 horsepower; New York, third, with about 700,000; Massachusetts, fourth, with about 580,000; Illinois, fifth, with about 525,000; Indiana, sixth, with about 315,000. These six States represent more than half the entire steam power consumption of the country, leaving the remaining forty-five States and Territories with a total of less than 4,300,000 horsepower, or an average of about 95,000—the highest figure being less than 300,000 and the lowest about 660. According to the general industrial tendencies of the day toward large establishments, and also toward the electrical transmission of power from large central stations, we find that the use of larger steam engine units is the general characteristic of the time. This may be illustrated by average figures taken from several industries. For example, in the cotton industry the average capacity of the main engines is at present over 300 horsepower, as against less than 200 ten or twelve years ago; the average in iron and steel manufacture is now about 250, as against about 170 in the last decade. In all cases, however, the average is perceptibly lowered by the fact that the larger powered engines require several small auxiliary engines, to pump water, to operate mechanical stokers, to drive draught fans, to work coal and ash conveyers, and to perform numerous minor utilities. In the last few years there has been a marked tendency to employ electric motors for performing auxiliary functions in engine rooms, which will eventually bring the average of power nearer the true figure, although apparently reducing the number of engines in use.

Gas Power

The gas engine, or internal-combustion motor, driven by the explosive ignition of illuminating gas, gasoline vapor, or oil spray, is, practically speaking, a product of the last twenty years. Although undoubtedly destined to occupy in future a much larger field in every branch of industry, its present significance, as a conveniently maintained and easily operated source of power, is yet much below that of the steam engine. There are now about 15,000 gas and gasoline engines in actual use in the United States as sources of power for purely industrial purposes; the total horsepower represented being not far from 150,000, or an average of about ten horsepower per unit. As in the case of the steam engine, the tendency is steadily toward high units of power, but, since the majority of gas engines are used where only a moderate output is required, the average has shown no appreciable increase within recent years.

Water Power

Although, according to popular supposition, water power is rapidly yielding to steam, gas and electricity, for manufacturing establishments of all sizes, we find that it still represents about sixteen per cent of the power used in the United States, or nearly 2,000,000 horsepower. This figure would be largely increased, undoubtedly, should we consider the several large plants in which it is used as a primary source in the generation of electricity. Here, as also in the case of the steam engine, we find a steady tendency toward the use of larger wheels, which amply explains the fact that, with an increase in horsepower of about 464,000 in the last ten years, there has been a contemporaneous decrease in the actual number of wheels in use from something over 50,000 to about 39,000 for the entire country. The greatest horsepower for water wheels is reported for New York State, whose figure is 368,500, while Massachusetts comes second, with about 188,000; Maine, third, with less than 168,000, and New Hampshire, fourth, with about 113,000. No other State shows as high a total as 100,000 horsepower, the average for the remaining forty-seven States and Territories being about 19,000 horsepower. With the actual increase in water-power throughout the country has come a complete revolution in the methods and objects involved in its use. Thus, a large part of the increase of power per unit has been made possible by the turbine wheel, while its use for the generation of electricity has enabled the transmission of power for long distances and enabled the building of mills and factories at places distant from the banks of rivers or water courses. Another eminent cause of increased use of water for propelling machinery is found in the growth of the wood pulp paper industry, as in Maine, New Hampshire, and Wisconsin, while paper-making and cotton-milling afford the largest occasions for its consumption in Massachusetts and North Carolina. The various methods and conditions of applying water power to the generation of the electric current will be described under Electricity and Electrical Power.

Electric Power

The successful transmission of power by the electric current forms one of the greatest industrial advances of modern times. Its present vast importance can be no more than a suggestion of future possibilities, since it is entirely a product of the last twelve or fifteen years. Previous to that time little could be done in the line of transmitting electrical energy, since neither the dynamo nor the motor had been brought to sufficient perfection to render the project practical. At the present time the total of transmitted electric power for the whole country is very nearly 400,000 horsepower, which, with nearly 20,000 motors of various capacities in the general industrial and manufacturing establishments, gives an average of about twenty horsepower per motor, which is of course very high, considering the immense number of small motors and the comparatively few of large output. At the present time, the bulk of the motors operated from line circuits are used to propel street railway cars; hence those used for industrial purposes generally take current from electric lighting circuits, there being very few lines devoted solely to transmitting power electricity. Thus, the New York Edison Company reports about 60,000 motors on its lines, while in Boston something over 5,000 are in use. One element that has contributed immensely to the success and efficiency of power-transmission, particularly on long-distance lines, is the alternating-current generator. With the use of alternating and polyphase currents, lines may now be constructed over distances formerly considered prohibitive, while at the same time achieving the highest degree of economy. Nevertheless, at the present time, there are no alternating current motors used in street railway work, while in industrial lines not more than twenty-five per cent of the total number are of this variety.

The development of electric power transmission on a large scale has been contemporaneous with the vast increase in large waterpower plants in various parts of the country. These are interesting largely on account of the varying methods of using the water for operating the great turbine wheels attached to the dynamos. At Niagara Falls there are two distinct power stations, one below and one above the Horseshoe Falls. The former has its water conveyed by a long canal that taps the river above the falls, giving a head of about 215 feet at the works, situated in the gorge, and discharging the waste just below the first suspension bridge. The other power plant is about one and a quarter miles above the falls, having its generators at the surface and the water wheels in a pit 150 feet below the ground, supplied by a short service canal 250 feet wide at the mouth. The waste water from this wheel-pit is carried off through a tunnel 7,000 feet in length, with a dip of six feet in the thousand and emptying just below the first suspension bridge. It is at this station that the power for Buffalo and other adjacent cities is generated, the present capacity of the plant being about 100,000 horsepower, with an average of ninety-eight per cent efficiency in current of the actual horsepower at the shaft. On the Canadian side of the river are three dynamos of 10,000 horsepower each, the largest in the world, delivering current at a pressure of 12,000 volts, thus dispensing with transformers. The current generated at the Niagara power stations supplies power to a large variety of industries, among them the electric lighting and street railway systems of Buffalo and other cities, and several important chemical and general manufacturing establishments.

Stoves and Heating Apparatus

The stove is the particular enemy of poets and novelists—in books. The sage of New Haven, Donald G. Mitchell (Ik Marvel) in his "Reveries of a Bachelor," denounces the stove as wholly lacking in poetry, a monster of brutal realism. And then he eulogizes the open fireplace—long life to it! But as this is the age of materialism, the people spend only a few thousand dollars a year for poetry, and millions of dollars for stoves. Sales of stoves have actually fallen off of late, however, as the result of the hot water pipe and the steam radiator. In 1870 the number of stove factories exceeded the present number by about seventy-five, and the volume of business was more than ten millions of dollars greater than to-day. But, as inferred, the falling off in the amount of business keeps pace with the development in hot water and steam heating apparatus. The manufacture of cast iron radiators is now of necessity an important and rapidly growing industry. The largest plants of this kind are in Detroit and Buffalo. Stoves are still manufactured in twenty-five States. The most important associations in the stove world are the Stove Founders' National Defence Association, and the National Association of Stove Manufacturers. Committees from these associations hold meetings with a committee from the Iron Molders' Union every year, to agree upon wages of molders, to adjust differences, and avoid strikes. In three of the many stove and furnace factories of Detroit, twenty-five hundred persons are employed, and more than two hundred thousand stoves are turned out annually. The city is easily the greatest stove manufacturing centre in the world. Throughout the State of Michigan, too, stove making is one of the leading industries.

In connection with the matter of wages in the stove industry, an employer calls attention to the action of the workmen regarding the restriction of output. He says:

> The cost of manufacture is increasing, the volume of business is increasing, and the tendency is for shorter hours. One of the unusual features that is arising in our business is the action of the labor unions in limiting a man's earnings. The Metal Polishers' Union, for instance, have as one of the laws of their association, that if a polisher working on piece work earns more than $4 per day, he is fined $25 by the union. The Stove Mounters' Union we understand have placed a limit of $4.50 per day. This is to prevent "spoiling the job," as it is termed among the men. The majority of laboring men being poor workmen, they have the majority vote and are able to prevent the good workmen from earning all they can, and it is done undoubtedly for the general good as they see it—that if some good mechanic earned $8 in a day the company would claim that they were paying too much per piece and would want to reduce the price; therefore they place this limit on the day's earnings.

Stove manufacturers formed in 1886 a Stove Founders' National Defence Association, concerning which the following facts were given to the Industrial Commission by the secretary of the association:

> For more than thirty years prior to the organization of the Stove Founders' National Defence Association the stove manufacturers of the United States were at war with the Iron Molders' Union of North America. The latter organization, which is composed of stove and machinery molders, is one of the oldest and most powerful of the organizations representing manufacturing industries of a special character, and up to the year 1890 seemed to be specially devoted to promoting strife and disorder in the stove manufacturing industry. The large membership and the power to control the actions of a large percentage of the workmen who followed stove molding for a living, made them very arbitrary in their demands, which were enforced upon manufacturers individually and collectively without regard to the prevailing conditions. An individual manufacturer, to undertake to fight against an organization so powerful, courted defeat and inevitably the ruin of his business. The primary object of the defence association is to unite the manufacturers of stoves for their mutual protection against unjust and unlawful acts of their workmen, whether through the influence of labor organizations or otherwise.

Electric Heating

Heating by the electric current is one of the most recently developed, as well as one of the most economical applications of electricity. As has been frequently remarked, it seems strange that current, developed in a dynamo, operated by a steam engine, which, in turn, derives its power from the heat of a fire under its boiler, should be even practical by the side of heat directly developed from fire. It is none the less true that, for house heating, cooking and a variety of other uses, domestic and industrial, a very material saving is accomplished by using the electrical current, instead of coal. This is true because the current may be so precisely regulated that only the exact amount of heat required at any one time need be used, a result nearly impossible with the use of coal or gas. Furthermore, there is no waste through chimneys, draughts or flues, and no dirt or waste. Electrical heat is produced by passing the current through a highly resistant conductor, generally a coil of wire of iron or German silver, which is surrounded by or surrounds a non-inflammable heat-conducting substance. The heaters used on street railway cars are certain metallic conductors wound about porcelain tubes, or such wires encircling a narrow, flat grid-frame. In some of the later patterns of domestic heater metallic paint is fired upon strips of mica, which are grouped together, so as to form the required total area of heating surface. Domestic utensils of various kinds, such as coffee heaters, chafing-dishes, etc., are arranged with a heating coil, requiring only a connection to the nearest lamp socket. The heaters for electric cars are usually arranged in sets of four or six, and may be closely regulated by switches, so as to control either the number of heaters in use or the amount of current passed. According to practical averages obtained from the trolley cars of Boston, it costs about 2.25 cents per hour, or 40.5 cents per day of eighteen hours, to maintain a heat twenty-five degrees above atmosphere in a car having twelve windows, two doors and 850 cubic feet of space in the coldest weather. Such heaters, moreover, being arranged under the seats, are well out of the way, and involve no danger of fire and no trouble to maintain, as must follow with coal stoves.

Electric heaters are coming into increasingly general use in several manufacturing industries—notably hat making and cracker baking. In the latter manufacture the use of electrical heat is particularly desirable, in that it may be accurately regulated so that any precise degree of baking may be accomplished in a given time. In the manufacture of hats the same fact greatly facilitates the several processes, enabling the pressing irons to be kept at precisely the right temperature, without constant journeys back and forth from the gas furnaces, to renew the hot slugs. Also the low temperatures required in the coloring and sizing vats may be accurately maintained. At one hat factory in New Jersey, where about 250 electrical horsepower is used daily for heating purposes, the installation permits a saving of about two hundred dollars monthly for gas, and even with a one-third greater capacity uses only ten tons of coal per day, as against eight tons under the old régime.

Again, electric welding by heat of an arc is a familiar process in modern railroad work, and in other branches, permitting sections of track, tubing, etc., to be welded into practically one continuous piece. Another common form of electrical apparatus, somewhat similar to the heater, is the rheostat, whose function is to use resistance coils to regulate the current; its real object being not to generate heat, but to prevent too high a power of current before the danger point is reached. In 1900 twelve States produced a total of nearly 100,000 electrical heaters, representing a total value of nearly $1,200,000. Since that time, however, this branch of electricity has advanced so greatly that the next census will probably show an increase of several hundred per cent.

CHAPTER XII

LOCOMOTIVE AND CAR BUILDING INDUSTRIES

Development of the Vehicle Building Industry—Manufacture of Locomotives—Different Types of Locomotives—Compressed Air and Electric Locomotives—Locomotive Construction—Railroad and Street Cars—Steel Cars—Palace Cars

Development of the Vehicle Building Industry

IN EARLY Colonial days in America the inhabitants depended for land transportation entirely upon horses. Later on the native wagonwright began his labors, thus starting a line of evolution which has brought us the beautiful carriage, the strong yet graceful wagon, the wonderful locomotive, the luxurious palace car, the winged automobile and the silent bicycle of to-day. In the years before George Francis Train formally turned over the first spadeful of earth, thus beginning the work of construction on the first transcontinental railway, travellers from New York to the Pacific spent months en route. To-day the journey can be made in about four days, without change of cars, in a magnificent vestibuled train equipped with every luxury found in the best hotels—bathroom, barber shop, library, stenographer and typewriter, brass bedstead, running water, hot and cold, ping-pong table, observation and dining cars, and "smoker"—enjoying all while travelling at a speed of fifty miles an hour. More than two-thirds of a billion passengers are now annually carried in steam railroad cars of all kinds in the United States, together with more than a billion tons of freight. To meet this enormous "traffic," there are in actual use 38,000 locomotives—one for each five miles of railway—the same number of passenger, baggage and mail cars, and nearly 1,500,000 freight cars. Still greater is the number in use on street railways, where the introduction of electricity as motive power has created so great a demand for new cars that the capacity of every shop in the country is overtaxed. Moreover, we have the bicycle of a weight so slight that a man can lift it with his little finger and yet so strong that it can easily carry the rider hundreds of miles, almost without need of repair. We have, also, the wonderful self-propelling vehicles, some of which can travel at a greater speed than the fastest locomotives. For all these achievements in locomotion and vehicles for land transportation, credit is again due to the American manufacturer.

The building of railway locomotives is, for the most part, a separate and distinct industry, though a number of locomotives are built in railroad repair shops. The "iron horse" is properly placed in a group which embraces all classes of self-propelled and self-contained engines, including tractors, steam road rollers and motor vehicles. Traction engines are built largely in factories whose staple product is farm machinery; road rollers represent only a small part of the output of the various shops in which they are built; while motor vehicles are manufactured in bicycle factories and in shops devoted to making all kinds of machinery.

Manufacture of Locomotives

Railroads, as a rule, prefer to buy their locomotives from regular builders rather than to build them for themselves. There are twenty-eight locomotive plants in the country, the largest being the Baldwin Works of Philadelphia. Here nearly fourteen hundred locomotives, valued at $17,-000,000, were turned out, complete, in 1901; and even then some orders of the year were unfilled. This company does not give long credits, but expects that all engines will be paid for on completion of the contracts. A certain percentage, however, may be retained for a time as a guarantee against defects. The company owns the patents on a certain compound locomotive—The Vauclain—but beyond this owns rights on no other important feature of construction. The capacity of the works is four locomotives daily, or about thirteen hundred a year. The plant comprises thirty-three buildings, covers sixteen acres of ground, and contains machinery whose operation requires seven thousand horsepower. The principal departments run continually twenty-three hours a day, with a force of about 11,000 workmen, who labor in shifts of ten hours. The average weekly wages paid amount to $130,000. The floors of the workshops are calculated to support a live load of 350 pounds to the square foot, and here are manufactured locomotives of every variety, from the lightest, weighing 5,000 pounds, to the heaviest, weighing 225,000 pounds, some of the monsters having driving wheels 84½ inches in diameter. The aggregate capacity of the locomotive shops of the United States is over three thousand annually, affording employment for about twenty thousand men. The average price of a freight locomotive is from $9,000 to $10,000, and of a passenger locomotive from $8,000 to $9,000. Practically all the locomotives in the United States must be replaced about every twenty years, as that is the period of the natural life of this wonderful machine.

The total output of eight locomotive building companies, representing fifteen plants, for the year 1901, was 3,384. This is over seven per cent more than in 1900, and is the largest output for any one year since the making of locomotives began. Those built at the railroad shops are not included here. In detail, the figures for 1901 include one hundred and seventy geared, forty-five electric, and forty-four compressed air locomotives, besides three hundred for light service, such as mine or plantation work, or contractors' use.

Not all the locomotives manufactured in America are for American railroads. About ten per cent of the total number go abroad. In the case of the Baldwin Works, the foreign trade amounts to twenty-five per cent, most of the number being sent to England, Norway, Sweden, and Germany. China takes a few, and Russia has purchased a number for her trans-Siberian railway. France also has some American locomotives pulling her heavy trains. In fact, almost every country where railroads are in operation has at least a few of our railroad engines. Cuba and South America, which were among the earliest customers, are still buying here. Officials of foreign railways agree that the advantages possessed by American builders are, first, that American locomotives can be built at less cost than those made in Europe; second, that the wonderful capacity of the American plants is such that a very large order can be executed in a comparatively short time; third, that American locomotives are superior to the European in size, type, and detail.

Different Types of Locomotives

Of the 3,046 locomotives of all classes built in the United States in 1900, 2,774 represented the product of the twenty-eight construction establishments situated in various parts of the country, and 272, of the twenty-six railroad shops; the total value represented being nearly $30,400,000. Of this number 525 were exported to foreign countries. The advance in the locomotive industry in the decade ending 1900 is shown, not only in the increased numbers produced, but also in the advanced values, which average nearly $1,600 per engine over the rates charged for the same class of product in 1890. This latter fact is largely accounted for by the increased size and weight of locomotives within the ten years, due to the greater demands for speed and power in modern railroading, also, to the adoption of improved constructional and operative devices, such as larger and heavier boilers and compound cylinders, which, in turn, have necessitated the practical reconstruction of transportation systems throughout the Union—the laying of heavier and better-ballasted beds, and the building of cars of greater capacity. The carrying capacity of freight cars has grown from an average of 60,000 pounds to 100,000, made possible by the modern steel construction. At the same time the use of improved air-brakes has enabled an increase of speed far beyond the safety limit recognized in former times.

Most of the important improvements embodied in the up-to-date locomotive relate to superior facilities for the generation and use of higher pressures of steam, which involves perfected fire boxes, stronger boilers, and more efficient engines. Within the last thirty years the average steam pressure used on railroad locomotives has been raised from 130 to about 225 pounds per square inch, necessitating a coincident increase in the thickness of shell plates from about one-half inch to seven-eighths, as is common practice at the present time. The length and diameter of boilers is also greater than formerly. These improvements have necessitated others, most notably such as relate to the size of the fire box and the effective grate area. As may be readily understood, the space between the side frames, formerly ample for the required width of the fire box, is no longer sufficient to furnish the required grate area. As a consequence, several constructions have been successively adopted, each one an improvement in several particulars. Nearly the first one involved a new design in locomotives, in which the driving wheels were set ahead of the fire box, which was extended beyond their planes on both sides, and supported on a single pair of wheels of small diameter. Thus was produced an exceedingly effective type of engine, frequently seen at the present day, and especially adapted for high-speed passenger service. The Wootten fire box, designed to burn small sizes and low grades of anthracite coal, overcame the disadvantages of added width by placing the grate above the driving wheels, and extending the fire box beyond their outer edges on either side. The latest, and in many respects the most effective, locomotive fire box is of cylindrical corrugated form, a modification of the type used extensively with marine boilers. Although its use in railroad locomotives is so far limited, it combines the advantages of simple construction, complete preservation of the cylindrical shape of the boiler and entire absence of flat surfaces and of the troublesome and expensive stay bolts, required with every other kind of fire box. It may also be removed with comparative ease. So far as grate area is concerned, it is fully equal to the average obtained with other improved fire boxes, except the Wootten type, while additional effect may be obtained by increasing the length.

The introduction of the compounding principle to locomotive construction is an immensely valuable contribution to economy of steam consumption and increased tractive efficiency. According to repeated practical tests, the result of compounding in locomotives is to save between ten and twenty-five per cent of steam, under average conditions, although the added complication involves greater expenditure for maintenance and necessary repairs. The situation on compounding locomotives differs somewhat from that met in stationary engines, as the principal object sought is the generation of sufficient steam for utilizing, to best advantage, the weight on the driving wheels. As the hauling capacity of a locomotive depends upon its adhesion to the track, the weight on the driving wheels is the limiting factor in the problem of increased efficiency. At the present time the size and weight of locomotives have been increased almost to the limit of driving-wheel load, possible with tracks and bridges, as now constructed, consequently the aim must be to obtain the greatest efficiency with the minimum of admissible weight on the driving wheels. That this end is obtained by compounding is the verdict of numerous authorities, who claim that a heavier train can be hauled at a given speed by a compound locomotive than by a simple engine of the same class and weight; while, owing to the fact that boiler steam can be admitted direct to the low-pressure cylinders, it is possible to keep a heavy train moving on a grade where a simple engine would stop and stall. In addition to these operative advantages, the compound engine permits the consumption of a smaller quantity of steam in the cylinders than the simple engine of the same power efficiency, while the amount of water evaporated in doing a given amount of work is much less, making possible a slower rate of combustion, a milder exhaust and a consequent economy of fuel.

Although in stationary, and particularly in marine practice, the compounding principle has been applied in triple, and even quadruple, expansions, it has not been attempted in more than two stages in locomotive operation. There are two general classes of compound locomotives; those with two cylinders, one high-pressure and one low-pressure, and those with four cylinders, or two duplicate pairs of double-expansion cylinders. The two-cylinder, cross-compound locomotive, which is nearly the most popular type, approaches most closely in the design of frames and in general arrangements to the common type of single-expension engine. The low-pressure cylinder, however, being considerably larger than the high-pressure, in order to afford an increased piston area and a consequent uniformity of power impulse in both, involves departure from the balanced uniformity of both sides of the engine. Naturally enough, considerable difficulty is met, in designing the larger sizes and higher powers of locomotives, so as to adopt the necessary greater width to the available space between tracks. For this reason any one of the several types of four-cylinder compounds offers superior advantages. The first and most popular of these is the type in which the two cylinders of each pair are superposed, or in one vertical plane, their piston rods connecting to a common cross-head. The low-pressure cylinder is generally placed below, if its diameter is not so great as to cause interference with track fixtures, station platforms, etc., although, except in unusually large engines, this result would not be so imminent; the common demands of power being met by four cylinders of reasonable proportions. The shape of the side frames, also, has considerable bearing on the arrangement. A more recent arrangement for a four-cylinder, cross-compound locomotive is to place the four cylinders side by side in one horizontal plane, the low-pressure cylinders on the outside of frame and the high-pressure in the space between. There are then four cranks; those of the low-pressure pistons working on pins attached to forward driving wheels, and those of the high-pressure pistons working on crank pins formed on the rotating axle shaft. The foremost advantage of this arrangement is that an almost perfect balance is secured; since, as the axle cranks are set opposite to those on the driving wheels, the effect of a continuous drive is realized. Such an engine will also permit a maximum load on the driving wheels, without injury to the track, since there is no unbalanced rotating weight on the wheels tending to lift them or to exert uneven pressures upon the track. The tandem arrangement of compounded locomotive cylinders, in which the high and low pressure cylinders of each pair are set end to end, both pistons being upon a single common piston rod, has the advantages of allowing the use of larger low-pressure cylinders than are possible with any other form of compounding, also, of reducing the weight of the moving parts and enabling the maximum power efficiency from the steam. As authorities agree, the compounding principle, as applied to locomotives, will see an increasing use, if not universal adoption, in the future.

Recent years have seen other improvements in locomotive construction, such as an increased use of steel castings, both for the frames and for the driving wheel centres, both of which were formerly made of cast or wrought iron. This has greatly simplified the work of construction, and is an important improvement in a number of particulars, as involving greater endurance, with the larger sizes of locomotives, equipped with compound cylinders.

Compressed Air and Electric Locomotives

While steam still holds its place as the motive power on railroads, compressed air and electrical locomotives are used for several special purposes. Compressed air locomotives are used principally in mines and manufacturing buildings, where steam engines, with their constant generation of smoke and gases, would be dangerous or troublesome. The compressed air for propulsion is carried in tanks, at pressures between six and eight hundred pounds to the square inch, and is used in very much the same manner as steam in either single-expansion or compound cylinders. In the former type of air engine the usual pressures employed approximate one hundred pounds per square inch, while in the latter the initial pressure in the high-pressure cylinder ranges as high as eight hundred pounds. In 1900, there were manufactured fifty-five compressed air locomotives, most of them of small size and power, and aggregating a value of nearly $116,000, or somewhat over $2,000 each. The greater part of these was of the single-expansion type. No effort has been made to build air motors large enough for railroad use, although in a few instances they have been tried on street railway lines with indifferent success.

During 1900 there were manufactured at various shops throughout the country 155 electric locomotives, which is to say electrically-propelled tractors, not provided with accommodations for either passengers or freight. Most of these were built for use in mines, although a few of larger capacity were intended for railroad yard and switching service or for narrow gauge railways, with short runs. Like street railway cars, which are, of course, electrical locomotives provided with accommodations for passengers, most of the tractors included in the number mentioned above were operated from trolley line wires; very few of them being equipped with storage batteries, except such as were intended for use in large manufacturing plants.

Locomotive Construction

The time required to build a locomotive varies from two to three months, according to conditions of contract. The shortest time on record is eight days, a narrow gauge locomotive having been actually completed within that time. The four principal stages in the process of construction are: Boilers, cylinders, frames, wheels and other parts; assembling and erecting. Perhaps the most interesting stage is the last, that in which all the parts are assembled and erected. This is done at the Baldwin Works in a great shop two city squares long and one city square wide, where seventy locomotives may be erected simultaneously. Here a steel mastodon is picked up, suspended bodily from the ceiling, and run twenty or thirty miles—without moving an inch, of course—to make sure that all the parts are in working order. The striking feature about an American locomotive is its lack of frills or furbelows or decorations of any kind. Utility is the object kept in view by the builders, and the massive machine is burdened with not so much as one unnecessary screw or nut. An ordinary locomotive now has six or eight driving wheels, coupled. A freight locomotive weighs about one hundred tons, and a passenger locomotive about eighty tons.

The practical work of building locomotives is greatly facilitated by the use of highly efficient tools and machinery. The boilers, which are built in two sections, are formed throughout by machinery—the plates are raised on travelling cranes; all the holes are drilled in several plates at once by a multiple spindle driller, and the rivets are driven by steam hammers—no handling being required, except in joining together the two sections. Parts requiring flanging, such as dome rings, furnace doors, tube sheets, etc., are worked in one heat by hydraulic flanging presses. The cylinders are also bored and faced on one machine, which performs the two functions successively. In frames carrying high and low-pressure cylinders, with their valve chests, all are bored and then faced simultaneously. The saving of time and labor is further carried out by clamping together several coupling rods, or other parts, and planing and milling them at one operation; by planing and slotting several frames at the same time, and as one piece, and by forming and finishing the minor parts of the machinery.

The processes of assembling the parts and erecting the engine are facilitated by the use of large overhead travelling cranes, which can lift the engine, so as to expedite the placing of the wheels, after the cylinders and other parts have been attached to the frames, and for other required purposes; also, by delegating special departments of the work to particular shifts of men, each of which performs only its own allotted task and none other. The work is thus so greatly simplified that a complete engine has been built in eight days from the raw materials, while the process of assembling a locomotive complete for operation has been performed in twenty-four hours.

The adoption of the compounding principle in locomotive construction, with the involved increase in size and weight of the engines, has brought the demands of stoking the furnaces very nearly to the limit of a man's working capacity. The result is that, with further increase in these directions, it will be necessary to employ two firemen on every engine, or else, to use some kind of mechanical stoker. Experiments have justified the usefulness of machines for this work, although their use has not been sufficiently extended to warrant positive conclusions. One solution of the problem, which has been widely approved, particularly in the West and Southwest of the United States, is found in the use of oil for fuel. The advantages claimed are that the heating value of heavy oils is quite equal to that of the best coal, while the proper installation of the burners and appliances demands no modification of fire box construction than some slight rearrangements of the brick work. The method of using the oil is simple; consisting merely in injecting into the fire box a spray of oil and steam, which burns with an intense and steady heat.

The electric headlight is another recent improvement, widely used on Western railroads. The current is generated from a small dynamo, generally placed directly behind the smokestack, and driven by a direct connecting engine. The light produced in the arc lamp illuminates the track for a great distance ahead of the train.

Railroad and Street Cars

A curious chapter in the story of car building informs us that the style of railroad passenger cars used in the United States, and almost unknown in England, was invented by an Englishman. The very type which British railroad men declined as unsuitable Americans have developed to its present state of perfection. Now, American car builders tell us that the English compartment car is doomed; that it is to be displaced by the American car with its centre aisle. In meeting the demand for railroad and street cars, the car building industry has grown to enormous proportions. It is called upon not only to make good the wear on fully a million and a half of railroad cars, but to provide for the growth of traffic on two hundred thousand miles of road. New mileage demanding new equipment furnishes also a great market.

During the year 1901 the various car-building works in the United States produced, altogether, nearly 150,000 cars of all kinds, the largest output for any one year, and 20,000 more than the output for 1900. The classes represented were 130,000 freight, 2,000 passenger, and 4,700 street cars for use in this country; and about 5,000 cars for export. These figures, of course, do not include cars built by railroads at their own shops, such as those of the Pennsylvania Railroad, which have a capacity of about thirty cars a day. This corporation not only builds in its own shops two thousand cars a year to replace those destroyed or put out of commission, but also repairs its own cars to the number of fifty or sixty thousand annually.

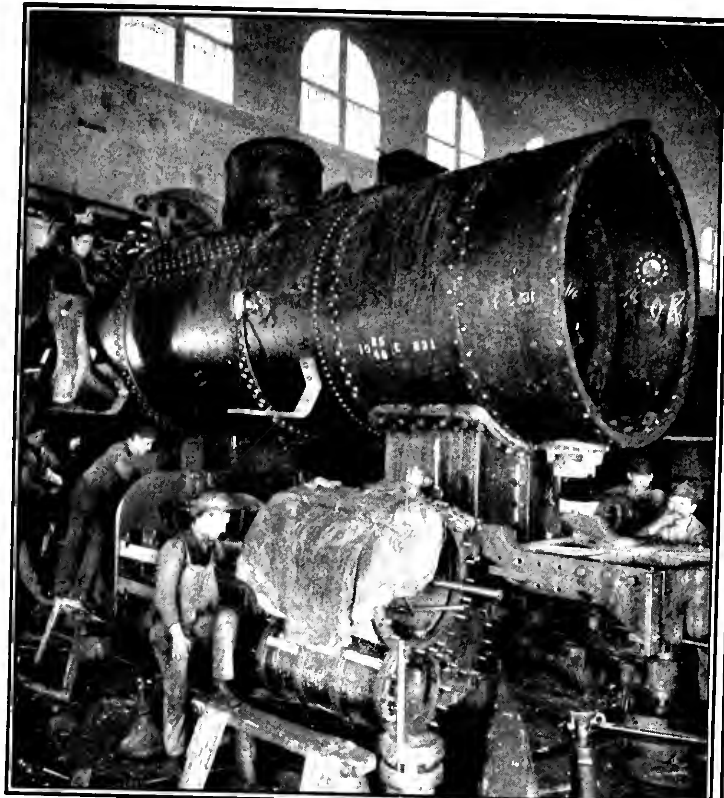
Although the constantly increasing traffic in this country rapidly absorbs the products of all the car shops, manufacturers are making every attempt to enlarge their plants with a view to supplying the already immense foreign demand for American cars. The exports of passenger and freight cars for steam railroads, in 1900, were valued at $2,600,000.

Mexico, the largest customer, bought cars to the value of $700,000; exports of cars to Egypt and Canada amounted to $400,000 each; and to France, to $280,000.

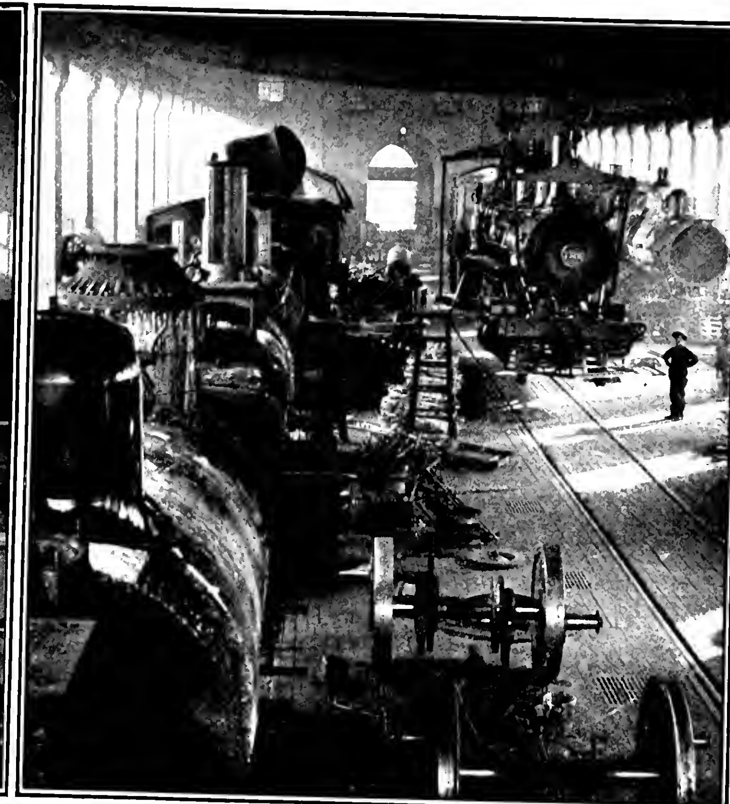
Cars built for street railways outnumber "passenger" cars more than two to one. It is here, with the rapid growth of street car lines, that car building has shown its most striking development—especially striking, since we have passed, almost with a bound, from the dancing little horse cars to luxurious electric cars, comparable in size, weight, and steadiness with railroad parlor cars.

Conventional designs in railroad and street cars, all fashioned after one pattern, have long been abandoned. In nothing in the construction line is more variety evinced. The cut-and-dried formality of the old and often uncomfortable cars has vanished. There are open cars for summer, the delight of those taking excursions, allowing the passengers all the bracing effect of the open air, which acts like a tonic upon jaded nerves. For the winter there are closed cars with electric heaters. Mail cars are frequently seen upon trolley lines, in addition to baggage cars and cars adapted for the suburban freight business. Private parties may hire parlor cars, and the observation car permits a view of scenery. Even snow-sweeping and water-sprinkling is done by cars. In the case of open cars, provision is made for protection from storms by adjustable side-curtains, which may be lowered upon emergency. A style of convertible car is also in use on some roads with a centre aisle and sliding panels and sashes. When the necessity arises the car may quickly be transformed into a closed one. Very large, heavy cars have been made for long suburban lines. Some of them are forty feet long, weigh more than fifteen tons, and are capable of seating seventy-two people. There are such cars on the line between Buffalo, Niagara Falls and Lockport, which attain a speed of fifty miles an hour, being easily controlled by air-brakes.

Among the problems, particularly trying in the earlier days of railroad car manufacture, were those relating to ventilation, lighting, heating and general safety to passengers and employés. Ventilation has always demanded serious consideration, for the reason that a steady supply of fresh air must be provided, without admitting cinders, dust, smoke and gases from the locomotive. Despite the large number and variety of expedients designed to meet the need, no finality has been reached to the present time. In the point of securing a cool, safe and satisfactory light, the Pintsch oil gas storage system is nearly the most popular, being employed on nearly all steam passenger coaches at the present day. The Miller automatic coupler and buffer platform, patented in 1867, was for many years in nearly universal use, on account of combining safety in coupling and running trains, with ease in travel. The Pullman vestibule platform has added further advantages; securing the safety of passengers going from car to car, and also providing a buffing effect above and below, to the reduction of vibration and the prevention of telescoping. Freight cars have been similarly



LOCOMOTIVE CONSTRUCTION



LIFTING A LOCOMOTIVE IN THE CONSTRUCTION SHOP

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improved by devices insuring the safety of delicate and perishable cargoes, to such an extent that at present special cars are provided to suit the requirements of different classes of freight: refrigerator cars being among the best known. By virtue of the combinations between independent railroad companies, it is now possible to transport any kind of goods in special cars, without change, to the greatest desired distances, and at the lowest cost. These elements have contributed to increase trade and have raised the importance of railroading to the highest point.

Steel Cars

The rapid growth of the steel car industry has been phenomenal. The largest single consumer of steel in the world is the pressed steel car company, at Pittsburg, which uses 1,600 tons of steel a day. Of the 137,000 cars built in 1901 for freight service, 28,000 were either all steel or had steel under-structure. About one thousand of these were sent abroad. The manufacture of this type of car is a new industry. In 1897 there was not a steel car in the country. The leading company before referred to as engaged in their manufacture uses a thousand tons of steel a day and employs ten thousand men, turning out over a hundred cars every day in a vain effort to keep up with the demand. The value of the year's output of this company exceeds $12,000,000. The steel freight car, especially, is a marvel of its kind. For instance, it enables a man to do ten hours' work in one minute, involving for proof a problem in arithmetic: whereas it takes seven men forty-five minutes to unload twenty-five tons from a wooden car, one man can unload twice that amount in one minute from a steel car. The force of gravity, rather than manual labor, does the work. Ore, coke, gravel, broken stone, loose material of any kind, can be dumped from a steel car while it is in motion, even while the train is speeding along at the rate of ten, twenty, or thirty miles an hour. One man, by the aid of compressed air, can discharge any of the cars at will. For this reason they are put to valuable use in ballasting, the spreading being regulated by the speed of the train. Even freezing of the material does not delay dumping operations. These cars are expected to last twice as long as cars of wood.

Palace Cars

In 1865 was completed the "Pioneer," the first palace car of the many thousands now owned by the Pullman corporation and operated under contracts with railroads. For many years the Pullman shops were located in different cities; but the business developed to such an extent that in 1879 Mr. Pullman decided to build a plant on a far greater scale than then existed, and to concentrate the principal manufacturing departments. The branch shops were maintained, however, though all except the one at Detroit are now used for repairing only. To carry out this plan Mr. Pullman purchased a large tract of land near Chicago.

The enormous extent of the operations of this corporation is best set forth in figures. The shops have a capacity for turning out each week three sleeping cars, twelve passenger cars, three hundred freight cars, and twenty street cars. The number of passengers carried on Pullman cars during a single year is nearly 10,000,000. The number of miles run yearly is about 300,000,000. The total mileage of railways covered by contracts for the operation of the company's cars is 165,000. The longest regular unbroken run of any cars in the Pullman service is from Washington to San Francisco, 3,626 miles. The average number of names on the payrolls at Pullman is about 6,500, the wages paid amounting to about $4,000,000 annually, making an average of more than $600 for each person employed.

The total number of persons in the employ of the company the country over, in all departments, is nearly 18,000, and the total wages paid yearly amount to nearly $10,000,000.

The purpose of the town of Pullman was to give such employés as chose to live in it dwellings of varying sizes and accommodations, well built and kept in good repair, and possessing perfect sanitary facilities. As the company retains the ownership and control of the place, it is able at all times to present object lessons in cleanliness and order, which exert influences for good upon the workmen. Homes are not sold to workingmen within the town limits, thus avoiding the introduction of elements injurious to the company's project. The area of the town, however, is so limited that the workingmen in the shops can buy homes at convenient distances from the works, or can avail themselves of the opportunity to rent homes from strangers who may build in the vicinity. A water supply and an extensive and scientific system of sewerage insure excellent sanitary conditions, while the company, at its own expense, keeps the paved and well-lighted streets in perfect repair and cleanliness. All the improvements, such as drainage, sewerage, paving, gas and water pipes, preceded the population, or were put in when the houses and shops were built. Brick homes were built for 1,700 families. They are provided with all modern improvements, and every house and flat, even the cheapest in rent, is equipped with modern appliances of water, gas, and internal sanitation. The rents of dwelling houses range from $4.50 to $50.00 per month, the average being $11.63, and there are hundreds of tenements ranging from $6.00 to $9.00 per month.

The merchandise of the town is concentrated under the glass roof of an arcade building. A market house adorns one of the handsomest squares. Churches were built for the various denominations. A schoolhouse was erected, in which over one thousand scholars are now in attendance. There is a library, stocked with more than eight thousand volumes. In addition to the library and theatre, a savings bank was established, paying a liberal rate of interest and conforming in its regulations to the greatest convenience of the wage-earner. Pullman is now a town of 12,000 inhabitants and the wage-earners have on deposit in the savings bank more than $500,000. About six hundred of them in fact have invested their savings in the purchase of homes in the vicinity. The company has no interest in the business of any of the stores or shops.

CHAPTER XIII

AUTOMOBILES, CARRIAGES, WAGONS AND BICYCLES

Manufacture of Automobiles—Three Types of Automobiles—The Automobile in Commerce—The Chauffeur—The Carriage and Wagon Industry—The Bicycle Industry—Making a Bicycle—Motor Cycles

Manufacture of Automobiles

OF ALL recent mechanical developments, that of the automobile has been most rapid. Although its evolution has been active only during late years, the experimental stage is already passed. There have been costly experiments, to be sure, but the work of perfecting constructions has been attended with no harrowing loss of time and capital, such, for example, as characterized the introduction of the locomotive, the telegraph, and the sewing machine. Brave pioneers built motor carriages previous to 1898, but it was not until that year that the conditions of manufacture were worked down to a business basis. The automobile industry now finds itself in practically the same condition as does every other large business at its beginning, with such exceptions as are due to the modern use of capital in contrast with former days. As with the sewing machine and the bicycle, automobile factories were opened in a dozen cities by small capitalists, who built motor vehicles to their ruin. Not that there was necessarily anything wrong with the machines thus constructed, but because there are always business conditions that are difficult to master with small capital.

One feature of the industry, which has now assumed great prominence, consists in assembling parts purchased from a number of different makers. Hence, as the parts become perfected and their manufacture specialized, the number of factories in which all the parts of a complete vehicle are manufactured, grows steadily smaller. Ever since automobiles were first produced commercially, the market has been flooded with a hundred and one accessory parts, including different makes of engines, boilers, and underframes.

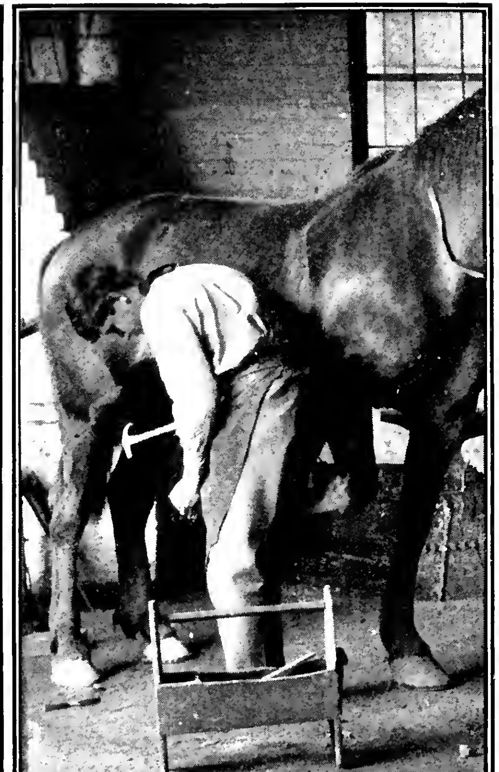
Three Types of Automobiles

There are three types of automobile in common use, classified according to the motive power employed: steam, gasoline, and electric. In each instance there has been extraordinary advance in the direction of combining lightness and compactness with high power efficiency. Indeed, the needs of motor vehicle construction in these directions have largely contributed to the production of several brilliant and valuable mechanical improvements, which must prove useful in other industries. The boilers for steam carriages are of the two familiar types—flue and water-tube boilers—in both of which the constant aim of inventors and designers has been to produce generators combining a large heating surface—and consequent rapidity in steam generation—with immunity from explosion and "burning out." Danger of explosion is provided against in both types by constructions avoiding large bearing surfaces for the steam pressure: thus the gravest catastrophe from abnormal pressures will be the rupture of one or two small tubes, involving no danger to life or limb. Safety is further increased in flue boilers by using copper tubes, which, from the tendency of that metal to contract under high temperatures, thus permitting the escape of the contained steam and water, prevents disastrous rending of the shell. Automobile boilers are generally cylindrical, the diameters ranging between thirteen and fifteen inches and the lengths between fourteen and eighteen. The typical flue boilers have about three hundred half-inch tubes, thus leaving a small clearance and securing extra-rapid evaporation of the contained water. Water-tube boilers are of great variety of design. A third type of steam generator, commonly known as the "flash boiler," in which the feed water is injected into coils, or trains, of heated tubes, thus being "flashed" into steam almost instantly, are used on a few American carriages. The type was originated in France, in 1889, by the well-known engineer and automobile builder, Serpollet.

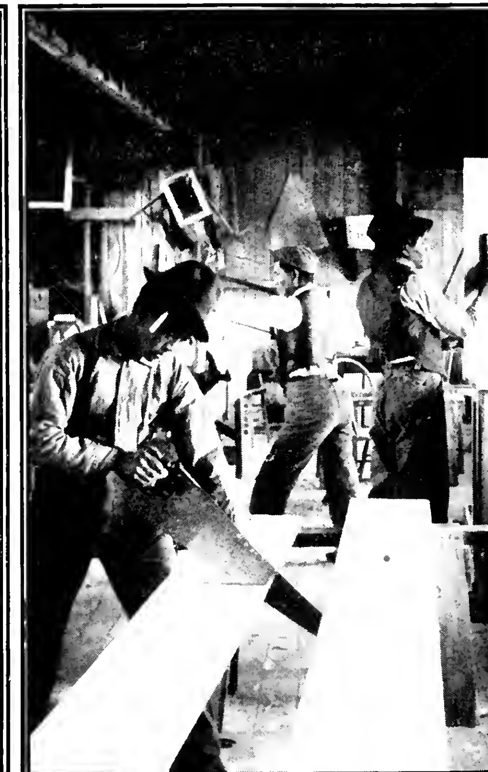
Automobile steam engines are similarly various, the most common type being the double-cylinder simple engine, having the driving sprocket at the centre of the crank shaft. Such an engine, with cylinders two and a half by three inches, can develop between four and five horsepower at four hundred revolutions. Compound engines are used on a few carriages, on account of the combined advantages of economizing steam, by the double expansion, on even roads, and of permitting an increase of power for hill work and rough roads, by admitting boiler steam to both cylinders. In order to avoid the complication of stuffing boxes, cross-heads, and slide valves, which are liable to give trouble on small motors, several types of single-acting engine, having the steam impulse on but one face of the piston, have been devised for carriage use. An excellent American engine of this type has four cylinders, with trunk pistons, working on two crank shafts, and driving a third shaft, carrying the sprocket. Steam is admitted by a rotary valve to each cylinder in succession.

The typical steam carriage burner, using gasoline vapor as fuel, is a flat closed cylindrical chamber, having the top and bottom plates perforated and connected by a number of draft tubes, around the opening of which in the top plate is a circle of pin holes. The gasoline vapor, admitted to the interior of the chamber, escapes through the pin holes, the fire there burning re-

THE WHEELWRIGHT



THE BLACKSMITH



THE CARPENTER

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ceiving air through the draft tubes. Later types of burner consist of a number of straight tubes having pin hole perforations on one side, attached to a single large gas tube. The air required for combustion is admitted through the spaces between the tubes. American carriages propelled by internal combustion motors generally operate with gasoline, on account of the difficulties attending the use of kerosene and the prohibitive duty on pure alcohol. The four-cycle type of motor is almost exclusively employed. on account of its superior efficiency and other conveniences. American engineers have brought it to a high degree of perfection. Carriage motors are often of the single-cylinder form, although double cylinders, parallel or opposed, or multiple-cylinder arrangements are widely employed. The gasoline gas is supplied from a properly arranged carbureter, generally of the "float-feed" pattern, although latterly a simple mixing valve, and ignition is accomplished by incandescent tube or electric spark, primary or secondary, the current coming from chemical cells, a small dynamo, or a magneto generator. The speed and power output of the motor is generally regulated by throttling the charge—varying the proportions of air and gasoline vapor—while the conditions of rough roads or hill-climbing are met by "speed-changing gears," which vary the effect of the power delivered at the driven axle.

Electrically-propelled carriages were first made possible by the perfection of the secondary, or "storage" battery, which thus enables the source of current for the motors to be carried in the body. From considerations of ready handling, absence of offensive odors and general cleanliness the electric carriage is preferred by very many people; although the fact that the batteries must be periodically "charged"—generally once in every fifty miles —with considerable loss of time, will limit its use for a number of years almost entirely to city traffic. In electric vehicles, the realized speed and power efficiency is varied by shifting the circuits of the battery units and motors between the multiple, or parallel, and the series arrangements, by use of a form of switch, called the controller.

Of the three classes of vehicles, the electric carriage is the costliest. Where a steam carriage costs from $650 to $1,500, and a gasoline carriage from $1,000 to $2,000, an electric carriage will cost from $1,250 to $3,500. The operating cost per year, exclusive of the wages of a chauffeur or a skilled mechanic to act as coachman and repairer, is about two or three hundred dollars for any kind of a machine. The electric vehicle has kept pace with steam and gasoline construction, as electric construction lends itself easily to the art of the carriage maker. The steam vehicle, like the electric, has reached its highest development in America, because we lead the world in steam engineering. At the New York Automobile Show in 1901, forty American manufacturers exhibited one hundred and forty-five vehicles, of which sixty-two were gasoline, sixty steam, and twenty-three electric. Of these makers, more than half made gasoline vehicles only, twelve made steam, and three electric vehicles, exclusively. The domestic exports of automobiles and parts aggregated nearly $400,000 during the ten months ending with October, 1901, and the imports in the same class during the same time aggregated only $100,000. These figures certainly show a remarkably large balance of trade in favor of the manufacturers of this country.

The Automobile in Commerce

Legislators have been invoked to pass measures for the protection of automobilists, and boards of aldermen and park commissioners have quarrelled over the admission of motor vehicles to public parks. In Bronx Park, New York, a speedway has been built exclusively for automobile enthusiasts, and no vehicle drawn by a horse is allowed there. All over the land, there is a movement to construct special automobile roads to connect principal points. It is even proposed to build a trans-continental highway that will connect New York and San Francisco. United States army officers are especially interested in this road, for it will have its strategic advantages. The purpose is to make it the finest and greatest road in the world. Many farmers, lumbermen, coal-dealers, and stone haulers now use motor vehicles to haul their products, at a cost from twenty-five to fifty per cent lower than with horse and wagon. The farmer may even cut his grass with an automobile mower. "France has led the world in the development of automobile vehicles," says a manufacturer of harvesting machinery. Hence, knowing how intensely interesting an automobile mower would prove, on so important an occasion as the Paris Exposition, he set about the task of building such a machine. One of these mowers, beautifully finished and painted, was exhibited. Another was used for giving exhibitions in cutting grass near Paris during the continuance of the exposition. This mower was equipped with a six-horsepower gasoline motor, and the mechanism encompassed within a wonderfully narrow space. The Post-Office Department has also been experimenting with the new vehicles, with a view to replacing delivery by horse. The postmaster of Syracuse reports that collections requiring three hours by mounted carriers have been made in an hour and twenty minutes by the automobile. Automobiling already is credited with a long list of trade papers. Clubs, led by the Automobile Club of America, have been formed in almost every State in the Union and in at least fifty large cities. The stages drawn by horses in a number of cities, notably the prehistoric Fifth Avenue stages in New York, have been supplanted to a large extent by electric " 'buses." The New York customs officials, also, have done away with some of the horses and wagons which carried goods between the docks and the Custom House, and use a single steam truck to carry most of the freight.

The Chauffeur

Like any other sport, automobiling has its amateurs and its professionals; that is, the chauffeur who drives a motor car of his own for the love of the sport, and the chauffeur who handles, runs, and races motor cars as a means of livelihood. The distinction between these two classes is as definite as in other sports. One well known amateur is the treasurer of an automobile manufacturing company, but that does not make him a professional automobilist. Other amateurs are stockholders in a company organized for the purpose of building a motor car embodying ideas which they have found to be most serviceable. Each of these amateurs simply conducts experiments from the point of view of the inventor.

Dearth of skill, lack of nerve—these are the two elements of danger in driving a motor carriage. To be sure, carriages have exploded, have refused to obey the brakes on a steep grade, have dashed to destruction, and in other ways have destroyed human lives and broken limbs, but the great majority of accidents result from the inexperience of the driver. To draw a lever, turn a handle, press a knob with one's foot—these can be soon mastered. However, mechanical knowledge does not make a chauffeur: dexterity and courage are necessary, whether running seven miles an hour in a crowded thoroughfare or a mile a minute on a country road. As understanding of automobile mechanism is spreading, men fitted to take care of automobiles are becoming more and more numerous.

A person who should volunteer to run a locomotive engine without previous training and instruction would be thought very unwise. And yet a large percentage of the accidents, delays and break-downs of the various styles of automobiles may be laid to the fact that people are eager to run them with no adequate knowledge of their mechanism, and no ability to repair the slightest flaw or displacement. So a man will offer his services as chauffeur, and take charge of a costly motor carriage without the proper training and experience. The general public has been hindered in its adoption of automobile traction by this very abuse. Again automobile types should be more generally designed for fitness in special fields of utility. The average speed of an automobile should be reduced to a rate not more than twenty-five per cent higher than that of horses. We are a mechanically-inclined people and ought to take naturally to the handling of automobiles.

The Carriage and Wagon Industry

At any county fair it is possible to count fully fifty different styles of vehicles, from the tally-ho to the sulky; but the buggy, the great American vehicle, is most in evidence. Indeed, twenty-five per cent of the volume of carriage and wagon business is represented by the buggy. The woodworkers, blacksmiths, trimmers, upholsterers, and painters in the larger establishments duplicate all the parts in immense quantities. Millions of spokes, wheels, and tires are manufactured, together with hundreds of thousands of wagon bodies, tops, and doors.

For farm wagons, alone, the public pays nearly fifteen million dollars a year; seven million dollars is also spent for broughams, coaches, victorias, and other heavy carriages; thirteen million dollars goes for light wagons, not counting the twenty-five million dollars for buggies; six million dollars is paid out for road carts, and nearly twenty million a year for repairing after buying. In carriage building, the workmen must be quite as skilled as those engaged in manufacturing pianos. It takes expert mechanics to construct a carriage with all the graceful lines and beautiful proportions in the plan as it comes from the designer. In New York City therefore there is a technical school, established by the Carriage Builders National Association, where young men are taught the art of carriage building in all its branches. Graduates of this school are employed as foremen in the construction department of great carriage factories. They are the "West Pointers" in the army of carriage and wagon builders.

A description of one of the largest carriage and wagon making plants in the world will at once illustrate the development of a great factory and show the enormous extent of this industry. In a little blacksmith shop in South Bend, Indiana, back in 1852, began the business of the company which now runs the plant in question. The combined capital, stock and money, at the outset, was but sixty-eight dollars. During the first year, besides the blacksmith work, two wagons were built, one of which was still in use in 1890. To-day the buildings cover one hundred acres, and the yearly capacity is seventy-five thousand vehicles of all kinds. The lumber yard connected with the plant carries in stock about fifty million feet of hardwood lumber, such as oak, hickory, maple, white ash; also poplar for wagon sides and pine for wagon bottoms. This lumber must be dried by sun and air from one to four years before it goes into the wagons and carriages. An average of ten cars per day are unloaded. Here are employed, besides yardmaster and foreman, a small army of assistants, inspectors, laborers, besides twelve teams and one hundred and sixty-five wagons. In the spring-making department, a stock of steel of about three hundred tons of the best quality is kept on hand, and over four hundred and fifty different kinds of springs are made for the various types of vehicles. In the foundry is made a general line of castings, such as boxes, skeins, etc. The floor space of the foundry covers about twenty-eight thousand square feet. In the blacksmith shops are combined the machine forge, the punch and hammer, the thread cutting, and finishing departments. The total floor space given up to these departments is one hundred and twenty thousand square feet. About fifty tons of iron and steel are here used every day. This is cut to the proper lengths, punched, forged, threaded, and finished, ready to take its place in the construction of the wagon. In the woodworking and dimension cutting department, lumber is prepared in quantities sufficient to make two hundred and fifty complete wagons a day. The machines of special interest, as time savers, in this department, are the automatic hub mortising machine and the automatic double-header axle lathes. There are many interesting machines in the wheel department. Such are the spoke drivers, the automatic tonguing machines, the hub press, and the electric band welder. In the wagon department are five hundred and sixty machines in daily use, and in the carriage department two hundred and seventy-nine, making a total of eight hundred and thirty-seven machines.

Another establishment of the kind—an immense farm and freight wagon plant—is located at South Louisville, Kentucky. It occupies an inclosure thirty acres in extent. Here thousands of farm and freight wagons are every year made to supply the demand of the busy region all around and to the West and Southwest.

The wagon and carriage industry, as a whole, shows a decided trend toward the Central States; first, because land is cheaper; second, because suitable lumber is abundant and prices are, therefore, favorable; third, the developed railroad systems afford abundant means of transportation.

The foremost State is Ohio, with an output valued at $16,000,000. The industry has developed with wonderful rapidity, too, in certain of the Southern States—North Carolina, Tennessee and Virginia—where lumber is cheap and where manufactures are fast gaining industrial predominance. A number of establishments now make a specialty of manufacturing the component parts of vehicles, such as rims, spokes, hubs, wheels and bodies; their products forming a very important part of the general industry. As a matter of fact, a large number of so-called manufacturers of carriages and wagons are in reality merely assemblers, who slip on the wheels, attach the top to the carriage part, adjust and tighten bolts and nuts, and touch up the polished parts. Among other facts of interest may be mentioned the work of inventors in this field, who have taken out nearly thirty thousand patents for articles used in the manufacture of carriages and wagons in the last seventy years. The exports of carriages or carriage attachments, in 1900, were valued at nearly $3,000,000. In the country districts the use of carriages and light wagons has been largely reduced, as a result of the rapid extension of the electric traction systems by which, during the last few years, thickly populated cities have been connected with the surrounding towns and villages.

The Bicycle Industry

At the height of the glory of the bicycle industry in 1896, two hundred firms, with an aggregate capital of twenty million dollars, were manufacturing "wheels." To-day there are three hundred establishments making wheels, employing a capital of thirty million dollars. Yet the popularity of the bicycle is waning, and manufacturers are turning to automobiles as a means of keeping their workmen busy. In the Connecticut Valley there is one great bicycle factory which still employs twenty-five hundred men and has three thousand agencies throughout the country; but this is a case of the survival of the fittest. In the first place, the bicycle dropped out of fashion. A few years ago bicycle riders simply flowed through the streets of all the summer resorts. During the season of 1902, however, to see a cottager riding a "wheel" for pleasure was a rarity—the wealthy folk had given all their bicycles to the servants. Then the bicycle was dropped by the general public as a vehicle of exercise. Thus there came a period of depression in the bicycle industry, and down to ruin went many manufacturers, as well as an army of dealers and a legion of mechanics who had rented stores as repair shops. One famous bicycle company, however, having a huge plant, reports that during 1900 the sales department employed fewer hands than they desired to employ, but had a prosperous season, considering the general condition of the bicycle trade.

Two good results, however, were achieved by the general depression: it established a legitimate demand for the bicycle as a mode of conveyance, and it brought the manufacture of "wheels" to the normal stage. From now on, so experts predict, the industry will show stability and normal progress. The export trade, especially, offers great promise. The bicycle, even now, is familiar to the inhabitants of every land, the exports, in 1900, amounting to $3,500,000. Not many years ago England supplied the world with these useful vehicles. But American manufacturers soon wrested the business from their English competitors, and have so far reversed the trade conditions that now we sell bicycles to Great Britain and her colonies, as well as to all other civilized countries. Our own manufacturers, too, lead the world in the quality and quantity of bicycles produced, and in improvements in methods of manufacture. Tools and automatic machines have been invented by American engineers, by the use of which the cost of making a bicycle has been so greatly reduced that foreign makers find it hard to meet American prices. Even in the matter of tubing, American manufacturers are turning out a product superior to any made in England. Each bicycle requires about twenty feet of tubing, and as about 1,200,000 bicycles were manufactured in 1900, one can judge of the vast amount of tubing needed.

Making a Bicycle

A visit to a bicycle factory reveals a multitude of ingenious processes and demonstrates the value of a subdivision of labor. An examination of this industry shows the perfection to which machinery can be brought in turning out a valuable product. We may note a few features of the departments of a model plant, and the divisions of work among the army of employés. Among them are the forging, annealing, and brazing departments, the processes for making the balls, the chains and the spokes, the tool-making shop, the model and designing rooms, the polishing, nickelling, buffing, assembling and pattern-making sections, blacksmith shop, "machining" shop, and others, not to dwell upon the electric plant and the power department with several steam engines. In the forge room there are several trip-hammers, each striking six hundred times a minute. The drop hammers carrying the die strike the sister die with a force of 1,100 tons. The fires for these forges are fed by vaporized crude oil in pipes from huge tanks. The annealing, case-hardening and "pickling" processes are accomplished in another big furnace room, the "pickling" cleaning the metal of "scale." In the great "drilling room" there are many lathes, drill-presses, boring machines, reamers, chucking machines, milling machines and thread-ing machines, from which the various parts go to their own departments for further treatment. The ordinary bicycle chain contains fifty-three links, each composed of five pieces, united by a marvellous "assembling" machine, and going then to a "kick-machine," which secures the links. An operator "kicks" the spring treadle of this machine thirty-two thousand times a day.

There are queer machines for making the sprockets or gear-wheels, and for bending the handle-bars, and making brackets and shafts and cases. Some of the turret machines work automatically, turning out screws and nuts by the thousand with absolute accuracy. In every bicycle there are thirty joints that require brazing, each operation taking from thirty seconds to a minute and a half. In the polishing department the workmen wear little black caps drawn down over their eyes to protect them from sparks. There is much dust, and the air is filled with the odor of glue and walrus hide, for walrus hide and emery are much used in this process, the emery being applied to the surface of the polishing wheels with glue. Wooden wheels are employed for heavy grinding, covered with oak-tanned and emeried leather, but the walrus hide gives the finest polish. In the nickelling department are big nickelling vats, nearly filled with a dark-blue liquid. In addition to these there are vats holding solutions of potash, lime, and muriatic acid, used to clean the various parts before the plating takes place. These parts first receive a coating of copper and then remain three or four hours in the nickelling vats. But they are dull when they come out, and, for polishing, they go to the buffing department. The buffing wheels are each made of 120 disks of cotton cloth, the dust being carried away by the suction of a huge blower. The last of the finishing processes is the enamelling. The parts of the bicycle to be treated are first cleaned in boiling water, then dried and smoothed down with emery cloth and washed again with benzine, when they get their first coat of enamel. They are then baked, after which they receive another coat of enamel, these successive operations being repeated several times. Each part is inspected with rigid carefulness to insure safety.

Motor Cycles

There really was no room for improvements in bicycles. Fortunes had been spent and the mechanical ingenuity of the world exhausted to find some little thing to make them better. But the acme of perfection in this particular line seemed to have been attained. The foot-propelled "safety" was ideally complete. Room for extension was left, however, for the motor cycles. The application of motors to bicycles has caught the attention of bicycle riders. In the present rule of the motor vehicle there is no reason why the motor bicycle and motor tricycle should not have a prominent place. The desire for rapidity of motion is gratified by these machines, without the exertion of pedalling. They are very easily charged and regulated and stand a great deal of hard use. Their novelty makes them attractive to many to whom the ordinary wheel was becoming rather an old story.

CHAPTER XIV

THE SHIPBUILDING INDUSTRY

Fall and Rise of Shipbuilding in the United States—Shipbuilding in Private Yards—Shipbuilding in Navy Yards—Iron and Steel Shipbuilding—Building a Great Steamship—Building a Modern Battleship—Sailing Vessels—Wooden Ship and Boat Building

Fall and Rise of Shipbuilding in the United States

IN THE early decades of the nineteenth century, America led the world in the industry of shipbuilding. Having a vast fleet engaged in the merchant service during the Napoleonic wars, she had a potential naval strength second to no other nation in the world. Later on, however,, particularly since the Civil War, the number of American-built ships engaged in trade with foreign countries showed a steady decrease, year by year, until, as within two decades, it became practically inconsiderable. The real reason for this surprising state of things is by no means far to seek; consisting almost entirely in the enormous growth of our domestic, coastwise and Lake traffic, in which, by Federal statute, none but domestic-built vessels are allowed to engage. This also accounts for the additional fact that the majority of ships built in this country are of wood, as against the almost universal European practice of using iron and steel construction. American shipbuilders being, therefore, engaged in producing vessels for the home trade, the proportion of foreign-built ships, particularly English, coming to our shores increased steadily until it passed into the majority.

The insignificant dimensions of our foreign shipping interests probably reacted considerably in the direction of maintaining the strength of the United States navy at a point far below that of any other of the great world powers, and in a condition quite inadequate to the needs of war. With the reconstruction of the navy within the last two decades, however, a new era in American shipbuilding has been inaugurated; nearly all the leading yards having been furnished with facilities for producing the most approved designs of modern warships, some of them having filled important contracts for this class of vessel.

Great impetus was given also by the business-like proposition made to Congress by the International Navigation Company, in 1891, to the effect that if an act were passed admitting the two great twin-screw liners, the *New York* and the *Paris,* to American registry, on condition that two other vessels of at least equal tonnage should be built in the United States and added to the fleet, the company would agree to operate these four first-class steamships under the American flag. A bill for the purpose became law in 1892. In the course of the next three years, the company complied with the conditions of the act by providing for the construction of two vessels, the *St. Louis* and the *St. Paul,* in Cramps' shipyards in Philadelphia. No foreign materials entered into the construction of these ships. They are entirely of American model and design, and of American material. They are built by American skill and muscle, and they represent the beginning of the effort to restore the prestige of the United States as a sea power.

Meantime, although the bulk of the business, exclusive of naval orders, is still confined to supplying the requirements of the domestic trade, very little being attempted outside of this, except in the line of building high-class yachts or filling an exceptionally occasional contract for a transoceanic liner, there are vast possibilities in providing for traffic with the new American possessions in the West Indian, Hawaiian and Philippine Islands. These conditions alone augur well for the future of American shipyards. and, as is confidently expected in many quarters, will eventually permit the production of vessels suitable for foreign traffic at a lower cost per ton than is possible in the present uncertain and spasmodic state of the demand. Should all the vessels actually required in American transoceanic trade be constructed in domestic shipyards the annual output would doubtless be increased fully one-third in point of tonnage, and nearly, if not quite, doubled in value. How to adjust conditions so as to bring about this result is one of the vexing problems of the day.

Although domestic traffic is confined by law to vessels built and owned in the United States, foreign-built ships may, under exceptional circumstances, and by special act of Congress, be admitted to American registration. Thus by the Navigation Laws it is distinctly provided that a foreign-built vessel wrecked on these shores, if purchased and repaired by a citizen of the United States, may be registered for domestic trade; but only "if it shall be proved to the satisfaction of the Commissioner of Navigation that the repairs put upon such vessel are equal to three-fourths of the cost of the vessel when so repaired." However, despite the registration of a number of vessels captured during the Spanish war and of many more built and owned in the Hawaiian Islands, at the time of their annexation, the total tonnage admitted to domestic traffic in the last ten years is far short of 150,000, or only little over fifty per cent of the total tonnage of vessels built at American yards for foreign trade during the same period. This fact alone shows the rigidity with which the law is enforced in this particular.

As an illustration of the great advance made in shipbuilding since the launching of the ships just mentioned, and as an indication of the attempt that is being made to again give the industry the prominence it had attained in 1885, it may be stated that the total tonnage built in 1901 was the greatest in our history, next to that of 1885; the total for 1901 being

1,580 vessels of 483,000 gross tons, while the total in 1885 was 583,000. The great number of new ships completed late in 1902 promised to make that year the greatest in the history of American maritime history. Within the year over 2,000 merchant ships and naval vessels were under construction. All these will have to be manned in 1903-4, and will require between forty and fifty thousand men to complete their crews. Here, certainly, is a splendid opening for the American youth who would follow the sea for a living.

Shipbuilding in Private Yards

One of the chief shipbuilding centres in the United States is the city of Philadelphia. Here, the building of ships has continued without interruption ever since William Penn, as the story goes, first helped to promote the industry by encouraging the building of a frigate which was presented to a king of France. The Cramps' shipyard, in the Quaker City, has a capital of $12,000,000 and gives employment to seven thousand men. Many more toilers will be needed within the next few years, during which time the owners hope to enlarge their plant. The Messrs. Cramp maintain that the ideal shipbuilding plant should be capable of turning out any kind of a war vessel, complete and ready for action, including not only the hull, machinery, and equipment, but armor, guns, and ammunition. There is one plant with just such a capacity in France, another in Germany, and two or more in England.

Even now, the modern American shipbuilding plant usually embraces, under one management, all the constructive trades which formerly worked independently of each other. These trades include the building of the hull, painting, blacksmithing, shipsmithing, spar-making, sail-making, rigging, and engine building. In the old days the shipowner was obliged to make a separate contract with each of these trades for the building of his vessel. Indeed, the modern shipyard, with its many departments and its ponderous machinery, is a revelation to those who have never visited such an institution. In the new private yard at Richmond, for example, where several government vessels have been built, one can watch the evolution of a vessel from the very beginning, gaining knowledge at the same time of those lesser details which are often overlooked when the ship is viewed in its entirety. There are draughting rooms, designing rooms, foundries, blacksmith shops, pattern shops, machine shops, brass and copper-fitting departments, and scores of other features which show the progress of the mechanical arts. An especially interesting department of the establishment is the bending shed, where heavy iron bars are bent into angles and curves according to the shapes required. In this yard, also, is a furnace sixty-five feet in length, one of the largest in America.

Of the thirty-two shipbuilding plants on the Pacific coast, the great yard at San Francisco, employing four thousand men, is perhaps the largest and most important. Among the naval vessels launched at this yard was the battleship *Ohio* in 1901. The government itself gave the first impetus to shipbuilding in this region, when contracts were awarded to the San Francisco builders between 1885 and 1890. Since then the industry has been confined principally to the building of war vessels, though quite a number of boats for the coast trade have also been constructed.

As for shipbuilding on the Great Lakes, the development has been remarkably prolific and, for more than ten years, has challenged the attention of the whole shipbuilding world. On the shores of the Lakes there are 122 shipyards, employing 9,000 hands. Eight of the establishments are equipped for the building of iron and steel ships; in all the remaining yards only wooden ships are built—including steam and sailing vessels, barges, canal boats and small boats.

A word about the conditions of labor and compensation in shipbuilding yards. In English yards all the steel work of a vessel is done under the piece-work system. The price per unit is fixed for certain shipbuilding districts by agreement between the builders and the trade unions. Thus, in English yards, a known portion of the work has a fixed value. In American yards, however, the system of payment for steel work is different. Piece-work here, too, is very general, but we have no uniformity in the methods of fixing the prices. Hence the greater number of mechanics in American yards are paid in direct wages, rather than according to piece-work. The earnings of steel-workers, whether on wages or piece-work, are about the same in the yards on both sides of the water. Carpenters, joiners, fitters and general finishers in American yards, however, receive fully fifty per cent more than is paid in English yards. American machinists and boilermakers also receive fifty per cent more in wages than is paid in English shipyards. This greater cost of labor is given as one of the reasons for the greater cost of American, as compared with English, built vessels, an excess amounting to at least fifteen per cent. Officials of the American Line assert that the steamships *St. Paul* and *St. Louis* would have cost hundreds of thousands of dollars less if they had been built in England instead of in an American shipyard. It is said, furthermore, that certain workmen in American yards are paid an amount disproportionate to the relative value of their work to the ships as a whole. It has been accordingly proposed to adopt the English system above outlined, whereby every part of a ship will have a fixed labor value, and the workman will receive as compensation the percentage which his labor represents of the total labor required for that particular division of the work.

Shipbuilding in Navy Yards

It is the practice of the British Government to have its vessels constructed in private yards. This is held to have resulted advantageously, in that it has led to the construction of numerous dry-docks and to the establishment of great shipbuilding plants which have been of valuable assistance in the formation of British fleets. Some years ago, two cruisers for the American Navy were built in government yards, but at the present time, following the English example, all save one or two ships for the government are under construction in private yards.

The custom of the United States Government in calling for competitive bids for the building of government ships is not approved by one of the most prominent shipbuilders, Mr. Cramp, who thinks the practice of the transatlantic steamship lines to be much wiser and better. As a rule each of these companies has its particular or favorite builder, and the builder's type of ship becomes the company's standard. The plan followed in building is for the shipbuilders to charge the steamship company for materials and for labor, and then to add a certain amount for operating expenses and for profit, of which the terms and percentages are fixed. Moreover, builders argue that the making of inflexible, written stipulations by the United States Government ties the hands of both the government and the contractors, and tends to lead to embarrassments which could be avoided if a little more leeway were given.

Of the nine governmental establishments engaged in shipbuilding and repairs, otherwise navy yards, seven are located on the Atlantic coast at Brooklyn, Boston, Philadelphia, Norfolk, Va., Washington, D. C., Port Royal, S. C., Kittery, Me., and two on the Pacific coast, one at Mare Island, Cal., and the other at Bremerton (Puget Sound), Washington. There is also a governmental establishment at Lockport, on Lake Michigan; but this yard is under the supervision of the State of Illinois, and is engaged in the repair of canal boats, locks and gates, rather than in shipbuilding in the broad sense. There is also a naval station at Pensacola, Florida. The principal work performed in all the navy yards is the repair of naval vessels, the manufacture of ships' boats, small boats and barges, the building and repair of machinery, and the ordnance and other equipment of vessels. An enormous capital is invested in the government yards, necessitated by the enormous cost of modern equipment, which fact explains the noticeably large investment necessary in private yards to enable them to undertake the construction of modern warships. Skilled workers are always in demand at the government yards, where short working days and good pay prevail. Between eight and nine thousand workmen are on the never-failing payrolls of the government in the various navy yards.

Iron and Steel Shipbuilding

After all that has been said in previous chapters concerning the iron and steel industry, it will not occasion surprise to state that iron and steel ships represent the larger part of the operations in the shipbuilding industry. True it is that the number of yards in which iron and steel vessels are built is very small when compared with the number of yards engaged in wooden ship and boat building. The proportion, indeed, is only one iron and steel yard for each fifty yards producing wooden ships, or only 44 of the former to 1,072 of the latter. Again, for every iron and steel ship produced, more than one hundred wooden ships and boats are turned out.

But the preponderance of iron and steel ship construction, therefore, lies rather in the amount of capital invested, the number of employés and the value of products. It may be interesting to add that the capital invested is three times greater than that in wooden shipbuilding, while the number of wage earners employed and the value of the product are each twice as great.

Less than 150 iron and steel vessels were built in 1900, but their value amounted to $50,000,000, as against a value of less than $25,000,000 in the same year for more than 17,000 wooden ships and small boats. The three principal classes of iron and steel ships produced are: Steamers, sailing vessels and barges. Those classed as steamers included a number of steam yachts.

Building a Great Steamship

We can judge of the importance of this industry when it is recalled that six thousand tons of steel are required for the building of a great steamship like the *St. Paul* or the *St. Louis*. The conversion of six thousand tons of steel into a ship begins on paper with the naval architect or naval constructor, the official title used in the navy. Not until he has spent months in making intricate calculations and drawing colossal plans, is he ready to turn over the work of his brain to be wrought by the muscles of the workers into a structure of strength and beauty. In the great shipyard at Philadelphia, an army of mechanics was given just such plans from which to construct the two newest American steamers—the *Kroonland* and the *Finland*—for the International Navigation Company.

In the work of shipbuilding, it is necessary, first, to form the skeleton, the bones of the ship. This skeleton must then be covered with flesh of iron, a cuticle, as it were, of steel plates. Then the body must be given muscles in the shape of machinery, and lungs in the form of boilers; and a heart—or two hearts—in the form of engines. The ribs, the first of the bones in the skeleton, are fashioned out of long, pliable bars of steel, issuing at white heat from the jaws of a monster furnace. These ribs, still at white heat, must be hammered into the curves required by the plans. With great pinchers and tongs the leather-aproned workmen seize the hot, straight bars as they come glowing from the furnace. They bend them between pegs that have been inserted in the holes of the perforated metal floor for the purpose of giving the required curvature to each particular steel bar. The rib-bands that hold the ribs together, are hammered into shape in the same way. Thus, with infinite care, and the hardest labor, the work goes on for months, until all the ribs and rib-bands are complete, until the skeleton has been riveted together. The ship has been advanced to the state known as "in frame."

To cover this frame with a flesh of steel, come the plates from the manufacturer, each as square and as flat as a flagstone. These plates must be bent and curved into as many different shapes as the leaves of autumn. This is accomplished by rollers, through which the plates pass as easily as a towel through the housewife's wringer. They must be smoothed down—a hydraulic or steam plane does this as readily as it would plane pine boards. Their edges must be trimmed—a machine performs this operation as deftly as a tailor cuts with his shears a piece of broadcloth. They must be punched full of holes for rivets—a punching machine does this, ten plates at a time, with the ease of a railroad conductor punching ten paper tickets. Curved, smoothed, trimmed, and punched, the plates are next hoisted up to the riveters, and then begins a deafening banging and hammering which continues for many months, while the plates are being riveted to the ribs. Millions of double-headed rivets are used, each particular rivet having been subjected to the closest scrutiny of an expert examiner. At this stage of construction in a wooden vessel the caulker would come with oakum and tar, filling the interstices between the planks. In the case of a steel vessel, however, no caulking, as such, is necessary. The sharp edge of each plate is turned in with a chisel, and so closely, then, do the plates meet, that water cannot possibly get in.

Decks and bulkheads now close in the hull, and the conversion of six thousand tons of steel into a beautiful form, as buoyant as an Indian canoe, is complete. Then in the presence of statesmen, with a pretty woman as sponsor, the ship is christened and water-born. Then into the hull the engines and boilers are lifted—two quadruple expansion engines expected to develop 20,000 horsepower, and ten boilers containing an amount of tubing which, if laid in a straight line, would extend thirteen miles. Even then the ship is not finished. She will still give employment to fully five thousand American workmen for a year or more. She must be painted and upholstered, furnished and decorated. This work will keep busy a large number of painters, electricians, plumbers, upholsterers, decorators and cabinetmakers. At last, when she leaves the shipyard and is put into commission, she will have cost her owners between two and three million dollars.

Building a Modern Battleship

The construction of a modern battleship presents many problems and involves enormous expense. Looking first at the hull, we see that it is a marvel of ingenious fabrication. It is virtually a "whale back," with the addition of the "armored box." Much of the bottom of the ship is double, being divided into water-tight compartments. For instance, the hull of the *Maine,* sunk at Havana, was made up of one hundred and ninety-eight "mild steel" cells. Between the sheaths there is space for a man to crawl. The outside bottom plating of the *Maine* was of steel one-half an inch thick, while the inner sheath had only a thickness of five-sixteenths of an inch. Of course there is the armor belt, twelve or sixteen inches thick, but this extends only a few feet below the water-line. The "protective deck" is a curved sheet of steel covering the whole ship, with varying thickness. On one of the new ships, the *Kentucky,* it is from two to five inches thick, being joined at the edges to the side armor-belt. Back of this comes a shield of teak and back of this again there is another coat of plate armor. The battleship of to-day must combine all the excellencies. It must be a cruiser, a floating fort, a monitor, a torpedo-boat and a torpedo-boat destroyer, and likewise a ram. Its prow is sharply extended beneath the water-line for this latter purpose. Back of the ram comes the heavy "collision bulkhead," to receive the impact of the ramming.

In the case of the "Iowa," the dimensions are respectively 360 feet, 72 feet and 24 feet, length, beam and draught. The displacement of the newest first-class battleships exceed 12,000 tons. The "armored box" contains the boilers, engines, and auxiliary engines. In it are stored the ammunition, the coal, the provisions, the treasure, and the equipment for repairs and general service. Everything is most carefully adjusted in reference to economy of space. The hull is divided into the hold, the platform-deck, the berth-deck and the main-deck. Above the hull come the superstructure-deck and the bridge-deck. The water-tight compartments of the hull are protected from each other by heavy partitions or bulkheads. Thus damage inflicted by collision or explosion may be confined to the immediate locality of reception. By shutting the narrow iron doors of these compartments isolation is secured. Cellulose, or fireproofed corn-pith, is packed in along the sides of the ship, swelling and automatically closing a hole which may be made from without. Of great importance are the engines driving the twin screws. There are two sets of triple-expansion engines, placed in water-tight compartments. The boilers are huge. Two fan blowers in each fire-room supply 10,000 cubic feet of air to these furnaces each minute. Stoking these furnaces must be done by hand, and is a most arduous duty. The coal capacity of such a ship as the *Kearsarge* is 1,200 tons, which, upon necessity, may be increased to 1,600 or 1,700 tons. The average maximum speed of these ships is about fifteen knots, although some have made more than this. The possession of many coaling stations is a necessity to a modern navy, as coal is as valuable to a ship as is ammunition. In it there is also a danger, the temperature of the coal being often taken to avoid fire from gas generated by heat.

The main magazines, as well as the engines, are shielded by the coal bunkers. The magazines are surrounded by steel bulkheads, and constantly watched, the commander having charge of the keys. The armored-box, as we have noted, also contains the general stores, including many necessities, such as submarine mine rooms, navigation equipment, medical stocks, paymaster's reserve, fresh water, shell-loading rooms, electrical appliances, hydraulic pumps and dynamos. There are also the tanks for "trimming ship," taking in water as ballast upon emergency. In the armored-box, also, beneath the conning tower, is the heart of the ship, or the "central station," with a most elaborate signal apparatus. There are five methods of steering the ship. Modern battleships carry a distilling and an ice-making apparatus. On some ships there are ninety auxiliary engines doing all manner of work. The turrets are an American idea, now generally adopted the world over. The two masts of a battleship are of steel, and, oddly enough, are mounted from the inside. They carry "military tops" for rapid-fire guns. A ship of the class of the *Kentucky* has a crew of five hundred men, with forty officers. The cost of such a ship is about $4,000,000.

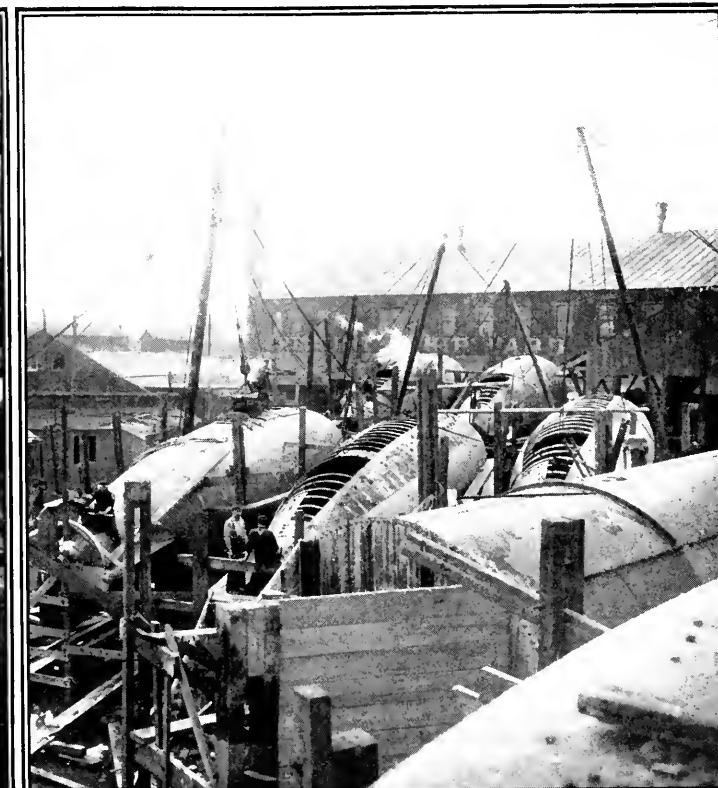
Sailing Vessels

The sailing ship is by no means a thing of the past. Nor is the sailer counted out in calculations for the future, especially in the carrying of the heavier cargoes. The steamer can not crowd the sailer from the face of the waters, any more than the automobile can drive the horse from the surface of the earth. Sails may furnish a slower, but they also furnish a less expensive, method of transportation than steam; and this consideration is bound to give to sailing vessels the bulk of such freight as lumber, grain, provisions, cotton, and mineral oils.

To cite some specifications of present day sailing vessels, the *Edward Sewell,* one of the largest steel sailers built in the United States, and launched in October, 1899, has a double deck, a length of 355 feet, a beam of 45 feet, a depth of 28 feet, and a draught of 23 feet. Another monster sailing vessel, the *George W. Wells,* built of wood and launched at Camden, Maine, in August, 1901, is 345 feet long on top, 48 feet 6 inches clear beam, and 23 feet deep. The *Wells* was followed by the *Eleanor A. Percy,* a six-masted schooner, with a cargo capacity of 5,500 tons of coal. A still larger and greater sailing vessel was launched from the Fall River Shipyard in Boston Harbor in the summer of 1902. The publication of the details concerning this craft astonished the sailors of the world. She is to-day the largest sailing ship in dimensions and capacity in the world, and the most remarkable.

The hull of this leviathan is of steel, 403 feet long over all, 368 feet 3 inches long on the water-line, 50 feet broad and 36 feet deep. She has three decks. There are 18-inch bilge keels to give strength and stability to the hull. The bottom is built on the cellular principle, with compartments that will hold 1,200 tons of water ballast. She has six steam-engines on deck fitted for pumping, getting up anchor, hoisting sail and handling cargo. In all, 2,000 tons of open-hearth steel were used in her construction. She carries 7,500 tons of coal on a draught of 26 feet 6 inches, and her displacement when so loaded is 10,000. Speaking strictly, she is not a ship; she is a schooner. Seven masts rise 155 feet above her deck. The ordinary square-rigged ship of 5,000 tons capacity requires a crew of from twenty-eight to thirty men; the new schooner is well manned with sixteen. The career of this vessel will be watched with the greatest interest by ship merchants the world over. The sailing ships of the world have had a hard time for twenty years or more in the competition with steam cargo ships, but now that the big schooners have proved more economical than alongshore steam barges, it is fair to suppose that they

BUILDING THE FRAME OF THE CRUISER "CHATTANOOGA"



SUBMARINE BOAT BUILDING

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will be able to capture the long-run traffic that is held by the "tramps," and so inaugurate an entirely new era for American sailing vessels.

Wooden Ship and Boat Building

The building of wooden ships and boats, unlike steel shipbuilding, is not centralized, as an industry, in a few large plants, but is divided among more than a thousand yards on both coasts, on the Great Lakes and on the Mississippi River. The principal classes of wooden vessels produced are: Steam, sailing, barges, canal boats, and small boats. In 1900, nearly 400 steam vessels, of wood, were built, these including many private yachts. The number of wooden sailing vessels built the same year exceeded 600. By far the greater proportion of the number of wooden vessels are in the small boat class, which includes launches, ships' boats, life, pleasure, fishing, and row boats. In the building of wooden vessels, Maine promises soon to lead all other States. The shipyards of this State alone employ three thousand men, two thousand in the yards at Bath, and one thousand in all other yards.

In yacht and small boat building, the most interesting firm in the world thus engaged is that of the Herreshoffs, at Bristol, Rhode Island. Of the seven Herreshoff brothers, three are blind. John Herreshoff began whittling boats as soon as he was old enough to handle a jack-knife. His eyesight lasted just long enough for him to build and to sail his first boat, a good-sized yacht, around Narragansett Bay. Then, despite the great affliction which overtook him, he went on building boats, having retained in his memory the models upon which he had worked when aided by his eyes. He was naturally of a practical turn of mind, hence when forced by his blindness to greater mental activity, his mind became capable of extraordinary concentration and acuteness. He even learned to set up pieces of machinery, and could readily explain their qualities of perfection or imperfection. At twenty-five years of age he had saved enough money to begin building boats as a regular business. He started in a plain little shed with a patched roof, in which there was not room enough to build a boat that measured over twenty-five feet at the water line. He took charge of the works, attended to the office duties, travelled, solicited business, and purchased material. From the very beginning, he was as familiar with the boats under construction or repair as were his employés. He was, and still is, the Milton of boatbuilding. The whole Herreshoff family, however, love boats. All are boat designers, boat builders, and boat sailors. After having given America two successful cup-defenders, the *Vigilant* and the *Defender*, they sent the *Columbia* twice over the line a victor.

There are, of course, many other yacht building yards, but none that achieved such fame as the one here mentioned. The best workmen are always in demand at the Bristol yards.

CHAPTER XV

PAPER AND WOOD-PULP INDUSTRIES

Survey of the Paper Industry—Paper Mills—Process of Paper Manufacture—Paper for Newspapers—Books and Magazine Paper—Wood-Pulp Manufacture

Survey of the Paper Industry

NOT much paper is made to-day either of rags or straw. The greater part of all the paper manufactured is made of wood-pulp. The introduction of wood-pulp, or ground wood, as material in paper manufacture has increased the usefulness of paper in a thousand directions. The number and diversity of articles in which paper now figures wholly or in part may be used as evidence of the prominence of this industry. The roof over our head may be of paper; also yonder chest of drawers; also the pail in which the scrubwoman is carrying water is paper; the tapestry on the wall is paper, and the boards beneath the tapestry are paper; under our feet is a paper carpet lining; and here is a barrel made of paper; the collar around the actor's neck is paper, and it is fastened to a shirt-bosom of paper by a paper collar button. Go canoeing—the frail craft is made of paper; enter a factory—the belting is paper; travel—the car wheels rolling and rumbling over the rails beneath us are of paper; finally, we may be buried in a paper coffin, said to be more enduring than one of lead, of wood, or of steel.

It is apparent that paper, like all other fabrics, may be divided into different and definite classes, depending mainly upon the use to which it is put. Broadly speaking, paper is used for three purposes: writing, printing, and wrapping. Paper for printing is the most important class. This may be further divided into paper for printing newspapers, and paper for printing books and other publications, although there is no hard and fast line between the two grades. The newspapers of this country consume one quarter of all the paper of all kinds made here. Book paper includes many different grades, known as cover, plate, lithograph, map, wood-cut, cardboard, bristol board, card middles and tickets. The principal grades of paper boards are known as cover, plate, lithograph, map, wood-cut, cardboard, bristol board, card middles, and tickets. The principal grades of paper boards are known as binders and trunk, leather, press and album, wood-pulp, and strawboard. Other products of paper-making establishments are classed as tissues, blotting, building, roofing, asbestos and sheathing, carpet lining, hanging and curtain. Products of the pulp mills include ground wood-pulp, soda fabric and sulphite fibre.

Paper Mills

There are now in operation in the United States 1,115 paper and pulp mills (although the official statistics place the number at less than 800), and their annual capacity of paper is about 2,500,000 tons, which is estimated to be worth upon the market not less than $200,000,000. It may aid to a clearer conception of what this means to say that the quantity of paper produced annually in the United States is 400,000 tons more than our annual production of cotton and four times the annual consumption; being equal to the annual consumption in the United States of all kinds of fibres, including cotton, wool, jute, flax, etc. The exports of paper from the United States have increased from a little more than $1,000,000 in 1890 to over $7,000,000 at the present time.

The largest single paper mill in the world is the Great Northern Paper Company's plant at Millinocket, Maine, which makes 250 tons of finished paper every twenty-four hours. Another plant in the same State makes fifty tons of manila wrapping paper a day. Nearly one-half of the total production of paper in the United States is made in New York. In the heart of the forests of the Empire State and bordering upon her wildernesses, the wheels of the mills are kept turning night and day, producing paper to be consumed entirely in the eastern States. So voracious are the great printing presses of the East that before the leaves cut from the trees have had time to wither, the paper made from the trunks has carried the news to thousands of homes. Outside of New York the principal paper producing State is Maine, after which come Pennsylvania, Wisconsin, and Michigan.

The introduction of wood-pulp paper has made possible an immense enlargement of all industries requiring cheap grades of the manufactured product, particularly newspaper and cheap book publishing. In no branch of industry, therefore, has the formation of a vast combine seemed a more natural and logical result. Such a combine, which might be fitly termed the "paper trust," was actually incorporated in 1898, under the name of the International Paper Company. Taking over a controlling interest in seven or eight large corporations engaged in paper-making, lumbering, realty speculation and other tributary industries, the company began business on an unprecedented scale, with a capitalization of $20,000,000. By virtue of constant enlargement of its interests, it controls, at the present time, the bulk of the business in the Eastern and Central States and Canada, besides owning and leasing various tracts of timber land, amounting in all to nearly 3,000,000 acres.

The daily output of this company in its several mills is 1,500 tons of various grades of paper. This quantity, if made into a strip of the weight and width used in a metropolitan daily newspaper, would represent a length sufficient to encircle the earth. The total annual output is, therefore, about 450,000 tons, or sufficient paper, in ordinary newspaper rolls, to fill 22,500 freight cars and form a train nearly 270 miles in length. An idea of the immense demand for wood-pulp paper of various grades, and for various uses, may be formed, when we consider that the corporation mentioned is only one of four, which between them control about ten per cent of the great establishments in the industry, with a total capital of about $40,000,000, or twenty-four per cent of the entire amount invested in paper-making in this country. In all, they give employment to 12,000 wage-earners, or twenty-three per cent of the total; pay $5,000,000 in wages, or twenty-four per cent of the total; their combined annual output representing a valuation of $31,000,000, or twenty-four per cent of the total.

Process of Paper Manufacture

Until the last half century practically all kinds of paper had been made from rags, as before stated; but since then various inventions have led to the almost complete substitution of wood fibres in the making of many grades, especially that for newspaper printing. These inventions related to the processes by which vegetable fibrous substances from their natural state are transformed into pulp. The processes are mechanical and chemical. Mechanical or ground wood-pulp, although invented in Germany in 1844, was first made by the present process in this country in 1867 at Stockbridge, Massachusetts. The sulphite process was invented in America in 1867; but the first sulphite pulp made in the United States was made in 1884 at Providence, Rhode Island. Pulp prepared in these two ways is the basis of most of the newspapers made in this country.

Paper was made in America first in 1690 at Germantown, Pennsylvania, by William Rittenhouse; to-day the United States manufactures more newspaper paper, as well as more paper in general, than any other country in the world, and also more per capita, which is of much significance, since it is said "the consumption of paper is the measure of a people's culture."

The present methods of paper-making date from 1804, when a machine which had been invented in France was put into successful operation in England. The inventor's name was Robert, but to this day the machine bears the name of the original maker, Fourdrinier. This machine multiplied the productive capacity of labor a thousand-fold, and produced a continuous web of paper instead of single sheets. Fundamentally, the process to-day is the same as it has been for the past century, although great improvements have been made in the machinery, very radical changes in the raw material, and vast progress in the rapidity and scale of manufacture.

Next to the wonderful newspaper printing presses, the paper-making machines in use to-day constitute perhaps the most remarkable devices in the field of machinery. The greatest of these machines is the (if indeed there may be said to be more than one) Fourdrinier, just mentioned. It is about two hundred feet long. This machine made the transferring of the fluid stock to finished paper an automatic process. By this method, the fluid mass is screened over a moving endless wire cloth made of closely woven brass wire, supported by metal rolls. An even surface is thus maintained, and, as the motion is regular and the flow of the fluid stock is scientifically regulated, an even sheet is obtained. Fourdrinier, by a stroke of genius, devised a sharp lateral motion, or a "shake," which interwove the fibres, and very greatly strengthened the texture of the paper. The water drains from the sheet of paper as it forms on the wire net, but it is dried afterward by being passed between rolls of felt and into driers heated by steam. The paper is given a smooth surface by the calenders, or smooth-faced heavy metal rollers arranged vertically in a stack, giving great pressure by their cumulative weight. The last process is the reeling off and cutting into desired sizes. Another machine is in the form of a cylinder, composed of meshed wire cloth, which takes up the fluid stock as it revolves partly submerged in the vat. But this, while more rapid and making less waste, does not make as strong paper, because it lacks the lateral or "shake" movement.

The heat required to dry the paper during the process of manufacture is extreme, the paper mills of the United States using as much as 3,000,000 tons of coal a year. A single company which turns out the bulk of all the news paper, consumes half a million tons of coal in its pulp and paper mills, in addition to the tremendous power secured from waterfalls.

Paper for Newspapers

The demand for paper by the newspapers of the country is so great that even one of the largest wood paper mills in New York is unable to supply the wants of a single newspaper with a daily circulation of half a million. Perhaps the largest item of expense that has to be met by the publishers of newspapers is that of the raw material or white paper. The daily newspapers of New York City alone consume nearly six million dollars' worth of white paper annually. This means from one hundred and forty to one hundred and fifty thousand tons of paper, or a daily consumption of nearly four hundred tons, costing very nearly twenty thousand dollars. The New York "Journal's" bill for a single day's supply of paper is said to be about four thousand dollars. The "World" pays about three thousand dollars daily, and the "Herald" about two thousand five hundred dollars. It is estimated that the sales of a one-cent newspaper will not pay for the paper upon which it is printed until eight hundred thousand copies have been sold. Judging from these items, it is manifest that if advertisements were to be eliminated from the newspapers, no daily journal could be issued excepting at gigantic financial loss.

Book and Magazine Paper

The process of making book and magazine paper, and in fact all the finer grades, is much more delicate than that by which common news paper is produced. Many cheap books, of course, are made from paper only a trifle superior to that of news paper, but for the better class of book paper it is necessary to add soda pulp made from poplar trees. Moreover, the ordinary news paper turns yellow in a short time. To prevent the paper used in books from turning yellow, the sulphite pulp is bleached in chlorine. Then, too, in book paper a fibre of an even length is produced by steaming the paper in refining engines. The finest grades are given their gloss, or finish, by running them through a stack of highly polished iron rolls, called calendar rolls and super-calendar rolls. Again, in the process of making book paper the pulp runs through the Fourdrinier machine only at about one-fourth the rate of speed at which the news paper is allowed to flow. There are wonderful opportunities in this comparatively new industry for inventors who can improve the present pulp-making machinery, even in the smallest degree. If it is true that the consumption of paper is the measure of a people's culture, then America should be known as the most cultured of all countries, for the American output of paper made from timber alone represents one-quarter of the total production of the globe, while the printing presses of this country use one-fourth of the entire American production of paper of all kinds.

Wood-Pulp Manufacture

There is the greatest abundance of woods that are adapted to paper-making. Those generally used are spruce and poplar, although other woods are used in smaller quantities. When wood-pulp is treated mechanically or chemically, wood-pulp paper can be given nearly all the qualities of the best rag paper. The first wood-pulp made for use in the manufacture of paper was sold for eight cents a pound. Now it can be bought for less than one cent a pound. When the wood-pulp process was introduced, rags were worth four to six cents a pound, while paper for newspapers was selling for fourteen cents, and book paper was selling for twenty-seven to thirty-five cents a pound, or three times the prices prevailing just before the war. In order to produce a stronger paper than mechanically prepared wood-pulp gives, the sulphite, or chemically prepared fibre, was introduced. The spruce wood is treated with sulphurous acid, and the fibres are separated in greater length than can be done by the machine method. A portion of this sulphite fibre is added to the machanically prepared fibre, to give it strength, and some of the stronger wrapping papers are made entirely out of the sulphite fibres. Soda fibre is made from poplar and other woods softer than spruce, and is used in the manufacture of paper for books. Caustic soda is used, instead of sulphurous acid. It is not as cheap a process as the sulphite. The wood is ground by water wheels fitted with stones by which it is converted into pulp. Steam machinery is used, as steam is more regular and the pressure can be more evenly maintained.

At the International Paper Company's mills there are 416 pulp grinders, attached to the shafts of water wheels, and requiring for operation about 124,800 horsepower, or about three hundred horsepower each, on the average. There are also 765 straining screens, from which about 1,100 tons of pulp are daily extracted. In these same mills there are fifty-eight digesters, ranging from twenty-seven to forty-seven feet in height and representing a total capacity of 780,000 gallons. In the production of sulphurous acid, about 20,000 tons each of sulphur and lime are annually consumed. The total production of sulphite pulp is about 415 tons daily.

The finer details of the process of manufacturing ground wood-pulp are described as follows by the Commissioner of Labor of Maine:

> The logs are sawed into bolts about two feet in length. The bark is removed from these bolts by holding them against a revolving disk having knife blades at intervals along its surface. This revolving disk is called a barker. The bolts are then placed sidewise in an iron inclosure that is adjusted to the grinder. The grinder is an immense sandstone wheel two feet in thickness. The bolts of wood are kept close to this revolving stone, by means of pneumatic pressure, and are thus ground into pulp. The ground wood is strained through sieves which remove all splinters and unground particles. It is then transferred to the wet machine, which converts it into sheets of wood-pulp. These sheets are then subjected to enormous pressure, in order to remove the water to some extent, although it is impossible to press them dry. It takes great power to run the grinders, hence the desire of pulp manfacturers to have ample and never-failing waterpower.
>
> The process of manufacturing what is known as chemical pulp is entirely different from that of producing wood-pulp. The wood is first divested of bark. In some mills the knots are cut or bored out. The wood then goes to the chipper, where it is cut into very small pieces, not larger than those that come from a planer in a woodworking mill. This chipped wood is then conveyed to the digester, an immense upright vessel of steel, sometimes fifteen or sixteen feet in diameter, and from thirty to forty feet in length. The digester being partly filled with wood, receives an acid or liquor from the great tanks, where it is made, till the wood is covered, when steam, under a pressure of about one hundred pounds to the square inch, is admitted, and the wood is cooked in this manner for nine or ten hours, till it is thoroughly disintegrated, and all the resin, pitch, etc., of the wood dissolved into the liquor.
>
> In the sulphite process, the acid is made somewhat as follows: Several tanks are filled with lime water of the desired strength, and then the fumes of sulphur, burning in iron retorts, or in a close walled chamber, are drawn through the lime water by means of exhaust pumps, till the water has absorbed the fumes to the requisite degree. The result is a powerful acid, which is capable, combined with the heat and pressure of steam, of completely disintegrating wood and separating it from everything but the pure wood fibre. When the wood is thoroughly cooked, the contents of the digester are blown into a vat with a sieve bottom, where the liquor drains off. The wood fibre is then washed by admitting pure water, and this process is continued till all the impurities are removed and nothing but pure chemical pulp remains. This pulp is then run through a paper machine, which transforms it into rolls of paper, having about the thickness and consistency of common blotting paper. In this form it can be easily handled or shipped to any point. In making news paper, manila or book paper, this chemical pulp is redissolved and mixed with the proper proportion of ground wood-pulp, according to the quality of paper to be made. In the common newspaper stock, there is but a small proportion of chemical fibre. In book or magazine paper a large per cent of chemical fibre is used. The more chemical fibre used, the stronger and whiter the paper will be.

CHAPTER XVI

THE PRINTING INDUSTRY AND TRADES

The Printing Industry as a Whole—Art in Printing—The Printing Trades—Compositors and Operators—The International Typographical Union—Illustrating and Engraving—Lithographic Color Printing—Stereotyping and Electrotyping—Bookbinding

The Printing Industry as a Whole

THE evolution of the printing press is one of the most wonderful developments of the latter half of the nineteenth century, and its story, if properly related, would read more like a romance than a record of invention and mechanical achievement in which clever brains have thought out and facile hands worked to keep pace with the demands of a never-satisfied news-reading public. The large and increasing demand for rotary web printing machines is one of the most remarkable facts in contemporaneous journalistic history. It is scarcely thirty years since such machines were introduced, and for a considerable time afterward it was thought that their use would be confined to a few of the largest cities, where were evening and daily papers of abnormal circulation. The experience has been far otherwise. There is now hardly a large town in the United States or the United Kingdom which does not possess at least one or two web presses, while in some places there are a dozen or a score; indeed, individual journals sometimes now possess four, six, eight, or more of these machines. As a result, the manufacture of such presses has come to be a large and important industry, necessitating the erection of huge manufactories, fitted with the costliest tools and appliances.

As two or more branches of the printing industry are usually carried on in one establishment, it is impossible to separate the statistics of the branches, though for purposes of discussion the industry may be divided into two grand divisions; namely, newspapers and periodicals, and book and job printing.

In the large cities the job offices are so numerous, represent such a great investment of money, employ such a diversity of materials, and turn out such valuable products, that this branch of the industry may be said to equal in importance the newspaper and periodical branch. As a rule in villages, towns and cities having less than twenty thousand inhabitants, the newspaper office is naturally the job office, the newspaper being but one item of the total product. The total value of all book and job products is about equal to the total value of all distinctive newspaper products. Including music, the former amounts to $169,000,000 and the latter $176,000,000. The number of establishments in the newspaper and periodical branch is eighty-four to every hundred publications. Sixty-three per cent of all newspapers and periodical establishments are owned by individuals, nineteen per cent in partnership, and only seventeen per cent by corporations. It has been elsewhere remarked that large combinations are not likely to be made in this industry. While New York, Boston and Philadelphia have always been the centre of the printing industry, large establishments may now be found wherever a thousand or more people are gathered in a town. The total number of persons engaged in printing is fully two hundred thousand, and the annual value of the product of 22,300 plants is $35,000,000. In the large cities book and miscellaneous printing, and the printing and publishing of newspapers and periodicals form two distinct industries. The plant of a large city newspaper would not, as a rule, be serviceable in a job office, seldom containing even enough job material to produce its own stationery, and the proprietors from their training are unfamiliar with job printing. The city job printer regards his business as entirely distinct, and does not consider the newspapers as among his competitors. Of course the small publications and the trade papers seldom own their own plants, but patronize job printers instead.

Art in Printing

In the last twenty years the artistic merit of all classes of printing has bounded forward. The time since 1870 we may divide into three general periods. In the first period many varieties of type faces were used in display-work and title-pages, accompanied by conventional ornamentation, including designs of birds, frogs, and scrollwork. Most of this was highly inartistic. In the second period was seen the imitation of designs and type faces supposed to be ancient. England placed printing under a ban in the seventeenth century. Much printing was secretly done, and old and battered type was used. Naturally the product, in the way of printed matter, was of an unattractive and undesirable appearance. The ornamentation was extremely crude, and a general decline was observed in the product of the printing presses of that day. To imitate this poor work was a great error, and yet it was done. Certain bizarre effects seemed to please the advertisers. But the better class of printers looked at it with disfavor.

In the third period better taste prevailed, and there was a return to simplicity in titles and ornamentation. Within the last decade very beautiful work has been done, enhanced by the improvement in paper. Forty years ago the white paper used for newspapers was made of cotton rags. It was of extremely poor quality and cost twenty-four cents per pound. Such paper now would not find any considerable sale at any price. Improved machinery and the use of wood-pulp have combined to give the printers a much better paper and the public more attractive books. The advertiser, too, has enjoyed his share of the results of the advancement of the last decade, and his circulars and booklets may now be classed among the most artistic products of the printing press. The public demands good work in this direction. Combining types, cuts, and paper in original ways, the printer has become a designer, some firms having special plants for this kind of employment.

Among the makers of books the same advance in good taste is evinced by the character of the product. Bindings are still subject to their annual changes in fashion, and such changes may be expected to continue. Automatic binding machinery has reached a high stage of perfection, and has by its general introduction reduced the price of books and furthered sales of remarkable magnitude.

There has been also a wonderful development in the art of printing illustrations. The photo-engraving process, for example, has practically destroyed the art of engraving on wood. The success of to-day's American magazines is largely due to the dry paper method of printing illustrations. In the old days a full-page magazine picture, a wood engraving, cost one hundred dollars for the services of the engraver alone, and required sixty or ninety days' time. The cost for a full-page illustration to-day is comparatively insignificant; hence the great success of the cheaper illustrated periodicals.

The Printing Trades

The fact that the expenses in all branches of the printing arts have been greatly reduced in recent years accounts for the great number of master printers. It is estimated that with a capital of ten thousand dollars a printing plant employing twenty hands may be established, the cost being about five hundred dollars per hand for presses, type and other materials.

One of the oldest of the labor organizations is the International Typographical Union. The position of this famous union, in regard to hours of labor and wages, is of interest, as tending to show how it works for the benefit of printers. Forty-eight hours per week are given to work by machine operators and composing-room employés, on the average, although one union restricts its members to eighteen hours per week for morning papers and twenty-four hours for evening papers.

The nine-hour day is widely observed in book and job printing offices, being one of the distinguishing features of a union establishment, and is coming into general vogue. In some instances wages were correspondingly reduced, but many unions have succeeded in re-establishing the wage schedules which prevailed when fifty-nine hours constituted a week's work. Wages still vary to a certain extent, owing to the conditions existing in the various localities, the difference in the cost of living, and the strength of the local organization. In many places machine operators still receive higher wages, with shorter hours, than hand employés. But proofreaders, floormen and "ad men" now more generally get the same wages, and work the same number of hours, as the operators. The "equality scale" is growing in favor. In some instances low machine scales are found, but in these cases the machines are not linotypes.

An institution of national interest is the Government Printing Office at Washington, which had its genesis more than half a century ago in a very small printing plant installed for government publishing. Clerical and special positions in this service naturally increase with the development of the plant, and to-day hundreds of pressmen, bookbinders, stereotypers, compositors, and electrotypers make their living in publishing Government records in book form. Experience in the trades and professions allied to the publishing and printing always counts in favor of applicants for positions in the printing service. Certified experience in some reputable publishing house covering a period of five to ten years will give higher marks than mere examination. The salaries paid for the different positions in this service are nearly the same as the commercial rates in private printing offices.

Compositors and Operators

Never has the demand for capable job compositors been greater than it is to-day. Never has it been harder to satisfy. Rapid introduction of machinery took from hand composition a large percentage of capable men. To fill the places thus made vacant in the ad room, the newspapers drew upon the job establishments. The newspaper composing room can always obtain the pick of the craft because those in authority know the value of good men, and are willing to agree to the financial consideration necessary to obtain them. The vision of the book and job employer is being gradually broadened on this subject, too. Difficulty in obtaining qualified men relegates to the rear the question of wages to a large extent. Typesetting machinery brought skill to the fore, and highly-trained men are in great demand.

The number of women wage-earners in printing establishments has greatly increased in recent years, suggesting that competition has led to a search for a less expensive form of labor. The introduction of typesetting machines has not driven women from the field which they have long ably filled.

Twenty years ago no practical substitute for the setting of type by hand had been invented. Here was a problem of vast interest. The first man whose ingenuity led him to its solution was Ottmar Mergenthaler. He invented the linotype machine. Its use soon became widespread, and several other inventors turned out machines adapted to the same purpose. In the linotype the unit is the "slug," or line. Types, themselves, are not considered in its construction. Brass matrices are assembled by the pressure of keys at the operator's will. When a line is completed, the matrices are pressed forward and come in contact with a bar of type metal in a molten state, and the line or "slug" is cast, while the matrices are shot back to their receptacles.

Without enumerating all of the variants of the typesetting machine, the more prominent may be properly mentioned. The Lanston monotype includes a keyboard, punching a strip of paper, through the indentations of which compressed air forms matrices, and from these the individual types are cast. The Goodson graphotype operates by electricity, and casts individual types. The Scudder monoline is a Canadian invention, in which the matrices are placed upon a disk.

Composition and distribution of type by mechanical processes are ingeniously done by the machines called the Dow, the Simplex, and the Empire.

The introduction of these new methods in typesetting gave rise to many disputes about wages, which were soon adjusted. In New York City, in 1850, the pay of an ordinary compositor was $1.50 per day. At present job compositors earn $19.50 per week, and machine operators more than this sum. As has been the case in the history of other inventions, the new labor-saving machine has increased the demand for labor and augmented the number of the employed. Thus the employé has not suffered, in spite of his very natural apprehension. The supply of labor in this particular field is seldom in advance of the demand. The city printing of New York was of such volume, on a certain occasion, that a call was made upon the Typographical Union of the town for an immediate supply of 150 extra men. At such short notice not more than two-thirds of this number, properly equipped, could be found. Neither, from 1890 to 1900, did the business of the typefounder suffer by these new inventions. Type could be sold cheaper by the introduction of the Benton punch-cutter and the Barth type-casting machine. The production of special faces and display type was greatly developed.

The "point system" of measuring type came into general use about 1890, insuring uniformity of measurement throughout all the foundries, as cars of the same gauge are manufactured in the various car shops. This was a great improvement on the old plan. In the direction of stereotyping a novelty was introduced, in 1900, known as the autoplate; considerably reducing the time required for casting plates. The use of a strong electrical current to hasten the deposit of copper was employed in electrotyping.

The International Typographical Union

The influence of the International Typographical Union has been especially efficacious in advancing the movement for shorter hours and higher wages among printers. The question of the introduction of so much new machinery has been met. Out of a total of 4,975 machines in use, 4,098 are in union offices, and nearly half the balance are operated by members of the union. The nine-hour day in book and job offices has become almost universal. In some cases the day is shorter. Many new unions have been established. There have, however, been some secessions among the allied crafts. The photo-engravers, for example, have, in some few local instances, broken away, particularly in Chicago and St. Louis, but reorganization is going on. Union No. 23, in New York City, is a strong and aggressive photo-engravers' union.

Great prosperity has been the rule with the stereotypers and electrotypers. The Stereotypers' and Electrotypers' Trade District Union is endeavoring to secure international prerogatives, but still maintaining relations with the International Typographical Union for organizing and defensive purposes.

Illustrating and Engraving

About 1875 photo-engraving was introduced, making a new departure in illustrating and engraving. In making a half-tone, the first step is the taking of an ordinary photograph on a wet, sensitive plate, a fine screen being placed in front of it in the camera. The screens are made by scratching lines on two glass plates. The lines are filled with some opaque substance, and the plates are arranged so that the lines of one plate cross the lines of the other plate; the lines varying from 40 to 400 to the inch. When the negative has been developed, the film is stripped from the plate and placed, after reversing, on another plate, "the turning glass," and thus becomes a "positive." This is exposed to the light for about two minutes, in contact with a sensitized copper plate. This plate, after developing, is enamelled and "burned in," and then etched with a solution of perchloride of iron, the lines formed by the screen in the original negative being etched away. A printed surface is left, composed of dots varying in size with the lights and shadows of the object, some hand work being necessary for finishing; many former engravers are employed in this process.

According to the treatment of the background, half-tones are divided into three classes—the silhouette, the square-etched, and the vignette; the first having an effect of sharply defined edges, the second being an exact reproduction as to background of the original, and the third having a softened, gradually fading, background, without definite termination.

In zinc etching the process is virtually the same. Pen and ink or line drawings are required, and there is no screen used.

For a deeper cut plate muriatic acid is employed in the process of etching. The result, however, is not so durable as the copper half-tone plate.

Frederick Ivis of Philadelphia, in 1888, hit upon the method of printing in colors from half-tone plates by photographic processes, and there has been much improvement in this field since then.

By a combination of red, yellow, and blue, the three primary colors, the production of almost any shade of color is possible. A glass screen is placed in the camera, and three photographic negatives are made, each of which is to produce a separate plate for printing. A screen of colored glass is used in each case, which excludes certain color-rays of light—a red colored screen for the plate printing blue ink; a blue-violet screen for the yellow ink plate, and a green screen for the plate intended to print red ink. The "geometrical pattern effect" is ingeniously avoided.

Zinc etching is the simplest method of making printed plates by photographic process. No screen is used as is done with the half-tones. The negative is printed on zinc. After treatment the plate is placed in a trough containing acid, and is given a "bite," as many, in fact, as are necessary to secure the requisite depth. After the unnecessary metal is cut way, the plate is mounted type high. Photographs and wash drawings can not be reproduced by this process. Zinc etchings are made from pen, crayon, or charcoal drawing, line or dot engravings, printed forms, and so forth; the plate lasting for many thousand impressions. Electrotypes should, however, be made for extensive use.

Photographs or wash drawings can not be employed, a pen drawing of these being necessary.

Lithographic Color Printing

About 1880, attempts were very generally made to substitute zinc for stone in lithographic work, only one firm achieving much success.

The use of aluminium was found much superior, as it is brighter, less bulky; may be employed on rotary presses, and for long runs. But the aluminium must first be manipulated, one method being to grind off the surface of the aluminium sheet, so that a porous surface is produced; the other method being the formation of an aluminium surface by electro deposition. Phosphoric acid is used to prevent the ink from spreading, and is removed by nitric acid. The employment of aluminium is rapidly increasing.

Stereotyping and Electrotyping

There has not been much change in stereotyping since it was adopted by newspapers in 1861. It is a method of duplicating type forms. The hot method is the most common in this work. A mold of papier-maché, and placed in a casting-box. Melted stereotype metal is then poured in, and the plate is trimmed and used as required. Only metal can be used in forms to be stereotyped, and the work is coarse, the plates soon showing wear. The perfecting press prints from curved stereotype or electrotype plates. Among the improvements in stereotyping the most notable have been a matrix-rolling machine, better drying tables; automatic casting-boxes, combined sawers and trimmers; combined planers and shavers, better devices for routing and bevelling, and a better half-tone bevelling machine.

Henry A. Wise Wood invented the autoplate, a mechanical contrivance for stereotyping. It is 4 feet in height, 7 feet in length, and 3 feet in width. The matrix is placed, face up, in a concave receiver. This slides forward into the casting-box, whose bottom, rising, lifts the matrix to a fluted cylinder. Simultaneously a pump begins to force molten metal into the casting chamber, sprays of water rapidly cooling the casting-box and the cylinder. The casting-box folds, on the completion of the plate, stripping off the matrix. The plate is then carried by the cylinder to the top of the machine. A metal arm bears it toward the back, and on the way it is automatically trimmed and finished. It is then finally prepared by a workman for the press. The advantages in the use of the autoplate are speed and the necessity for fewer workmen.

But for fineness and finish electrotyping far excels stereotyping. The latter serves for newspapers, but electrotyping is now generally used for books, magazines and job printing. For electrotyping, a wax mold is made by pressing the form into very stiff wax, and is suspended in a bath which holds copper in solution. By an electric current, the copper is deposited on the mold. After the mold has received a coating of the proper thickness, it is removed from the bath and the shell is taken off. The shell is then backed with metal resembling lead, and is mounted upon wood or metal.

Half-tones are much more difficult to electrotype than other matter, and thus the process is more expensive. An electrotype ought to be good for two hundred and fifty thousand impressions under favorable circumstances.

When intended for use in color printing, electrotypes are often nickel-plated, and they must be made with very thick shells when meant for printing in certain colored inks, such as those containing bronze, "bronze-blue," for example. There have been introduced many improvements in electrotyping. Among these may be enumerated an invention using a dynamo to increase the action of electro-deposition; a combination of metal kettle, wax-heating table, and case-filling table; a black-leading device utilizing a blast of air; a hydraulic molding press; a power wax-shaving machine, and better saw and routing machines. In process engraving, the Muller patent half-softening hammers and punchers, and the Richards improved ruling machines are used.

Bookbinding

In the bookbinding department of the printing and publishing business there have been some advances, but nothing revolutionary. Among these are automatic feeding devices for folding machines as well as for printing presses. Three-fourths of the folding machines are now supplied with automatic feeders, and they have also been improved by parallel-fold arrangements and by automatic pointing. In wire stitching machines many improvements have been introduced, one of these stitching anything from two sheets to a book two inches thick. A recent device is a combination folding and wire-stitching machine, which automatically folds, gathers, collects, covers and wire-stitches copies of magazines and pamphlets, delivering them ready for distribution. Improvements in paper-cutting machines are new devices for automatic clamps, indicators, and gauges.

Mention should be made of a steam rounding and backing machine, with a capacity of from 5,000 to 6,000 books per day.

A recent case-making machine feeds itself from a roll of cloth, cutting it automatically. The cloth is glued and cut, and nicked in corner sections; boards and a back lining being also supplied. The cloth is folded over the back lining, and the binding, passing through a case-smoother, is delivered in a finished state.

For covering paper books and magazines there is an invention with a capacity of 22,000 books per day. New, also, are a casting-in machine, and a gathering machine.

The regular custom of issuing editions of books in ornamented cloth covers originated in England not more than thirty years ago, earlier efforts being merely sporadic. Previously to that time publishers, as a rule, were content to use plain boards, individual purchasers having their books bound to please themselves. But now it is sometimes said that "the cover sells the book," that is, it is made so attractive that the eye of the purchaser is drawn to it, and he is led to examine it. This idea quickly spread to America, where the art of making ornamental book covers is now more fully developed than in any other country. American bookbinding machines easily surpass all others. At first paper sides were imposed upon the boards, and a paper label was usually pasted on the back. A better material was soon found in bookbinders' muslin. Then it was discovered that gold-leaf would adhere to paper and to the muslin. Thus it happened that paper, muslin, and sometimes leather, title labels were stamped in gilt and fastened to the backs. An early example of this treatment is the 18mo edition of Byron's works, published by Leighton & Hodge nearly sixty years ago. Between 1865 and 1870 came the transition to stamping covers in ink and combining black and colored inks with gold. The first step toward this work was the use of blind stamps upon cloth covers, with occasional designs in gilt; occurring between 1845 and 1860. The once popular blue-and-gold editions were of this period. Twenty years ago the services of an artist were enlisted in designing commercial covers. Before that the publisher was dependent upon his binder, who in turn relied on his die-cutter. It was not until 1875 or 1880 that artists' designs were very generally used. Many women have entered this very attractive field of work. Many writers now illustrate their own books and design covers for them. Altogether, bookbinding is a constantly progressive art, new developments continually coming into vogue.

The rapidity with which bookbinding is now conducted is marvellous. Some bookbinderies have a capacity of 10,000 books per day. A recent instance illustrates this fact, a publishing house taking an order on Monday for a cloth-covered 12mo volume of 350 pages, and shipping 2,000 copies of it on the following Wednesday; the entire edition being out of the way by Saturday night.

CHAPTER XVII

PRESSES, TYPE AND TYPESETTING MACHINES

Press Building—Job, Cylinder, Perfecting and Lithographic Presses—Newspaper Presses —Achievements of Newspaper Presses—Presses for Weekly Papers, Magazines and Books—Color Presses—Typefounding—Composing and Typesetting Machines

Press Building

IN few departments of industry has there been, of recent years, such a marked development as in press building. The progress in perfecting presses has been extraordinary. The size and capacity of these machines is such that a newspaper press may be obtained producing 100,000 impressions per hour, printed in twelve colors. Even more remarkable is the development of the perfecting-press for the very finest work in type and cuts. These presses work as rapidly as if they were merely printing newspapers. and yet their work is of the finest character. Without them the enormous output of cheap magazines and newspaper supplements would be impossible. Printing in colors has made long strides. A machine now is able to print the three primary colors; several more may be produced by combination, and a complete picture results from one impression. Turning to the department of illustration, we find that it has kept pace with other improvements. Steel-engraving and wood-engraving have given place to the "line-cut" and the "half-tone." These illustrations are the result of a combination of the methods of photography and etching. For the "line-cut," the drawing is photographed and the negative is printed upon a zinc plate. Acid is applied to all the surface except the lines of the photograph, which have been protected from its action, and a relief is thus produced. Somewhat similar is the process of obtaining the "half-tone." Here the relief is obtained by small dots produced by photographing the drawing through two closely ruled glass plates. The negative thus secured is printed upon a copper plate, and this is etched.

The printer has not benefited by these great developments, since 1880, as much as the public. This does not apply to the wage-earner, whose condition is better than it was. Then, again, the typefounder and pressmaker may enter combinations. The printer can not well do so. Inventions and competition have cut down his profits.

Two types of printing presses, the platen or job press, and the cylinder press, were popular up to about 1870. In the job press the impression was made by direct pressure. The cylinder press consisted of a flat bed holding the type form in a horizontal position, which oscillated beneath a revolving drum or cylinder that carried the sheet to be printed. In 1846, Hoe & Company produced a press permitting the type to be placed upon a cylinder, and utilizing the later perfected rotary principle, but its processes were too slow to satisfy the newspapers. But from the discovery of the methods of casting stereotype plates on a curve the progress began.

Job, Cylinder, Perfecting, and Lithographic Presses

In job presses the principal development has been the employment of the rotary principle. This is used in the Harris automatic press, which has a curved electrotype plate, though admitting the use of separate types by an appropriate adjustment. An automatic feeder may be used, and the speed reached is from 5,000 to 14,000 impressions per hour. The job presses of the Kidder Press Company feed automatically from a roll.

The cylinder press was, until recently, most generally used for books, posters, and large forms of all kinds, and for high-class work. It was employed also by small papers. To some extent it has been replaced by the perfecting press. Of three kinds of cylinder press, the drum cylinder, the stop-cylinder, and the two revolution cylinder, the last is now preferred. The Century two revolution press is one of the leading machines of its class. Among recent improvements in this class, are the substitution of a crank movement of the bed instead of cam gears; and better ink distribution.

The machine constructed by Hoe & Co., in 1871, was the first entirely successful perfecting press. It printed 15,000 papers per hour from one set of plates. The rotary folder was introduced by this firm in 1876, and has developed until, at present, papers from four to thirty-two pages are turned out, cut, pasted, folded, and counted at a speed which varies from 12,000 to 150,000 per hour. A web of paper passes into the press, and is "perfected," that is, printed on both sides, before being cut and folded. First came the "single" rotary press; then the length of the cylinder was doubled; then the double-supplement press appeared. After this followed the quadruple press, now generally used. This has a capacity of from 48,000 4-page papers to 12,000 24-page papers per hour. Sextuple and octuple presses are employed, the latter in such establishments as the New York "American" and the Chicago "Tribune." A press consisting of two sextuples, side by side, has been built for the New York "American and Journal," equivalent to six double presses. These presses have been adapted to color printing, making possible the colored supplements of the newspapers. There is a rotary multicolor and half-tone machine, printing in eleven colors, with a capacity of 48,000 8-page papers per hour.

The two classes of the web press are the angle bar and the straight line, the latter having been invented by Joseph L. Firm, of Jersey City, N. J., connected with the Goss Company of Chicago.

Other styles are the Scott Company's all-size, the "multi-press" of the

Campbell Company, and the Cox "duplex." The methods of the perfecting-press have been so much improved that it has come into larger use for the best magazine work.

The introduction of aluminium plates as a substitute for stones may be noticed here, special presses for lithographic work with this process having been made.

Newspaper Presses

After many efforts, and the failure and destruction of several machines which had been constructed at great expense, the Hoe double supplement press was produced, the first one being purchased by James Gordon Bennett. This machine made a complete revolution in the methods of fast newspaper printing. Its most remarkable features are its extreme simplicity, considering the varied work it performs, and great speed, accuracy, and efficiency. Four, six, eight, ten or twelve-page papers are turned out at the rate of 24,000 per hour, and sixteen-page papers at 12,000 per hour; the odd pages being in every case accurately inserted and pasted in, and the papers cut at the top and delivered folded. The machine is constructed in two parts, in one portion the cylinders being twice the length of those in the other. The shortest cylinders are used for the supplements of the paper when it is desired to print more than eight pages. The plates having been secured on the cylinders, the paper enters from the two rolls into the two portions of the machine, through each of which it is carried between the two pairs of type and impression cylinders, and printed on both sides, after which the two broad ribbons or "webs" pass over turning bars and other devices, by which they are laid evenly one over the other, and pasted together. The webs of paper then pass down upon a triangular "former," which folds them along the centre margin. They are then taken over a cylinder, from which they receive the final folds, a revolving blade within this cylinder projecting and thrusting the paper between folding rollers, while at the same moment a knife in the same cylinder severs the sheet, and a rapidly revolving mechanism, resembling in its motion the fingers of the hand, causes their accurate disposal upon travelling belts, which convey them on for final removal. From this rather summary description it will be apparent that the principle of retaining the paper in the web or unsevered form, up to the final fold and delivery, and performing all the operations without retarding the onward run of the paper, effectually prevents chokes or stoppages through any miscarriage of sheets severed before the folding. Hundreds of these presses are now in operation in the United States, and in offices of the large newspapers in Great Britain. Previous to the introduction of the double supplement press, however, Hoe & Co. had made what is known as the double perfecting machine. The success of this press, which embraces substantially the printing and folding devices embodied in the double supplement machine, was the connecting link between the ordinary single or two-page wide press and the double supplement machine.

The next improvement in fast presses was the construction of the machine known as the quadruple newspaper press. This machine was a step in advance of anything before attempted. The first one was constructed in 1887, and placed in the office of the New York "World." The same principles were embraced in this as in the double supplement, but developed to a greater extent. The supplement portion of the press was increased in width. By means of ingenious arrangements and manipulation of the webs of paper, this press was made to produce eight-page papers at a running speed of 48,000 per hour; also 24,000 per hour of either ten, twelve, fourteen, or sixteen-page papers; all delivered in perfected form with great exactness and perfection, cut at the top, pasted, and folded, ready for the carriers or the mail.

It was thought that the limit of printing capacity in one machine had been reached in this new invention, but, in 1889, the same firm undertook the task of constructing a machine for Mr. Bennett which would even eclipse the quadruple machine, which had, together with the double supplement press, superseded almost all others in the large offices of the United States, as well as in Great Britain and Australia. This press, known as the sextuple machine, occupied about eighteen months in construction. It is composed of about sixteen thousand pieces. The general arrangement differs entirely from that of the quadruple machine. The form and impression cylinders are all placed parallel, instead of any being at right angles as in the quadruple and double supplement presses.

Achievements of Newspaper Presses

It seemed as though the limit had been reached in this marvellous machine, but new wonders were in store. In 1902 Messrs. R. Hoe & Co. built, for the New York "American," even greater presses than these. The "American's" plant now includes six giant combination color and sextuple presses, five quadruple stereotype and perfecting presses, one multi-color and half-tone press, printing seven colors at once; one pictorial half-tone web press, and three giant octuple rotaries; all Hoe machines. The sextuple presses in question were the first of their class ever made, and are capable of printing in colors, or black, or both combined, and printing from half-tone and stereotype plates. A sextuple press of this class is fed from three rolls of paper sixty-six inches wide, and prints two papers side by side. The paper is led between the separate sets of impression and plate cylinders, where they receive the impression in the usual manner. After printing, the sheets are taken over associators to the folder, which also pastes. Each set of cylinders is equipped with its own ink fountain, and by special mechanism is arranged for taking a separate color if wanted. The product of a sextuple machine is 48,000, of four, six, ten, or twelve-page papers, with two pages in four colors, and two pages in two colors, or 24,000 of eight, ten, twelve, fourteen, or sixteen-page papers, with four pages in four colors and two four-pages in two colors, making eight color pages, or the whole paper can be printed in black, 12,000 twenty or twenty-four page papers per hour can also be printed with sixteen pages in color, or all in black. There is a wire-stitching device attached to the machine that staples instead of pasting when required, and this, too, when the press is running at full speed. The machine takes up a space of about 22 feet long, 12 feet wide, and 13 feet high, its weight being about seventy tons.

Three great octuple rotaries, among the largest presses in the world, are now at work in the "American's" pressroom. The machines are constructed to print the paper in black or in colors; the Sunday edition of the paper being produced with the illustrations printed in colors from half-tone blocks. Each of the new presses weighs, when in running order, about 100 tons. Each press has 11 pairs of printing cylinders, 40 ink-distributing cylinders, 100 composition rollers, 22 ink fountains, 5 sets of oil fountains, and 850 gear wheels. Counting all the parts, each press is composed of about 50,000 separate pieces. The presses are 35 feet long, 10 feet wide, and 15 feet high. An 80-horsepower electric motor is required to start one of them from a state of rest until it attains its proper speed, after which it performs its work at considerably less expense of power. On these presses a magazine can be printed with its pages embellished throughout with half-tone work and numerous pages in five colors, besides the black of the printed text. All these pages can be printed from stereotype or electrotype plates, as desired. The combined production, when running an edition, will be as follows: Of 8-page papers, inset and delivered, pasted and folded, with the cover pages in black, half-tones and colors besides, 288,000 per hour. Of 10, 12, 14, and 16-page papers, all inset and delivered, pasted and folded, with the cover pages in half-tones and colors, 144,000 per hour. Of 18 and 20-page papers, all inset and delivered, folded, with the first and last and two centre pages in half-tone or in three colors and black, 96,000 per hour. Of 16-page papers, collected, composed of two 8-page sections laid on each other and folded to half-page size, with the first and last pages of each section in half-tone, or in three colors and black, 144,000 per hour. Of 16, 20, 24 and 32-page papers, collected, composed of two sections folded together with the first and last and two centre pages of each section in half-tone or in three colors and black, 96,000 per hour. They are not restricted to one size of page. They will print half-page size, with color pages distributed throughout sections which may number up to 64 pages. They are also equipped with a labor-saving device for the blending of colors while the presses are in motion, by means of which three or four simple colors produce tints as artistic as those obtained by seventeen separate colors printed on flat-bed presses.

The arrangement of the type cylinders is such as to make the press one that can be handled with great ease and rapidity. Between the two rows of cylinders is an open passageway. It is large enough for men to pass through either from the ground or from the gallery near the centre of the press. From this open passageway the pressmen are able to watch every movement of the machine's interior working, and from it they are enabled to make quick changes on the plate cylinders. The change in position of only two ink-rollers is necessary to change a plate on any cylinder. In running a press at such a tremendous speed as these octuple presses are run, the greatest care has to be taken in order that the paper may not break. Breaking the paper means delay, and delay means loss. On the new octuple presses each roll of paper is especially guarded against breakage. There is a device in the shape of a short, endless belt of rubber which passes over two pulleys and rests on top of the roll of paper. The paper then is pulled from the roll as gently as the thread is pulled from the spool of a sewing machine. The belt pushes the roll along at a speed equal to, and sometimes a little greater than that of the stereotype cylinders. Hence all tension is removed from the paper.

One of the great printing machines actually running at the present time, in a daily newspaper office, is described as follows:

A few years ago, when the first of the modern web perfecting presses was seen turning out newspapers already folded and counted from a continuous roll of white paper at railroad speed, that style of machine was considered a wonder. To-day the "New York Herald's" mammoth press does the work of twelve of those presses. It is twelve presses in one, and folds, counts, and delivers the papers in bundles of fifty, ready for carriers and news-dealers, at the rate of 150,000 complete eight-page sheets per hour. More "intelligent" machinery does not exist.

This press sweeps the gamut of mechanical ingenuity—from the most delicate chronometer to the swiftest locomotive. Twenty hours is the fastest time between New York and Chicago, a distance of nine hundred miles. In half this time the "Herald's" big press runs more than one thousand miles of paper through its flying machinery, the papers falling, printed, folded, and counted, at the little stations on either side of the great press. Such is the triumph of ideas practically worked out in machinery.

Here is a condensed description of this press—called the Goss duodecuple six-deck straightline compound newspaper printing and folding machine:

One of the fastest newspaper printing and folding machines in the world. Built on the straightline principle. The word "duodecuple" meaning twelve times, it will, therefore, be readily understood that this mammoth machine has a capacity of twelve single-roll web presses.

The capacity of this machine is as follows: 300,000 four-page papers per hour, or 5,000 per minute, 150,000 eight-page papers per hour, or 2,500 per minute. 100,000 ten or twelve-page papers per hour. 75,000 fourteen or sixteen-page papers per hour. 50,000 eighteen, twenty, twenty-two or twenty-four page papers per hour. All are printed, folded, and delivered.

Ninety rolls, or sixty to sixty-five tons of paper, are used on one of these mammoth machines in operating for ten hours. This amount of paper would reach 1,073 miles in a straight line, or from New York to Chicago. It requires ninety-six full page stereotype plates to equip the machine for printing. The newspapers of various numbers of pages are delivered from six different deliveries, all automatically counted in bundles of fifty. The paper magazines at the end and top of the machine contain, when fully loaded, eighteen large rolls, or about twelve tons of paper.

Presses for Weekly Papers, Magazines and Books

The experience gained in the construction of fast newspaper machines, and the accumulation of patented devices entering into them, which are numbered by the score, have had their influence in the improvements which have been made upon presses for the printing of weekly newspapers, periodicals, and magazines. In 1888 was introduced a patent Hoe machine called the three-page-wide press. It has a capacity of printing, perfecting, and delivering 2-page papers, with one fold, at the rate of 60,000 per hour; 4-page papers, with two folds, at 24,000 per hour; 6-page papers at 24,000 per hour; 8-page papers, folded twice, or to carrier size, at 12,000 per hour; and 12-page papers, folded in the same manner as the 8-page, at the same speed, viz., 12,000 per hour; all the supplement sheets being inset and pasted if desired. The prominent features of this machine are: First, the outside pages may receive the first or last impression at will, thus enabling large cuts and other similar work to be printed without offset. Second, grippers and horizontal folding knives and all tapes but short leaders are done away with in the delivery and folding mechanisms, the movements being all rotary. Third, the press occupies but a small space on the floor, being 6 feet 1 inch high, 8 feet wide, and 15 feet 5 inches long over all.

In 1889, the Hoe concern constructed a patented perfecting machine, in which the plates, or forms, for both sides are placed upon one cylinder, one side of the form of matter being placed upon one end, or half, of the cylinder, and the other side upon the opposite portion of the cylinder. One impression cylinder only is used, and the inking apparatus is greatly extended. This machine is remarkable for the great variety of work it will do. At a high rate of speed sheets of 8, 16, 24, and so on up to 96 or 128 pages, may be printed and delivered folded in either 12mo, 8vo, 4to or folio sizes, ready for the binder. The press does the work of ten flat-bed cylinder presses and ten hand-fed folding machines. The paper is supplied to the machine from the roll by an automatic feeder, and after printing passes over the "former" into the folding machine, where the folding and cutting cylinders produce the required number of pages in the form desired. Curved electrotypes are now made very successfully, and this press is the first to bring the printing of the average book and catalogue within the range of web press work. While in general principles the press is similar to the large newspaper perfecting presses, though very much smaller in bulk, it has increased facilities for distribution, and finer adjustments throughout. The plates admit of underlays and overlays the same as on a flat bed press. There are no tapes, the folding being done on rollers and small cylinders without smutting the printing. In the folding machines there are knives which cut the sheet into the right size for folding, after which they are automatically delivered, counted in lots of fifty each. The speed on a 32-page form is about 16,000 copies per hour. This style of machine is probably destined to revolutionize book and pamphlet printing, as it combines the finest construction and facility of operation with the greatest speed. In 1886, Hoe & Co. made an advance toward perfection in the rotary system of printing as adapted to doing fine work, and constructed for Theodore L. De Vinne a perfecting press to do the plain forms of magazines. The success of this perfecting press in magazine work induced the makers to devise a machine on the rotary principle adapted for the finest kind of illustrations—in short, to make a press which should do work as fine as it was possible to do on the hand press or the stop cylinder. The result was the setting up, in 1890, at the De Vinne Press, of a machine known as the rotary art press.

Color Presses

The demand for printed matter seems to increase with the ability to furnish it, and much attention is now being directed to the subject of color printing on the rotary system. From present appearances, and from the enterprise displayed by the publisher, the artist, and the press maker, it would seem as though the day is not far distant when this subject alone will furnish matter for a new chapter in the history of the printing press.

The last few years have witnessed an immense advance in the art of color printing. The magazine without an elaborate color cover, or perhaps colored illustrations, is now an exception, whereas it was the reverse not long ago. After satisfactory experiments it was ascertained that with the inks properly prepared and suitable plates to print from, colors could be printed almost simultaneously upon the paper, without mingling; in short, that the necessity in much of the work done, of drying the sheets after the impression of each color on the paper, was not necessary for the production of a good quality of printing. Further experiments also proved the mechanical possiblity of obtaining most accurate register in printing from a roll, and that the number of impressions, or colors, could be increased to advantage. These various experiments resulted in the construction, by Hoe & Co., of color presses which were almost simultaneously installed by the proprietors of the New York "Herald" and the New York "World," who commenced the publication of colored supplements, upon a system which has been adopted by the papers in most of the large cities, and which they have never discontinued. The practicability of printing in colors has been so fully demonstrated, that color attachments are being added to very many of the large newspaper presses throughout the country.

The most extensive of the color presses, and the largest printing machine ever constructed, is the color press made by Hoe & Co. for the New York "American," and now used in printing portions of the Sunday edition of that paper. This machine gives as many as eleven separate impressions, or colors, on a single copy of the paper; that is, it will print in six colors on one side of the sheet and five on the other, or it may be arranged to print three colors on one side and six on the other, giving a speed of about 16,000 8-page papers an hour, or at every revolution of the cylinders the equivalent of two perfect 8-page papers printed in colors. Four, six, eight, ten, twelve, fourteen, sixteen, twenty, twenty-four, twenty-eight, or thirty-two page papers may be printed on this machine as required; from one, two, or three double-width (or four-page wide) rolls of paper. It will also produce magazine forms (with pages half the size of those of the regular issue of the paper) at from 16,000 to 24,000 an hour; either sixteen, twenty, twenty-eight, thirty-two, forty, or forty-eight pages, delivered folded, cut, and automatically wire-stitched, with all the pages printed in colors or half-tones.

Such a development of the art of printing, especially in colors in which accurate register is not only necessary, but must be maintained, would have seemed incredible a few years ago; but this is now a daily occurrence, and other newspaper offices produce colored supplements in the same manner and with the same results.

Nor has this development of colors been confined entirely to the demands of the newspaper world. It is gradually finding its way into the weekly periodical and the monthly magazines. It was considered impossible to print half-tone illustrations on both sides of the sheet at one operation, and deliver them flat, without smutting.

Not only has this difficulty been overcome, but in the latest presses, such as are used by "Collier's Weekly," the finest half-tone work is done on a perfecting press printing on a roll of paper. This periodical is printed in multiple pages, as required, and delivered from the machine folded, cut apart and pasted, ready for the binder. It is not desirable, of course, when using fine inks, to make immediate delivery from the press; therefore the papers, after having been perfected, folded, and pasted, are left to stand for some hours before they are distributed to the readers. Satisfactory methods of doing this have also been devised.

The capacity for printing fine half-tone illustrations on a rotary press having thus been demonstrated in "Collier's Weekly," the next step is evidently the production of colored half-tones, and the time is undoubtedly near at hand when the monthly magazine as well as the weekly periodical will appear, instead of in black half-tones now so popular, with these same illustrations printed in the most delicate manner in colors, and all delivered from rotary presses, folded in entirely, or in signatures, ready for the binder.

Typefounding

In the manner of designing types there has been no great change in late years. The execution of the design has, however, materially altered. The Benton punch cutter, introduced about 1885, was a great improvement upon former methods in punch cutting. Without attempting an elaborate and technical description of this machine, we may state that it consists of a framework a trifle over 5 feet in height, which occupies a floor space of 22 by 28 inches, and in which a table is set about 3 feet from the floor. The first step is a pencil sketch of letters 12 inches high, on paper. A pantograph reproduces this drawing, as a model letter, 3 inches in height, having a raised outline. This letter is then electrotyped. The electrotype is firmly fastened upon the table of the machine, just beneath a tracing needle. Four rods are attached to the head plate of this needle. They hold the cutting part of the machine, which is at the top. This consists of a borer, which revolves rapidly, in a stationary position, in a movable framework. In this framework is placed the metal bar intended to be cut. The machine being adjustable, any body of type may be cut by it, ranging from 2-point to 72-point in size. The needle or index is moved over the model letter on the table or platform, and its direction is accurately repeated by the tools which cut the punch. These tools used for cutting are of the most careful workmanship, two or three kinds being employed in succession; and are of a very high temper. They are operated by steam power at a very high rate of speed, and the steel is cut by them as indicated by the movement of the index or needle over the model letter. No handwork is demanded by the punches which are the product of this machine. They are finished in all points, and are more accurate than those made by hand; the counters being deeper, while the bevels are truer and have a uniform slope. Model letters may be reproduced by this machine in direct or in reverse order. Hard steel is used where the punch is employed in producing matrices by the process of driving. This is the case in making small characters. For the larger ones, the matrices are made by electrolysis from soft metal.

The American Type Founders' Association, in 1886, appointed a committee for the purpose of examining the new system, and, influenced by their report, the pica was accepted as the basis of the point system. The twelfth part of a pica is called a point. This point was taken as a unit. All bodies of type were scaled on multiples of this point. They were given numerical names. Pica was called 12-point, long primer was styled 10-point, brevier became 8-point, and the principle was continued down to the excelsior, or 3-point. The American Type Founders' Company, formed in 1892, virtually controls this business in the United States.

Composing and Typesetting Machines

The Mergenthaler Linotype is very ingenious in its scope. A bank of keys connect with a magazine, which contains about 1,500 brass matrices. These little plates have, on one edge, the die from which the letter is cast. At the upper end is a series of indentations, or teeth, for the purpose of distribution. Every character has a different combination. Each magazine contains not only a number of matrices for each letter, but also all the characters of a complete font of type of differing thicknesses. For justifying each line as it is cast, are supplied various "spaces," to be inserted between the words. The magazine is stationed at an angle with the floor. Within it are various channels in which the matrices for the different letters are stored. As the keyboard is manipulated, the matrices are picked up as they are desired to appear in the casting or "slug." As soon as a key is struck, the corresponding matrix comes from its channel, and is borne to the "stick" or assembler. At the completion of each word, a touch of the space key inserts the wedge-shaped space necessary between each two words. Errors may be corrected by substitution of matrices, after which the wedge-shaped "spaces" are pushed up, and immediate justification obtained. Automatic transference of the completed line then takes place. Behind the mold is a melting-pot, which is full of molten metal. In this pot is a pump-plunger, which leads to a perforated mouth so arranged as to close the rear of the mold. The plunger automatically forces the metal into the mold. It is compressed against the line of matrix letters and becomes a solid "slug." The mold is then brought in front of a blade, which pushes the "slug" into a receiving galley. It is now ready for the proof-press. The "slugs" are made type-high.

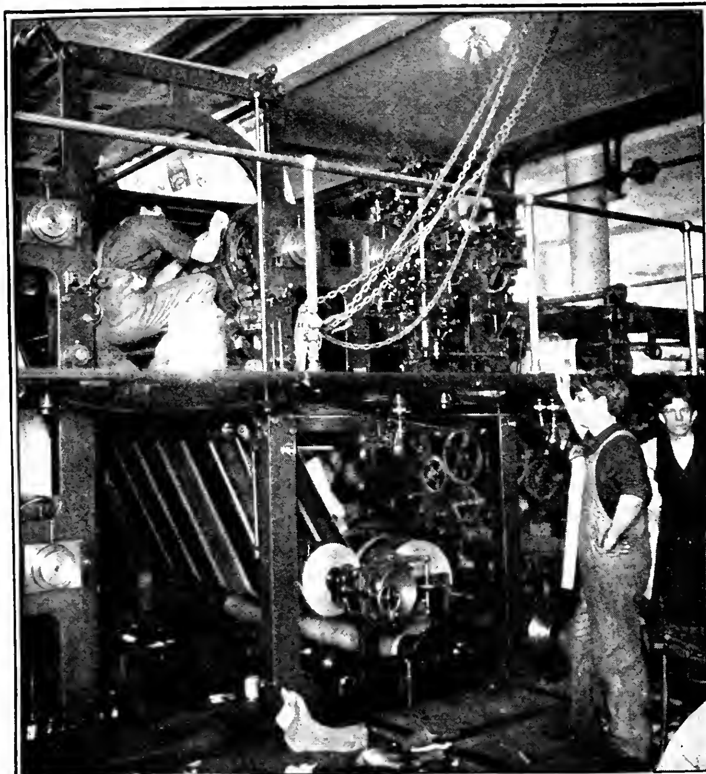
The distribution is a simple process. A long arm lifts the line from the mold, and it is moved laterally until the teeth at the top of the matrices are seized by the teeth of a bar lowered for the purpose. This bar, in rising, takes the matrices to the distributor at the top of the machine, but does not take the wedge-shaped "spaces." The latter are removed to their magazine. The matrices are now pushed along a distributor bar, which, in one single piece, is placed horizontally over the upper end of the magazine, being supplied with longitudinal teeth fashioned to engage the teeth of the matrices, thus holding the latter in suspension as they move along the bar. Over each of the channels the teeth of the bar are cut away, producing a different number or combination. When the matrix, in travelling over the mouths of the channels, arrives at the point where its teeth fit those of the bar, it is immediately disengaged, and falls into its own channel.

A record of 13,000 ems per hour has been reached. The average speed is at the rate of 4,000 ems per hour for a good operator. In each magazine there are matrices for any face of type. The ordinary list of type faces now runs from ruby to pica, or 12-point. Some matrices, however, have been made for English, or 14-point. This machine can also supply the alphabets of different languages and various faces of letters. The effect of "leading" may be obtained by casting a 6-point face on a 7-point body, or a 7-point face on an 8-point body.

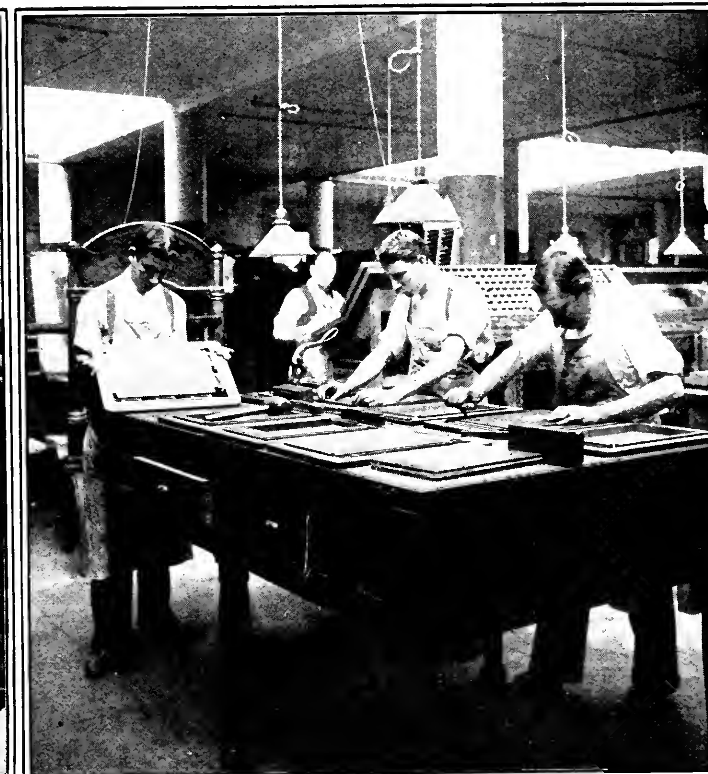
The linotype company makes all the matrices for its machines. A two-letter matrix has recently been invented, the principal letter being a body-character, placed above the other, which is italic, small capital, or bold face. A special finger-key moves a small slide into the assembler or out of it. The matrices entering the assembler take the usual height, and, delivered to the mold, produce the upper or body characters. If the operator desires italics or small capitals, he draws out the lower end of the finger-key. Any desired combinations of faces may thus be obtained, this two-letter device having greatly increased the employment of the machine. The output of the company is about one thousand machines per year. Practically, a new font of type is supplied for every issue of a newspaper, the "slugs" going back to the melting pot as soon as used. The substitution of the line for the letter insures extraordinary rapidity.

The Scudder Monoline manufactures a solid line of type, or type-bar. All its different parts are in view of the operator. The Scudder monoline differs from the linotype in the construction of the matrix-bars, using bars each of which has 12 characters indented on the front edge, instead of a single intaglio. There are 500 of these matrix bars. The keys are struck and the matrices and spacers fall into the assembling-box. The bars are dropped a distance adapted to the position of the letter to be brought in line for casting. The operator begins the composition of a second line as the first is automatically justified, carried to the casting-pot, and delivered upon the galley, and the matrices and spacers are returned to their proper receptacles in the magazine.

The Lanston monotype machine shows a radical difference from the principle of the linotype, producing single types cast in the order of their use. These types are set in automatically justified lines. Two machines are used. One is a perforating device operated by a keyboard. The other is a casting machine. On the keyboard, there are 225 different characters. This includes a complete font, with italics and small capitals. The arrangement of the keys is in 15 columns of 15 rows each, and, at the top, 2 extra rows for justification, a different color being used for each series of characters. The keyboard rests on an iron bar upon a base one foot square. A roll of paper at the top of the machine unwinds from one spool and winds on another as the keys are struck. Here there is also a paper-scale which registers the body size of the type. The first thing that the operator does is to set an index of the number of ems required per line. The paper ribbon is perforated at each stroke of a key in such a way as to control the matrix of the proper letter in the casting machine. This causes the registering scale to charge to the line an amount which equals the body width of the type just selected. Thus a line is duly perforated and charged. As the end is neared, the line-scale indicates that the line cannot receive the next word or syllable, and another part of the registering scale shows the amount of unfilled space in the line, if any. Account is also kept, by another part of the scale, of the number of spaces used between words of the line. The amount of space to be added and the number of space-types suitable for this purpose are mechanically recorded for the operator, who, as each line is completed, is able to know at once what additional holes to perforate for perfect justification. The spool passes from the perforator to the casting and setting machine. In the casting machine the ribbon is unwound in reverse order, and the casting and setting operates in like manner. The pressure of the air passing through the holes as the ribbon moves over a rounded plate controls the casting machine. There are 32 air tubes within this plate. As different perforations appear, different connections are made through these tubes with the casting machine. In a die-case



MAKING READY ON A HOE WEB PRESS



COMPOSING ROOM—MAKING UP FORMS

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there are 225 matrices. The matrix-case is shifted according to the combination of perforations which passes over the air tubes. The perforations for justifying control the casting of space types between words. The molds, in which the bodies of the types are cast, can be quickly exchanged. An automatic plunger forces hot metal in the melting pot into a nozzle leading to the mold upon which the matrix rests. The metal is pressed against the matrix, which is at once filled. The matrix immediately occupies the body of the mold under pressure. The types, when chilled, are ejected through the mold into the carrier, and this transports them to the line in the galley. The keyboard and casting machine may be operated separately. An average speed, in setting, is 5,000 ems per hour. According to the body size, the type-casting machine casts and produces from 4,000 to 5,000 ems per hour. It can cast type on bodies from 5½-point to 12-point. The faces may also be varied.

In the Goodson graphotype, the motive power is electricity. It consists, first, of a small table with an ordinary typewriter, a perforating machine and a small dial; and, secondly, a caster and setter. The operator is required, at the end of every line, to touch the key indicated by the dial which controls the spacing, and thus the line is automatically spaced and justified. As each letter is written by the key on paper, an electrical communication is made with the perforator. The latter perforates a narrow paper ribbon with round holes in such arrangement that when the ribbon takes its place in the casting and setting machine, an identical electrical connection is made through this perforation. The ribbon and the corrected typewritten sheets may be preserved for future use, without the expense incurred by retaining metal. The same ribbon and corrected first proof may be used to set from 5½ to 12-point type. The perforator does not determine the size or style of type. This is done by the caster. The caster and setter is operated automatically. Its speed, in casting and setting type, is about 5,500 ems per hour, although a rate of 8,000 ems has been reached. The molten metal is carried to the mold through a tube heated by electricity. The type is equal to foundry type.

By the Dow system of composition two machines are required, one for composition and the other for distribution. Individual foundry types are set and automatically delivered, properly justified, on the galley, by the composing machine. Its typewriter keyboard has 90 characters, the keys being used merely to release certain parts. The rest of the work is done by the motive power of the machine. The main type-magazine is divided into two parts. In the type channels, the types lie with their faces in sight. They rest on their sides, additional channels being supplied for the letters more frequently used. As the keyboard is touched, a single type is pushed from the magazine to a type-raceway, which is in a continuous horizontal line and widens at one end. The type is stopped at the centre and conveyed into an upright channel or "stick." As the types enter the "stick," the operator can see their faces and make the desired corrections. When the line is nearly completed, a gauge indicates whether the line is short or redundant. As the line is filled, a line key is touched by the operator, the "stick" of type turns halfway round, and the line of characters is forced to a point called "the bridge." Here the justification begins. Rectangular bits of brass, type high, temporarily separate the words during composition, each word being removed at the "bridge" and carried to the galley, where the proper justifying spaces are substituted, the justification being executed by means of an automatic calculator. This calculator serves to register the shortage in the line and the number of spaces required for it, apportions the spaces to the shortage, and ejects the proper spaces, placing them between the words during their progress through the raceway to the galley. The operative force of the machine is one-half horsepower, all its movements being "positive" and independent of other forces.

Entirely separate from the composing machine is the Dow distributor. It is also "positive" in its action, and is automatic. A special nick of identification is provided for each type character. The distributor is a flat, central disk joined to a fan-like set of channels. At the outer edge of the disk there are 36 type carriers. In rotating past the galley channel each receives a single type. This type is carried round until it meets the proper channel, into which it is pushed, while the distributor continues its motion.

The Cox typesetting machine and the Thorne machine, in combination, form the simplex one-man typesetter, which can compose and distribute simultaneously, if desired, requiring less than one-fourth horse-power. It consists of two cylinders, one above the other, and each about one foot and one-half in diameter, the lower one being stationary, but the upper one rotating in the common axis. There are 90 parallel channels extending, vertically, the full length of each cylinder. The channels of the lower cylinder form a magazine for the storing of type distributed from the channels of the upper one. As each key, connected with a small plunger at the bottom of its special channel, is struck, the plunger ejects one type upon the flat surface of the rapidly moving disk at the bottom of the cylinder. The type is borne to the right-hand side of the machine, and is deflected to a flat travelling belt and conveyed to the "separator." The types now go, one by one, to the "packer." Here they are lifted and carried to the proper position. The packer receives types, with a three-em space between the words, until a continuous line is formed across the back of the keyboard, face in view. Now the operator takes his place at the left, at the justifying mechanism, and separates from this long line about enough matter for a line of the column being set. This he corrects by hand. A thumb lever beside the galley is now touched. This releases a "pawl" engaging with a ratchet on a rotating wheel beneath the keyboard. As this wheel makes one revolution, the rule behind the type line is drawn below it. A line-pusher comes up in front of the line, carrying it to the galley behind the rule. There is a simple device for the automatic "leading" of matter. At the rear of the upper cylinder is the mechanism for distribution.

CHAPTER XVIII

THE PUBLISHING INDUSTRY

The Publisher—Book Publishing in the United States—Publishers and Authors as Friends—The Manufacture of Books—The Publishing of Periodicals—Newspaper Publishing—American Newspaper Publishers' Association—The Co-operative Plan of Printing Papers—Newspaper Combinations—Weekly Papers—Magazines—Trade and Technical Papers

The Publisher

PUBLISHERS are sometimes mere followers of the local or national trend of thought or taste, but the aim of the true publisher is to lead the thoughts of the people into high channels and to develop a taste for that which is pure in literature. Hence the publisher is an educator as well as a business man. He follows a profession as well as a branch of manufacture. As an educator, much depends upon the use he makes of his selective power. The selection of reading matter for the general public is by no means an easy task, nor can such matters be decided in a moment by snap judgments. A publisher is obliged ever to consider the different ages of readers and their variety of tastes. As he must select for the many, not for the few, he is not always permitted to publish that which seems to him the very best, but that which appears to be the very best for the greatest number of readers. Different publishers have different kinds of readers, and issue different kinds of books, hence it has been very aptly said that "the imprimatur on the title page is a flag covering merchandise, and the discerning public at a glance determines from the name of the publisher the quality of the wares purchased."

Book Publishing in the United States

The greatest readers and book buyers in the world, meanwhile, are the people of the United States. According as there is mental activity or mental sluggishness among the people, publishers flourish or languish. Certain it is that where there is illiteracy there can be no great demand for reading matter. The widespread greed for knowledge among the American people, however, makes almost any publishing scheme in this country a comparatively safe venture.

Many publishing houses issue two kinds of books—new publications and reprints, though certain publishers confine their business almost entirely to the issuing of reprints; that is, new editions of old works. There is a distinction, therefore, not at all disparaging, between the book manufacturer who confines his business to the reprinting of old works and the publisher who issues for the first time in book form an entirely new and original work. From the commercial point of view, the reprinting of old works involves risks quite as great as the issuing of entirely new books, for in all books there enters an element of uncertainty. Moreover, it is often the case that the publisher risks more capital in a new edition of an old work than in a first edition of a work, especially when the reprinted work consists of an *edition de luxe* on the finest paper and containing pictures for which artists have been paid many thousands of dollars.

Reverting to the publisher as an educator, his responsibilities are probably greatest in the selection of text books, for such works are issued purely for the purpose of instruction, and have a large influence in the training of young minds.

To say that the American people are the greatest book buyers in the world is the same as saying that the book trade in the United States is not equalled in extent in any other country. To meet the great demands of this trade there are between 700 and 800 American book publishers, who issue between 7,000 and 8,000 new books each year. There are, besides, more than 10,000 publishers of newspapers and other periodicals, and maps. In Greater New York, alone, there are more than 200 publishers of books; in Philadelphia about 75; in Boston and Chicago each about 60; and in San Francisco 15. The remainder are to be found in the chief cities in every State of the Union. The great bulk of the books published in this country, however, are issued by not more than 100 firms—a fact which is suggestive of the conservatism of the trade. This means, too, that a large proportion of the 700 or 800 book publishers issue only one or two books a year; but it is very frequently the case that such publications are very important works, issued at very great expense. A firm may publish exclusively, for example, a dictionary, an encyclopedia, or a directory. Owing to the tremendous original cost, such works have to be sold in enormous quantities, usually by subscription. Directories, which have been called "books that are not books," are usually issued by firms which devote themselves to one new edition of such a publication each year. Such publications may be city directories, or State directories, or business or professional guides, giving lists of dealers or persons engaged in each business or profession; or they may be catalogues or genealogies, or indexes of various kinds. Some of these directories contain as many as 2,500 pages in fine type, 11 by 13 inches in size, their preparation having required not only a large staff at the home office, but an army of correspondents the country over.

The chief book market in this country, of course, is New York; Philadelphia and Boston come next, and then Chicago. As the centres of population move westward new central book markets are created, and it is only a matter of time when St. Louis and Denver will rank with Boston and Philadelphia in the book trade; for as fast as the new sections of the country west of the Mississippi are opened, publishers and book distributers provide facilities for meeting the demand for books in such regions.

In addition to the hundreds of regular book publishers there are fully 60,000 firms in the United States engaged in the selling of books. The book trade of these firms may be either the whole or a part of their business, though the great majority sell only books and periodicals.

The books published in this country may be roughly divided into seventeen classes, the chief of which is fiction. Of the 8,000-odd new books published in 1902 nearly 2,000 were works of fiction. The remaining sixteen classes of new publications, according to the number of new works issued, are as follows: Law, theology and religion, education and language, juvenile, poetry and drama, politics and social science, history, physics and mathematics, biography, medicine and science, travels, fine art and illustrated books, sports and amusements, domestic and rural, mental and moral philosophy, humor and satire.

As an indication of the increase in the publication of new books the following figures may be interesting: In 1890, 4,500 new books were published; in 1891, 4,600 new books; in 1892, 4,800 new books; in 1895, 5,100 new books; in 1894 the issue of new books fell back to 4,400; but in the succeeding years the issue was increased by nearly 500 new publications each year, until in 1902 the total production of new books and new editions was nearly 8,000.

The volume of business done in the book publishing world involves about $75,000,000—the public spending annually over $35,000,000 for general literature and over $35,000,000 more for school and text books, for subscription books and directories. Several million dollars' worth of books are exported annually, about one-third of the foreign trade being carried on with the United Kingdom, a second third with the West Indies, and the remaining third principally with Canada and other British colonies.

With the continuous increase of educational institutions, and with the ever-increasing need of general instruction which dominates the American mind, and above all, with the rapid growth of the country, the publishing business is bound to flourish, the increase in the trade being healthful as the result of natural conditions.

Publishers declare that they are publishing larger editions of new books than ever before, though the question of how many copies one should issue of a particular book continues to be as difficult as ever to answer. Meanwhile the number of copies issued varies from 100 copies for a very expensive work, to 500,000 copies of a work of fiction. The best "sellers" in the book trade are school books. It is said that at one time over one million copies of Webster's Speller were sold every year. An ordinary edition of a text book is 50,000; and 500,000 copies of a certain school book are not infrequently sold in a single year. Thus the public school children of the country form a large and important class of book consumers. Then, too, vast quantities of text books are sold to the ever-increasing army of young men and women who are preparing for the higher professions. Again, the public libraries of the country, of which there are about 5,000, buy great quantities of books, many of them requiring a large number of copies of a single work.

As for the average life of a book, one-third of the new books published on a certain date in a certain year are uncalled for on the same date in the succeeding year. One-third of all the new books live two or three years, while all but a few of the remaining third become "dead stock" within six or seven years. Publishers agree that the short life of the average work of fiction is chiefly the result of the cheap library system, by which a new book is issued every fortnight or every month or two.

Publishers and Authors as Friends

This seems an appropriate place in which to emphasize the fact that under modern conditions the publisher is not the natural enemy of the author. In the old days this may have been the case, and even to-day young authors are prone to regard publishers with suspicion; but a common-sense view of the situation, in which the interdependence of the publisher, the author and the reader is kept in mind, will convince both the beginner and the veteran in literature that the modern publisher generally treats the modern author fairly and squarely. On the walls of the Aldine Association, in New York —which is probably the representative publishers' club in the United States —there is an old print representing a publisher as a man of extreme corpulence and surrounded by all the good things of life. A companion picture represents the author as a very lean man, his face "sicklied o'er with the pale cast of thought," his hair hanging over his collar, his pockets empty, and his surroundings devoid of even the comforts of life. But these pictures do not represent modern conditions. Publishers and authors now meet on equal terms, smoking cigars of perpetual peace. Our authors are no longer emaciated, their hair is trimmed to normal length, they have money in their pockets, their surroundings, if not generally as luxurious, are quite as comfortable as those of the publishers. Certainly it is to be conceded that this change in the general conditions of authors is due to a change of heart on the part of the publishers. In short, the author and the publisher have clasped hands and are ready to respond to the toast, "Each for both, and both for each."

The Manufacture of Books

One notable tendency of the time in bookmaking is to print books in large open-face type. The fashion for imitating copperplate and lithographic effects is passing away. There is an increasing admiration for the strong bold types. In short, printers are going back to first principles, and instead of trying to reproduce feminine delicacy, are striving to show masculine boldness.

As to paper, the discovery of the art of making paper of wood-pulp has done a great deal to cheapen the fabric of newspapers, but has been of great damage to books. The paper used now in ordinary book work is not as good as that used forty years ago when paper was made from cotton and linen rags. The skill of paper makers is greater now than ever, but the quality of the average output is distinctly inferior. While news paper can be had for three cents a pound, publishers have to pay from twelve to eighteen cents for book paper made of cotton or linen rags, and if it is desired to have hand-made paper chiefly in linen stock we must pay from thirty to sixty cents. The difficulties of doing good book presswork on ordinary low grades of paper can not here be clearly explained, but they are great. Modern books are often printed on paper that may fall to pieces within a hundred years, so that the preservation of the literature of to-day is in danger.

Regarding machinery: The culmination of invention in the use of fast machinery for book printing has probably been reached. Rapid machines for book work find their greatest use at present in the printing of large editions. Ordinary editions, however, have to be printed substantially by the methods and machinery that were in use forty years ago. The machines are larger and better, but they can not be made quicker.

One of the auxiliary arts to book printing is electrotyping, which has supplanted the older process of stereotyping. This art sorely needs improvement. The electrotypes of cuts and types are fair copies, but are rarely exact copies of the originals. One of the greatest expenses of nice book work is the additional time a pressman has to give to the preparation of his form and to remedy the imperfections of the electrotype process.

Modern cloth bindings are probably the cheapest and best bindings for books that have been invented. But there is still need of some new method of holding the leaves of a book together securely, though allowing it to open flat. The present method of wire stitching is cheap enough, strong enough, and rapid enough, but it makes unsatisfactory books.

The prices of our modern books have not been, nor can they be, much reduced by machinery. The making of a book costs now for labor twice as much as it did in 1860, and yet the price of books is no higher. The price is kept down by the largely reduced price of paper, and by improvements in the art of book-making in other directions. One of the greatest elements of cost in the ordinary book of small edition is that of typesetting and electrotyping. Book printers have not been able so far to derive any benefit from typesetting machines. Indeed, the greatest benefit derived from these machines seems to exist in the turning out of morning newspapers. Publishers declare they see little chance that typesetting machines will ever reduce the price of books, as the slight saving made in a quicker picking up of type is fully offset by the greater expense in other directions.

The greatest attractions in modern books are the illustrations. Since they have been cheapened by the photo-engraving processes, they have destroyed the old art of engraving on wood. It is not probable that photo-engraving will ever go out of fashion, but the time is coming, and is not far off, when the half-tone plate will be looked upon by the critical reader with quite as much contempt as a connoisseur in paintings looks upon the modern chromo.

The Publishing of Periodicals

To give a greater value for the money than any competitor does—that is the secret of success in publishing periodicals. Many failures are made because the publishing business is not taken seriously enough by some of its followers. The publisher of a magazine or newspaper is generally unwilling to invest largely upon his faith in the future. Every dollar has a string tied to it. Returns, he thinks, must be realized next week or next month. There is lack of faith, lack of grit in spending. The publisher must form his plans, and get his business into certain lines, not being swayed by precedent or criticism. He must not swerve. The only successful policy is a broad, aggressive, generous one, from which consideration for the immediate present is barred. The eyes must be kept on the future, the goal, not the starting place. The equipment, the printing plant, the editorial department, the counting room, the advertising, the circulation, must be made as perfect as possible. Such an equipment compels success.

Some think that the advertiser is altogether too much in the foreground, that many publishers truckle to him too much, sacrificing the publication's independence. Such a condition of affairs seldom exists in a publishing office. The advertiser does not edit the periodical, neither is he allowed to influence its policy. It is the reader who is usually first considered. Thus circulation is achieved, and advertisers buy space. Of course, the advertiser is indispensable. From his payments come the publisher's profits. Not for a moment is he ignored by the business office. But the editor edits his own publication, and no outsider controls it.

Newspaper Publishing

The newspaper press of to-day is a colossal institution. Its ramifications are limitless. There is no class of people that is not interested in it. The ancient flavor of dogmatism has been largely dropped. The tone at present is more educational and less oracular. In political struggles there is less newspaper virulence. Personal malevolence and animosity are relegated to the background. The old fashion sometimes practiced of hounding a man through thirty or forty years of his life, and then continuing for years the attack on his memory after his death, is no longer considered "great journalism." Independence and fairness characterize the best papers. The investment of capital in a journal is too enormous to admit of policies injurious to its welfare, and thus the press is becoming more conservative and more scrupulous every day. No outside person, no clique or particular interest, now holds a great newspaper in thrall. It is said that the newspaper publishing business is progressing so rapidly that no one can foresee its possibilities.

That versatile Frenchman, Max O'Rell, says that "the press of the twentieth century is the greatest power of the earth." "Is it going to be a power for good or for evil?" he asks. "The duty of the press," he continues, "is to enlighten and teach, besides giving the news of the day. Let those who have seen and know teach and enlighten those who have not seen and do not know. Let no journalist of any paper in the world write on a nation whom he does not know. When every important paper of the world understands this, and acts on this suggestion, I guarantee that before twenty years the peace of the world will be assured, the peoples will seek, study, respect and love one another. Let the journalist understand that his is not only a profession, but a mission, and one which may be the holiest of missions."

The hurrying public hardly gives a thought to the enormous outlay of money necessary for the production of the daily newspaper which may be bought for a cent. Taking New York as an example, the growth of daily journalism has been stupendous. The 1,000,000-a-day mark for the circulation of all the dailies of New York City, six years ago, was not quite attained. Now the 2,000,000 mark has been passed. Eight or nine papers have what might correctly be termed huge circulations. Even an East Side "Yiddish" paper has a daily circulation of 40,000, while four English newspapers may truthfully lay claim to a circulation of about 100,000 each. There is another paper that has worked up a circulation of 200,000, and two others have achieved a circulation of about 600,000. A circle drawn about New York, with a radius of twenty miles from the City Hall, would include two-thirds of this circulation. Allowing that there are 3,000,000 reading people within that territory, we find that they have a daily allowance of a million and a quarter newspapers to digest. These newspapers are not small affairs. They exhibit from twelve to twenty pages on an ordinary day. The Sunday editions frequently number from forty to ninety pages, while on festival days there may be a hundred or more. With New Yorkers newspaper reading has become almost a mania. Three or four different papers are read by many every day, in order to get comments on topics from different points of view.

As to the expense account, two great one-cent newspapers published in New York will furnish examples. Seven floors of a skyscraper form the home of one of them. The other pays about $100,000 in rent for quarters in eight or nine different buildings, which are connected, of course, by telephones and pneumatic tubes. From the sale of copies and from advertisements such a paper must take in about $3,000,000 a year. But, as a matter of fact, it is well known that receipts from sales of papers pay only about a quarter of the total expenses. These receipts may amount to $17,000 or $18,000 a week. The price of this paper to the newsdealers is a trifle over half a cent, or nearly four cents for the Sunday edition, which does not cover the price of white paper alone. This item of white paper is the most serious expense of all those incurred in running a great daily. The difference of a fraction of a cent in its price may upset all plans. If the publisher can only keep the cost of white paper down to the selling price of the newspaper, or a tiny trifle below it, he is satisfied. Every raise of a newspaper of this order from twelve pages to fourteen means an additional cost of $450 for the edition, with no increase in the selling price. The great daily pays for white paper from $18,000 to $20,000 every week. Thus, by a process of elimination, we arrive at the fact that the profits of the enterprise must come from the advertisements. In them lies the success, or failure, of the newspaper of this sort, and, unless the advertisements amount to $40,000 to $45,000 a week, there is a loss. The profits, then, come from the surplus of advertising beyond this sum. The rates for advertising differ somewhat, running from $30 to $90 a column. Evening rates are higher than morning charges, while the tariff for Sunday is still higher. "Display" advertisements are placed on a more expensive basis than others. The morning, evening and Sunday issues must have about 30,000 columns of advertising *per year,* at an average rate of $70 a column to pay expenses. About one-half of this goes into the Sunday issues, the other half being divided between the morning and evening editions. In the Sunday issue, then, lies the welfare of the great newspaper, as a money-maker for its owner. With its higher price, greater circulalation, and greater rates for advertising, a big newspaper will sometimes take in $35,000 for a single Sunday, or more than $30,000 from advertisements alone on a special occasion. Sometimes neither the morning nor evening issues pay their expenses, and with the Sunday issue the newspaper sinks or swims. The circulation should pay for the white paper, and out of the advertising must come the other running expenses, say $40,000 a week. For weekly disbursements the business office calls for $1,000 a week; the stereotyping, $1,000; the press room, $1,500; the cable and telegraph, $2,000; circulation, $3,000; composition, $7,000. The mere item of postage amounts to from $150,000 to $200,000 a year. Thus in the office of a great paper the bills payable for commercial and mechanical charges are often $20,000 a week.

Such has been the march of progress that the business of a great daily is now phenomenal. The pressroom turns out 750,000 8-page papers per hour. For the stereotyped cylindrical plates one hundred tons of metal are held in readiness, the Sunday issue requiring seventy tons for the 1,400 plates employed in its make-up. The Sunday issue of a great newspaper often weighs as much as 275 tons.

The editorial and news departments require a goodly outlay, amounting to from $18,000 to $25,000 a week. The editorial manager may receive from $15,000 to $25,000 a year. The editors and their assistants in the great establishments get from $6,000 to $20,000 annually. Some cartoonists are paid as much as $15,000, and editorial writers and correspondents earn from $8,000 to $10,000. The rest of the editorial staff make from $2,000 to $7,000 a year.

It was inevitable that the newspapers should be beneficially affected by all the improvements in typesetting machines, plate-making, press-manufacturing, and illustrations. Note, for example, the enormous circulation of the Sunday editions. A few decades ago they did not exist. And yet in

1902 the Sunday editions of seven New York newspapers amounted, in the total, to nearly 400 pages. The comic illustrations are remarkable examples of color printing at an unprecedented rate of speed.

The chief development of the newspaper during the last decade was along the line of increase of news published. The rivalries of news establishments in New York led to great expenditures, and the quantity of news printed was something never dreamed of in the old days. An important occurrence was reported with the same disregard for space in the columns, whether it happened at the antipodes or around the corner. The incidental tolls for telegraphing by cable were not considered. During the decade the list is a long one of events which happened in Europe or Asia only to be recounted at great length in the newspapers of this country: the war between China and Japan, the war in the Philippines, the war in South Africa, and the war of the Allies against China. As to the Spanish War, the better part of whole editions was telegraphed by correspondents to the New York papers. A fraction of the expense thus incurred was met by the organization of so-called syndicates of newspapers, which paid a proportion of the outlay for the privilege of using the despatches. The world became better acquainted, but the newspapers did not increase their profits thereby.

Advertising, meantime, forms nearly one-half the total of the revenue of the publishers of periodicals. Subscriptions and sales form 35 per cent of the total; and book and job printing 21 per cent.

The total circulation, per issue, of dailies is enough to supply one copy for every five inhabitants; of weeklies and monthlies, together, enough to give one copy to every two inhabitants. Publications printed in foreign languages increase according to the growth of the foreign population, their circulation depending principally upon recent arrivals. It seems that as soon as an immigrant learns to read English, he drops the publication printed in his native language. Daily evening newspapers increase much more rapidly than morning papers, the increase showing a close connection with the growth of suburban population.

American Newspaper Publishers' Association

Mutual benefit associations existed in very many branches of industry before they were developed among newspaper publishers. But they took their place in the line of evolution in 1887, when a number of newspaper publishers met in convention at Rochester, N. Y., on the 14th of February, and the American Newspaper Publishers' Association was organized. Within a year it had 113 prominent papers on its rolls, and its membership now includes more than 160 papers of the United States and Canada. One of the objects of the Association is to conduct a business agency for the benefit of its members. The headquarters is in New York, whence it sends out credit-ratings and other advices and information of value. Another of the functions of the Association is that of a collection agency for the members. It has been of notable service to the press, securing a reduction in express charges on newspapers, and using its influence for the great benefit of the profession at large. It does not aim to swing editorial opinions, confining its work strictly to the business side of journalism. At the annual February meetings, the discussions are of great value, and by them the interests of the guild are promoted.

The Co-operative Plan of Printing Papers

While there has been some progress in the methods of the "patent insides" system, growth in this line has been relatively slow. More than 60 per cent of the papers printed on the co-operative plan are found in the North Central Division of the United States. The highest number for a single State is in Illinois, equalling the number for the entire North Atlantic Division, while Iowa comes next, surpassing both the Western and South Atlantic Divisions.

Many of the newspapers of this class are the only ones in their respective towns. This is true of 60 per cent of those sent out by one concern.

Most of the newspapers of this class are weeklies, forming about one-half of the weeklies in the United States. In this way many semi-weeklies and tri-weeklies are also issued, and even some dailies, the latter being sent by express every morning from a distributing centre; and finished in the afternoon at the local office.

Some concerns issue stereotype plates, which the local editor selects from proof-sheets, and cuts up to suit himself, often supplying new head-lines.

The American Press Association, of New York, organized about 1880, controls much of the plate-matter business, being supplied by the Associated Press with telegraphic news, to be used twelve hours after the regular service; which it distributes to about 2,500 dailies for use the same afternoon. It also sends out electrotype or stereotype plates of miscellaneous matter, and sells type uniform with that used for the plates, to provide a sameness of appearance in the papers.

The use of plate-matter, in place of the half-printed sheets, seems to be growing, country journals now largely demanding telegraphic news.

Newspaper Combinations

A tendency has lately been noted toward combination, under one ownership, of newspapers published in different places. Examples of this common ownership are "The Galveston News" and the "Dallas News"; the "New York Herald," and the "Evening Telegram," New York, and the "Herald's" European edition; the "New York Times," the "Philadelphia Times," and the "Chattanooga Times"; the "Washington Times," the "New York Daily News" and the "Boston Journal"; and several papers owned by William R. Hearst; namely, the "San Francisco Examiner," the "New York American," and the "Evening Journal," New York, and the "Chicago American."

This system does not seem well adapted to small places, where subscribers and advertisers prefer newspapers owned and published in the place of circulation.

Weekly Papers

On both sides the Atlantic, simultaneously, there have been interesting and important developments in the publishing of weekly papers. In the later nineties there was a sudden and quick forward movement in this field in England. "This thing ought to, and shall, succeed," seemed to be in the minds of publishers. Capital, hitherto brave enough up to a certain figure, now dashingly extended the limits to which it would go, and investments were made in amounts which until then were not even dreamed of as possible in this branch of journalism. Artists and writers of the first class were engaged; skilled men were placed in charge of the mechanical departments, with the result that the "picture papers," as we call them, presented such a high degree of literary and artistic excellence that they could no longer be ignored or kept out. The market was forced. The public of Great Britain was taken by storm. People bought the picture papers, perceiving that here they could read as they ran. In these journals they could see the people, the places and the happenings that figured in the comedies, dramas, tragedies of the news, as well as read about them. Money—and men who knew how best to spend it—had "made the mare go."

To the closest student of journalism this sudden development of an apparently well-filled field, not only in London, but in New York as well, was, and is still, a surprise. With the development of pictorial journalism in England there was a corresponding call for more and still more periodicals of this kind in America. There is now a large number of established weeklies in New York, Boston, Brooklyn, Chicago, San Francisco, and newspapers in all the large cities issue special Saturday night half-tone supplements, or Sunday pictorial magazine sections. The better class of readers now think no journey complete unless they possess one or more of these illustrated weeklies. One reason for this state of affairs may be found in the increasing, almost universal, demand in the United States for more accurate information; for to offset the haste and inaccuracy of daily newspapers appears to be the province of the American weekly newspaper. Another thing that helps to account for the support of weekly papers is the modern demand for pictures—for the actual, as exemplified in photographs and for the artistic as evinced by the finished drawing. In both of these departments of journalistic work, in monthlies as well as weeklies, Americans lead the world. Yet another reason for the demand and the success of the weekly is the improved public taste. Again, people nowadays spend more money for periodical literature than ever before. It is a poor household indeed in which the various members, from grandfather to schoolgirl, do not pay out as much for journals in a week as they used to spend in a month. Once more, the rise of the pictorial newspaper has been helped along by the spirit of trade, by commercial enterprise. The man with something to sell sees in the weekly a midway-counter between the daily and the monthly for the display of his wares. The seal of the people's approval of a weekly is the patronage of the advertiser. An illustrated weekly newspaper lies about in a house for seven days at least. It is read by every member of a family. It is perhaps eventually mailed to some one out West, or to a relative or friend in the Philippines or Porto Rico. Thus the existence of the weekly is stretched in many cases into seven weeks.

Weekly publications of the newspaper class have largely increased in number, in recent years, especially in the West and Northwest, where they are most numerous in proportion to inhabitants. In Nevada, for example, there is one weekly for every two thousand inhabitants, while in Rhode Island the proportion is one weekly for every twenty thousand inhabitants. In densely settled regions, like those in the New England States, the dailies have a larger circulation, proportionately to the inhabitants, than the weeklies. Among a certain class of weekly newspapers, however, there has been a decrease. The New York "Times" and the New York "Sun," for example, found it advisable to give up their weekly editions. The agricultural character of the New York Weekly "Tribune" enabled it to continue publication.

New weeklies of the pictorial class, however, have entered the field and have gained national importance. The enormous circulation of "Collier's Weekly" shows that there was room at the top.

Magazines

Turning to the magazines, we find that in the last few years there have been changes which might be termed revolutionary. The ten-cent magazine has seized upon the attention of the public. "Munsey's Magazine" started at twenty-five cents in October, 1891. It came down to ten cents in October, 1893. "McClure's Magazine" began in June, 1893, at fifteen cents, and appeared at ten cents in July, 1895. After changing its price two or three times, the "Cosmopolitan" became a ten-cent magazine in 1895.

It was found that, in the case of "Munsey's Magazine," the reduction in price to ten cents served to increase the circulation to an extent which was temporarily embarrassing, as the printing of the first edition had to be stopped to permit the printing of the next month's issue. As to "McClure's Magazine," the circulation was doubled by the reduction to ten cents, and in a few months it had risen to about 150,000. Owing to the opposition of the news companies, "Munsey's Magazine" had to be distributed independently, and the project was not considered a wise one. But cut-rates were popular, and the improvements in presses and machines for stitching and covering, reducing the cost, contributed to the success of the bold enterprise. The improvements in machine composition and the development of illustration, valuable as they were, generally speaking, had not much effect on the cost of the large editions, being a fixed charge. These low-priced magazines have reached an enormous circulation, in the United States and Canada. Looking, briefly, at the characteristics of these magazines, we see that "Munsey's Magazine" is distinguished by the large number of its illustrations and for its selection of timely topics and statements of facts about people who stand in the light of present publicity or fame. "Munsey's Magazine" contains an average of 240 pages, of which 80 pages are given to advertisements.

The policy of "McClure's Magazine" includes articles by prominent writers and the discussion in detail of subjects attracting the popular attention. The "Cosmopolitan" does not differ largely in scope from the older magazines. This very broad field seems to be liable to invasion by the Sunday edition of the daily newspapers. It has been stated that the combined circulation of Munsey's monthly publications, the "Ladies Home Journal," "McClure's Magazine" and the "Cosmopolitan" reaches about 2,500,000 copies each month.

Trade and Technical Papers

The growth of what are called trade journals has been extraordinary. They are found representing every industry and trade, every science and art. There are often many competitors in the same line, nearly fifty papers being devoted to the printing interests, for example. The technical press, it has been remarked, "brings all professional and scientific men together in one vast university, where the thought, investigation and experiments of all are made valuable for the common use."

The trade papers gather all the news of the various trades, with descriptions of improvements and new money-saving methods in manufacturing processes. Their editorials are of great influence. The reporters must be specialists in various lines, and must be absolutely accurate. Only facts are of value in these journals. The manufacturer or merchant must know the cost of raw materials and the market fluctuations. Most of the trades and industries, if not indeed all of them, are "interdependent." The woollen manufacturer looks in his trade paper to find out the price of coal, for instance, because it is an indispensable thing in his business, its price affecting all the textile industries. Thus the industries are allied to some extent in the trade and technical press, and each paper must give all the news, domestic and foreign, in any way bearing on the trade it represents. The trade and technical papers form a most valuable adjunct to the press of the country.

CHAPTER XIX

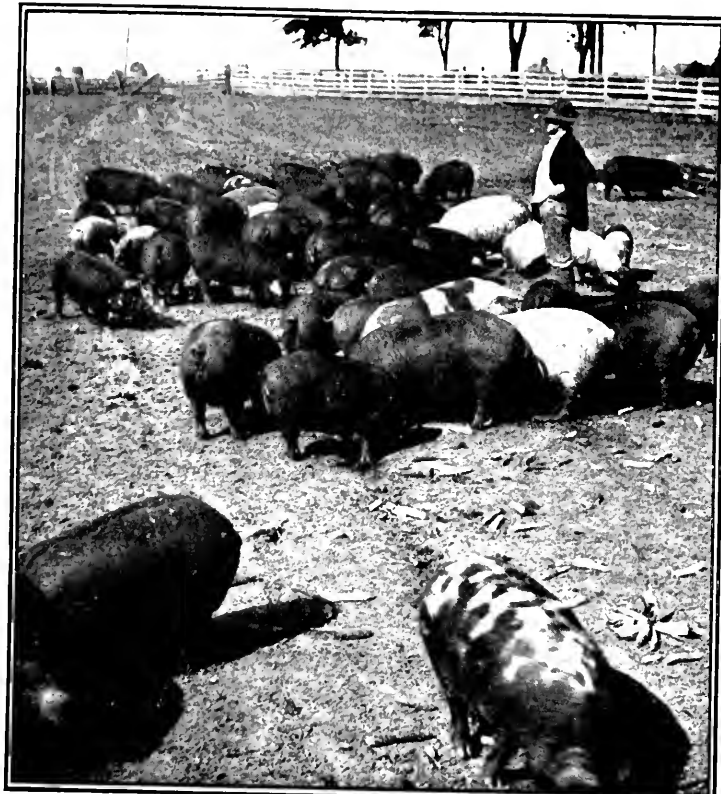
FOOD PRODUCTS, SLAUGHTERING AND MEAT PACKING INDUSTRIES

The Manufacture of Food Products—Slaughtering and Meat Packing—Hogs and Cattle for Market—The Stockyards and Packing Houses—By-Products—Refrigeration and Transportation—Meat Cutters and Butchers

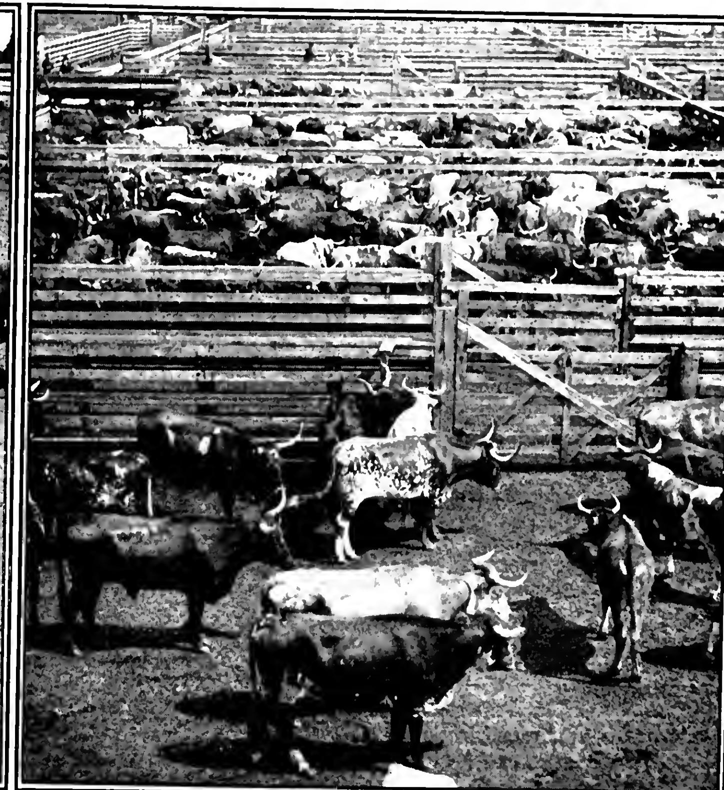
The Manufacture of Food Products

THE importance of the industries concerned with food products, impressed upon us from a point of view which begins at home, while the details disclose their vital relation to the material welfare of the whole people. The twenty-five industries which utilize for food the different forms of agricultural supplies are classified in a group which turns out seventeen per cent of all our manufacturing products, standing second in value only to the metal industries. They include chiefly the interests devoted to meat products, flour and baking, canning and preserving, sugar and confectionary.

Slaughtering and meat packing may be taken as representing the greatest value in investment and production among these food industries. The growth of this industry is the outcome of the rapid settlement of the Western country, and its exploitation by the great railways for thousands of miles toward all points of the compass. Every resource of chemical and physical science has helped to devise methods for treating and preserving, for storing and transporting the enormous output. In half a century the investment of capital has increased sixty-fold. Naturally it is a Western business, its great market and base of supplies centring in Chicago. We find the same features of modern progress prevailing in the next division of food industries, those which prepare for our use the "staff of life." Flour mills that are now being built are gigantic by comparison with those of an earlier period; small mills are being abandoned, unable to survive the stress of competition and cope with present requirements. Modern progress in this industry, unlike some others, has reduced the number of workmen. Of a number of flour centres in the Western States, Minneapolis holds the chief rank. The immense supplies of grain necessary are handled expeditiously by mammoth elevators. The commercial operations of the elevator system make possible a shorter cut from the farmer to the miller, doing away to a large extent with the middleman. Of such bakery products as are turned out by wholesale, we find that American biscuits or



RAISING HOGS FOR MARKET



BIRD'S-EYE VIEW OF THE UNION STOCK YARDS, CHICAGO

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"crackers" are the most important. All the work of manipulating the dough is done by machinery under rigid sanitary supervision. The business is so prosperous that there is always a demand for help, both male and female, at good wages. This product is exported in quantity to Spanish-American countries, an unlooked for valuable trade.

Another branch of food production which must be reckoned with is that of canning and preserving. Although it is within comparatively recent times that any practical method has been discovered for preserving foods without loss of juice and flavor, yet American enterprise already leads the world with over two thousand canneries, exclusive of meat-packing establishments. Could he have seen the sardine and salmon canneries of Passamaquoddy Bay and Puget Sound, would not that quaint old Puritan worthy have been proud of his having been christened "Preserved Fish!"

The final grand division of the food industries is that of sugar. It is of interest to note that raw sugar is an exceptional commodity in the fact that we are obliged to import it from other countries in great quantities. It will surprise many to learn that one-half of the world's sugar is made from beets. In the manufacture of chocolate there has been an extraordinary development. Thirty years ago the consumption amounted to two million pounds. It is now fifteen times as great. The output is valued at ten million dollars. It is gratifying to recall that our new possessions are located in the chocolate producing belt.

Thus a rapid survey of the immense field covered by the principal food products, meat products, flour, canning, and sugar, may give some idea of the benefit to be derived from a consideration of this great group of manufacturing industries.

Slaughtering and Meat Packing

Although slaughtering and meat-packing is closely allied with the agricultural features of the raising of live stock, it can still be classed, quite properly, as a manufacturing industry. The process involved, that of converting live stock into food for human consumption, furnishes employment directly to about 80,000 persons, and indirectly to as many more. The first branch of the industry, slaughtering, involves the preparation of fresh meat; the second branch comprehends the packing of meat and the preparation of various other animal products and by-products.

The development of this industry, as shown by the census, during the last fifty years, has been most remarkable. The settlement of the Western country and the consequent expansion of territory devoted to stock raising; the extension of railroads and the increased facility of communication; the methods devised to insure preservation of meats, such as improved methods of curing, and the introduction and improvement of mechanical and chemical processes of refrigeration, rendering summer packing possible; the utilization of every part of the animal; and the adoption of labor-saving devices, are among the factors that have contributed to its growth. In the fifty years the number of establishments increased from 185 to 921; the capital invested, from $3,000,000 to $189,000,000.

Within the last ten years, a percentage of increase is noticeable in the number of women and children employed and the wages paid them. In

1890 the number of women employed was only 1,000; in 1900, three times as many. Only 700 children were employed in 1890; the number at the present time is nearly 2,000. With an output of $785,000,000. Therefore, this industry is of the utmost importance to the people of the United States and to the world. It is second, perhaps, only to the iron and steel industry. It is natural that the West, largely dependent as it is, for its industrial welfare, upon the live stock industry, should have made slaughtering and meat-packing essentially Western in location and growth. Chicago leads the whole world as a slaughtering and packing centre, and Kansas City, Kansas, is next in importance.

A combination of many of the principal meat packers of the United States was brought about in the latter part of 1902, though it was supposed a long time previous to the formation of the "Trust," that an "understanding" existed among the packers.

Kansas City has within its limits the largest single packing house in existence, covering ninety acres of floor space. There is scarcely a nation in the world to which these Kansas establishments do not send their products. Scores of train-loads of beef, pork, and mutton are sent out every day to points far and near. These great packing plants give constant employment, at good wages, to thousands of men and women. Almost every trade and profession is represented in the houses. There are men from every walk in life—laborers, mechanics, clerks, and chemists. The weekly pay-rolls are enormous; in a year they amount to millions of dollars.

Hogs and Cattle for Market

The curing and packing of hog products plays the chief part in the packing industry. To supply all the establishments in the United States, $800,000 dollars worth of hogs is required every day. The packing of the products of cattle and sheep is but a small part of the business, in comparison. "Hog and hominy" is a homely way of expressing two important economic facts. One is that the hog ranges over a territory that is co-terminous with what is known as the corn-belt. Within this domain the American hog is king. The other fact is, that the hog and the cornfield supply the great majority of the people within this area with their ordinary food. It is more often bread than hominy, but the proverb holds. The most profitable form in which corn can be marketed is in the portly form of the American hog. It is an interesting fact that nearly all agricultural products—chiefly excepting wheat—are enhanced in value by being transmuted into meat products. Sheep-raising is now largely confined to the Rocky Mountain States, because of the abundance and constancy of pasturage. The live stock and cattle also come, in greatest quantities, from the same region and from the vast stretches of prairie of the West and Southwest.

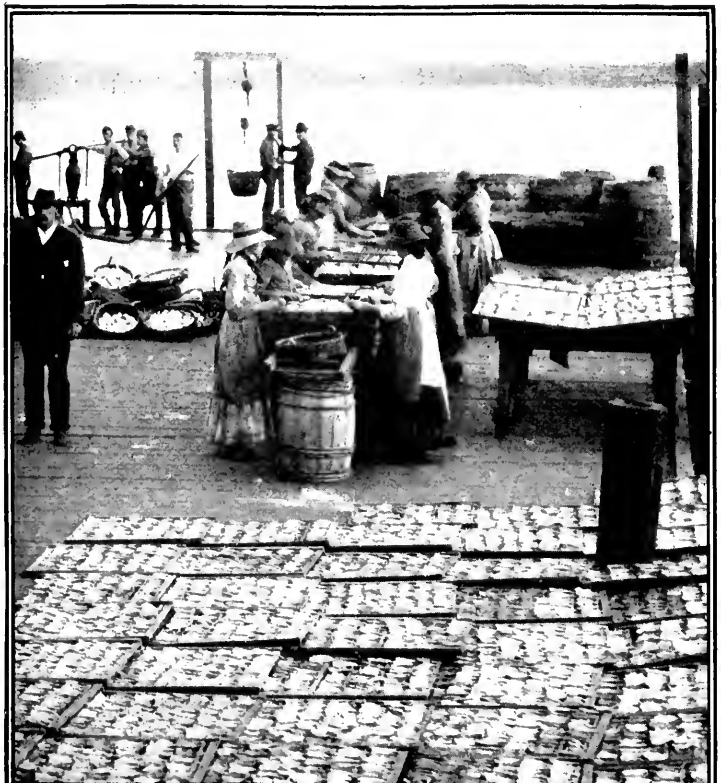
The slaughter pen is the place where sheep, hogs, and cattle meet at last on a common ground. Like all other branches of industry, the slaughter pens are getting nearer to the source of supply. Chicago is still the great centre; but the tendency is to get into the corn belt. This is shown by the development of the slaughtering business in Omaha, Kansas City, Kansas, and St. Joseph, Missouri, and South Omaha, Nebraska. This also indicates the high rank taken by the hog. Another tendency is in the pasturing and feeding of hogs and cattle during the winter. This has been brought about by the exhaustion of vast areas of pasture lands in the West, and by the fact that exposure to the weather, under the old methods, resulted often in a loss of one-third of the herd. More attention is also paid to breeding. The effect has been felt already in the improvement in the size of animals and in the quality of the flesh.

The Stock Yards and Packing Houses

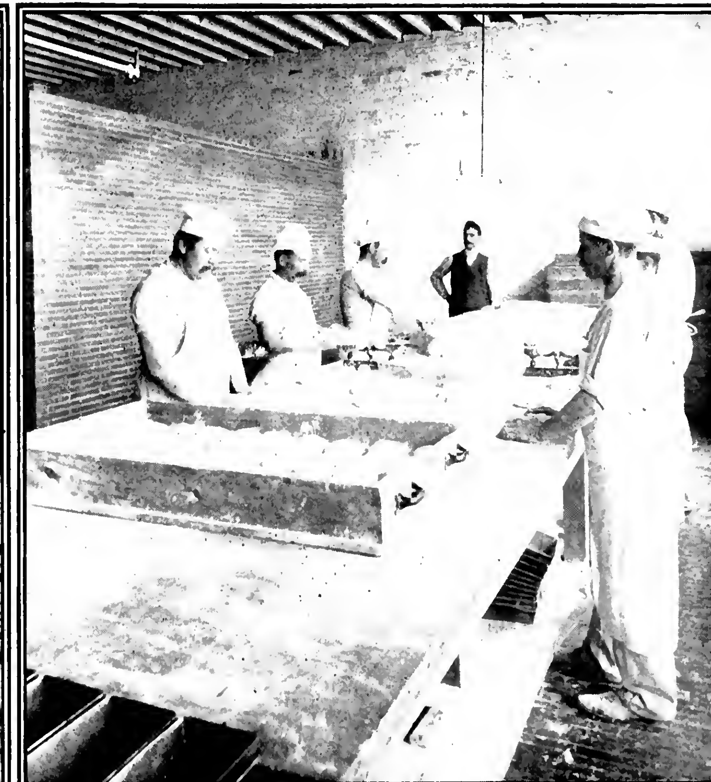
The stock yard is one of our national institutions. It represents American opportunism, ingenuity, enterprise and resourcefulness. It is the central point of two vast businesses—the breeding of cattle and hogs, and the distribution in all markets of the world of American meat products. Perhaps no other branch of industry has been so thoroughly specialized and perfected in all of its ramifications as the business generally classed under the term "stock yard." In the brief period in which this business has been conducted, not much more than a third of a century, it has been developed in every part and in the minutest detail. The work of the yards is so expert, so swift, so stupendous in its proportions, that the Chicago stock yards have become one of the sights of the United States, if not, indeed, of the world.

The work of the stock yard may be said to commence in the vast prairies of the West and Southwest, or in the hog ranges of the corn belt. The yard is distinctly in view always, and the hog, the sheep, or the steer is fattened for it, and is raised with a view to ending its career in the great slaughter pen. Cattle are driven to the Chicago yards from great distances, often several hundred miles. Hogs are also driven to the yards, but are oftener shipped in cars, as they come, as a rule, from more settled parts of the country. The business of purchasing, shipping, and selling the hogs and cattle is taken out of the farmer's or breeder's hands very soon; frequently the stock is bought before it is old enough to be slaughtered. The early disposal of herds and the increasing business of purchase and sale have led to the evolution of the live-stock broker, who, with the stock yard company, transact all the business the moment the herd or the hogs are bought.

When cattle arrive at the yards, they are put in pens, watered and fed, and are allowed to rest for a day or two to permit the temperature, heated by the long drive or exhausting travel, to cool down. If the sale has not been arranged before, it is closed up in the yards immediately upon the arrival of the animals. The hog fares worse than the steer, and is not treated with as much consideration in the slaughter pens. He is not permitted to rest long, and sometimes is merely treated to a douche of cold water to cool and cleanse him outwardly, and then driven into the shambles. The process of killing and preparing him for the market is swift, certain, and ingenious. The hogs are driven near a large wheel to which are attached a number of chains, and each chain is attached to the hind leg of the animal. As the wheel revolves, the hog is lifted until, almost at the top of the wheel, another mechanism takes hold of him, and he is swung from the wheel and carried rapidly down a sloping rail to the butcher stalls. As the poor beast reaches the butcher, the latter, with a quick, almost automatic motion, cuts the animal's throat lengthwise, and the carcass is run along a short distance to allow the blood to drain out. Then the body is plunged into a hot bath, after which it is passed over a table where a scraping machine removes the hair and bristles better than it can be done by hand and with less injury to the bristles—which are a very valuable by-product. The body is then thoroughly washed with a hose. After this comes the process of cleaning, cutting off the head, and preparing the body for its final sundering into various "cuts." Prior to the development of the business, the only cuts were hams, sides, shoulders, and cuts for barrelled pork. But now the markets of the world have to be consulted, with the result that the cutting up of the carcass has developed into a sort of sub-art of itself. Some of the fancy cuts are known as the "Wiltshire," "Cumberland," "Yorkshire," and "Staffordshire." A dressed hog is about eighty per cent of its live weight. After the cutting up has been finished, the various parts are sent to the curing rooms. Some of the cuts lie for sixty days in dry salt, and the hams, shoulders, sides, etc., which are to be smoked, are treated for an equal period in vats of sweet pickle. The pieces intended for smoking are then soaked for twenty-four hours to force the salt into the meat and make the flavor uniform. The trimming tables, the next objective point, arrange the pieces and put them in their final shape for the market; and they are then sent to the store-rooms, or to the branding and labelling departments, and some of the cuts are covered with canvas. The hog has then reached his end, so far as the slaughter pen and the stock yard are concerned. From these, he goes into the world's markets, from Chicago to Tokio. The slaughtering and dressing of cattle are processes slightly different from those of the killing and curing of hogs. The cattle are allowed to cool thoroughly after the drive, as it is necessary that the flesh be in normal condition and not overheated, to get the best meat. The cattle are driven up an incline to the top of a four or five story building, and forced into a lane so narrow as to admit the body of only two animals at a time. As the two animals in the lead reach the end of the lane, a partition is lowered behind them. This is repeated until the entire line is divided into twos. As soon as this is done, a man walks along a raised platform and, with a single blow above and between the eyes, fells the animal with a heavy hammer. The floor of the lane is then tilted by machinery, and the carcass is thrown upon the slaughtering floor. Here the body is immediately raised on a hoist, and the animal's throat is cut. The blood is drained into a large tank. The head is then severed, and the hide removed by several workmen, each cutting off only a small portion, but the operation is finished with the greatest despatch. After this,



THE SARDINE INDUSTRY, MAINE



IN A BREAD FACTORY

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the carcass is dressed, cut into various pieces as may be required, and is shipped out. The processes are not so complicated as those of the dressing and curing of hogs. The slaughtering of sheep is similar to the killing of cattle.

Canning beef is, of course, one of the great industries, and is intimately connected with the stock yards. The meat used is generally cow beef of an inferior grade. It is boiled in great kettles, and is pressed into the cans as soon as it is cooked. After the cans are soldered, they are steamed to ascertain if there are any air holes. As the tins are air-tight, climatic changes do not affect the quality of the meat. Around the yard springs up a great variety of associated industries—tin-shops, car-shops, box factories, etc.—which make the receptacles used in the packing and shipment of the dressed and canned meats.

The Union Stock Yards at Chicago cover 475 acres of ground, together with 320 acres of pens. They have, also, miles of railway track completely equipped, water works, a hotel, an office building, and a bank, and they employ 1,800 workmen. This is the great hive or centre of the industry. While the amount of meat handled, and the number of stock slaughtered, are so vast, it is remarkable how closely every detail of the work is inspected and how every care is exercised to see that the dressing and handling of the meat is cleanly and that the meat itself is not diseased. Both the State and Federal governments have inspectors to see that no diseased meat is put upon the market. The inspectors of both governments also take samples of almost every carcass, in order to make the examination as thorough as possible. These samples are examined under the microscope, and the meat of hogs is specially tested to discover signs of trichinæ. The volume of the work may be imagined by some of the figures of a day's slaughter. As many as 18,900 hogs have been killed in these yards in a single day; and in the various plants the total killing for a day has exceeded 40,000 hogs.

There has recently grown up a large business in by-products of the slaughter pens. The extract room, where beef extracts, bouillon, vigoral, soluble beef, and many similar preparations are made, is now a very important part of the plant. There is, also, the sausage room, and the room where lard is made and packed; and, finally, there is the pickling room, where pickled tripe and pigs' feet are manufactured.

By-Products

Within comparatively recent years the packing houses absorbed certain industries in which the raw materials were the waste products of the abattoir. The products of these industries were principally glue, soap and fertilizers. With increasing competition the packing houses found that they could utilize all, instead of a part, of the "waste." Hence it is that by-product manufacture, carried to a high degree of perfection in the leading packing establishments, has assisted materially in the development of the meat industry and the large radius of distribution of its products. A steer weighing fifteen hundred pounds, dresses out approximately eight hundred and twenty-five pounds of dressed beef. The remainder of the animal, consisting of hide, head, feet, blood, fats, casings, etc., and also the offal from hogs and sheep, furnishes material for the by-product plants. The head and feet go to the fertilizer and glue works; the horns are cut off to be converted into combs, buttons, hairpins, and fertilizer; the hard shin bone is cut from the feet, and with the thigh and blade bones, made into knife and toothbrush handles, pipe mouthpieces, buttons and bone ornaments, and the waste into glue and fertilizer. The hoof is made into hairpins, buttons, yellow prussiate, and fertilizer. The feet, knuckles, hide, clippings, sinews, small bones, etc., are made into glue, gelatine, isinglass, neatsfoot oil, tallow, grease, stearine, and fertilizer. The cattle tails go to the curled-hair works; bristles to the bristle works. The tallow and grease go to the soap works and are converted into toilet and laundry soaps, washing powder, and all grades of glycerine. The pig's stomach and pancreas, the sheep's thyroid and other glands, go to the pharmaceutical laboratory, and are made into pepsins, pancreatins, dessicated thyroids and other medicinal articles. The blood and tankage (the residue left after extracting grease and tallow from meat scraps) and all waste of a nitrogenous or phosphatic character from the various products, are taken to the fertilizer works and converted into fertilizers of different analyses; albumens, stock and poultry foods, etc. Phosphoric acid and phosphorus, bone-black and black pigments, sulphate of ammonia, bone oil, and many other articles are also made from packing-house waste. The sheep pelts go to the wool pullery, where the wool is taken off, cleaned and graded for the woollen goods and felt manufacturers. The skin goes, with the cattle hides, to the tanner. Hair waste is made into hair felt for insulation purposes, or prepared for the plasterers. All by-products are manufactured under supervision of expert chemists, and thoroughly equipped laboratories are maintained. Under the system in vogue before the centralization of packing, this inedible material was largely thrown away. Now it is saved, and thousands of skilled employés, working in expensive plants, transform it into millions of dollars' worth of useful products.

Refrigeration and Transportation

Food products, if they are to be transported, must be put in condition to keep during distribution and until used. This applies especially to meat products. The problem has been solved, and food of this character can now be carried to the consumer so that the miner, the lumberman, the explorer, the sailor, the soldier, and the dweller in the city, can secure the best of meat foods at low cost. The producer of this food is the American farmer; the conservator and distributer is the American packer.

"The meat packing business," said Philip D. Armour, who established the largest American packing plant, "received the greatest impetus when the stationary ice refrigerator was perfected, enabling the slaughterer to pack meats in summer as well as in winter, and also to keep fresh meats in good condition for many days. Following this the artificial ice and cold storage method of refrigeration and preservation was developed, materially increasing the possibilities of centralized packing. In 1871, an ice refrigerator was mounted on car wheels, filled with dressed beef, and started for an eastern market, where it arrived in good condition. From this start the modern refrigerator car system of transportation has been evolved."

And the business prospered and grew. For it was more economical to slaughter live stock in the West, near the source of supply, ship the edible portions to the consumer and convert the offal at the point of slaughter into by-product, than to transport the live animal.

The Appert process of preservation of meat in tins, through sterilization by thorough cooking and concentration and packing in air-tight packages, was first successfully applied to meat food products, on a large scale, in 1874, enabling meats to be safely transported and held for an indefinite period in any climate, without cold storage. This system secured a still wider radius of distribution of beef products, from centralized slaughtering points.

Meat Cutters and Butchers

Probably no craft was in a worse condition than the journeyman butcher at the time their organization, known as the Amalgamated Meat Cutters and Butcher Workmen, was formed in 1897. This was owing to the concentration of the meat industry in the hands of a few large firms who have the supreme control. The hours and conditions were unbearable. Men were compelled to be at the plants as early as two or three o'clock in the morning; and then were obliged to wait until such time as cattle could be gotten into the plants, sometimes for many hours. For this there was no pay. If the machinery broke down, all time lost was deducted from the men's wages. The packing firms, by this course and by keeping a far greater number of men upon the list than was required, made it impossible for a workman to make more than three or four day's pay a week; and often much less than that. In the retail shops at that time, men were compelled to work from fourteen to sixteen hours per day, and in many instances were required to work until noon on Sundays.

Since the formation of the association, however, the meat cutters and butchers have succeeded in securing steady time in the packing houses, and a twelve-hour day, and no Sunday work in the retail shops. In the State of New York, they influenced the passing of a law closing all meat markets on Sundays. The organization welcomes to membership all men identified with the industry. When first organized, the union met with opposition from both the packers and retail butchers; but as the men have shown that they are not organized to create trouble, but to prevent it, they are meeting with much less opposition now than formerly. The membership now numbers about 15,000, including men in all the packing centres in the United States and many in Canada.

CHAPTER XX

MILLING AND BAKING INDUSTRIES

The Flouring and Grist Mill Industries—The Modern Mill—Process of Flour Milling—Grain Elevators—Bakery Products—A Biscuit Factory.

The Flouring and Grist Mill Industries

EXPERIENCE in the milling of cereal products, as in every other industry, has established the fact that greater economy in manufacture can be secured in a small number of large mills than in a large number of small mills. Many new mills have been built in recent years, all of the larger class, while during the same time many mills of the smaller capacity have been closed. One noticeable feature of milling within the last ten years is the decrease in the number of wage-earners employed. The number to-day is less than forty thousand, while in 1890 it was nearly fifty thousand. The amount of manual labor required has diminished as the result of improved processes in handling the grain and products. In this industry, in 1900, the quantity of the principal cereals used was as follows:

	MILLIONS OF BUSHELS
Wheat	489
Indian corn	241
Rye	12
Buckwheat	8
Barley	12
Oats and other cereals	70

The Modern Mill

In the "trade" two kinds of mills are known—merchant and custom. Custom mills, generally described, are those which grind wheat, corn, rye and other grain furnished from farms of the neighborhood. These are best known as grist mills. Merchant mills are the large manufacturing establishments which supply the home market and export flour to foreign countries. In reducing cereal grains to powder there are three distinct types of grinding machines. First comes the mortar-and-pestle type, the chief forces of impact being grinding and rubbing. Secondly, we find some form of machine with two roughened surfaces. One or both of these are in motion, usually only one. Between them the grain is crushed or cut. Then comes, thirdly, the roller system of milling, or mashing. In this the grains are disintegrated and successively subdivided by passing through a series of rolls, smooth or corrugated, in which series there is an increasing approximation of surfaces. Sometimes the rolls may revolve at the same peripheral rate. In other instances the rolls revolve at different rates of speed. By the latter method two processes are gained by the same operation, a grinding or tearing process and the mashing or disintegrating effect. In these three steps we have the history of the art of milling. In all mills of great size the third method is almost universally employed at present.

The roller mill came into use only about twenty-five years ago, but within that period milling processes have been completely transformed. The historic millstones have given place entirely to the swiftly moving porcelain rolls, and the many small mills scattered throughout the country have been displaced by enormous mills like the one at Minneapolis, which has a daily capacity of seven thousand barrels of flour. A later development has come in the use of crushing rolls, with which followed rolled oats, rolled wheat, and later on an endless variety of cereal foods. These rolls are now sometimes made hollow and are steam heated, so that while the grains are crushed they are at the same time partially cooked, thus rendering their preparation for the table the work of but a few minutes.

Process of Flour Milling

The process of flour milling, as conducted in the vast mills of the present day, differs in numerous particulars from the methods in vogue until within forty years. The principal points covered by the improvements consist in securing a greater degree of separation between the flour-making berry and the several layers of husk than was possible with the older forms of bolters, also in more perfectly cleaning the grain previous to grinding. Thus, according to the degree of cleaning and grinding, the product is divided into several distinct grades, to be sold at correspondingly scaled prices, and particularly suitable for as many different uses. It is further classed according to the variety of wheat from which it is produced; some special stocks having been found preferable for high class flour. Red River Valley wheat is ranked highest, on account of its large percentage of gluten—nitrogenous or flesh-forming substances. Of the two common varieties, spring wheat and winter wheat, the former, rich in gluten, is preferable for bread-making, yielding between forty and fifty pounds more flour to the barrel than the latter, which, however, is particularly suitable for pastry, from its greater proportion of starch. There is also considerable variation in the quantity of flour obtainable from the several varieties of wheat taken bulk by bulk.

The starchy body of a grain of wheat is covered by a layer of gluten cells, outside of which is the skin, known as the "episperm," containing the brown cerealin, and covered, in turn, by the two layers of husk, or "pericarp." The three outer skins contain little or no nutriment, and are separated, as chaff, in the process of making the finer grades of flour. They have commercial value as bran, or "shorts," for animal feed, on account of the small residue of nutritious matter adhering to the fragments blown out in the middling.

Briefly described, the modern process of milling, as conducted in the vast establishments at Minneapolis, and at numerous other points on the Mississippi River and Lake regions, and in the West and Southwest, is as follows: From the farms the wheat is taken by the car-load to the various elevators, where it is stored in bulk, until ready for shipment to the great centres of manufacture. The grain is dropped from the cars into a pocket or boot under the floor, whence it is conveyed to the top story of the building in steel scoop buckets carried on lines of belting, and deposited in suitable bins. At the elevator the wheat is inspected and graded by State officials, who, in the process, observe the standard of judging it according to the primary market, or source of production. The storage capacity of some grain elevators is immense. Thus an elevator company in Chicago possesses total storage facilities for 13,500,000 bushels; one elevator alone having a capacity of 3,400,000, and another of 2,500,000: these are nearly the largest in the world. From the market elevator the wheat is conveyed to the mill elevators, as required by the millers.

On reaching the mill, the grain is transferred to the top story of the building by a belt-conveyer, and is dumped into the cleaner. The most usual method of cleaning is to carry the grain, with great force, against a stream of water; the thorough cleansing thus received being followed by quick drying in a blast of hot air. Eight separate processes of cleaning are usually necessary for the perfection of this branch of the work, including degermination, after which the grain is ready for the grinders. Unlike the old-fashioned process, in which the wheat was ground into powder between two mutually revolving sandstone disks—the degree of fineness being determined by adjusting the distance between the stones—the present method is to pass it between successive pairs of parallel rotating rollers, which, by virtue of the progressive diminution of the clearances between them, complete the pulverization in stages. After passing between each pair of rollers, the partially crushed wheat is purified, or separated from its chaff, or "offal," somewhat as, in former days, the whole ground product was bolted, to eliminate the fragments of husks. The purifying machines, although greatly improved in recent years, operate on substantially the principle first devised by La Croix in 1865. Briefly, this consists in passing the ground product through a horizontal sieve, from beneath which a blast of air is blown upward, removing the chaff, but allowing the heavy meal to continue its downward movement undisturbed. The grinding completed, the flour is ready for packing in bags and barrels, a process usually performed by hand.

The immense producing capacity of some of the leading flour mills of the United States is ample evidence of the great extent of the business at the present time. One of the largest flouring mills in the country, at Duluth, produces 8,000 barrels daily, or 1,500,000 annually, using the product of 3,500 farms, representing a collective acreage of 560,000. Yet it employs, in all departments, but 250 men. Other extensive mills and systems represent correspondingly large figures. At present there are about 15,000 large mills in the United States.

"To give us this day our daily bread" requires, for the population of the world, nearly seven million bushels of wheat a day. In a year the amount exceeds two and a half billions of bushels, the greater part of which the millers of each country grind into flour. The seat of this branch of the milling industry in the United States is Minneapolis, which, in the value of its product as a single flour-making centre, heads the list of the milling centres of the world. The output of its great mills equals the total production of the eight great centres next in size; namely, Chicago, Duluth, St. Louis, Milwaukee, Buffalo, Toledo, Kansas City, and Indianapolis. As for the export trade, the United States annually supplies Great Britain with about ten million barrels of flour and the continent of Europe with two million barrels.

Grain Elevators

With the enormous quantities of grain to be handled and cared for, the elevators have become an important link between the great transportation and milling interests. In Minneapolis there are thirty-eight grain elevators. In addition to these, there are certain smaller establishments connected with the mills, which are used exclusively for preparing the grain for grinding. The system in this city is divided into regular and private houses, with the regular houses again divided into State and Chamber of Commerce houses. There are thirty-two regular houses, six of them being registered as State houses and twenty-six as Chamber of Commerce houses. There are six private elevators, two of them used chiefly for handling wheat, and the other four for coarse grain. The coarse grain elevators are not of large capacity. The houses that are regular and conducted exclusively under the Chamber of Commerce rules, have a storage capacity of about 21,000,000 bushels, while those conducted by the State have a storage capacity of nearly 7,000,000 bushels. The private houses have a capacity of 2,000,000 bushels, making the total capacity for grain storage in Minneapolis 30,000,000 bushels, exclusive of the small elevators connected with the mills.

In Chicago, the public elevators handle about twenty-five per cent of the grain received, the balance being handled by private elevators and warehouses. Changes in the marketing of grain have come about through the extension of the grain acreage in the grain belt of the Northwestern and Western States, just as the cost of labor, the supply and cheapness of raw materials, the necessity for closer proximity to the fast-growing markets for manufactured products in the great Central and Western States have induced so many of the seaboard manufacturers to move nearer to the base of supplies and the seat of growing demand. To-day there are eighty-one elevators in Chicago, with a storage capacity of 57,000,000 bushels. Competition and the natural desire of both producer and consumer to come closer together—to eliminate the middle man and all unnecessary intermediate expense—have resulted in dispensing largely with commission men, brokers, and travelling solicitors.

The city of Duluth is the third greatest wheat market. As the Lake Superior terminus of many railroads and the head of lake navigation, this city promises to become the foremost milling centre. It contains, with its sister city, Superior, elevator capacity for 25,000,000 bushels of grain, and handles annually about 100,000,000 bushels, of which over one-half is wheat. In Kansas City, the annual wheat receipts are about 24,000,000 bushels, almost equal to those of Chicago. St. Louis receives annually about 12,000,000 bushels of wheat. Peoria, Toledo, and other inland points, have become largely grain trade channels and handle enormous quantities; while lake cities, like Milwaukee, Detroit, Gladstone, and Manitowoc, actively compete for this trade.

Bakery Products

Bread, pie and cake are made in thousands of bakeries—for local consumption only. The very nature of these products narrows their sale to the immediate city in which they are baked. There is, however, one bakery product that may be sold, still in fresh condition, hundreds, and even thousands of miles from the place of baking. This is the great American biscuit, the foremost product, commercially considered, of the bakeries of the United States.

Within the last twenty years the biscuit industry has grown to marvellous proportions; first, as the result of enterprise on the part of manufacturers; second, as the result of the "centralizing" of the industry through successive combinations.

While the principal foreign markets for American biscuits at present are the West Indies and Central and South America, these same "crackers," to use the old-fashioned name, are gradually being introduced to the palates of all nations. The writer witnessed a sensational illustration of the truth of the latter fact while travelling in India. The train was standing at a lonely station, the roof of which slanted downward to within a few inches of the car windows. Suddenly down the inclined roof came a huge monkey, and sprang through the car window into our midst. Before we had recovered from our surprise, our visitor had jumped back to the roof and scampered away; but he left a souvenir—a package, a pasteboard box of familiar appearance—a box of a certain well known brand of American biscuit. Here was a problem for Sherlock Holmes. In the heart of the Punjab, a monkey springs out of the jungle into a railway carriage, delivers a box of American biscuit, and vanishes. All the way to the next city we wove theories, and not until we were seated at the long table in the dining-room in the great station, was the mystery cleared away. One of our neighbors at the table was a young Englishman—"Queer thing happened at a little station down the road," said he. "A monkey jumped from the station roof into my compartment, seized a box of biscuit and scampered away."

"Permit us to return your biscuit," we said in chorus; and the Englishman stared at us and at the box we proffered him in blank amazement.

There is a large trade in biscuit, packed in tin, with several of the South American republics. This trade is, in a way, the result of "bread cast upon the waters." At the time of a considerable scarcity of food in Venezuela, John R. Van Derveer, of New York, shipped a large consignment of biscuit from his factory for free distribution in the stricken districts. Months later, large orders for biscuit were received from dealers in Caracas, and from that time forward Mr. Van Derveer developed the trade by careful study of materials best adapted to tropical climates, and the proper packing of biscuits for such markets. To Mr. Van Derveer, therefore, belongs the credit for the introduction of the American "cracker" into South and Central America. Just how necessary it is for biscuit manufacturers to study the peculiarities of foreign markets is shown in this little story: One of the largest American firms in the business shipped a quantity of a certain "fancy" cracker to the East Indian market. The crackers were designed in the shape of animals. In two months, or within the length of time required for a round trip to Bombay, the goods came back. Also came a letter from the company's agent in India: "The religion of these people forbids them to eat even the image of any living thing."

The relation of biscuit manufacture to other industries is suggested by the amount of materials used annually. Take sugar, for instance, of which about 55,000,000 pounds are consumed; lard, 35,000,000 pounds; soda, 25,000,000 pounds; butter, 6,000,000 pounds; salt, 4,000,000 pounds; molasses, 2,000,000 gallons; not to speak of 2,000,000 dozen eggs; and millions of pounds of raisins, cocoanuts, and honey; and half a million gallons of milk. These items represent only a part of the requirements of the manufacturing departments. There is a yearly demand, besides, for hundreds of thousands of dollars worth of tin for cans, 6,000 tons of paper and pasteboard for packages; 10,000,000 wooden boxes, and over 7,000,000 barrels.

Progress in this industry has been so rapid that the manufacturers are perennially "short handed." Mixers and bakers are in constant demand. Deft-fingered girls can earn as high as $2 a day in the fancy and icing departments, and other girls in the packing and labeling departments make usually high wages. The employment is steady. Excellent engagements are open to travelling salesmen, especially those who have had experience in the West Indies and in South America and can speak Spanish.

A Biscuit Factory

At the largest biscuit factory in New York hundreds of men and girls may be seen hurrying into the building as the morning whistle summons all hands to work. The day gang of engineers and firemen descends into the hot air regions to relieve the night gang—for in a cracker bakery, where it is of the utmost importance to keep the ovens very hot, the fires must never go out. On the floors above, absolute cleanliness prevails. The foreman of each department shouts: "All hands fall in for inspection." And lo! on each floor men or girls line up ready to present, not arms, but hands. For this ceremony is literally an inspection of *hands*. Rapidly down the line of girls walks the foreman, his practiced eye noting the condition of each particular pair of hands. Woe to the owner of a hand that fails to satisfy Mr. Foreman's idea of what constitutes cleanliness in a human machine that is to assist in the making of an article of food for the multitude. Suddenly he pauses. A finger of a certain hand is rag-bound and blood-stained. "Fall out, Lizzie." He next comes to a hand, on one of the fingers of which there shines a ring. Evidently, he has not seen that ring before. Again he pauses, and for one second scrutinizes the ring. "Brass!" he exclaims. "Fall out, Mamie." So Mamie joins Lizzie, who is in tears. Mamie, however, smiles in a don't-care way, for she knows that she will only be reprimanded and forbidden to wear her brass ring, as only gold rings are permitted in the bakery. But Lizzie, poor Lizzie, who has cut her finger the evening before on the edge of one of the tin packing-cases, continues to weep; for she knows that she will be "laid off" until her finger gets well, and she needs her $1.25 a day. "If we made a practice of laying 'em off *with* pay," remarks the superintendent, "every girl in the factory would straightway cut her finger."

Thus the day begins in a large cracker bakery. Long before daylight, however, the "yeast men" had arrived to mix and "raise" dough enough to give work to all hands at seven o'clock. So now, out of the huge troughs, the dough is taken and rolled into great sheets, then cut into all sorts of shapes, and finally put in the capacious ovens. This is exactly the same process pursued by the family cook in making breakfast rolls—only while the cook mixes flour by the handful, the men in the cracker bakery mix flour by the barrelful. It is no unusual thing for a cracker bakery to use daily from 500 to 1,200 barrels of flour; and the largest of all the bakeries uses 1,500 barrels a day. By "largest bakery," is meant the one which has the greatest number of ovens: the bakery just mentioned has thirty ovens, each of which has a baking capacity of at least 8,000 pounds of crackers a day. The ovens are of more than passing interest. The dough, having been cut into the forms desired, arrives at the oven door on a travelling canvas table. The door yawns, and a black tray, like a great tongue, comes forth, laps up the dough-forms, and then draws back into the oven and into a heat of 350°. Thus begins the baking process, requiring from 10 to 15 minutes, according to the temperature of the oven. The exterior of the ovens look like huge chimney-places of brick. They are known as "real ovens." In the interior of each is a wheel—a miniature Ferris wheel—ten feet wide and ten or twelve feet in diameter. The pans on this wheel correspond to the cars of the Ferris wheel; the crackers, growing browner and more crisp each minute, are the passengers. The wheel turns so slowly that a pan of crackers is usually baked in one revolution. Owing to the fact that different crackers require different degrees of temperature in baking, each oven is kept at work on the same kind of cracker all day.

On another floor "mixers," in white aprons and white caps, are at work in front of great troughs, getting more dough ready. In the old days the dough was mixed by hand; now, however, the bakers are not allowed to lay their hands upon the dough, or even to touch it with the tips of their fingers, under a heavy penalty for disobedience. So the dough is mixed by machinery and handled with shovels and forks. The mixing process is, of course, most important; for unless the right kind of dough is used, the right kind of cracker can not be produced. The most valuable man in the cracker bakery, therefore, is the chief mixer, the expert who knows exactly what kind of a mixture will make a strong cracker, or a crisp cracker, or a soft cracker.

In the "die-room" all forms of crackers are cut from the dough. The steel dies are one of the most costly tools used in the factory. They are of many forms—for Knick-knacks, Noah's Arks, Brownies, Maltese Crosses, and the hundred and one other fancy and grotesque forms in which the cracker now comes to the table.

In the packing room, a hundred girls, each dressed in the whitest of aprons and caps, operate the packing machines. One pretty girl explains the work: "We take a row of biscuits, so—and we put only one finger on the top biscuit, so—and only one finger on the bottom biscuit, so—and the machine, it does the rest, so." In this department, whatever falls on the floor—whether a single biscuit or pounds of biscuits—is left there. The "sweepings," or broken crackers, are packed in barrels and sold at a very low price as food for dogs, chickens, birds, pigs, barnyard animals or pets of any kind—for a biscuit is a staff of life for beast as well as for man.

One rather odd occupation has been created by the necessities of cracker establishments. It is that of professionl rat-catcher and vermin-exterminator. The person following this occupation, usually an old man, has the freedom of the factory at all times. He does not walk about like the ordinary workman, but prowls ever in search of his prey. Every bakery of any pretensions to cleanliness hires such a man and pays him from $400 to $600 a year. It is his business to keep the factory free from vermin, from bugs and insects of all kinds, and from rats and mice.

CHAPTER XXI

CANNING AND PRESERVING INDUSTRIES

The Canning Industry as a Whole—Vegetable and Fruit Canneries—Pickles, Sauces, and Preserves—Fish Canneries—Oyster Canneries

The Canning Industry as a Whole

THE great American canning industry comprises the hermetic sealing of food, a relatively important branch of manufactures, having long since passed the experimental stage. Traced to its source, "canning" brings to light a foreigner; for the art of hermetically sealing food was discovered by a Frenchman. Sixty years ago, a very old man—he was ninety-one—lay on his death-bed in Paris, neglected, alone. He had long before spent the last of 12,000 francs awarded him by Napoleon for the discovery of a method of preserving certain foods without robbing them of their natural qualities and juices. On his tombstone in Père La Chaise is his name—Nicholas Appert. His male descendants to-day bear the title of Chevalier, in honor of their ancestor, who was the father of the canned goods industry. If Appert could but look upon the development of the industry he founded, he might travel through forty-four States and find canneries in each one. In Maine he would find the people monopolizing the business of canning sardines and lobsters. In Massachusetts he would find the great baked-bean canning centre. In New York he would find the greatest corn canneries in the world. In Baltimore, the "cradle of the canning industry," he would find the principal pineapple and oyster canneries; and in Maryland twenty-five per cent of all the canneries in the United States, giving this State first place in the industry. In Florida the people would show him the canning of turtle meat; in Mississippi and Texas the canning of green figs. California would dazzle him with her marvels in canned fruits. All these things, and many more quite as wonderful, would he see during his tour, from the canning of dandelions and mince-meat for pies in New York, to the great "salmon pack" on the Pacific coast.

The principal articles canned in the United States are these, in the order named: tomatoes, corn, milk, oysters, corned beef, salmon, sardines, peaches, pears, beans, apples, peas, pineapples, small fruits, and pumpkins. A train of 60,000 freight cars would be needed if a year's product had to be moved as a whole. The canneries are of great importance to several other industries: to the tin industry, for example, by buying over 2,000,000 boxes of tin plate annually; to the lumber industry, by purchasing 30,000,000 packing boxes; and to the paper and printing industries, by using a label on every one of the more or less than 750,000,000 cans, representing the total annual output. Over 400,000 persons are employed in the conduct of this industry, and in the various industries upon which it draws for materials. The development of the canned goods trade has effected great changes in the relation of foods to seasons. Most of the chief garden products now know no season. All kinds of fruits and vegetables are now to be had at all times of the year, not always, perhaps, with all the flavor of the freshly gathered article, but yet with much of their original freshness and flavor. The producer in the country is benefited by an enormous extension of his market, and the consumer, both in city and country, is provided with cheap, wholesome food in hitherto impossible variety.

Many canneries divide the year's work into two parts—canning fruits and vegetables during the summer, and fish and oysters during the winter. Nearly sixty thousand persons are employed in 2,100 canneries, in which fruits and vegetables, fish and oysters are the products, the canneries being distributed in every fruit and vegetable raising locality, and in States in close proximity to fish and oyster supply. The total value of the products (fruit, vegetables, fish and oysters) in 1900 was $82,500,000. The value of the exports of canned, or preserved, fish amounted to $4,000,000; of fruits $5,000,000, and of vegetables $1,000,000—a total of $10,000,000 for the export trade in canned goods. The imports in the same year exceeded $8,000,000.

Vegetable and Fruit Canneries

The canning and preserving fruits and vegetables gives employment to more women than men—the numbers being 20,000 women and 14,000 men. But it is only a matter of a year or two before these numbers will be reversed; for the introduction of new machinery is rapidly doing away with hand work. Between three and four thousand children are employed under the hand work system. These are, of course, averages for a year; for the number of hands is greater or smaller according to the season. In February, 1902, in all the fruit and vegetable canneries, the total number of persons employed did not exceed 6,000. But in September, when the canning season was at its height, nearly 12,000 were engaged. In August about 100,000 were employed, but in October the number dwindled to less than 70,000. Before the opening of the canning season the operatives are usually employed in making cans, and after the season in labelling and packing. The canneries have been undoubtedly of vast advantage to farmers, for they purchase enormous quantities of farm products, thus stimulating the culture of fruits and vegetables. Only a few of the canneries are operated by incorporated companies, the great majority being conducted by individuals. Many such establishments also engage in the manufacture of various classes of food preparations.

Operations in a typical corn canning factory are thus described by Maine's Labor Commissioner:

First, the husking department. This is a sort of a picnic affair in the sense that it is conducted out of doors. Seated beside immense stacks of corn in the husk are old women, able-bodied men, and boys and girls, their cushions being piles of corn husks. It is a husking bee on a big scale. The huskers are a jolly crowd, yet all are intent on their work, hands flying swiftly as they strip the husks from the ears. The baskets hold a bushel, and for every basketful the huskers receive four cents. Now to the cutting machines, where the corn is cut from the cob. From the cutting machine the corn is carried to the cooker and filler, where it is partially cooked as it passes from the top to the bottom of a cylindrical vessel called a cooker. The cans are fed into the cooker from above by means of long upright tubes. Immediately on being filled with the partially cooked corn, they are carried along by a revolving disk on to an endless chain supplied with horizontal arms that carry the cans around a curved channel to the wiping machine. After pushing through that device, the cans are capped by hand as they pass by on the chain to the soldering machine. Before reaching that machine, each can is given a run round with acid in order to make the solder take. So deftly is this done that no acid ever gets into the can. The can is then pushed on to an immovable plane, and each set of twelve cans is soldered in six seconds.

To an observer this automatic machine seems to be endowed with the intelligence of a human being, so perfectly and systematically does it do its work. After leaving the soldering machine, the can again enters into the endless chain and passes by two men who stand ready with gas-heated soldering irons to seal the vent in the new securely fastened caps. This is done with a touch, and the can passes along to the test bath. This bath is a tank filled with hot water, into which the cans are plunged. They are held under the surface but a moment, when they will violently bubble if containing a leak. The cans are then ready for the last cooking, which is given to them in machines known as retorts. The cans are kept in the retorts from one to two hours and are then taken out, cooled in cold water baths and packed in great tiers in the shipping room to await labelling and boxing. Almost invariably the packers pay farmers one dollar and a half per hundred pounds for corn after it is cut from the cob. The amount of corn raised per acre varies according to soil and methods of tillage, but farmers realize generally from twenty-five to forty dollars per acre, although an acre of land has been known to yield over sixty dollars worth of corn. The factories are scattered all over the State. In the western part of the State, especially, there is generally a corn factory within a few miles of almost every farmer, and he can find a ready cash market for all the sweet corn he can raise. Besides corn, there are canned in many of the factories, succotash, Lima beans, squash, pumpkin, apples, tomatoes, string beans, peas, sugar beets, cabbage, and baked beans.

In California are the great fruit canneries. The combined output of the Alameda County canneries is about 500,000 cases per year. The total fruit pack of California's is estimated at 3,000,000 cases, so it will be seen that the canneries of this single county contribute one-sixth of the total quantity. In addition to the pack of fruit, there is also a large vegetable pack, amounting to 110,000 cases a year. In the Alameda County canneries, as well as those of other localities, a large part of the products consist of apricots, peaches and pears. Cherries and plums are also canned in considerable quantities, besides currants and other small fruits. The canning of vegetables, particularly tomatoes and peas, has become a great industry, and both of these products are grown in great abundance in the neighborhood of the canneries. The canning season begins with the packing of peas, about the middle of May, and continues through the summer and autumn, until the end of October, when the run is finished with tomatoes. From June to September first is the busiest season, and during these three months the canneries are rushed, and generally take all the laborers they can get. During this busy season the canneries of the California Fruit Canners' Association employ 1,200 hands, 700 in Oakland and 500 in San Leandro. Most of the operatives employed are women and girls, and those who become experts make good wages. Many earn as high as $2.50 and $3.00 per day, and the slowest make $1.00 per day.

Pickles, Sauces and Preserves

A number of the fruit and vegetable canneries derive additional profit from what may be called the manufacture of pickles, sauces and preserves. There are indeed a surprising number of establishments engaged in making these table luxuries, 484 in all, employing 8,000 persons—figures that entitle "pickles, sauces and preserves" to a place as a distinct industry.

The largest establishment of the kind in the world is in Pittsburg, Pennsylvania. Nearly three thousand persons find constant employment in preparing the annual product of eighteen thousand acres of farm land, which is consumed by the company. In addition to the main plant in Pittsburg, the manufacturing interests of the business are augmented by the operation of nine branch factories and twenty-nine salting houses located in eight States and Canada. A glass factory is operated to supply the bottles used in packing the numerous products. The company also operates its own box and tank factories. The distribution of goods is effected through twenty-six branch warehouses, located in the leading commercial centres of the world. The export business, particularly that of Europe and South Africa, is handled by a specially organized London branch. This company helps to better the conditions and surroundings of its two thousand employés by providing dining-rooms, dressing-rooms, bath-rooms, hospital, reading-rooms, girls' library, and roof gardens. An auditorium is also a feature of the establishment, like a theatre, with a stage, proscenium boxes, a gallery, and a seating capacity of over fifteen hundred. The auditorium is intended for entertainments and lectures in the interest of the employés; also for conventions of the different corps of the workers. The firm arranges for weekly lectures, and engages a well-known singing master to train such as desire culture in vocal music. This immense establishment was built up from a modest beginning, and during its entire development to its present proportions there has never been a strike or a dispute over wages. From this record it can be argued that by co-operation between employer and employé by a give-and-take policy, there need be no labor problem to vex the captains of industry, but that it solves itself. It has been the policy of the company to cultivate friendly relations between employer and employé; to make each feel that his connection with the industry did not merely consist of his labor, but that there was a mutuality of interest. This has been the dominant idea. Nothing is left undone that can contribute to the comfort, the health, and the pleasure of operatives. By way of diversion in the hot summer months, afternoon drives in park wagonettes are furnished for the girls. An interesting feature is the annual outing for all the employés, when special trains or steamboats are chartered for the purpose.

Fish Canneries

For years there has been a steady internal growth and development in the establishments engaged in fish canning and preserving, as well an expansion of the industry as a whole by the construction of new plants. In the 348 establishments in operation, the greater number of employés are men, though more than 2,500 women here earn their livelihood. Over 1,000 children are also given employment in the busy season.

There are five general classes of canned marine products—viz., first, plain-boiled, steamed, or otherwise cooked; second, preserved in oil; third, prepared with vinegar, sauces, spices, jellies, etc.; fourth, cooked with vegetables; and, fifth, preserved by some other process, but placed in cans for convenience of marketing. The first class includes salmon, mackerel, herring, menhaden, cod, halibut, smelts, oysters, clams, lobsters, crabs, shrimp, and green turtle. Sardines almost exclusively make up the second class. The third class includes various forms of herring, prepared as "brook trout," "ocean trout," mackerel, eels, sturgeon, oysters, lobsters, and crabs. The fourth class comprises fish chowder, clam chowder, codfish balls, green-turtle stew, terrapin stew, and devilled crabs. The fifth class is made up of smoked herring, halibut, haddock, carp, pickerel, lake trout, salmon, eels, sturgeon, brine-salted mackerel cod, and caviar. The total value of the domestic output of canned oysters, canned salmon and canned sardines alone approximates $15,000,000 annually.

Salmon canning, as conducted on the Pacific Coast, is the most extensive branch. Next in importance is the canning of sardines in Maine.

Fish canneries on the Pacific Coast are located principally in the State of Washington, and bear the same relation to the Western coast that the fish canneries of Maine do to the Eastern. Until very recently, the greatest packing combination on the Pacific was the Alaska Packing Company, with headquarters in San Francisco. But to-day the centre of the industry is Puget Sound, and here is located the largest fish cannery in the world. It should be stated that in the fisheries of the State 8,000 persons are employed. The capital invested in the business amounts to more than $4,000,000, and the value of the yearly output is about $5,000,000. Nor do these figures represent the whole value of the industry to the working people of the State. For, besides those engaged in catching, handling, curing and marketing the fish, thousands are employed in supplying the demand for millions of feet of piling for fish traps and repairs, for millions of tin cans and millions of labels. In addition, each cannery operates in connection with its plant a fleet of steamboats, tugs, launches, and scows. And, allied to the fisheries, there are numerous ice plants, box factories and fertilizer works. Salmon is king, as before stated, and next come sturgeon, smelt, halibut, cod, herring, catfish, carp, trout and shad. The market for salmon extends across the country; and the same is true of halibut even to the Eastern markets so long controlled by Boston and Gloucester.

The Washington State Labor Commissioner reports that salmon are caught for the canneries, fresh and cured fish establishments on Puget Sound, chiefly in traps and gill nets. The fish trap is a mystifying arrangement of piles, wire webbing, nets and ropes. First a row of piles, from ten to fifteen feet apart, is driven, starting from the shore and diagonally from the incoming tide to deep water, and on these piles and held down with rocks wire netting is fastened. This forms the "lead," and, under the law, must not be more than 2,500 feet long. 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 or "tunnel" of the pot by the flanges, called "hearts." The pot is suspended on piles like a huge bag, or dip net, about forty feet square. The mouth, or funnel, is a hole about ten feet in diameter, so arranged that fish once in are almost certain to remain there until the trap is full, when they are turned into an extra pot or yard of netting called "spiller," and are loaded on to scows to be taken to the canneries. This operation forms a wonderful spectacle, especially when from forty to seventy thousand salmon are in the pot.

The branch of the industry next in importance, as before stated, is that of sardine canning. Twenty thousand persons are connected with the industry, directly and indirectly. The total number of sardine factories in Maine is about seventy-five—and in this branch of the canning industry the State in question stands alone, no other State being engaged in the industry. A syndicate has absorbed about two-thirds of all the sardine factories in the State, although some of the largest packers have not yet sold their factories to the new company.

The State Labor Commissioner describes, as follows, the largest sardine cannery in this country:

When fish are received at the factory the steam whistle is blown for the employés to assemble, every factory having its own peculiar whistle by which to call its help. The fish are hoisted from the boats in great tubs, the hoisting being done by steam power. They are immediately carried to the cutting room and spread out on long tables or benches. The cutters are mostly young boys and girls, but there is a sprinkling of older people among them. All are armed with sharp knives, which they learn to wield with skill and swiftness. With one blow the fish is decapitated, and with another dexterous movement the entrails are removed. All this is piece work, but these busy little people make from two to three dollars a day each. It is not neat work, neither is the odor so attractive that visitors care to linger longer than is necessary.

The next step in the preparation of the fish is to thoroughly wash them. This is done in tanks filled with sea water. The fish are then thrown into large tubs filled with strong brine, where they are kept from fifteen to thirty minutes. They are taken out of this pickle and laid on iron flakes and carried to the huge ovens, where they are placed on the projecting arms of a slowly revolving shaft. The oven is heated to such a degree that the fish are cooked sufficiently in one revolution of the shaft, occupying about five minutes.

They are then carried to the packing room, where young women pack the larger fish in mustard and the smaller fish in oil. The mustard is a mixture of ground mustard seed and vinegar. The oil is cottonseed oil. The cans have been partly filled beforehand so that the work is quickly done, the cover of the can is put in, and the cans are passed along to the sealers. The sealers sit on either side of long tables, on which, at short intervals, are the stoves for heating the soldering coppers. These stoves are connected with a blower, by means of which the air is forced through a small tube, meeting, as it emerges, a small jet of kerosene oil, which is atomized by the air, and, being ignited, produces a very hot flame. The sardine can is placed on an iron disk, which is revolved by foot power, the sealer takes a ribbon of solder in one hand and his soldering copper in the other, and, giving the can a whirl by means of his foot, he seals the cover with a neatness and despatch that compel admiration.

From the sealers the cans go into a bath of boiling water, where they are kept two hours. They are then taken out and tested for leaks, each can being carefully examined. The leaky cans are sent back to be resealed, and this must be done by those responsible for their faulty condition. In order to trace cans they have to be marked by those through whose hands they pass in the successive stages of canning.

Nearly all the work done in a canning factory is done by the piece, but excellent wages are made during the canning season, when fish are plenty. Sealers make from $3 to $4 a day, and very often more than these figures. The girl packers earn on the average $3 per day, while the cutters, mostly young boys and girls, will averge $2 per day.

A large number of factories are located on Passamaquoddy Bay and its tributaries. The bay with its tributaries is the fishing ground from which practically all the herring which are used for sardines in this region are obtained.

The herring are caught in weirs, set at the mouths of rivers, in the small bays and coves, and along the shores of the islands. The fishing season corresponds to the canning season, which is fixed by law, and is now from May 10 to December 1. To catch the entrapped fish in a weir, a seine must be used. The time selected for seining the weirs is low tide, whether in the daytime or in the night, for it is customary to fish on both tides. The fish are brought together in a body sufficiently compact to be dipped out of the seine into the boats with large dip nets. Regular collecting boats are usually near by to convey the "haul" to the canneries.

Oyster Canneries

Oyster canning and preserving as an industry has its chief centre in Baltimore. The practical details of the industry have been greatly improved of late years, so as to permit of handling in the large quantities required by the increase of the traffic. Hand shucking was supplanted by scalding in 1858, and, two years later, by steaming; both of which processes greatly facilitated removal of the shells. The steaming process is accomplished, briefly, as follows: A number of oysters are placed in iron framework cars, six or eight feet long, and run on a track into a steam-tight chamber, into which, when closed, steam of any desired pressure may be admitted. After about fifteen minutes of exposure to the steam, the cars are run into the shucking shed, where the oysters are easily removed from the shell with knives, being then washed in cold water and canned. Having been hermetically sealed, the cans are placed in a cylindrical basket, and lowered into the "process kettle," in order to be steamed at a temperature sufficient to destroy all fermentative germs. This takes, usually, about half an hour; the process then being complete, except for a brief immersion in the cooling vat. The method thus described is universally followed, except in the canning of Mexican Gulf oysters, which, on account of their peculiar structure, rendering them liable to disintegration, must be treated differently, for the purpose of coagulating the fatty portions and rendering the body firm. According to the Maybury process introduced in 1880 a specially prepared solution—ten gallons of pure water, one-half gallon of commercial vinegar, one-tenth gill of saturated aqueous solution of salicylic acid, and sufficient salt to impart a flavor, the whole being boiled together about five minutes—in a bath of steam at 202° F. The temperature of the steam being gradually raised to 240°, and so continued about forty-five minutes, the cans are removed, vented, resealed, and again steamed for half an hour.

CHAPTER XXII

SUGAR, CONFECTIONERY, AND CHOCOLATE INDUSTRIES

Sugar Refineries—Process of Sugar Manufacture—Beet Sugar—Beet Sugar Factories and Process of Manufacture—Statistics—Maple Sugar—Confectionery—Candy Making—Cocoa and Chocolate

Sugar Refineries

ALL the principal sugar refineries in the United States are located on the seaboard, a small number on the Pacific coast, the majority on the Atlantic coast. It is the business of these refineries to change the sugar from brown or raw sugar, to granulated and other forms of white sugar. The chief sources from which the refineries get their raw sugar are the central European countries; Germany, France, and Austria; the West Indies, chiefly Cuba and Porto Rico; and the Hawaiian Islands and Java. The sugar from Europe is made from beets, that from the tropical islands from cane. Russia, Africa, Asia, and South America produce vast quantities of sugar, but as yet comparatively little raw sugar is shipped from those regions to America.

The cane crop of the world is propagated by planting the stalks or portions of them. In Louisiana cane is planted at any time between September and April; and the general harvest begins in October and lasts till January. The juice from sugar cane is usually extracted by heavy iron rollers, three to nine of these constituting a sugar mill. After the canes have passed through the first set of rollers, generally three, they are saturated with water or steam and passed through another set of rollers. This process is called maceration.

The largest sugar refining company, or combination, in the world is the one headed by Mr. Henry O. Havemeyer, which controls the output of about seven-eighths of all the sugar in this country and one-third of the output of the world. The company operates about seventeen refineries, though the official reports credit the company with only five plants. The refineries are scattered among nine cities, and each plant includes a group of colossal building; four such groups in Brooklyn, four in Philadelphia, and four in Boston; two each in Jersey City and San Francisco; and one each in Portland, Maine, Baltimore, St. Louis, and New Orleans. The average number of employés in each refinery may be estimated at 1,000. The refining company also operates a number of tributary plants—such as cooperages, where the barrels to hold the sugar are made; nine coal yards, nine mammoth warehouses, nine factories for the manufacture of bone-black used in purifying sugar, and nine large machine shops. In gathering and splitting the wood for staves, and in making barrels, 5,000 men are kept busy. Five thousand more find employment in shovelling coal and in making the bone-black and the sugar-mill machines. Thus the company employs altogether about 30,000 persons, and produces about 45,000 barrels of sugar a day.

The largest refinery operated by the great sugar combination is in Brooklyn. This single establishment produces, every working day, 13,000 barrels—that is to say, about 4,000,000 barrels of sugar during the year. The plant occupies seven big buildings, spreading over one-quarter of a square mile of territory. Here 3,000 men are employed, receiving at least $150,000 a month in wages. Incidentally, the work requires 48 engines, with an aggregate of 24,000 horse-power, and 800 tons of coal a day. The towering buildings extend for six blocks along the East River front. Adown the wharves, at the very doors of the refinery, is lashed a fleet of steamers and sailing vessels, each discharging its burden of raw material. These vessels come from every sugar producing country on the globe. Jamaica sends her sugar in huge hogsheads; Cuba, in brown bags; Java, in baskets; Manila, in mats.

Process of Sugar Manufacture

Once up and once down a thirteen-story building, containing thirteen separate sets of machinery for as many different processes, the substance must pass before it is ready for market. It goes up a brown, moist mass. It comes down a snowy solid. The time required to refine a given amount of sugar—say one hogshead—is about eight hours. During the process, all sugar, of whatever kind or grade, undergoes four principal operations—mixing, boiling, filtering, and drying. Additional treatment depends, of course, upon the quality of sugar required. The process, and the heat, too, begins on the ground floor, where, having been weighed and tested by the chemist, the raw material is emptied from the bags or hogsheads into the "mixers." "Mixers" are great tanks, filled with boiling water, over which the hogshead or bag is suspended, while big, brawny workmen slash it open and the raw sugar, looking like wet, coarse sand, falls into the tank. The sugar is now a seething liquid, and is forced by giant pumps up 155 feet through half a hundred pipes to the "blow-ups" or vats on the top floor. The "blow-ups" are fitted with mechanical stirrers, with steam pipes coiled snakelike in their bottoms. In these, the liquid boils twenty minutes, or until the "mixing" is complete. The liquid then runs out of the "blow-ups" into troughs, which carry it down one story into the filters. Here the process of removing mechanical impurities begins. The filters are long, pipelike bags, with an inner casing of thin woven material and an outer sheath of network. They are suspended from the troughs, and the liquid, in filtering through them, leaves behind such impurities as would form a sediment.

The sugar is now free of mechanical impurities, but it is still a dark brown color, which means that chemical impurities remain. These must now be removed. The liquid must be decolorized. For this purpose it is filtered through "bone-black," or animal charcoal, a substance made from burned bones. Sixty thousand pounds of "bone-black" are put into each of 168 great air-tight cisterns, and through this the liquid slowly soaks until it drops into troughs on the floor below, a beautiful white transparent liquid. It is now free of foreign substances. Cane fibre, albumen, and other mechanical impurities were left behind in the bags, while all chemical impurities were lost in the "bone-black." The filtering process is over, and now begins the boiling—in five great vacuum pans, by which process it is concentrated or crystallized. "Boiling" but very tamely designates the rough treatment which the sugar undergoes in these monster caldrons. It is whipped, beaten, flayed, hurled into "grain." The process is very wild and terrible, like a caged cyclone, and lasts three and one-half hours. Each of the pans is 16 feet in diameter, 32 feet high, and holds 85 tons. As any liquid can be crystallized by excluding the vapor from it, so can sugar; and as the boiling point is lower in a vacuum, the process is facilitated in this manner. So every pan has its twin condenser to get rid of the vapors, and thus the sugar boils at a temperature of 112°. To supply these condensers, five great pumps draw 20,000,000 gallons of water from the East River every day.

Now the pans discharge their crystallized mass into six long coolers, or trenches resembling bowling alleys, down which the sugar pours like so many sluggish rivers. But the sugar still contains some liquid which must be removed, and in the manner of this removal we come to the most interesting, most magic-like operation of the whole sugar-refining process—the "centrifugal"—a broad, porcelain-lined, concave-shaped tub, which revolves with great rapidity. It is filled with sugar, which comes through faucets from the coolers above, and is then set in motion. It revolves violently, driving the moist sugar to the sides of the tub and holding it there. The sides are perforated at the top to allow the moisture still remaining in the mass to escape. The magic of this process to the ordinary onlooker lies in the fact that as the sugar is whirled around it turns gradually, chameleon-like, from a distinct yellow to a pure white. Thus the moisture is driven off by rotation. Each "centrifugal" holds about 1,800 pounds, and does its work in about two and one-half or three minutes. The workmen know instinctively just when the sugar has reached the required dryness and exact color. They stop the machines, and the sugar is found to be caked, solidly, like driven snow, to the sides. A wooden paddle soon loosens it, and it is dropped through the bottom of the "centrifugals" into a number of bins extending downward two stories. The white, snowy mass no sooner falls than it is gobbled up by an endless chain of bucket elevators and carried up five stories, only to be sifted down again seven flights. In its descent it runs between rollers which crush all the lumps, falling at last into great receivers, a finished product. Thus the sugar is mixed, filtered, boiled, and dried. It is now called refined.

Thus far goes all sugar. But special forms, like granulated and loaf, undergo further operations. For example, granulated sugar must be passed through granulators—hollow cylinders 36 feet long and 8 feet in diameter, with an ingenious combination of fans and hollow drums. As the granulators revolve, the crystals of the sugar fall through currents of hot air and, in the course of their passage from one end of the cylinder to the other, become granulated. When loaf sugar is to be made, small crystals only are allowed to form in the great vacuum pans. The *granula magna* is then run into steam-jacketed open pans and raised to a temperature of 180° to 190° F., which liquefies the grain. Next the hot solution is cast into conical molds, in which the sugar, as it cools, crystallizes into a solid mass, still surrounded and mixed with a syrup containing colored and other impurities. After thorough settling and crystallizing, a plug at the bottom of the mold is opened and the syrup is allowed to drain away. The loaves are whitened by treating them with successive doses of saturated syrup, ending with a dose of pure colorless syrup. These doses are poured on the upper side of the cone, and, percolating down through the porous mass, carry with them the impure syrup which still may adhere to the crystals. During this process the molds stand in rows, thousands and thousands of them draining into a huge trough. This process lasts two whole weeks. The syrup gone, the sugar, now a solid cake weighing eighty pounds, is easily shaken from the molds. The cakes, which are hard as rock, are thrown into sawing machines, which cut them into slices and then into little cubes. After drying, the cubes are ready for packing. In the packing room, hundreds of barrels dance jigs in unison. That is, in order that the barrels may be "full weight," they are put upon a "jiggling" stand, and as the sugar falls into them, the constant rising and falling, pitching and plunging, packs the mass solidly.

Beet Sugar

In the political, as well as in the industrial world, beet sugar has for some years been a topic of great interest. The beet sugar manufacturers of Michigan, California, and other States were long ago obliged to ask for certain Federal and State aid. While Congress debated the question, several State legislatures repealed the bounty laws passed by their predecessors. In Michigan, the bounty act was even declared unconstitutional. Meantime, local aid was extended, in a few instances, in the form of factory sites and exemption from taxes for a term of years. The Department of Agriculture, at Washington, also helped the beet sugar men by making provision for admitting beet sugar machinery of foreign make free of duty, by prosecuting investigations relative to the industry, by according prospective investors every facility to aid them in deciding upon locations for factories, by defining the areas best suited to beet culture, and by distributing printed information and beet seeds among farmers. With this aid, despite the fact that it fell short of the expectations of the manufacturers, the making of beet sugar is now generally a profitable business, both to the farmer who raises the beets, and to the manufacturer who turns them into sugar. The industry has become firmly established in many of the Northern and Western States, from New York to California.

In the matter of machinery, Americans have so improved that of foreign construction, that they have produced machinery far better adapted to our own labor and climatic conditions. But while, as a result of this development, many mechanical devices are now in use here, though unknown abroad, a considerable number of the factory operatives are of foreign birth. In the transportation, in methods of unloading and storage of beets, as well as in the construction of factory buildings, and in other departments, such wonderful advance has been made that manufacturers believe the experimental stage has passed, and that now it is certain that the industry has a great future. Substantial buildings have been so constructed, and machinery so arranged, that the plants can readily be enlarged.

Nearly all the factories built in the last ten years, indeed, have been designed with a view to doubling their capacity.

Beet Sugar Factories and Process of Manufacture

It seems that the greatest problems in the beet sugar industry still unsolved, are not to be found in the factories, but in the field, the main difficulty being to convince the farmer that with persistent effort and experience he will find sugar beets a surer and more profitable crop than many others. Formerly when the farmer was encouraged by bounties, he was sure of selling his crop at a profitable price. This is not at all certain in present conditions. He usually makes a fair profit, but is never certain of a large return. The beet sugar factories are gradually obtaining control of the beet lands, just as the cane sugar industry is slowly getting control of the cane lands. They are doing this in several ways. Sometimes, as in Colorado and Utah, the factories own their lands, and have them cultivated under their direction, thus governing exactly the production of their supply. Sometimes, the work of raising the beets is done by colonists, who are controlled by agreements with the factories. And in almost all cases, the growers of beets have some sort of agreement with the sugar mills, as to how much acreage they will plant, when they will harvest, and at what prices they will sell. The factory once started can not afford to shut down, as the machinery is costly; and it is the object of the management to have a constant supply of beets. To do this, they arrange with the farmers that they are not to harvest their crops until notified by the factory. This frequently works a hardship, as the beets are gathered in a changeable season, and frost often injures the quality of the crop. Many factories now have sheds, for the housing of beets, so that they may buy of the farmers at any time. The growers may, therefore, allow their beets to mature, and gather them when they are in the best condition. Heretofore, they have had to put the beets not wanted in pits, or silos, where they suffer some deterioration.

The American factory, as a rule, manufactures only the "white granulated." No bone black is used, the bleaching of the juice being accomplished by sulphurous acid. While, within recent years, a number of factories have lost heavily and others have only paid expenses, still the larger number have earned a fair return on their investments. The beet sugar factory is often handicapped by a limited supply of material, at the time when it means great loss; and, also, by the fact that it must manufacture the beets into sugar within three months. The average factory has a capacity of 500 tons a day. It needs, therefore, some 45,000 tons of beets for a three months' campaign. It usually works day and night. Around a factory of this size, there would have to be about 4,500 acres of good beet land. This is a condition hard to meet, and often the factory is forced to be idle. There is one factory in California with a capacity of 3,000 tons a day. The average American factory is larger than that of Europe, and has the best machinery in the world. Nearly all factories in this country have their own refineries. There is a profit in refining whenever the difference between raw and refined sugar is more than a half cent. If the difference falls below this, the sugar factories generally turn over their product to the great refineries.

In the process of manufacture, the beets are treated by diffusion, to extract the juice. This process is also frequently used with sugar cane. The canes or beets are cut into small pieces and carried into large cast-iron cells or diffusors, where they are treated with hot water under pressure, ten to sixteen cells constituting a battery. Being forced from cell to cell over fresh chips, the juice is finally drawn off and sent to the juice-tanks. The bottom of the cell is opened at the proper time to drop the refuse chips, receiving fresh ones from the top. If white or yellow sugar is desired, the juice is treated with the gas obtained by burning sulphur, which bleaches it. It is then drawn into the clarifiers. These are copper vessels holding from 400 to 800 gallons, having steam coils at the bottom. The juice is here treated with milk of lime, and heated to about the boiling point of water. The heavy blanket of impurities is brushed off and sent to the filter-press. After the cleansing, the juice is evaporated by the use of direct or exhaust steam to a syrup containing about 40 per cent of sugar. This syrup goes to the vacuum strike pan and is there granulated. When the grain has grown to the proper size, the pan is full, and a "strike" is made. The bottom of the pan is opened and the semi-fluid mixture of sugar and molasses, called "masse cuite," is emptied into a large mixer. From the mixer it is drawn into centrifugals, which revolve at the rate of 1,200 to 1,500 times per minute, throwing out through fine sieves the fluid molasses while retaining the sugar. The sugar is then washed with water or pure syrup, according to the quality of sugar desired. Thus brown, yellow-clarified, or white sugar may be obtained, which are called "first sugars." For "yellow clarified" a little salt of tin is put into the wash-water, to produce the color. Often the white sugar is granulated before being marketed. Brown sugar goes almost entirely to the refinery. The molasses, thrown off by the centrifugals, is cooked to such a density that it will "string" out into a fine thread before breaking. It is then sent to the hot room, with a temperature of 110° to 115° F., and granulates. This "string sugar" soon become charged with crystals, which are separated by centrifugals. The process produces brown sugars, which are sent to the refineries, being known as "second sugars." The repetition of the process gives "third sugars," or "thirds." Some mills even make "fourths" from the cane. The method of clarification is different in the beet factories, carbonators being employed at a certain stage. But the operations are the same after clarification. The final molasses from cane is black, and contains very little sugar. It is sold as "centrifugal molasses," some of it being distilled into rum or alcohol, which is the sole use of beet molasses. The "open kettle" factories are disappearing. There are a few sorghum mills in Kansas, sorghum not being a very profitable sugar producer, as it contains such a large proportion of "foreign" solids which hinder granulation.

STATISTICS

The total consumption of sugar of all kinds in the United States in the year 1901, was 2,372,316 tons, consisting of 292,150 tons domestic sugar cane, 124,859 tons domestic beet sugar, 5,000 tons maple sugar, 17,977 tons molasses sugar, a total of 439,986 tons domestic production, and 1,672,529 tons of foreign cane sugar, 217,286 tons of foreign raw beet sugar, and 42,515 tons of foreign refined, a total of 1,932,330 tons of sugar from foreign countries and insular possessions. Of the imports from external sources, 309,070 tons were Hawaiian, 66,279 tons Porto Rican, and 5,100 tons Philippine. The amount of refined sugar which went into consumption, in 1901, was 2,287,828 tons.

Three-fifths of the sugar consumed in the country is beet sugar. Of the total world's production of sugar, more than half is produced from beets, nearly all the beet sugar being made on the continent of Europe. The demand for beet sugar increases at a very rapid rate, the annual increase for the past thirty years being twelve per cent. The manufacture of beet sugar in 1900 was reported by thirty establishments, including, besides the Michigan factories, establishments in California, Colorado, Illinois, Minnesota, Nebraska, New Mexico, New York, Oregon, Utah, and Washington. Of the thirty-one factories, twenty-nine were controlled by incorporated companies, and two by individuals. The total capital invested in beet sugar manufacture in 1899 aggregates $20,958,519, of which $682,705 represented land, $3,891,371 buildings, and $14,420,325 machinery. The output of the thirty factories operated was about 80,000 tons. The American beet sugar factories now have a nominal daily capacity of 22,310 tons of beets, and when fully supplied with the raw material should easily manufacture 240,000 tons of sugar per annum. These statistics show that after many years of manufacture on a small scale, the beet sugar industry has assumed large proportions, more than one-third of the domestic raw sugar product being obtained from the beet in 1900. This quantity of sugar, seventy per cent of which was suitable for immediate consumption, was produced in a year of extremely unfavorable agricultural conditions in the beet sugar districts. The yield of beets per acre was less than half that of an average season. The factories could readily manufacture more than two and one-half times the quantity of sugar produced, if supplied with sufficient raw material.

Maple Sugar

Maple sugar is produced to some extent in about half the States of the Union, but its production is greater in Vermont, New York, and Ohio, in the order named. In Vermont the maple sugar industry is, with the exception of dairying, as important as anything the farmers are engaged in, bringing them an income of from $1,000,000 to $1,500,000 a year, without interfering with other work, since the sugar season comes at a time when there is not much else to be done.

The method of producing maple sugar is familiar. The sugar maple grows in most of the Northern States. At the close of winter the sap rises and the trees are tapped about three feet from the ground, and, by means of plugs, the sap is drawn into buckets. By clarification and evaporation it is converted into maple sugar.

Confectionery

In the days when candy-pulling parties were in fashion, New York was treated to the spectacle of a workman in blue jeans standing in the window of a candy store, on one of the business avenues, pulling taffy. Passersby stopped and stared, then stepped inside and bought what was advertised as "old-fashioned molasses candy." So well pulled he of the blue jeans that before long he was obliged to hire other men to pull even as he pulled. Then followed other articles besides taffy—such as bon-bons, burned almonds, chocolates—until he was obliged to open a second store. The business thus founded has now a chain of stores across the United States, from Boston to St. Louis, one or more stores in each large city. At the time the workman in the store-window began pulling taffy, the annual amount spent for confectionery in this country was less than twenty million dollars. To-day the people of the United States buy at least eighty million dollars' worth of candy, and an additional million dollars' worth is sent abroad. Satisfying the national "sweet tooth" gives employment to some 40,000 persons, who are paid $15,000,000 a year in wages. About $45,000,000 worth of material is used in 4,200 candy establishments, in which the capital invested is $35,000,000. These figures do not include the thousands of smaller candy-making establishments and candy shops. The magnitude of the confectionery trade is such that a number of concerns are engaged exclusively in the manufacture of candy-making machinery. A decline in the candy trade would extinguish the fires of more than one sugar refinery. To avoid such decline, the National Confectioners' Association, embodying the Houses of Congress, as it were, of this trade, is pledged to the following platform:

To advance the standard of confectionery in all practical ways, and to absolutely prevent adulterations.

To promote the common business interests of its members, and to establish and maintain more intimate relations between them.

To take united action upon all matters affecting the welfare of the trade at large.

A committee promptly investigates all charges made in writing and properly supported, against any individual, firm, or corporation in the United States believed to be guilty of using any mineral substance, or any poisonous or hurtful color or ingredient in the manufacture of confectionery. If such charges seem to be substantiated they prosecute the same, whether against members of the association or other persons, and bring the offender to punishment and public exposure.

Candy Making

When the medical faculties pronounced the craving for sweets to be perfectly natural, the hygienic embargo on pure candy was removed and its consumption vastly increased. Still, the candy must be pure. In many of the cheap candies, which children are sometimes deluded into buying, are large quantities of deleterious materials, such as plaster of Paris and terra-alba, or an undue proportion of glucose. The cheaper grade of gum-drops, for instance, is entirely made of glucose and glue, having no cane or beet sugar or gum-arabic in its composition.

In the way of coloring matter, there are many perfectly harmless materials, which in the good qualities are always employed. In the cheap grades the coloring matter is most harmful, consisting often of chrome-yellow, sulphate of arsenic, and different salts of lead and copper.

The basis of pure candy is "sucrose," or common sugar, obtained from the sugar-cane, beet, maple and date-palm. Grape-sugar, or glucose, has only one-half the sweetness of sucrose, and does not crystallize. Glucose is largely manufactured from cornstarch, and grape-sugar is a solid product from the same source. Candy made from glucose, unless colored, is slightly yellow, and lacks sweetness.

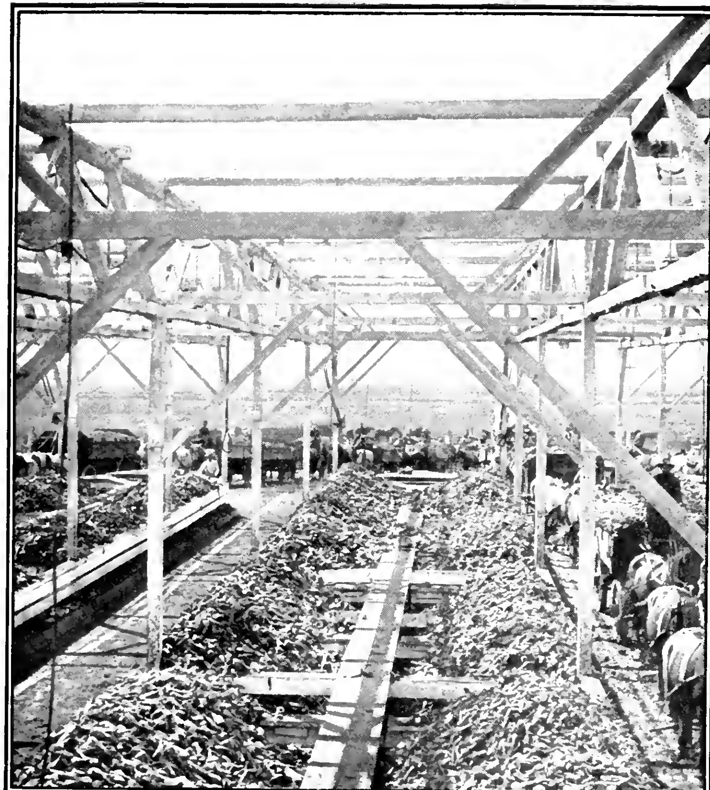
For children, clear acidulated fruit-drops, or barley sugar are the best. Adulteration of these is easily detected, as it destroys their transparency. One or two tests of the purity of candy may be named. One method is to place a small quantity of the candy in a glass partly filled with hot water, and let it stand for twenty-four hours, when the foreign substance will form a sediment at the bottom. Another method is the iodine test for starch when its presence is suspected. Boil a little of the alleged sugar, or the candy under suspicion, in a cupful of water until a thin paste is formed. Then, after it is allowed to cool, add a drop of liquid iodine. The whole substance will turn blue if starch is present. To prevent crystallization of sucrose, the sugar must be "inverted." This is a technical term, which means a rearrangement of molecular structure induced by yeast or heating with dilute acid. Cream of tartar and other acids are used by confectioners with cane-sugar for this purpose. The differentiation in the forms of the candy product are interesting. A cup of water poured upon half a cup of sugar and allowed to evaporate, produces rock-candy, though the rock-candy of commerce is sugar crystallizing around a string, after being boiled at a temperature of 230° F. The purest of all the candies of commerce is known as "barley-sugar," which is sugar melted at 310° F., and which liquefies quickly unless kept in air-tight cans. At 320° F. sugar is in the early stages of "caramel," becoming true caramel at 400° F. The name caramel comes from Count Albufage Caramel, of Nismes. Caramel in a certain stage is known by confectioners as "burned sugar." Gum-arabic is next to sugar in order of importance and frequency of use in candy-making, coming from Egypt.

In making candy, crystallization must be avoided, which is done by placing a cover over the pan in which the sugar has been stirred until dissolved, thus confining the steam, with the desired result. For "cutting the grain" confectioners use largely glucose or cream of tartar, as has been said, but this may also be done by a few drops of acetic acid to one pound of sugar, added as it begins to boil, or by a few drops of lemon juice, added at 290° F., or by a scant saltspoonful of cream of tartar to one pound of sugar, added at the beginning. If the degree desired is higher than 240° F., the addition should be made after the cover is removed, to avoid yellowing.

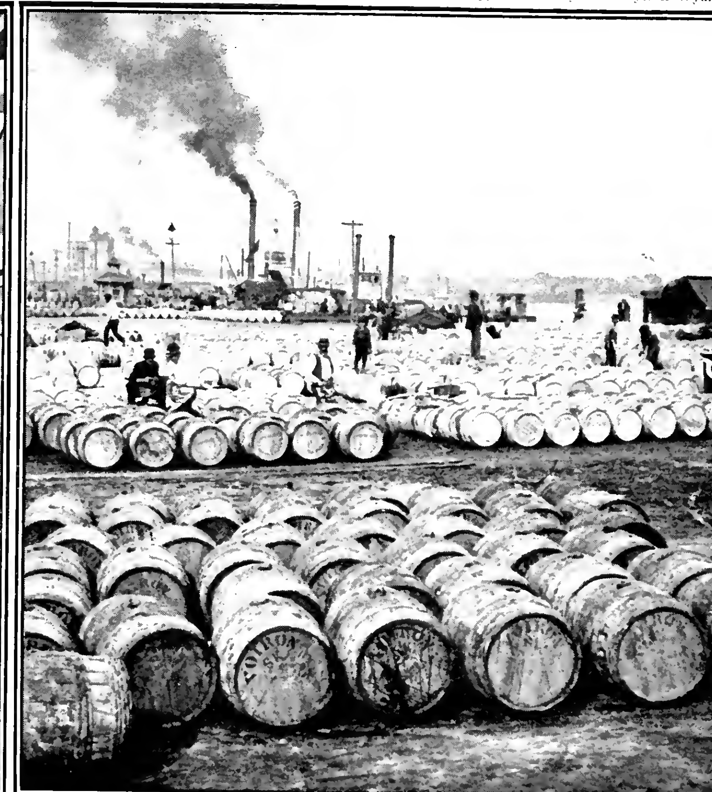
Cocoa and Chocolate

Cocoa and chocolate, common preparations from the seed, or bean, of the cacao tree, grown most largely in South America and the West Indian Islands, are food products whose use is steadily increasing. Within the last thirty years their total consumption has risen from 2,000,000 to nearly 30,000,000 pounds, annually, although, as beverages, neither of them is a serious rival to coffee and tea: the wide use of chocolate in confections would seem to explain the figures. Among the principal sources of supply for the American market are Ecuador and Venezuela, in South America, Hayti, Cuba, St. Lucia, Trinidad and Jamaica, in the West Indian and Atlantic Islands; while Java, Surinam and Africa contribute a good share. It may also be confidently expected that the Philippine Islands, also within the cocoa belt, will prove important producers of the crude material for our market within a very few years. According to conservative estimates, there are about twenty large concerns in America engaged in manufacturing cocoa products, and giving steady employment to at least 2,000 persons.

In the process of manufacture, the beans are first mechanically cleansed of all dust and impurities, and are then carefully roasted. In this roasting it is essential to secure a uniform effect upon the entire mass, in order to secure the best effect of the produced flavor; avoiding alike the crude taste of under-roasted seeds and the harsh and bitter taste due to over-roasting.



IN A BEET SUGAR FACTORY



SUGAR LEVEE, NEW ORLEANS

Since a change in the color of the beans is the surest indication that the correct flavor has been acquired, this process must be carefully watched throughout. Another effect of roasting is that the shells are made readily separable from the beans, being thoroughly detached in the crushing process that follows, and carried away by winnowing. The next step is the mechanical separation of the hardened pieces of the germ from the "cocoa nibs," or crushed fragments of the body, thus removing all non-nutritious substances. Although the unground "nibs" may be used to produce a palatable beverage, the difficulty of retaining the full flavor in the necessary boiling renders this form unpopular. The result is that both cocoa and chocolate are finely pulverized, previous to packing in cakes or loose form. Chocolate is the name given to the pulverized product of the cacao bean; while cocoa represents the substance of the seed purified and rendered more digestible by separation of much of the "cocoa butter," or essential oil. Commercial chocolate is generally sold in the form of cakes, which are principally interesting, on account of the process of molding. The seed fragments are ground to the greatest possible fineness, producing a perfectly homogeneous mass or paste, with which is mixed finely powdered sugar, pulverized vanilla bean, or other flavoring. On account of its tendency to stick to the presser, the chocolate can not be forced into shape, and, as a consequence, is placed in molds, which are violently shaken on a rocking tray, until the desired density is produced, and the shape of the mold imparted to the cake. This done, the molds are removed to the cooling room, whence, after a sufficient period, they are taken to the packers.

CHAPTER XXIII

LIQUORS AND BEVERAGES

The Grand Divisions of the Liquor Industry—Malt Liquor Industry—Breweries and Brewmasters—Process of Beer Manufacture—The Distilled Liquor Industry—Distilleries—The Wine Industry—Wineries—Process of Wine Manufacture—Manufacture of Champagne—Soda and Mineral Spring Water and Apparatus—The Bottling Industry

The Grand Divisions of the Liquor Industry

LONG years before temperance societies were heard of, the Massachusetts Colony offered immunity from taxes and a prize in money to any energetic brewer who would manufacture five hundred barrels of beer in a single year. And it was written in the law that "not only does the peaceful beverage add to the prosperity of the farmer by giving him a market for his grain; but, by supplying to our worthy citizens a beverage of milder form, adds much to the temperance and good order of our Colony." And so the brewers worked day and night in a mighty effort to produce five hundred barrels in a year. This happened in the evening of the eighteenth century. Note the difference in the morning of the twentieth century. The people of Boston alone drink over a million barrels of beer in a year; a single brewery in Milwaukee turns out three thousand barrels every day; and the annual beer production in the United States amounts to forty million barrels, which allows yearly about half a barrel of this beverage for each man, woman, and child in the country. At the same time, the annual consumption of whiskey, gin and brandy, per capita, is a little more than one gallon.

The three grand divisions of what may be called the alcoholic liquor industry are: (1) Malt liquors, embracing beers, ales, porters, and all similar beverages fermented from malt infusions and included in the products of the brewing industry; (2) distilled liquors, embracing all ardent spirits separated by distillation from fermented fruit juices, molasses, or malted infusions of grain; (3) and vinous liquors, embracing all varieties of wines fermented from the juice of grapes and berries. Divested of technical terms, the three divisions may be summed up as beer, whiskey and wine, which are meant to comprehend all the "drinks" manufactured in breweries, distilleries and wineries. The relative popularity of each of the three classes mentioned is shown in the average quantities annually manufactured: twelve hundred million gallons of malt liquors, one hundred million gallons of distilled liquors, and nearly twenty-five million gallons of wine. The actual grand total in 1900 was 1,325,000,000 gallons. The total number of establishments engaged is very nearly 3,000, including more than 1,500 breweries, about 1,000 distillers, and 350 wineries. The pre-eminent feature of the liquor manufacturing industry is that the vast majority of the persons employed are in the breweries, the proportion being 47,000 for breweries, and only 6,000 for all other liquor making factories. These numbers apply only to the larger establishments. To include all those with a product of less than $500 would probably double the official numbers.

Localization in each branch of the industry is governed by different considerations. Breweries localize at the point of consumption, because the transportation of the finished product costs more than that of the materials. For an exactly opposite reason, distilleries localize near the materials used—that is, at points where the grain supply is abundant and its cost least, because the finished product is less bulky than the raw material, and consequently involves less expense for transportation. Wineries naturally localize where the soil and climate will produce the varieties of grapes particularly desired.

Malt Liquor Industry

Public taste for a beverage milder than ale, or porter, or stout, was rapidly developed after the year 1840, when the manufacture of lager beer was first established as a distinct industry in the United States. The leading State in the value of the product of malt liquors is New York. In the matter of localization in cities, Milwaukee and St. Loius are probably foremost. In Milwaukee in 1870 a few barrels of beer were made, while now $17,000,000 of beer and malt tonics are made annually, and over three thousand people are employed in their manufacture.

Barley, hops and corn, the principal materials used in malt liquors, have steadily declined in cost for ten years or more. The cost of the production of beer has been otherwise reduced by the improved methods of manufacture which led to a more thorough extraction of the productive elements of the cereals used, and by the introduction of more economical methods of refrigeration. The largest shipments of beer in recent years have been made to "our new possessions"—Cuba, Hawaii and the Philippine Islands. The annual consumption of beer, *per capita*, in the United States is between fifteen and sixteen gallons. The total number of barrels of beer, ale and porter made in 1900 was very nearly 40,000,000, the internal revenue tax of one dollar being imposed upon each barrel.

Breweries and Brewmasters

The brewers of the United States contributed to the support of the general government in 1900 to the extent of $78,000,000 in internal revenue taxes. The Chicago brewers had a friendly discussion concerning the truth of a statement made by a Milwaukee brewer to the effect that his company had paid to the United States Government, in internal revenue tax, an amount exceeding the combined salaries of all the Presidents from Washington to McKinley, as well as the salaries to be paid for one hundred years to come. This discussion ended in a wager of one hundred dollars that the statement could not be proved. Called upon to furnish proof, the brewer made the following statement:

From 1864 to 1898 this company brewed 12,553,892 barrels of beer, during all of which time it paid to the United States Government the sum of one dollar per barrel in Internal Revenue taxes. George Washington was inaugurated as President in 1789. Therefore, from Washington to McKinley would intervene 109 years. Washington, and several Presidents succeeding him, received very small salaries, and it was not until General Grant's time that the President's salary was increased from $25,000 to $50,000. We shall assume, however, for the purpose of this argument, that Washington and every succeeding President received $50,000 per year, which, for 109 years, would make a total of $5,450,000; and for the next one hundred years at $50,000 a year we add the sum of $5,000,000, which would make a grand total of $10,450,000. Thus, to recapitulate we have as follows:

Internal revenue tax paid by the brewing company from 1864 to 1898...	$12,553,892
Washington (1789) to McKinley (1898), 109 years, at $50,000 per year..	5,450,000
One hundred years, hence, at $50,000 per year........................	5,000,000
Balance after paying from Washington to McKinley and one hundred years to come..	2,103,892

The brewing company above referred to has over forty branches, all owned and controlled by the home office and under the direction of salaried officers and their assistants, who are paid directly by the home company. In addition to these branches, the company has some six hundred local agents, who purchase their beer exclusively and who act as wholesale dealers in their product. This single establishment produces enough of beer in bottles each day to cover an acre of ground. As this is one-thirty-third of the production of bottled beer the country over, we can imagine a field of thirty-three acres covered with full bottles of beer at sunrise every morning, and the same thirty-three acres covered with empty bottles the next morning, the contents of the bottles having been drunk by the inhabitants of the United States during the twenty-four hours.

With the exception of the Ale Brewers' Association of New York and New Jersey, organized in 1830, no association of brewery owners existed in our country before the year 1862. Since that time the brewers of nearly all beer-producing States were compelled, by the unfavorable character of their environments, to organize for self-protection. Breweries of the entire country are now represented in the United States Brewers' Association.

American brewers aspire to out-German the Germans in the matter of quality, and what is called "durability" of beer. If quality could be judged by the amount of wages paid, American beer would be pronounced twice as good as that of Germany; for workers in American breweries are paid twice as much for their services as those in breweries in the Fatherland. In Munich, the men work eleven hours a day and are paid from 75 cents to $1.50. In Milwaukee, the wage-earners work only ten hours a day and receive from $2 to $3.

It is only recently that brewing has been taught as a trade or vocation in this country. Up to a few years ago most of the American brewers employed experts, who had been trained in the great breweries or had graduated in the brewers' academies of Europe. In 1880, the first academy for the purpose of training brewers was established in New York. Since that time a great many brewers have been educated in this country, and the principles of the manufacture of ales and beers have been thoroughly examined and formed into a practical science. The training is of course essentially practical. In one of the brewers' academies there is a model brewery with a capacity of ten barrels of beer a day, and also a pneumatic malting plant, which give the students full opportunity to unite theory and practice. Very often the study goes far beyond the mere practical requirements of brewing, which could readily be gained in the brewery itself. However, in the competition between the manufacturers of beers and ales, it is necessary for a successful brewer to understand exactly the quality of his rival's product, how it is made, and how it may be improved. This demands considerable scientific knowledge. Of course, "brewer" means, in this sense, the man who actually directs the method of brewing, and not the capitalist who may own the plant. It often happens that a trained brewer is also the owner. The practical brewer is better known in the breweries as a brewmaster. Thus the process of brewing beer has become an exact science and thoroughly commercial. Girls no longer work in the vats with their bare feet, as they once did, giving a touch of poetry to the making of the great Teutonic and Saxon beverage.

The lectures at the academies are generally in English and German, and there is a considerable study of practical chemistry. The brewmaster must be able to analyze the materials that go into the making of any malt liquor, in order to ascertain if anything is wrong with the process, and to detect any irregularities; in other words, he must make a quality of beer that will compete successfully with the famous beers of Germany, which have been the standard of the world for generations. The brewmaster is also trained in the economies of beer making. He is taught the value of location, of good water, of new improvements in machinery. For he must be able to make a good beer at a cost that will enable him to sell for a profit, and at the same time a beer that will keep and grow better, like wine.

Process of Beer Manufacture

The soul of beer is malt. Malt is barley-grain which is allowed to germinate to a certain stage. The process of germination is arrested at the proper point by heat. The maltster maintains an even, regular, temperature throughout the building during the entire year. The best barley from the fields of Wisconsin, Minnesota, Montana, and California is used. The grain is first cleaned and graded. Extraneous substances, such as dust, foreign seeds, oats and half-kernels, are removed by the cleaning machines. The barley is stored in enormous bins, being supplied while there with pure air. Taking up the process in detail, we find that the malt is first washed to remove impurities. It is then steeped in vats of carefully tempered water. After absorbing moisture enough, it is ready to begin the germinating process, which is delicate and wonderful. Modern methods have rejected the old system by which the malt was spread on great floors and allowed to germinate in its own way, subject to variations of temperature and turned over by shovels wielded by hand. Now the sprouting grain is taken from the steeping vats into immense steel troughs, with flat, perforated bottoms, where it is slowly stirred by mechanical cranes, not a kernel or a sprout being injured. Pure, damp air is drawn into these germinating chambers, through this sprouting grain, through the perforated bottoms of the troughs, into pits below, carrying with it all the gaseous products exhaled by the growing grain. This air is afterward drawn away by suction fans, sometimes sixteen feet in diameter. Fans of this size throw out 20,000 cubic feet of air a minute.

The apparatus for purifying the air as it enters the building is located on the top floor, generally occupying the whole of it. The air first passes through immense metal screens or perforated plates, over which artesian well water is constantly running, and is freed from dust, and cooled, and loaded with moisture. The temperature is kept even by steam-coils in winter and ice-machines in summer. This cleaned and wet air is drawn down to the germinating floor and passes through the sprouting barley, as before described, then going away with its gaseous load. All the year around, the temperature of the germinating rooms is maintained at 50° F., all the doors being double. The expert malster knows just the proper moment for checking the process of germination. The standard malting period, in the best breweries, is eight days.

The work of stopping the germination is a critical process. The green malt passes from the germinating troughs by conveyors to the top floor of the kiln-house. The kilns are intended for more than simply drying the malt. The kiln-house has many floors, each one being of perforated metal, made like the slats of a shutter laid flat. These plates of metal can be turned up, thus dumping the malt down upon the floor below. Hot air from great ovens in the basement rises through the successive perforated floors of the kiln, escaping at the top. The greenest malt is at the top, constantly replenished as the malt disappears down through the successive floors. When the malt gets to the floor directly above the ovens it remains till completely dry and finished, and is quickly transferred to large steel bins, where it is cooled by pure, dry air, and then cleansed of dry sprouts by machines. From these the malt goes to the malt elevator. The elevator, in some good breweries, is a series of immense cylinders of fire-proof hollow tile, held together by steel. These are virtually enormous wells, having outlets at the bottom, and sometimes with a capacity of 6,000 bushels of perfect malt. Here the malt is stored, free from moisture or atmospheric changes, until wanted by the brewmaster.

Among the food products of the day, nothing more readily lends itself to adulteration than beer. Brewers usually know a great deal about chemistry, and most of our beer consumers know very little about beer. A few of the smaller brewers make use of their chemical knowledge to use foreign and injurious substances to produce color, which the drinker is apt to accept as the sole and proper test of purity. Hence much of the beer sold to-day contains only a small percentage of barley malt. All over the world the beer of Bavaria is noted for its purity, the beer drinker being protected by very strict laws. The legal requirement there is that "brown" or ordinary beer shall be made from barley-malt, hops, yeast and water, all other ingredients whatsoever being excluded. Violation of this statute subjects the offending brewer to a good round fine, ranging from $42 to $128, and confiscation of the beer of that brew, which is destroyed. Many brewers in the United States admit using substitutes for hops and malt, wrongly claiming that they are not hurtful. Such articles are even advertised in the trade papers under the name of "flakes" or "auxiliary," or "malt color," or "antacid powder," or "porterine," or "preserving fluid." Some of the substitutes contain bi-sulphate of lime and bi-sulphate of potash. Although they produce the desired color, experts can detect their presence by the taste of the beer.

The Distilled Liquor Industry

The manufacture of distilled liquors is exceptional, in the fact that it has more attention from the government than almost any other branch of industry: government regulations affecting brandy, whiskey, rum and gin production being most stringent and exacting. All barrels, kegs, or other, packages, containing such liquors, must bear the necessary revenue stamps, and all distillers of grain or molasses must provide warehouses, where the products are to be placed for record, even if they do not require aging. These warehouses, called "bonded warehouses," are in charge of bonded officers of the government. The tax on whiskies that are not immediately marketable, but require aging, is not collected until they are withdrawn. Consequently, they are allowed to remain in the bonded warehouses eight years, if the manufacturer wishes to take advantage of the maximum time allowance. Under this arrangement, very few distillers themselves pay the excise tax. There is a trade custom under which distillers give the purchaser a warehouse receipt, showing that a certain quantity of whiskey has been made and delivered, and payment is then made to the distiller, exclusive of revenue, the purchaser, of course, paying the tax when he withdraws the spirits.

Excise taxes in the United States, it should be added, have changed with each of the three great wars, namely, the Revolutionary War, the War of 1812, and the Civil War. The present system of internal taxation now in operation was put into effect in 1862, though slight modifications have been made from time to time.

Distilleries

The localization of the manufacture of whiskies and brandies, as an industry, depends upon the character of the demand. In the newly settled parts of the country, or where there is a scattered population, as in the West or the South, a number of small distilleries are in operation, while in the settled or thickly inhabited sections, as in the East, where the demand can be mathematically calculated, the industry is centralized in a few very large establishments. In Illinois, the leading producer in value of output, the industry is concentrated in a few large distilleries, chiefly in Peoria; while in Kentucky, which ranks second, a large number of small distilleries are in operation in many different parts of the State. In Illinois and Indiana the distilleries produce alcohol and pure, neutral or cologne spirits; those of Kentucky, Bourbon whiskey; from Indian corn and rye; and those of Pennsylvania and Maryland, pure rye whiskey.

The principal materials used are: grain for the manufacture of gin, whiskey, alcohol and cologne spirits; fruit and wine in making brandy; and molasses in distilling rum. Corn is the principal grain used, because it is cheapest. "Fire water" may be made from ripe fruit, such as apples, peaches, or grapes, as well as from grain.

A description of the process of distillation, of converting liquid into vapor in a closed vessel by means of heat, and then conveying the vapor into a cool vessel, where it is reconverted into a liquid, would interest the specialist rather than the general reader. It is sufficient to say that spirits are not so much the result of distillation as of the previous operation of fermentation. Distillation merely separates the spirits from the mixture in which they originally exist.

An immense quantity of distilled spirits is consumed in the manufacture of medicines, and by the arts and sciences. The total quantity manufactured in the United States, for all purposes, in the year 1900 was 109,245,000 gallons, while the total quantity of spirits deposited in bonded warehouses in the year 1901 was 125,000,000 gallons. The revenue derived from this industry, and paid to the Internal Revenue Department during the last ten years of the nineteenth century, aggregated nearly one billion dollars.

The Wine Industry

Wine-making in the United States was first undertaken on a large scale, about 1825, by a certain Nicholas Longworth of Cincinnati, Ohio, in whose extensive vineyards Catawba grapes were practically introduced. This variety of grape, named for the Catawba River region of North Carolina, is indigenous to America, and has proved to be one of the best wine producers in the States. The wine industry in Cincinnati was interrupted by several serious plagues of "black rot," which destroyed the grapes in vast quantities. At the present time, the culture is successfully conducted at various places in New York and Ohio, particularly in lake or in river regions, where the sloping banks afford most excellent sites for vineyards.

Though the wine industry in the United States is still in its infancy, it is nevertheless a fact that nearly nine-tenths of all the wine consumed in this country is made here, more than one-half of the total amount being supplied by California alone. All the leading cities of the country are markets for American wines. The drug trade recommends them. Producers and merchants alike report the industry in a most prosperous condition at present, and full of promise of great developments within the next few years.

The greatest wine district of the country, as already inferred, is the State of California, in whose borders is found nearly every climatic and physical condition favorable to grape-culture; with the result that a correspondingly wide variety of wines may be successfully produced. Domestic sherries, ports, and particularly champagnes, are manufactured in California; and, with the development of the industry, it is confidently expected that most of the leading European varieties of wine may be satisfactorily imitated, perhaps improved upon. Wine-making in California indeed has been developed to such a high degree of perfection, and has been established on such an extensive scale, that the State authorities report it the most profitable agricultural industry in the United States. This success is partly due to the excellent business methods of the wine producers, who have consolidated their interests, so as to be able to regulate production as carefully as the output of steel mills. The State was fortunate in having a thoroughly good foundation laid by the old Catholic Missions, the inmates of which planted the best grapes and thoroughly understood the natural conditions of the region. The State itself has steadily and materially encouraged the industry. The demand for California wine has so very greatly increased that it is rapidly driving from the market the cheaper grades of imported wines. The increase in 1901, which was not unusual, was one-third over the shipments of the previous year.

While California produces more than one-half of all American wine, and while wine-makers of the State employ about sixty per cent of the total number of persons engaged in the wine industry in the country, the business in other States is still worthy of consideration as an avenue for the investment of capital and the employment of labor in the immediate future. The most prosperous viticulturists in the East are in New York, Ohio, Missouri, Illinois, Virginia, and Georgia. The principal grape and wine-growing district east of the Rocky Mountains is the lake region of New York, including Lake Keuka, the richest district of all, and Lakes Seneca, Cayuga, and Chautauqua. Grapes are also grown along the Hudson River. In Ohio, which is about on a par with New York as a wine-producing State, the principal centres of the industry are on Kelley's Island and Put-in-Bay, and in the vicinity of Cleveland and Sandusky. Besides the great quantities coming from North Carolina, Missouri, and Virginia, wine is now being produced successfully in New Jersey, and experiments are under way in Connecticut. That California, New York and Ohio are easily the leading wine-making States is shown by the fact that the combined output of these three States in 1900 was 22,000,000 gallons, out of a total of 23,000,000 gallons for the United States.

The most important grape-growing region east of the Rocky Mountains is in New York State, where the industry is followed in three principal districts: in the valley of the Hudson River, in the neighborhood of Chautauqua, near the shores of Lake Erie, and on Lakes Keuka, Canandaigua and Seneca, and others in the central part of the State. In these three districts are nearly one hundred thousand acres devoted entirely to grape-culture, and yielding millions of pounds of fruit annually for table use and also for wine-making. Out of the total crop of over 100,000 tons, a large proportion is packed in crates and baskets for the fruit markets in New York City and other centres; although the vast growth of the wine-making industry in recent years has caused many vineyards to entirely abandon the fruit traffic. The baskets for packing grapes are nearly always made at the vineyards, most often by women, who can make, on an average, 450 per day, including tops and handles; although some recent improvements in automatic machinery for this purpose will likely make considerable difference in methods during the next few years.

Wineries

This industry is now conducted here upon a scale befitting a country of big manufacturing plants and wholesale production. There are many wineries that have tanks with a capacity of from 25,000 to 100,000 gallons. Machinery has revolutionized the process of manufacture of wine as of everything else. Thousands of tons of grapes are thrown into the crushers, where they are crushed by machinery and pressed into a cylinder, from which the juice is carried by a six-inch hose into the fermenting tank. It is still true, however, that the best wines are those made by hand and in the most careful manner. Not even a "comet" vintage could give a very excellent flavor to hundreds of thousands of gallons of this machine-made wine. The United States Government has warned the larger establishments in this country that they can not expect to produce the best grades of wine by machinery. Commercially they have proved very profitable; but the wine of the connoisseur, the wine with an unforgettable flavor, will always be, perhaps, the result of a careful selection of grapes and the minutest attention to all details of crushing, fermenting, and storing.

Process of Wine Manufacture

The several qualities of wines, as well as the famous brands, taking their names from the districts in which they were originated, obtain their natural classification primarily from the several varieties of grape entering into their composition, and also from the climatic conditions under which they are grown. Thus a warm climate tends to the production of sugar in greater degree than is possible in the grapes grown in higher latitudes; with the result that the wine undergoes a correspondingly greater fermentation, as the excess of sugar is transformed into alcohol. This is the reason for the "dryness," which is such a distinguishing mark of those wines. In addition to the classification of wines as "dry" and sweet, we also distinguish them as red or white, and as still or "sparkling"; in every case, according both to the natural qualities of the grapes and to the processes of manufacture. Sweet wines are made from grapes having an excess of sugar; the sweetness being rendered permnanent by "fortifying," which is to say, adding free alcohol, in the shape of grape brandy, to give the requisite "strength" before the natural sugar has had time to become entirely fermented out. This arrests the process of fermentation. Were "fortifying" omitted, the wine must inevitably become "dry" in the course of the requisite period. Red wines are made from dark grapes, the skins being left in the must and allowed to ferment with it. Thus are obtained the peculiar properties of this kind of wine, due to the tannin in the skins, which, along with the coloring matter, is absorbed by the alcohol of fermentation. White wines are made from white grapes, the juice being fermented without the skins, and thus absorbing none of their chemical constituents. The distinction of wines as still and "sparkling," or effervescing, refers also to qualities imparted in the process of fermentation. The effervescence is due to the presence of carbonic acid gas, naturally generated and prevented from escaping by keeping the wine closely corked after a certain stage in its development.

Practically any desired property may be produced in a wine by observing the proper conditions in the process, although, as already suggested, certain varieties of grape are better adapted than others for certain kinds of wine. However, the skilful manufacturer can produce almost any desired effect by the judicious addition of sugar, alcohol or water, up to the point of changing the characteristic flavor: wines may also be artificially "charged," to produce effervescence.

In all cases the flavors and qualities produced in the course of natural fermentation are superior to those imparted by even the most skilful adulteration. Thus the native wines, traditionally known by the names of the districts originating them, will always hold their reputation against the best imitations, as being made from grapes possessing to perfection the natural properties required for the particular given effects. In general, wines are classed as follows: champagnes, dry, effervescing white wines, named from the French province of that name; clarets, dry, still red wines, originated in Bordeaux; sauternes, dry, still, white wines, named from a city near Bordeaux; Rhine wines, dry reds or whites, named from their origin in the wine districts along Germany's great river; burgundies, both red and white, still and sparkling, named from the French province of Burgundy; sherries, sweet or dry, still wines, generally red or tinted, named from Xeres, Spain; ports, still, red, sweet wines, named from Oporto, Portugal, and madeiras, possessing much the same properties as sherry, from the Spanish island of that name.

Manufacture of Champagne

The manufacture of champagne is a complicated and tedious process, involving repeated handlings and constant watchfulness of experienced wine-makers. The grapes intended for this wine are ground to pulp in a heavy screw-press, in which several layers, each folded in a coarse canvas blanket, are superposed. The must, being collected in tubs, is then placed in casks for its first fermenting, which must take place in dark closed vaults, on account of the poisonous character of the carbonic acid gas generated in the process. The generation of this gas is nearly the greatest danger involved in the manufacture of wine, and numerous workmen have been killed by not observing the necessary caution. At the end of three weeks or a month, the fermenting juice is racked off into clean casks, and carefully blended with juice from other varieties of grape, in order to secure the desired flavor. The particular difficulty in this process is to secure the correct proportions of sugar and acid, no more and no less, the object being to maintain exactly the same qualities from year to year, also to avoid such over-generation of gas as would break the bottles in which the mixture is to be confined.

The "sparkle" of champagne is secured by a "second fermentation," which takes place in bottles. This is the point at which the wine-maker's trouble begins, since, even with the most improved processes of cooling, there is a loss of thirty per cent, at least, from breakage, due to excessive pressure on the glass. After a short period in the blending casks to settle, the juice is bottled, and placed in a warm vault, to restart fermentation. When activity has begun, as shown by the bursting of a few bottles, the whole batch is removed to a cooler vault, there remaining for about two years, in order to "clear itself." The first evidence of the process is a cloudy appearance of the wine, first yellowish, then dark brown, followed, as the wine clears, by a deposit of sediment on the under side of the bottle: this is the "ferment," containing a certain amount of cream of tartar. When the required period is completed, the bottles are shaken by an experienced workman, about twice a day, each time slightly lifting the incline of the bottles in the rack, until, at the end of six weeks, they are nearly upright, the sediment, meantime, having worked down upon the cork. In order to "disgorge" this sediment, the bottles are taken to the clearing tables, where they are carefully uncorked, neck down, so that the escaping gas forces it out. Carefully closing the neck of the bottle with his thumb, the workman claps the bottle upon a revolving table, where it is stoppered with rubber, "dosed" with syrup of sugar dissolved in wine, or, if "extra dry," with pure wine alone; and, finally, recorked, wired and labelled, all by machinery.

Soda and Mineral Spring Water and Apparatus

At least sixty thousand persons are employed in mixing and serving drinks at the temperance bars of the United States. These bars are soda-water fountains, of course, and over sixty thousand of them are in use. The soda-water fountain is supposed to exercise an influence in promoting temperate habits among the people by lessening the consumption of alcoholic liquors.

Considered as a distinct industry, the manufacture of soda-water and soda-water fountains is of some magnitude, while the sale of soda-water, wholesale and retail, is by no means an insignificant feature of modern trade. Experts are unable to give even an approximate estimate of the total capital invested in the business. The capital of the principal soda fountain concern is known to be about $4,000,000. This company is a combination of four or five which were formerly engaged in the manufacture, independently, of soda-water apparatus. The company owns seven plants. One of the formerly independent concerns was the one bearing the name of John Matthews, the father of soda-water, as it is known in the United States. The combination employs more than twelve hundred hands, including about a hundred and twenty-five travelling salesmen.

The soda-water business depends for its success largely upon the attractiveness of the fountain and its surroundings. The thirsty crowd will always flock to the most gorgeous and glittering apparatus. It has also become an art to cater to the popular taste in fancy drinks and to invent new ones for sated appetites. More than one hundred different kinds of fancy drinks are sold over the soda-water counter. The range of these beverages is from the mildest syrup flavoring up to something very nearly as strong as liquor. As a result, soda-water fountains are almost as numerous as bars which dispense stronger drinks, for almost every confectionery and drug store has a fountain as its chief ornamental, if not its most profitable, feature. The fountains are sold to retail dealers on the instalment plan, payments being made on non-negotiable lien notes. Fifty per cent of the receipts of drug stores in busy localities is taken in over the soda-water counter. The profit per unit is small, but as in the selling of newspapers the dealer's salvation lies in the sum of the many small units of profit. On the principle of Shakespeare's maxim, "Costly thy habit as thy purse can buy," the soda-water dealer may dress up his store with a fountain costing only $450 or with one for which he pays $3,000. It is possible, in one hundred different drug stores, to see fountains of one hundred different designs, most of these coming from one great establishment. Many of these are elaborate and gorgeous affairs, modelled after old castles and palaces.

Soda-water, which is pure water charged with carbonic gas, is, perhaps, the most profitable article that is sold in bulk in modern commerce. In a five-cent glass of this beverage there is a profit of from 300 to 900 per cent. It has been calculated that a plain glass of soda-water costs seven-tenths of a cent. Even if syrup is added the cost is increased to only one and a half cents a glass. A glass of plain mineral water costs, wholesale, one cent, root beer one cent, and ginger ale one and one-fourth cents.

The making of the carbonic gas used in soda-water is generally done by a manufacturer, who sells it to the dealer put up in steel fountains, each holding ten gallons or more. It is more profitable for the dealer to make his own gas, but, as there is a great margin of profit, most of them prefer to avoid the trouble of manufacturing it. All that the boy at the fountain has to do, therefore, is to tap one of these hermetically sealed receptacles whenever he needs a new supply. The gas is manufactured by treating a carbonate of lime, soda, or magnesia with sulphuric acid. Common marble is much used for this. The gas is forced into the pure water, which then becomes charged. It is not drunk in this form very extensively at the fountains, but is used especially in the form of seltzer or "selters," in mixing with Rhine wine and in "high-balls" and other fancy whiskey drinks. It is also extensively consumed in the home and at hotels and restaurants as drinking water, where it is generally used from siphons. At the soda-water fountain the soda-water is now chiefly an adjunct to invigorate concoctions of syrups, grape juice, extracts, and crushed fruits. These drinks, which generally sell for ten cents a glass, cost much more than the soda-water flavored merely with a syrup extract. As for the wholesale trade in soda-water, a single dispenser in Chicago sells about $25,000 worth of carbonated waters annually.

Another distinct and growing branch of what has here been called in a general way the soda-water business is the selling of mineral waters in bottles direct from the spring. The total number of commercial mineral springs in 1900 was 561, while the amount of commercial natural mineral water sold in the same year was 47,500,000 gallons, worth $6,250,000.

The Bottling Industry

Bottled beer is coming more and more into favor, and bottling is, therefore, now an important part of the brewmaster's art. So extensive is this business that it is often done by separate firms, although generally it is a part of the work of the brewery.

But bottling, as a distinct industry, depends upon other manufacturers besides the brewer. The wine-maker and the distiller, manufacturers of temperance drinks, of root beer, ginger ale and mineral waters also help the bottling business to an enormous extent. Altogether there are about six or seven million customers to be supplied. The bottler loans his bottles, which must be returned when empty. This is a large item of the business, since, as is estimated, the various companies own from $16,000,000 to $18,000,000 worth of bottles with an annual loss of about twenty-five per cent to be charged to "breakage."

CHAPTER XXIV

THE TOBACCO INDUSTRY AND TRADES

General Conditions—Home Production and Foreign Trade—Cigars and Cigarettes—Chewing and Smoking Tobacco and Snuff—The Cigar Trades

General Conditions

AT the present day the use of tobacco is practically universal, salt alone exceeding it in quantity consumed. Its popularity depends, of course, upon its well-known narcotic qualities, in which it is surpassed by no other known drug. But another factor, scarcely second in commercial significance, is its ready adaptability to nearly every physical and climatic condition not utterly hostile to vegetable life, the numerous variations in texture and flavor thereby made possible creating new demands and greatly increasing the international importance of the traffic.

The question of classifying tobacco as a food product has of late years been agitated by scientists. Up to the year of the Spanish-American War it was supposed that tobacco was in no way necessary to man's health. During the war, when the soldiers were lying in the trenches before Santiago, the food grew short, and there was a mild famine. Yet the soldiers complained not. Nor was there any impairment of the general health of the army, at least none that could be traced to the scarcity of food. But, shortly, the supply of tobacco was exhausted. Then, and not till then, did the soldiers show signs of discontent and discouragement. No tobacco! The soldiers would live gaily without bread, or fresh meat, or coffee, or milk, or vegetables; but when they no longer had tobacco, then the real trouble, the feeling of actual hardship, began. As a result of this experience, the question of making tobacco a part of the soldier's regular official rations is being discussed. Scientists say Yes, but Nays come in thunders from the moralists. Thus the question, metaphorically, lies on a table in the War Department at Washington.

In figures, the story of the tobacco industry, like the stories of the distilling and brewing industries, can be told only in millions and billions—and this despite the frowns of the church, the taxation of the State, and the opposition of moralists. Nearly six billion cigars, for example, were smoked in the United States in 1902—nearly eighty cigars for each man, woman, and child in the land. In addition to this, over three and one-half billion cigarettes and one hundred million pounds of smoking tobacco went up in smoke.

Over one hundred and seventy-five million pounds of plug and fine cut chewing tobacco were consumed; and, considering that so many persons believe that snuff-taking is an extinct habit, it is interesting to add that over fourteen million pounds of snuff were sold.

The manufacture of this stupendous supply of the "weed" gives employment to an army of salaried officials and other workers, 150,000 strong. This army is divided among 15,000 establishments, having an aggregate invested capital of $124,000,000. The pay table of this army shows that over $58,000,000 is divided among the rank and file annually. Among the larger factories throughout the country, are four snuff mills turning out annually about 2,000,000 pounds of snuff each; ten great plug tobacco factories, with capacities ranging from five to twenty millions of pounds; fifteen smoking tobacco factories, with an annual production of from one to five millions; and five chewing tobacco factories, producing from one to four million pounds; finally, there are over fifty factories manufacturing one million pounds; and two hundred factories with a capacity of less than one million and over one hundred thousand pounds.

Manufactures of tobacco ranks number eleven in the great groups of manufacturing industries in the United States. The three principal classes are:

Cigars and cigarettes; chewing and smoking tobacco and snuff; and tobacco stemmed and rehandled. The last named division consists chiefly in sizing the leaves and sorting them with regard to shade, general character and quality; stemming and drying them for export; and treating them by fermentation and other processes, according to the manufacturer's individual requirements. It is apparent, from the nature of the work, that this branch requires small expenditure of manufacturing forces. The industry is localized within the tobacco growing districts, in Virginia, Kentucky, Ohio, Tennessee and New York. In nearly 300 establishments of the kind, 10,000 wage earners are employed.

It is interesting to note that of the total of 15,252 establishments of all kinds officially reported, for the tobacco industry, all but about 700 are engaged in the manufacture of cigars and cigarettes. Then, too, over 56 per cent of the total value of all tobacco manufactures is represented by cigars and cigarettes.

The great independent plants, as well as those controlled by the tobacco combinations, are equipped for the manufacture, under one roof, of almost everything that contributes to the tobacco industry—such as tin, paper, cloth, paper and wooden boxes and other packages and cases. Some of the plants also maintain printing and lithographing shops, for turning out labels and posters.

The Manufacture of pipes and smokers' articles is an important allied industry. The capital invested in this field is about $2,500,000. Over $3,-000,000 worth of conveniences for "my Lady Nicotine" are sold each year. The making of wooden Indians and similar statues, which decorate the fronts of cigar stores, gives employment to hundreds of persons on the East Side in New York City, and in the foreign sections of Boston and Chicago.

Home Production and Foreign Trade

Tobacco is grown in every State in the Union excepting Rhode Island, Nevada, Colorado, and Utah, but its cultivation on an extensive scale is confined to Kentucky, North Carolina, Virginia, Ohio and Tennessee, these in the order named being the greatest producing States. One-third of the entire tobacco crop of the country is raised in Kentucky alone. The most profitable crops, perhaps, are grown in the Connecticut valley and down the Atlantic seaboard to Florida. The middle section of the country produces, generally speaking, the kind of tobacco used in pipe-smoking, chewing, and cigarettes, while the leaf, or cigar, tobacco is grown above and below that territory. Connecticut grows a broad leaf and also the Havana seed leaf. It is air-dried, and left to ferment during the winter, spring, and summer. It is then generally sold at private sale, the buyer doing his own packing. This is also true of the Pennsylvania tobacco, which is of the broad leaf variety. New York produces a variety between that of Connecticut and that of Pennsylvania. Wisconsin produces only a binder leaf, but it is profitably used with a Connecticut wrapper and Pennsylvania or Ohio filler. The Ohio crop is mainly of the filler variety, of Spanish and Dutch tobaccos. There is a great difference in the leaf of the different varieties. The Cuban leaf, as produced in Florida, is rather heavy and has too much body, the amount necessary to wrap 1,000 cigars being as much as nine pounds; while the best Sumatra leaf is so thin and elastic, that two pounds will wrap 1,000 cigars. This makes the Sumatra leaf worth to manufacturers the high price at which it is sold in our market, often bringing $1.50 to $3 and $4 a pound. The Sumatra variety must be raised from fresh seed, or from seed saved from the first or second crop, which is kept for eight or ten years. The Cuban variety will reproduce itself for seven crops.

The qualities most appreciated by smokers in a good cigar demand the use of a tobacco entirely different from the kind used in the manufacture of cigarette, chewing tobacco, and, of course, the tobacco intended for pipes. It is for this reason that the tobacco crops of Virginia, North Carolina, and Kentucky are mainly used in the manufacture of cigarettes, pipe tobacco, and chewing "plugs." The leaf crops of other States, on the contrary, are generally used in the making of cigars.

While New York is the principal cigar manufacturing State of the country in point of quantity, Florida leads in quality. It is there that the tobacco leaf attains its highest perfection, and it is there, also, that the skill of the manufacturers, aided and supplemented by the long training and deftness of the Cuban cigar makers, has reached the highest development. It is due to the Cubans, indeed, that the cigar manufacture of Florida has become so important and so profitable an industry. The best material is also drawn from Cuba, so that the industry, in spite of the fact that the cultivation of excellent tobacco is largely carried on in the State, and that the capital that finances it is largely American, is really Cuban in its methods. The principal factories are in the city of Tampa, on the west coast, and its Cuban suburb, Ybor City, and in Key West. Most of the cigar business is confined to the Cuban quarter, and nearly all of the workers are Cubans, with a few Spaniards, and the community is, to all appearances, a typical quarter of Havana itself. Only the great port of New York exceeds Tampa in the volume of tobacco importations for cigar making. Although the little Florida city has only some 16,000 population, it imports more than one-tenth of all the tobacco leaf brought into the United States.

While the Cuban, or, as it is generally called, Havana, leaf is the material used in the making of the best cigars, the leaf grown in Florida is of very high grade, and is used to a large and increasing extent. The Cuban leaf has certain delicate qualities, and a certain flavor that connoisseurs demand, and it is therefore the tobacco par excellence for the highest grade of cigars; but the Florida growers, since they have begun the study of tobacco production, are reproducing the qualities of the best Cuban leaf in the native tobaccos. The "Habanas" of the market are frequently, therefore, made in Florida, either of genuine Cuban leaf, or of leaf that is grown in Florida. The soil and climate of the State are admirably adapted to tobacco growing, and it is possible to reproduce there almost any other tobacco of the world. For instance, the Cuban filler leaf that is grown in Florida as a competitor of the genuine Cuban, or Habana, leaf, is very nearly as fine as the very best product of Cuba, and, in time, will be raised into fully equal rank with it. It now commands the highest price among domestic tobaccos. It has been found that the Florida soil can produce a wrapper superior even to the Sumatra product. At the Paris Exposition of 1900 the Florida grown Sumatra wrapper was awarded the prize above the genuine article. The development of the cigar industry in Florida has been very rapid. In 1890, there were 5,300 employés in the factories, and the total value of the product was about $8,000,000. In 1900, there were 6,500 employés and the value of the product had increased to $11,000,000.

Our foreign trade in tobacco is far more extensive than the general public imagines. Nearly 345,000,000 pounds of unmanufactured American tobacco was exported in 1900. The product consisted of leaf, stems and trimmings. The United Kingdom was the heaviest purchaser, Germany, France, Italy, and the Netherlands being the next most important buyers. American tobacco is sold in enormous quantities; also in Belgium and Spain, in Canada and Mexico, and in Japan. Our imports of unmanufactured tobacco, in 1900, amounted to less than 20,000,000 pounds, principally from Sumatra and Cuba. The imports and exports of cigars, cigarettes and cheroots, are about evenly balanced in value between $2,000,000 and $2,400,000.

Cigars and Cigarettes

In the production of cigars and cigarettes, the five leading States are New York, Pennsylvania, Ohio, Florida, and Illinois. No cigarettes are made in Ohio, and only small quantities are made even in Pennsylvania, Florida and Illinois. New York, therefore, is the principal State in cigarette manufacture. The manufacture of cigars in Pennsylvania is usually done at home, the members of the family either devoting themselves to the work as a trade, or using their leisure time. Often a manufacturer supplies the home workers with material. There are sometimes as many cigar factories in a village as there are homes. A suggestion of the localization of cigar manufacture in cities is conveyed by the fact that as many as ten cities make each a number of cigars exceeding one hundred million, with Detroit at the bottom of the list, and New York at the top, with a production, in 1900, of 760,000,000 cigars. The eight cities between the two just mentioned, in the order of their rank according to value of product, are: Cincinnati, Philadelphia, Pittsburg, Richmond, Chicago, Baltimore, Lancaster, Pennsylvania; and Tampa, Florida. In the number of cigarettes manufactured, New York still leads with more than one and one-third billion. The cigarette manufacturing centres next in importance are Richmond, Virginia; Durham, North Carolina; Rochester, New York; New Orleans, Lynchburg, Virginia; San Francisco, Wilson, North Carolina; Chicago, and Philadelphia. There is, of course, a revenue tax on tobacco products, fixed by the Internal Revenue Bureau. On cigars or cigarettes weighing more than three pounds to the thousand the tax, in 1900, was $3.60 a thousand. The tax was reduced, however, and in 1902 was only $3.00. For cigars weighing less than three pounds to the thousand, the tax is $1.00 a thousand; and on cigarettes $1.50 a thousand. The tax is not collected on products for export, nor on those intended for domestic consumption, until they are withdrawn from the manufacturers' warehouses.

Both cigars and cigarettes are manufactured in extensive establishments at the present time, although the bulk of the business in the former product is still conducted by small concerns and retail merchants, who do most of the work by hand. Several qualities of tobacco enter into the structure of a cigar, being used, according to selection, for fillers, binders or wrappers. The leaves intended for the several uses are sorted, cut, and prepared by hand. The filler, being rolled and bound, is placed in the mold, in order to receive the desired shape, under a hand press; several hours' pressure being required to fix the shape preparatory to wrapping. This is the final stage of the manufacture, after which the still moist cigars are packed in boxes.

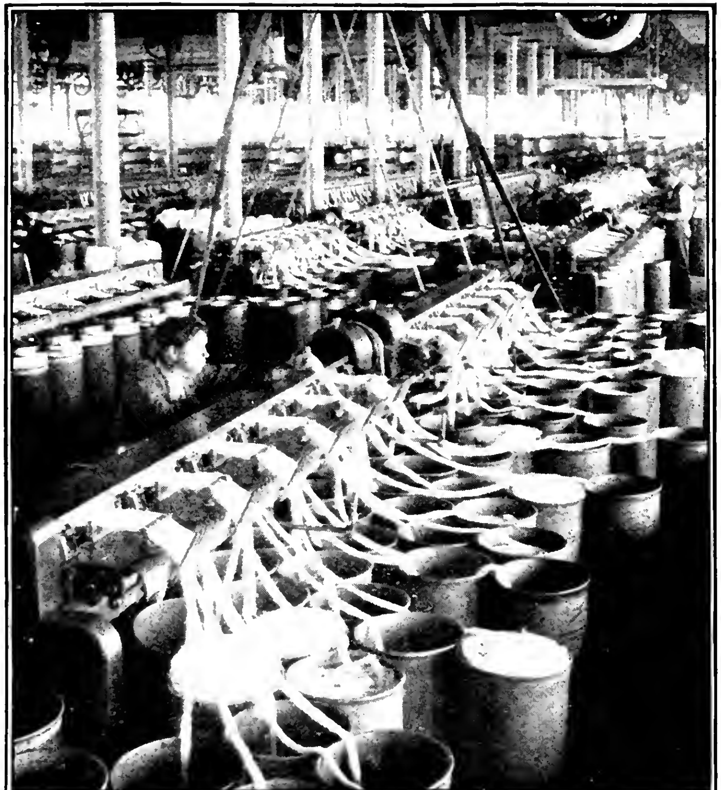
Cigar making is one of the few paying enterprises to be successfully conducted with a moderate capital; no particular plant being required beyond a set of molds and a hand press. It is also one of the few industries in which modern labor-saving machinery has made comparatively small headway: even in the largest and best-equipped establishments the bulk of the work is still done by hand. The first attempts at cigar manufacture on anything like a large scale were made in Connecticut, in 1810, but from that date until about 1870 very few large factories were started. Within the decade beginning at the latter date, however, the business received a decided impulse in the direction of wholesale undertaking, and at the present date (1902) there are numerous extensive cigar factories in all parts of the Union, employing thousands of operatives and producing millions of cigars annually.

The manufacture of cigarettes, unlike that of cigars, is conducted invariably on a large scale—some half-dozen well-known brands monopolizing nearly the entire traffic of the Union—and almost every stage of the process is performed by machinery. This is true for two very good reasons: In the first place, cigarettes did not come into very general use until about a quarter century ago, at a time when labor-saving machinery was beginning to be adopted into nearly every branch of industry. In the second place, the enormous popularity of the product—its annual output has increased over 8,000 per cent in the last twenty-five years—has rendered necessary a far greater supply than could profitably have been produced by hand.

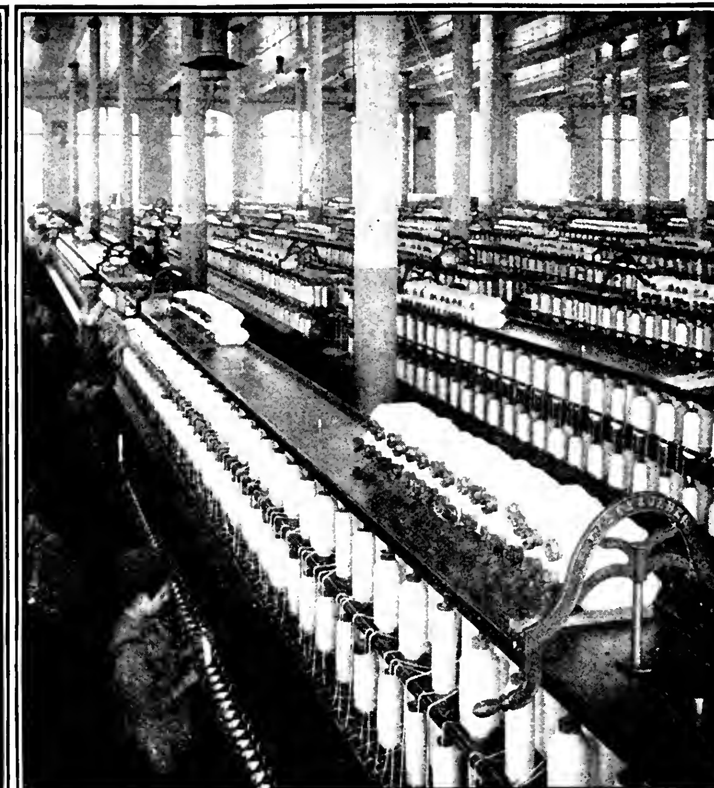
In order, therefore, to meet the necessities of the traffic, machines have been devised, and are in constant use, which perform every stage of the process of manufacture automatically. Into these machines the tobacco is fed in quantity, and the paper, in sheets, the required amount of tobacco being accurately measured and rolled with leaves of paper of the proper size, which are also cut and gummed as needed. Thousands of cigarettes are thus produced, complete, in an hour by a single machine, which also boxes them for sale; delivering the completed packages into the hands of the packers. The vast increase of cigarette consumption is interesting and significant in several particulars, marking the growth of a habit that has been deplored as harmful, but which, at the same time, affords nearly the most satisfying effect of the tobacco. This is true because the leaf used is either of a mild variety, or is appropriately cured, treated and flavored, to reduce the natural harshness of effect; permitting the smoke to be inhaled and the narcotic quality to be absorbed by the membranes of the respiratory tract, to the immediate production of the desired physiological results. As a consequence, the shortness and mildness of the smoking is liable to confirm the habit of using cigarettes in undesirably large quantities, frequently to the detriment of health. Nearly every manufacturer of cigarettes has his own secret process of curing and flavoring the leaf, which includes peculiar details of blending, sousing and bleaching, to the end of overcoming undesirable "strength," while, at the same time, retaining the full narcotic quality. A typical stage in the process of preparation is dipping or soaking the leaf in a weak solution of hydrochloric acid.

Chewing and Smoking Tobacco and Snuff

In the manufacture of chewing and smoking tobacco and snuff, Missouri holds first place. The States next in importance are Kentucky, North Caro-



IN A COTTON MILL



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lina, Virginia and New Jersey. Jersey City is the most important centre in the vicinity of New York, one of the large corporations having concentrated there the manufacture of certain forms of tobacco. Otherwise, the leading cities in the manufacture of plug chewing tobacco are St. Louis, Winston, North Carolina; and Richmond; in fine cut chewing tobacco, Chicago and Detroit; in making tobacco, Durham, North Carolina; and Baltimore; in snuff, Philadelphia, and Helmetta, New Jersey.

The three common forms of smoking tobacco—granulated, cut or shredded, and plug—are prepared according to the same few general formulæ for fermenting, blending, sousing and flavoring, which are varied slightly, however, to produce the qualities required in the several popular brands. In the manufacture of granulated tobacco, the cured and flavored leaf is fed to special breaking or chopping and sifting machines, which reduce it to the required fineness of flake ready to be packed. The long-cut, or shredded, tobacco is produced by feeding the prepared leaves, properly flavored and gummed, into presses, from which it is conveyed, in the form of cakes or slabs, to a carriage sliding under vertical or rotary reciprocating knives, and cut to the required fineness of texture. The plug smoking tobacco is similarly produced, except that a larger amount of gum and flavoring is added to the leaves, which are then subjected to a much greater pressure to form them into slabs of the desired thickness and density. These slabs are then cut into lengths and plugs by a "guillotine" knife, similar to that used for cutting paper in quantities.

The process of producing the two forms of chewing tobacco—plug and long cut—is very similar, except for the fact that the leaf intended for this purpose is cured and flavored to suit the peculiar requirements. The plug form has a much larger percentage of flavoring, licorice, and other sweetening substances, which serve the double purpose of imparting a pleasant taste and rendering the juices readily soluble. In all up-to-date tobacco manufactories, the entire process is performed by machinery, including even the packing of the finished product in tin, wooden or paper packages. Some of the modern packing machines have a daily capacity of forty thousand packages.

As a general rule, also, such establishments conduct their own plants for manufacturing the paper, tin, cloth, etc., used in the packages, as well as for producing the printed or lithographed labels, posters and advertising cards.

Of all the products of tobacco, snuff requires the most complicated processes of manufacture, which vary only according as the article produced comes under the head of dry or moist. Because it is possible to utilize much waste material in producing snuff, it is frequently made in connection with cigars and chewing tobacco. In making dry snuff, the leaves, properly cured and flavored, are first moistened, in order to permit of being finely cut or shredded. After this it is thoroughly dried and fed to the grinding machine, which reduces it to a powder. After grinding, the "flour," as it is called, is subjected to various stages of sweating and fermentation—

these differ with the several manufactures—whereby the color is deepened and the peculiar flavor developed. Different ingredients are also added to produce desired flavors and perfumes.

The Cigar Trades

The Cigar Makers' Union reports the employment of over 77,000 cigar makers. Of this number, 39,000 are males and 22,000 females. Twenty-one thousand are hand workmen; 26,000 mold workers; 8,800 filler breakers and rollers; 3,800 machine workers, and 4,500 apprentices. The number of non-union cigar makers is 38,500. Over 3,000 females are members of the union.

The value of cigars as an article of commerce is attested by the fact of their enormous consumption. They are sold not only in tobacco shops, but also in stores of many other kinds. The small stationer is no longer contented to carry a stock of writing-paper and books, newspapers and periodicals. He must have, in addition, his cigar counter and his show-case filled with all brands of tobacco. The druggist is not content to depend for his income on chemicals, patent medicines and drugs. Were it not for their sales of cigars many druggists would shut up shop. The same may be said of some well-to-do grocers. It is very natural that, with such an extended market, the manufacture of cigars should enormously increase. It is well known that there are better cigars in America than in any other country. In Paris, for example, it is said that there are only two places where ordinarily decent cigars may be obtained, and they are imported. The industry there is a government monopoly, an argument against "state-socialism," as far as it goes. Immigration has a different effect upon the industries of America. In some it is of great benefit, as tending to prevent the "levelling down to the standard of the laziest," inculcated by some trades-unions. Glancing for a moment at the effect of immigration upon the wages and employment of cigar makers, it must, of course, be considered in connection with improvements in machinery, division of labor, country-competition, and the employment of women and girls. Various improvements in machinery have permitted the substitution of less skilled labor. Among these new inventions is the "suction table." This is limited in its scope, but it admits the employment of men less skilled in the trade, and of girls, to take the place of the skilled workmen. A new condition of affairs has thus been introduced. Girls working at $4.50 per 1,000 cigars can earn wages amounting to $7.50 per week, whereas the union scale is $7.50 to $8.50 per 1,000. In some of the great cities the manufacture of widely advertised cigars has been enormously extended. The value of advertising is proved by the phenomenal sales of some of these brands, whose name is seen in the advertising columns of every newspaper, and on advertising-boards throughout the country, from Bangor to Seattle, and from Chicago to New Orleans. In these great establishments the working force is almost exclusively made up of girls and women; the American-born daughters of immigrants.

Then, again, the standard of wages in the city shops is affected by the extraordinary development of country shops. This holds true particularly in the State of Pennsylvania. In the counties of Berks, Bucks, Montgomery, York, and Lancaster, in that State, Philadelphia manufacturers have located their "annex shops." These shops are recruited from farmers' families and the village homes. In them the manufacturers can have a cigar made for $5.50, which the union scale of Philadelphia schedules at $7.50. This rate is so low that the "suction table" is not profitable. The advantages of country employment to the manufacturer are many. In the first place, he finds taxes much less onerous. Very often, indeed, he is exempted from them entirely, for a period of years. As an inducement in many cases, the ground is given for the plant by the citizens of the village, and there are subscriptions toward the cost of the buildings. Of course, the chief advantage is the low cost of living, which permits the lower wages. It is said, on the other hand, that much of this work is very crude. Cigars of a higher grade, ten-cent cigars, for example, are not made in these localities to any great extent.

Looking at the effect of trades-unionism upon this industry, we note some curious complications. In the first place, the union, through its strong organization, has brought about a continuous increase in wages paid to its members. It is estimated that, in the class of work in which sweatshop and non-union labor earns $6 to $9 a week, union labor earns from $12 to $18. The use of the union label, however, really acts as a substitute for expensive advertising, and the large manufacturer is thus enabled to pay the advanced wages. The union is, in this way, successful in keeping up wages, excluding immigrants, and prohibiting the use of machinery. But, on the other hand, the union loses control of the very large establishments which employ, in some cases, as many as 2,000 working people. The immigrants naturally crowd into the cheaper lines of work, and the unorganized branches have forced down prices to an extremely low standard. In the Jewish sweatshops of New York and Chicago cigars are manufactured at $4.50 per 1,000, which are equal in quality to the grades made by union labor at their scale of $8.50 and $9.50.

CHAPTER XXV

TEXTILE INDUSTRIES AND TRADES

The Combined Textiles—Dyeing and Finishing—Textile Education—Textile Trades

AMONG primitive peoples each individual household accomplishes for itself the business of providing clothing—gathering the raw materials and working them over into the fabrics which are fashioned into wearing apparel. Later on in the social evolution, a division of labor throughout society relieves the family from these duties, and the products of the loom are purchased in the open market. In America, in the older settlements, the primitive stage did not long continue, but in the market most of the products on sale were imported from Europe. There was little of domestic manufacture which could meet the requirements of the consumer. Now, however, this state of affairs has been completely reversed. In some of our textile industries American enterprise has led us to the front rank of the world's providers. In all these fields we now hold a very high position in international commerce. A consideration of the extent to which American enterprise is devoted to the work of the loom is therefore of interest.

The Combined Textiles

"Textiles," third in rank in the great groups of manufacturing industries, include forty-four classes of manufacture. Textile fibres of every variety—cotton, wool, silk, flax, jute, hemp, and admixtures of fibres—form the fundamental materials for this valuable class of products, which includes the manufacture of clothing, hats and fabrics, carpets, oilcloths, mats, nets and cordage. At the head stands cotton manufacture, in which the United States, judged by relative spinning capacity, holds second rank among the nations. While cotton manufacture has advanced rapidly to a perfected factory system, wool manufacture is still a more or less "scattered" industry, though there are numerous establishments of enormous productive capacity. In wool manufacture are comprised four great groups—woollen goods, worsted goods, carpets and felts. Notable achievements have been especially made in the carpet industry, and this country is to-day the greatest carpet manufacturing nation in the world. In the hosiery and knit industry, too, the United States has outstripped all other countries. More machine-knit goods, both underwear and hosiery, are produced annually in the United States than in all the rest of the world. Again, in silk, within fifty years the United States has become the second silk manufacturing nation, the silk products only of France showing a greater value. The single textile industry in which the United States has not advanced to a front rank is that of linen manufacture, the reasons for which are set forth in another chapter.

Different conditions govern each of the three most important divisions of manufacture, namely, wool, cotton and silk. As spinning wheels and hand looms are the simplest forms of machinery, and as sheep can be raised in almost any region where warm clothing is necessary, it is natural that wool manufacture should be carried on, even among the poor people, in every State in the Union, in small mills as well as large. In the cotton industry, however, conditions are radically different. In poor communities the people can not afford to prepare the raw material and spin and weave it; first, because the labor is great, and, second, because of the very decided superiority of the products of cotton machinery over those of hand work. As a result, the cotton industry is almost entirely in the hands of capitalists. Thus while wool manufacture has spread all over the United States, cotton manufacture is concentrated either in the vicinity of the supply of raw cotton, or where power is cheap, labor abundant, or transportation rates low. In the silk industry still other conditions exist. Silk culture in the United States has never proved commercially successful. As an occupation it is difficult and uncertain, and requires constant care. It has brought disappointment and loss rather than gain to most of the Americans who have tried it. But while we have not been able to produce the raw material, the manufacturing branch has been established and has grown until it is now one of our foremost industries. But as silk is a luxury, and as poor communities, therefore, have no interest in its manufacture, the industry is characterized by even greater concentration than that of cotton.

Statistics show that the United States is the second manufacturing nation in the world in the textiles as a whole, being surpassed in the extent and value of production only by the United Kingdom. In the matter of spindles, the United Kingdom has 45,000,000, the United States 18,000,000. The number of wage-earners employed in all the textile manufactures in the United Kingdom is 1,000,000; in the United States 660,000. In respect to employés, it may be added that so great is the efficiency of machinery that only one person in each one hundred of the population is required to furnish the American people with materials for clothing. In cotton manufacture twice as many persons are employed as in wool manufacture, which in turn employs three times the number of persons engaged in silk manufacture. Other noteworthy figures furnished by the statistician concerning wage-earners show that nearly as many women as men are employed, and that the number of children under sixteen years of age working in the mills reaches a total of 70,000, more than half the number being found in the cotton mills alone.

For the purposes of the present work, the various branches of the textile industry may be divided according to the vegetable or animal fibre which predominates in the manufacture. At the same time, it is necessary to call attention to the fact that all the branches are closely allied. In a single establishment several different processes may be combined, and two or more fibres used. Many cotton spinning factories, for example, also weave yarn, twist and finish it into sewing thread, or knit it and make underwear. Others combine cotton with linen in producing towels. In the manufacture of cloth, many woollen and worsted mills use cotton. Raw silk is often used in cotton or woollen mills. In mills where upholstery goods are manufactured, jute yarn is used. In cordage and twine mills, even wool and silk are sometimes employed, in addition to many other fibres. Because of these conditions, authorities declare that the textile industry should be treated as a unit, based upon the spindle—but this manner of treatment is manifestly impossible in the present instance.

Dyeing and Finishing

As dyeing and finishing is carried on as one of the processes in factories in each of the three great textile branches—cotton, wool and silk—mention of this industry is properly included in this section. The important fact to be noted is that dyeing and finishing is not only included as a process in cotton, wool and silk mills, but is carried on as an industry in nearly three hundred independent establishments, employing about 30,000 wage-earners. An idea of the magnitude of this business may be conveyed by the figures giving the cost of the chemicals and dye stuffs used—nearly $11,000,000 in the independent factories, and nearly $15,000,000 in all other textile mills.

By the modern improvements of the dyer's art it is possible to produce many surprising effects, among which may be mentioned the feat of dyeing goods in several colors, threads or stripes, in the piece. This is, however, a simple matter, so far as the theory is concerned, consisting merely in taking advantage of the known affinity of certain dye stuffs for some fabrics and their neutrality to others; or of treating the separate threads, previous to wearing, by diverse chemical mordants. Thus, there are very few dyes that will tinge wool, cotton and silk equally, with the same preparation or in one process. If, for example, a piece of half-woollen weave, wool and cotton, be treated to a dyeing process capable of coloring the wool, the mechanical precipitate on the cotton fibres may be "stripped," without attacking the color "lake" on the wool, generally by boiling in distilled water or in a weak solution of acetate of soda. The cotton is then mordanted with tannin and antimony, or with simple antimony salt, and may be dyed with basic dyes from cold to warm. A very similar process is employed for producing the familiar "changeable effect" in piece-dyed glorias—these consist generally of a woollen warp with a silk filling—except that the peculiar effects of differing temperatures on the separate threads is made an essential part of the operation. Thus, the wool is dyed in a boiling bath, after which the small amount of color adhering to the silk is stripped by boiling in pure water for thirty minutes, the silk being then dyed in a cold bath. By this process a rotation of colors may be produced which will show the wool red and the silk green; the wool garnet, the silk blue; the wool orange, the silk garnet, etc.

Again, precisely similar results may be achieved by taking advantage of the fact that numerous dye stuffs will produce different colors with the use of different mordants. Thus it is possible to produce three and more colors in a homogeneous piece of goods, by the simple expedient of diversely mordanting the separate threads previous to weaving. By treating one thread with chorme, a second with alum, a third with iron, we may derive bordeaux, high red and lilac, respectively, when the weave is dyed in alizarine red; the effect being a triple-colored weave. By leaving one thread unmordanted a weave of four thread colors may be obtained. In the same manner, different shades of a single color may be produced, according as the interwoven threads have been diversely treated, for example, with sumac, tannin-antimony or simple antimony, or left unmordanted.

Textile Education

What opportunities has a young man for obtaining an education in textile manufacture in this country? The question is answered by a former President of the National Association of Manufacturers, thus:

> The opportunity for obtaining an education in the textile trades in this country as compared with foreign countries is, in my judgment, very much less. Foreign countries have, for many years, been educating their people by means of technical schools to do technical work. We have no more emphatic instance of the working of that matter than is shown by Germany, where nearly all the hands employed in textile mills are graduates of the textile schools. Since I began manufacturing, in 1872, I have seen the advantage of trained help. I was in a position at that time where I could not avoid making a study of the case. I found that our trained help in this country had been largely imported. The trained hands, principally foreign born, and the mills that were making the best progress, were under men who had the courage to go out and bring in that kind of help. I decided that Americans ought to have the positions then held by foreigners, and that there ought to be an opportunity given our boys to educate themselves to take such positions. It was with that end in view that I started a textile school in Philadelphia. A few years ago we took examples of our work down to Boston and exhibited them to the National Association of Wool Manufacturers, and the result of that exhibition is that Massachusetts has two schools doing similar work, one of them in Lowell and another in New Bedford, and the State is supporting the work by contributions for the purpose. The South has also one school. They are agitating for another one, and so the good work is spreading.

Since 1890 the facilities for textile education in the United States have increased to such an extent that now it is possible for manufacturers to draw on a number of American schools for skilled workers, and the importation of textile workers from Europe is no longer necessary. The first school in this country devoted exclusively to textiles was the Philadelphia Textile School, connected with the Pennsylvania Museum of Fine Arts. Interest in textile education has in recent years been aroused, especially in Massachusetts, where schools were established in Lowell and New Bedford, supported partly by the State and partly by the cities, and from private sources. The textile trades receive some attention also in the School of Design connected with the Massachusetts Institute of Technology. There are evening schools for loom fixers and weavers at Fall River and Lawrence, Massachusetts. In the South, there are at least four large textile schools, connected respectively with the South Carolina Agricultural College at Clemson, the North Carolina Agricultural and Mechanical College at Raleigh, the Georgia Institute of Technology at Atlanta, and the Mississippi Mechanical College at Starkville. Besides these, a number of correspondence schools at different places in the United States give instruction in the textile trades. These schools and results produced by the graduates are of great practical help to the textile industries. The technical training given in the higher branches of what is really a profession shows in all departments in more artistic styles, and in the economies of manufacture. The advantages of the schools, otherwise, consist mainly in the more adequate facilities which are furnished the pupil to carry all, or nearly all, the work projected by him to completion. In the Philadelphia school the student has to carry his individual design to completion, performing or assisting at every process in its progress, from the preliminary sketch to the dyed and finished fabric. Whatever this last represents of taste, of knowledge, or of skill, whatever calculations are involved, the commercial ones as well as those possessing artistic or technical significance, all must be the pupil's own. In the New Bedford school the instruction is confined to cotton mill operations.

In no trade or calling is the usefulness of the modern popular technical school more thoroughly apparent than in the field of cotton manufacture. Thousands of persons are employed in this line throughout the country, gaining great expertness in special lines of work, although at the smallest rates of wages, while the demand for thoroughly trained men, to take positions as designers, superintendents or overseers still continues greater than the supply. This is due, of course, to the lack of technical, or theoretical, training, in addition to practical experience, however broad and various; in other words, a knowledge of underlying theories and general principles. Of course, with his entire time during the day spent at some branch of cotton manufacture, the average worker has no opportunity to obtain the necessary training in ordinary schools, or to pursue a requisite course of reading unaided. It is to him, then, that the offers of a correspondence school come with remarkable force. Numerous men, now occupying responsible and highly paid positions in such factories, owe the first steps of their advancement to the assistance thus obtained.

Many of the best designers, superintendents and overseers, employed in the numerous woollen mills throughout the country, have risen from the ranks in their trade—from the loom or the "mule"—having taken advantage of the opportunities offered in some one of the textile schools to add requisite technical training to the mechanical skill acquired in their daily work. The number of such openings awaiting persons with just this kind of training is remarkable, and the prospect of greatly advanced compensation should spur the ambition of the dullest. Furthermore, on account of the desirability that the holder of one of these responsible positions should combine actual practical experience with the necessary technical knowledge of processes and products, the presumption is in favor of the ambitious worker in the large majority of cases.

Textile Trades

The present condition of the textile trades is the resultant of many new influences and numerous modern developments. Take the department of machinery. We see here constant improvements, new time-saving devices, and the introduction of methods leading to great subdivision of labor. Then there is the varying tide of immigration, swelling the ranks of workers, who come from different countries to find a home, temporary or permanent, with us. Most desirable are those immigrants who come to stay. The nomads of a year or two, flocking down from French Canada, tend neither to raise the standard of living among workmen nor to better the general conditions of the trades. The employment of women and children must also be considered in its general effect, and its relation to trade conditions and prospects. Country competition is also a factor not to be overlooked. Referring to the introduction of improved machinery, weavers have more than doubled their capacity in the last thirty years, and, with the employment of the Northrop loom, they are able to produce five times as much as they produced forty years ago. The ring-spindle machine does twice the work of the mule spindle. It may be stated that with the increase of machinery the intensity of exertion and the alertness of the weaver have also increased. Under former conditions the machines ran much more slowly, and there were frequent breaks of the thread. There are better machines now and better cotton, and there is also greater speeding, and no cessation. A hard-working spinner in the spindle-room formerly earned $12 to $14. Now the woman at the ring-spinning machine earns $6 to $8, the work not being so hard.

The many improvements in machinery have opened a place for the extended employment of unskilled labor, which, in so many departments, has been able to take the place of skilled labor. For instance, only a week or two is needed to learn to operate the ring-spinning machine, and the operator in three or four weeks can run four looms and begin to earn something. Very naturally the immigrant has taken advantage of this widespread and ever increasing opportunity. He has seen his chance for immediate employment, with a speedy return in wages. The effect of this incessant tide of immigration is observed in a comparative study of the nationalities succeeding one another in the cotton-textile trade. Fifty years ago the Americans were the only employés. Following them came the English, Irish and Scotch. The high wages caused by the Civil War were again reduced by the French-Canadians, who began to come in 1866, and by the declining markets. Without tracing in detail the fluctuations of wages, we may note that in 1897, for instance, the earnings which thirty years ago were $12 to $13 had been reduced to $8 and $10 a week. A slight increase since that time has again been checked, with the prospect of a reduction, by the rise of a new factor, the competition of Southern mills. In these mills the operatives work sixty-six hours a week, the employers having the advantages of low fixed charges, the latest improvements in machinery, and very cheap labor.

The influence of various classes of immigrants upon trade conditions may be observed by a glance at the characteristics of the French-Canadians who come to this country in search of work. They brought with them, at first, a remarkably low standard of living, and were willing to work for almost any wages. Their standard has gradually improved, and they live more like their fellow laborers of other nationalities, English, Irish and American. The French-Canadians are apt to look upon their American employment as more or less temporary. The families of French-Canadian farmers come to Fall River and other New England towns to earn a little money and then return, their numbers varying with the price of labor. A small percentage more of them are now inclined to remain. But the general temporary nature of their residence has tended to make them indifferent to the improvement of their standard of living, and willing to endure privation for the sake of the savings which they may take back with them to Canada. The French-Canadians were accustomed to place their children at work at a very early age. Legislation has stepped in and interfered with this objectionable practice. They also, in former days, were in the habit of working unlimited hours. In many States this sort of competition has been legally restricted. In Massachusetts, for instance, the law fixes the hours of work at fifty-eight hours per week. Thus the State of Massachusetts has come to the fore in legislative enactments for the benefit of labor, in these two regards at least, the prohibition of child labor and the reduction of the hours of employment, and a general tendency is observed toward the protection of the American standard of living.

CHAPTER XXVI

COTTON MANUFACTURE AND ALLIED INDUSTRIES

The Cotton Industry—Cotton Mills—Machinery in Cotton Mills—Skilled Operatives and Child Labor—Cotton Ginning—Cotton Seed Products

The Cotton Industry

AMONG the textile industries, cotton holds the rank to which it was once entitled in agriculture. Cotton is king. It stands first in the amount of capital, in the number of operatives employed, in amount of wages paid, and in value of product. The number of employés is double the number engaged in wool manufacture, and four times that in silk manufacture—the average number in the cotton industry exceeding 300,000. Altogether, this industry, as conducted in the United States, typifies the factory system in its highest form and on the largest scale. Fall River, Massachusetts, may be called the capital of the world of cotton manufacture. Another great Northern centre is New Bedford, Massachusetts, which claims superiority as a cotton goods town because of the humidity of its atmosphere. The advantages offered by Fall River, on the other hand, are its nearness to market and its water communications. In New Bedford all the finer grades of cotton goods are made; no finishing is done there, however, operations being confined to spinning and weaving. In Fall River, while a variety of cotton goods are manufactured, the city is noted chiefly for its print cloths, which are turned out in the unfinished state. A large proportion of the output is sold through brokers to converters in all parts of the country. Finished cloths for domestic consumption are sold through commission houses. At New Bedford a different sales method prevails. The bulk of the goods there manufactured are sold direct to purchasers, and goods for export are sold to such local houses in New York as engage in foreign trade.

Another noticeable fact is that the system of industrial combination has not entered seriously into the cotton industry. In 1900 there were only three combinations in this field—one in cotton yarn, one in cotton duck, and one in sewing thread.

Though the manufacture of cotton goods in this country has reached a high state of development, we still import cotton goods in quantities and value twice that of our exports. In 1900 over $40,000,000 worth of cotton goods were imported, while in the same year our exports amounted to only $24,000,000. We import chiefly goods of the finer grades, the labor cost of which in this country would be very high. Competition from China and Japan may in time become a serious matter, as the cost of labor in the Orient is so much lower than in the United States, and yet one of the principal foreign markets for our cotton goods is China. Thus far the cotton goods manufactured in the "Celestial Kingdom" have not interfered with the sale of well-made American goods, for the Chinese manufactures are sold principally in sections of the country in which the people are willing to use an inferior article. As the trade stands at present, only a small proportion of the product of Southern cotton mills is consumed in the United States, many of the mills sending their entire output to China. The next best foreign markets are South America and Africa. Printed cottons are also sold in Great Britain, Australia, Canada, and Continental Europe at the same prices charged for similar goods here.

The particular goods which American manufacturers have never attempted to produce on a large scale include certain bleached and unbleached cloths, the finer painted and printed cloths, embroideries, laces, insertings, trimmings, and lace curtains. American manufacturers, meantime, supply the entire demand for plain cloth woven from coarse or medium yarns, the tariff being such that foreign manufacturers are not able to compete successfully in this market.

Before leaving the subject of foreign trade in cotton goods, it should be noted that very lately American manufacturers have placed some of the finer grades of goods on the market, in some instances in large quantities. Within the last five years especially the process of development here has led to the manufacture of lace curtains, the industry having centred in Philadelphia. Nottingham lace is used, and the manufacturers of the Quaker City are supplying lace curtains equal in every respect, grade for grade, to curtains made in England. The finest grades of ginghams and calicoes have also been produced here, but purchasers still have such a deep-rooted preference for the foreign make that it is not safe to produce large quantities of these goods.

Cotton Mills

When cotton mills are well managed, they invariably make money. The earnings of the New England mills, though not so large as those of the Southern mills, are yet, in many instances, stupendous. Dividends as high as one hundred per cent have been declared. Special dividends are frequent; but in the majority of the mills the earnings remain normally at six per cent. It is claimed that many of the New England mills are undercapitalized, and hence the apparently large earnings. In the Southern mills the profits are oftentimes phenomenally large. One mill, in 1898, paid a dividend of forty-five per cent, and in 1899 one of ninety-three per cent. Another, in 1899, paid a dividend of sixty-two per cent. And yet the Southern mills have to pay not only a higher rate of interest for money than do Northern mills, but also higher freight rates on manufactured goods. The secret of profits in the South lies probably in the lower cost of labor.

In the North the mills manufacturing cotton yarns entered into a combination which in 1900 controlled nine plants and had a capital of eleven and one-half million dollars. Since the combination was formed wages have increased fifteen per cent. The combination sells its entire output through its own salesmen direct to the customers, thus eliminating the middleman.

The business organization of a cotton mill is not different from that of any other large factory. The largest mill of this kind in New England, which is perhaps the largest in the world, is managed by a board of directors elected by the stockholders. The directors appoint the necessary officers, of whom a treasurer and an agent are the most important. The treasurer's duties are obvious: the agent is the practical man, the one who manages the mill. The agent divides the work into many departments—carding, weaving, spinning, bleaching, printing, and packing—and places a superintendent in charge of each. The superintendents in turn employ foremen, according to the number of hands and character of the work. Operatives working by the piece usually require less supervision than those who toil by the day.

It has been demonstrated beyond a doubt that the Southern States are by nature best suited to the manufacture of cotton goods. They are near the raw material, fuel is cheaper, and labor costs less than in the North. For these reasons more cotton machinery has been sold in the South within the last few years than in the North. Many Northern manufacturers are opening mills, and cotton manufacture is increasing far more rapidly in Georgia, for instance, than in Massachusetts. Thus equipped with the newest and most improved machinery, the Southern mills are making the lower and medium grades of cotton goods. Wages in these mills, however, are thirty per cent lower than in the North, and a week's work in Georgia is eight hours longer than in Massachusetts.

One of the largest cotton mills in the South is at Pelzer, South Carolina. The owners employ 2,800 operatives, and conduct their business and look after the interests of their employés in such manner as to conserve the highest and best development of both. The town has a population of about 6,000, all directly or indirectly dependent upon the mills. Every dwelling house and building, of which there are about one thousand, belongs to the company. The town is not incorporated, but is held as private property, and is governed entirely by the rules and regulations of the mill corporation. The dwelling houses, which contain an average of four rooms each, and which are rented to the mill hands at fifty cents per room per month, are tasteful and convenient in construction. Each house is provided with about fifteen thousand square feet of ground, utilized by the tenants for gardening purposes. The town has two well-equipped schools, attended by eight hundred children, and maintained entirely by the company for ten months in the year without expense to the residents of the place.

A more patriarchal relation exists between the managers and the employés of the Southern mills than can be found in New England. The sanitary conditions of some of the mills, however, are declared to be bad. Naturally, the mill operatives, as a class, are not as healthy as country people who work in the open air. Where company stores and tenements exist, the employés are, as a rule, under no compulsion to patronize the stores, or to live in the houses. The rents charged by some employers are forty-two and one-half cents a room for two weeks, fifty cents a room for a month, and two dollars a month for a four-room house. In some cases country cotton mills furnish houses without any charge for rent.

In respect to the general progress made in cotton manufacturing, it is interesting to note that single establishments in Massachusetts now pay annually a larger sum in wages than the entire cost of labor in Southern cotton mills twenty years ago. In the South, the rapid development of the industry dates from the year 1881, when the Cotton Exposition was held in Atlanta. At this fair the Governor of Georgia appeared in a suit of clothes made of cotton and manufactured on the grounds from cotton which had been picked from the stalk that morning—the entire process taking place in sight of the visitors. It was this episode that brought to the minds of Southerners the facts that the product of cotton could be worked up into finished cloth without transportation to a distant manufacturing town, and that the South had abundance of unemployed labor for mills such as those operated in Waltham, Lowell and Manchester, in the North. To-day, the cotton mills of Georgia, Alabama and the Carolinas consume about one-third of the cotton crops of those States.

The development of cotton manufacture in the South continues to be of material benefit. Besides increasing the profits of cotton growing, the presence of local factories, by diverting labor from the fields to the factory villages, creates an increased demand for butter, eggs, and other agricultural products, and thus adds to the prosperity of the whole section. In Louisiana the newer cotton factories are organized by joint stock companies, a plan which has been successful in North Carolina. The shares are paid for in instalments of one dollar a share weekly, each person subscribing for ten shares at one hundred dollars each.

Machinery in Cotton Mills

In the machinery used in the spinning and weaving of cotton, constant improvement has been going on ever since mechanical power was first applied to the spindle. The development has seemingly reached the highest stage, yet there is still a chance for inventors in the matter of devices of the shuttle-changing variety. It should be explained that, as the capacity of the shuttle is limited, the speed at which modern looms are run, for example, in the manufacture of print cloth, exhausts the yarn in the shuttle box in about eight minutes. This means that the shuttle must be changed several times an hour. As the cost of labor in weaving is one-half the cost of converting a pound of raw cotton into cloth, it is of the utmost importance that the time occupied in changing shuttles be reduced to the minimum. A few machines now effect the change with promising rapidity, but they are yet in the experimental stage.

The Northrup Loom is a wonderful piece of mechanism. Since its introduction in 1895 its use has been widely extended. Such is its efficacy in the weaving of plain cloth that in the first five years the output was more than 42,500 looms. There are two fundamental improvements in this loom. They are the "filling-changing" mechanisms and the "warp-stopping" devices. The time of stoppage on account of exhausted shuttles is entirely saved by the first, and by the second the machine is stopped immediately upon the breaking of a single warp thread. It is easy to see that in combination they must add enormously to the productive capacity of the weaver. A glance at his work will show this to be true. A good weaver operating plain narrow looms has a capacity of eight looms, most of his time being employed in replacing empty shuttles and in mending broken warp threads. An empty shuttle stops a loom, and the failure to repair warp breaks causes an imperfection in the weaving. The new "filling-changing" mechanism minimizes the time needed to supply looms with weft, and thus the weaver has most of his time free for repairing warp-breaks. This more than doubles his capacity over the number of plain looms which he formerly tended. Often the weaver going home to dinner, and leaving all his looms running, with the filling magazines all full, finds some of the looms still running on his return, a breakage of the warp having stopped all those looms in which it had occurred.

In the broadest sense, it may be stated in conclusion that remarkable improvements have been made in the last thirty years in spindles and looms. It is admitted that the speed of the cotton spindle of to-day is limited only by what other parts of the machinery will stand. As for the looms, the newest, as related above, are so easily operated that a single weaver can run from sixteen to twenty of them at the same time. In England, the machinery used in cotton mills is still of the old style, so that a weaver can run only three or four at a time. In Italy, the weaver can handle only one or two looms. Naturally, then, the American-made loom is in demand, and while the manufacturers turned out two thousand every month in 1900, the demand still exceeds the supply. Over one thousand of these looms are now in use in Japan, while France, Switzerland and Austria are building machines of this pattern in their own shops. As a rule, American cotton machinery, on account of the higher wages paid here, is too costly to export. Fully one-half of the cost of such machinery here is represented by the amount paid for labor. A large number of English cotton machines are imported, not because English machinery is better, but because it is cheaper.

Skilled Operatives and Child Labor

Not another industry compares with cotton manufacture in the number of employés within the mills. Moreover, there is no other industry in which the work is so nearly divided between men and women. Another fact generally deplored is that more children under sixteen years of age are engaged in cotton goods manufacture than in any other great industry. The whole number of children employed is 40,000—the Southern States alone employing 24,000, and the New England States 10,000.

The result of recent sociological studies of the condition of affairs in Southern cotton mills, however, point to improved conditions in the near future.

Skilled operatives in the cotton manufacture include spinners and weavers. The vast majority of mule spinners are men. On the other hand, the greater number of frame spinners are women. As weavers, too, more women than men are employed. The introduction of the latest fast looms, however, as previously intimated, is leading more and more to the employment of men as weavers, upsetting the old idea that weaving is peculiarly the work of women. Southern mill operatives have not yet become sufficiently skilled to make fine fabrics, though they are said to be making rapid progress. The average earnings of spinners range from sixty to seventy-five cents a day, and those of weavers usually from ninety cents to one dollar and a quarter. The price of unskilled labor ranges from sixty-five cents to eighty-one and one-half cents a day, the majority getting from seventy to seventy-five cents. The earnings of children are included in these averages. One employer, who considers it a material advantage to be able to work sixty-six hours a week instead of fifty-eight, as in Massachusetts, declares that New England wages on the same class of goods are no more than his mill pays. Spinners, he asserts, get ten cents a side, on an average, in New England, while his company pays eleven cents. In the Northern mills, especially, there is a decided tendency not only to substitute men for women at the machines, but to do away entirely with child labor. Though these changes in labor conditions are noticeable only in the mills of New England, yet there is no doubt that the elimination of child labor, even in the South, is a question only of time, and it is equally certain that the employment of women in all the factories will gradually cease. As usual, economy is at the bottom of both changes. It is not the kind of economy which appears on the surface, but the kind which counts in the long run through a higher efficiency of service, and in the betterment of social conditions. Some years ago the looms in all the mills were managed by women; but it was soon found that the complex modern machines demanded such unremitting care and fine skill as to be beyond the physical and nervous capacity of many of the women. The disappearance of women from Northern factories is also due to the fact that a skilled operator now earns a great deal more than formerly, and, consequently, is able to relieve the women of his family from work in the factory. Women and children would, of course, accept lower wages for the same work, but it has been found that they can not endure the strain, even if they have the requisite skill; the result being the employment of more men and an ultimate economic saving.

Conditions are entirely different in the South, where labor is not skilled in machine work, and where the cotton manufacturer has to employ whatever help he can find. The result is that a great many women and children are employed. Since 1890 the increase in the employés in the Southern cotton mills has been tremendous. Generally the number of women employed is twice as great as it was ten years ago. There are three times as many children, and a little more than three times as many men as there were in 1890. The increase has been: children 15,000, women 17,000, and men 28,000. So that even in the worst conditions, it is shown that men are gradually displacing women and children. The employment of children in the South was forced, as, otherwise, the mills could not have been worked. The system of child labor has been economically bad, and no one has understood this better than the Southern cotton manufacturer. There is, of course, an apparent saving, which tells for a short period; but in the total count the factories employing children have found that they were doing so at a serious loss in both the quality and quantity of the product.

The great majority of employers in the South state that they do not wish to have any children under twelve years of age in their mills. Sympathy for the children or for their parents, they protest, leads to the hiring of small children. In North Carolina the number of child laborers under twelve has diminished more than half during the past few years. On the other hand, it is often the case that men who seek employment are more apt to find it if they have a number of children who can be brought into the mills. Again, some of the mills will not employ the older members of a family without employing the children also. In such cases the children displace adults, and fathers often live in idleness on their children's earnings. Even the opponents of child labor admit that the work is not laborious, while asserting that the confinement during long hours, in dusty rooms, is detrimental to health and physical development.

Several mills in the South have experimented with negro labor. This has caused considerable irritation among the white operatives; but no serious trouble has resulted. It is generally believed that the negro is not capable of, or has not yet developed sufficient skill for, doing the high class work necessary. The experiment, however, has not been carried far enough for definite results, although some mills have already abandoned it.

Cotton Ginning

The most important branch of the cotton industry is that of ginning —the process of separating the seed from the lint, preparatory to placing the cotton on the market. The three classes of gins are: (1) those operated for the public; (2) those operated only for the plantation on which the cotton is grown; (3) those operated jointly for the plantations owning them, and for the planters of the neighborhood. The latter class is by far the most numerous, as it includes 20,000 gins out of a total of 29,000 in the United States. About 10,000,000 commercial bales of cotton have been ginned annually for the last several years. One-quarter of the entire output, each year, was baled in Texas, the great marvel of the cotton belt.

Before Eli Whitney revolutionized this industry with his wonderful invention for seeding the cotton, the work of separation by hand was so slow that it would have taken one person two years to turn out the quantity of cotton contained in one standard bale. The modern ginnery yields from forty to sixty bales per day; and we have automatic ginneries, representing years of effort to combine ginning with baling plants, in which the speed attained and the labor economized comprise very remarkable features.

The picked cotton is removed from the loaded wagon by a suction pipe, which conveys it to the vacuum separator and cleaner, in order to remove all twigs, leaves and impurities; this waste being dumped into one place, the seeds being blown to suitable bins or wagons in another, without danger of impairing their vitality, and the cotton deposited on the ginnery floor, ready for baling. The cotton is conveyed from all the gins by a flue system to a condenser, and fed, as required, into the packing press; to be formed into the ordinary square bales, or into one of the modern cylindrical packages, now coming into general use.

The standard square bale measures fifty-four inches in length, twenty-four to twenty-seven inches in breadth, and twenty-eight to thirty inches in height, having an average weight of about five hundred pounds or, approximately, twenty-two pounds per cubic foot. Numerous inventors have sought to produce devices for securing an even greater density to the baled product, although none of their inventions is widely used.

The two common methods of packing lint cotton in cylindrical bales are known, respectively, as the Bessonette, or "Round Lap," system and the Lowry system. In the former process the lint, coming from the gin, is blown into a storage reservoir and bat former, and, being there converted into a continuous bat of even thickness, is wound upon a cone under the gradually increasing pressure of two rollers pressing upon opposite sides, until the bale is completed. The density thus produced gives a weight of thirty-five pounds per cubic foot in all bales, ranging from 270 to 425 pounds, and from 35 to 45 inches in length, with a diameter of 22 inches. The bales thus produced have the additional advantage of being self-containing, owing to the mutual adhesion of the successive layers of cotton bat, thus avoiding the use of the iron straps, always required for the old-style square bales.

In the Lowry system the lint cotton is fed loose from the gin into a tube, surrounded by a cap plate having a number of slots radiating from centre to circumference. The bale is started by packing loose cotton in the tube by hand, after which the tube and cap plate are set into relative revolution, with the result that loose cotton thrown upon the top comes into contact with that inside the tube, being drawn in through the slots and building the bale up endwise. The pressure in this system is thus applied at one end only, as against the double circumferential pressure of the Bessonette process. The bales, averaging 250 pounds weight, measure 18 inches diameter, 36 inches length, and have a constant density of 45 pounds per cubic foot, as against 22.5 pounds for the square bale, and 35 pounds for the Bessonette cylinder.

Cotton Seed Products

The cotton gin produces two pounds of seed to every pound of cotton. That two pounds of seed represents an asset, and yet any elderly person of to-day remembers when the seed was thrown away as waste or used as fuel. One day in 1855 a Rhode Island firm had a carload of cotton seed sent up from the South and made it into oil. The oil sold, and to-day the manufacture of this by-product forms a distinct industry. One company alone produces cotton-seed oil to the value of twenty-five million dollars annually. This one company employs between five and six thousand persons, and the once despised cotton seed furnishes a means of livelihood for thousands more. The American Cotton Oil Company has fifty-seven plants and a capital of thirty-five million dollars.

Cotton-seed oil can not be used to light the parlor or kitchen lamp; but it is in your lard and in your soap, salad is dressed with it, salt and paper manufacturers use it in their factories, miners burn it in their lamps, druggists sell it as a liniment, finally thousands of pounds of it are used in making butterine.

One hundred and twenty-five establishments are at work crushing cotton seed into oil, and it is a pygmy mill that does not crush ten thousand tons in a season. With a cotton crop of eight million bales, one and a half million tons of seed are crushed, producing sixty million gallons of oil, cake and meal. All this means that in the same year twenty million dollars is divided among the Southern planters and transportation companies, representing the cash payment for cotton seed and the carrying thereof. The amount of oil exported is about fifteen million gallons annually, worth about six million dollars.

CHAPTER XXVII

WOOL AND CARPET MANUFACTURES

The Wool Industry—Woollen Goods—Worsted Goods—Felt Goods—Yarns—The Carpet Industry—Carpet Weaving

The Wool Industry

WOOL manufacturing is second in importance among the textile industries. The divisions treated in this chapter are woollen goods, worsteds, felt goods, shoddy, carding mills, and wool scouring and pulling. Information concerning the manufacture of carpets, wool and fur hats, and hosiery and knit goods will be found in other chapters.

A general survey of the field reveals a number of features highly creditable to American manufacturers. The productions of American looms, for example, compare very favorably with imported fabrics. The importations consist chiefly of those high grade goods and novelties which require more time for their production than labor conditions in the United States will permit. In wool manufacturing machinery some of the most important inventions were made by Americans. The plants in which wool products are manufactured are superior in many ways to those abroad, containing every modern appliance for facilitating production, such as cards, combs, mules, spinning frames, looms, and other machinery, with all the latest stop motions and other automatic devices for the prevention of imperfections. The rooms in which the operations are conducted are usually large, lofty, well ventilated, lighted by electricity, and heated by steam—all of which shows that the conditions surrounding the wage-earners are far from furnishing a cause of complaint. The hours of labor do not exceed sixty hours a week in any known instance. Wages are paid in cash, either every week or fortnightly. Factory inspection laws insure the best sanitary conditions, and prevent, as far as possible, the employment of children under fourteen years of age. More than 11,500 children are employed, but it is assured that they are nearly all of an age between fourteen and sixteen.

Spinning, weaving, dyeing, finishing, in fact the entire process of converting the wool as it comes from the sheep's back, is, in this country, usually accomplished under the roof of a single mill. In England, each of these operations is done in a separate mill, this constituting the particular difference between American and English manufacture. Philadelphia, the chief centre of wool manufacture, offers an exception to the general rule. There the mill superintendent or even the operative of to-day becomes a manufacturer on his own account to-morrow, little capital being needed to equip a small plant. These small manufacturers, "late of" such and such a great mill, having thus entered into business for themselves, carry on one process only; that is, they become either top makers, yarn makers, dyers, or finishers, making nothing but the one thing, as in England. As a vast market for their products exists within the city limits, and as they can produce at surprisingly low cost, their profits greatly exceed the amount they formerly earned in wages. In the textile world so great is the variety of goods made, and so vast the market, that a man with the skill and a moderate capital, can establish a small factory and make a specialty of one thing, with reasonable assurance of success. The cities next in rank to Philadelphia, according to value of products, are Lawrence, Massachusetts, and Providence, Rhode Island.

A factor in the woollen industry to-day is a company formed by a combination of a large number of formerly independent concerns. There is still a lively competition, however, for the combination can not be said to hold a monopoly. In its thirty plants it manufactures all kinds of woollen goods except knit goods, ladies' dress goods, and the very cheapest fabrics. Through its own travelling salesmen it sells goods direct to jobbers and manufacturing clothiers. Owing to an increase in the volume of business and to a reduction in the cost of manufacture, the number of employés in the various plants has been greatly increased since the formation of the combination. Wages, too, have been increased ten per cent, and the company is now paying higher wages than have ever been paid in the woollen goods industry in America. As in the case of combinations in other industries, it has been found a great advantage to be able to utilize in the management of all the plants the brains and energy of the best men in each of the plants.

The business of wool manufacture has shown a remarkable increase in the last half century, alike in point of capital invested, wages paid, cost of materials used and the market value of products. Within one decade (1861-70) alone, the percentage of increase in all branches of the industry rose as high as 171.3 per cent, due most largely to the unusual demand for clothing and uniforms for army equipment. Since that time the progress of the business has been steady, save for an occasional season of depression, owing entirely to extraneous conditions. In America, also, the several changes in tariff regulations, both on the raw material and on the finished product, have had an influence. Thus, the year 1900 was an unfortunate one for the trade in all parts of the world, leading to the failure of numerous important manufacturing firms and to the formation of several large combines, while most of the stronger mills were running at about half force. This remarkable condition was brought about by the fact that world commerce in wool had begun to feel the universal tendency to expansion, with the consequence that, in attempts to meet the new demands, prices rose to nearly prohibitive figures. In London the price per pound of a certain class of raw wool rose from 20½ *d.*, as quoted for several years, to 34½ *d.* within twelve months; other classes rose at an average rate of about seventy-five per cent. These unusual advances were followed by a sudden fall, which brought the figures to a point lower even than at the start, creating widespread consternation; but, in the words of one authority, involving the "lesson that wool is wool, whether it be merino or crossbred, and that no class of raw material can long maintain a price which is out of all proportion higher than another."

The industry in the United States was largely affected by variations in the tariff duties on both raw materials and finished products during the decade immediately preceding (1881-1900). By the Law of 1894 raw wool was put upon the free list, while the duties on wool manufactures were put upon an ad valorem basis; but by the Law of 1897 substantially the old rates of duty on the raw material were restored, while wool products were again taxed on the "compound system," partly specific, partly ad valorem. During this decade the total imports of all classes of raw wool amounted to over 1,500,000,000 pounds, representing a total yearly average of over 126,000,000 pounds under the Law of 1890; of over 272,000,000, under the Law of 1894, and of not quite 118,000,000 under the Law of 1897. The yearly average for the entire decade was about 167,000,000 pounds, or more than 60,000,000 pounds less than the average under the Law of 1883.

Wool manufacturing in the United States is mostly concentrated in the States of Massachusetts, Pennsylvania, Rhode Island, New York, New Jersey, Maine, Connecticut, New Hampshire, Vermont and Tennessee; their relative importance in all branches of the industry following in the order given. In special branches however, the relative importance is somewhat different. Thus, while Massachusetts leads in the value of its woollen and worsted products, distancing its nearest competitors, Pennsylvania and Rhode Island, respectively, by over $5,000,000 in the one article and by over $7,000,000 in the other; Pennsylvania is the first in carpet manufacture by over $8,000,000; New York leads Massachusetts by over $200,000 in the production of felt goods, and exceeds Pennsylvania by over $200,000 in the production of wool hats. During the ten years ending with 1900 there was an increase of 11.3 per cent in productive capacity throughout the country, while the cost of raw materials was increased by about 8.3 per cent and the value of finished products by about 9.8 per cent. Taking into consideration all advances in mechanical appliances and manufacturing methods, an average increase for this period in production of a given class of work was fully ten per cent.

Woollen Goods

The class of fabrics under the general head of "woollen goods" includes all products of card manufactures, among which are broadcloths, doeskins, cassimeres, satinets, jeans, flannels, blankets, mixed cotton and wool dress goods, linings, and the like. They represent the varieties of fabric most common and most suitable for clothing and other needs of the consumer; also the most important numerically, both in point of the number of establishments engaged in their manufacture and of the number of persons employed. According to the showing of the last census, however, this branch of the wool industry seems to be in danger of losing its relative importance, principally on account of the increasing use of combed wool, or worsted, fabrics for men's wear and of knitted underwear and stockings. Thus, while the number of concerns engaged in the manufacture of this class of goods was 2,891 in 1870, it was 1,990 in 1880, 1,311 in 1890, and 1,035 in 1900. The number of persons actually employed was 80,053 in 1870, 86,504 in 1880, 76,915 in 1890, and 68,893 in 1900. The value of products similarly decreased from about $160,000,000 in 1880 to about $133,000,000 in 1890, and to less than $119,000,000 in 1900; while within the same two decades the value of raw materials used was decreased about $30,000,000. These figures, however, do not indicate the precise relative proportions in the matters noted, since these decades were also periods of falling values. It may be partially explained, also, by the fact that cotton and other fibres have come into more general use in the last twenty years, particularly in the manufacture of horse-blankets and carriage robes, the production of which was over 3,000,000 square yards more in 1900 than in 1890. Shoddy also shows an increased consumption of about 15,000,000 in the same period.

For dress goods the figures differ, according to the product, some showing a decided falling off, others a proportionate, if not greater, increase. Thus, broadcloth, once highly popular for men's suits, is now manufactured in very small quantities; also the all-wool cassimere has largely given place to worsted cassimere, increasingly popular, on account of its handsome appearance. The increasing popularity of light flannels for men's wear partially explains the fact that the production of union and cotton warp goods was not as great in 1900 as in 1890, when measured in square yards. However, the total production of all-wool goods rose from about 26,000,000 square yards in 1890 to about 35,000,000 in 1900, while the value per yard fell in the same period from about 94 cents to 66 cents, giving a total decrease of over $2,000,000 in ten years. Union, or mixed, goods are becoming increasingly popular, the total production being nearly 31,000,000 square yards in 1900, as against a little over 21,000,000 in 1890; while cotton-warp goods, having a wool weft, including tweeds, jeans, satinets, have fallen off over 15,000,000 square yards. According to census returns, the falling off in flannels amounts to over 40,000,000 square yards in ten years, although a part of this decrease may be owing to the fact that some goods of this variety are classed as cloths. Strangely enough, the production of bed blankets shows a decrease of nearly 3,000,000 square yards, from 20,793,644 square yards in 1890 to 18,155,505 square yards in 1900. In shawl fabrics the decrease is even greater, as might be reasonably expected; the product in 1900 representing only about one-seventh the quantity and one-fourth the value of that of 1890.

Worsted Goods

The increased production of worsted goods is largely to be explained by purely mechanical considerations—the perfecting of machinery capable of combing wool of "short staple," which was impossible with the old hand methods. The additional fact that the merino sheep has been crossed with some of the commoner varieties has been another element in the successful issue, producing a grade of wool peculiarly adapted to combing. Previous to 1870 very little was done in the line of manufacturing worsted goods for men's wear, although several concerns made unsuccessful attempts in this direction, the first experiment having been tried in 1843. In 1860 there were but three establishments in the United States engaged in this business, and only 2,378 employés; but by 1870 the figures had increased to 102 establishments, with 12,920 employés. In 1880 there was a decrease in the number of establishments to 76, although the number of employés had risen to 18,803; in 1890 the figures were 143 and 42,978, respectively, while, in 1900, they were 186 and 57,008. During the same period (1870-1900) the total value of products has increased 120-fold, despite falling values, while the number of spindles has risen from about 200,000 to 1,371,026; of looms, from 6,128 to 26,372; and of combing machines, from 161 to 1,194. Similar figures are shown for all other matters connected with the industry. It has shown a steady growth despite the heavy tariff duties on imported wool and the unsuitable character of much of the domestic material.

In 1900 over 54,000,000 square yards of all-wool worsted coatings, suitings and overcoatings were manufactured, an increase of about two hundred per cent over the quantity produced in 1890, representing nearly twice the total value. The production of cotton-warp worsteds in the same period was maintained at about an even quantity. Although the importations of all these fabrics was heavy in 1900, the home manufacture represented more than ninety-one per cent of the total supply in worsted suitings and overcoatings. The figures for women's dress goods are similarly hopeful. Out of a total product of over 103,000,000 square yards in 1900, the all-wool fabrics represented nearly 58,000,000 square yards, and the cotton-warp fabrics nearly 46,000,000 square yards, showing an increase of nearly 30,000,000 square yards over the product of 1890. Meantime, the manufacture of woollen dress goods, representing both all-wool and cotton-warp, had increased by nearly 30,000,000 square yards over the product of 1890, proving that the influences tending to decrease the product for men's wear had been somewhat compensated in the domain of dress goods intended primarily for women. Further, although the average annual importation of women's dress goods during the decade 1891-1900 was over 63,000,000 square yards, the domestic manufactures supplied at least seventy-one per cent of the total demand in 1900.

In the production of worsted and woollen braids, the figures for home manufacture represent a total of seventeen establishments in 1900, as against eleven in 1890, with a corresponding increase, in the same period, from 10,750 to 15,086 employés in the mills, situated principally in Massachusetts, Rhode Island, Pennsylvania and New York. Of these figures New York claims nine mills, 9,628 hands, and manufactures nearly one-half the product of the United States, representing a total value of $1,092,713.

Felt Goods

Of all the departments of the wool industry the manufacture of felt goods is the smallest, both as regards the number of establishments engaged, and also as to the quantity and value of the product. Still there is a wide variety of uses for feltings of all kinds, and the last twenty years has seen a steady, healthy growth in the business. Feltings are used in a large variety of connections, among which may be mentioned their application for slippers and shoes, for piano keys, for upholstery and dress linings, for polishing and, as endless belts, for paper-making. In some of these uses the demand has remained about constant, while, in others, it has increased or diminished for similar reasons. Thus, during the decade 1891-1900 the manufacture of felt cloths continued at about the same rate and quantity, and felts for boot and shoe linings decreased about one-half, while the production of endless felt belts for paper-making machines increased from 216,982 to 1,114,357 square yards, and the product for trimmings and linings was nearly doubled. In 1900 there were thirty-six felt establishments in the United States, representing an advance of two in ten years and ten in twenty years. During the latter period, however, the invested capital has increased over six-fold, and the value of products has nearly doubled, in spite of the fall in values of raw materials.

Yarns

Although the use of cotton and of cotton yarns for hosiery and general knitted goods increased immensely in the ten years ending 1900, the estimated increase in other branches of the industry was comparatively small, representing only about 500,000 pounds for 1900, as compared with an increase of over 15,000,000 pounds in the decade ending 1890. A part of this cotton was used on cards with wool, for making merino and mixed yarns, and a part was made into cotton-warp yarns for dress goods, linings, flannels, etc. In all, the amount of raw cotton actually consumed in woollen manufactures was about 108,000,000 pounds, as compared with over 394,000,000 pounds of wool.

The total quantity of yarns purchased for the various branches of woollen manufacture in 1900, including woollen, worsted, merino, cotton, silk, linen, jute and several vegetable fibres, amounted to over 181,000,000 pounds, and represented a total value of nearly $45,600,000. Of this supply a total of about 35,500,000 pounds was purchased by the woollen mills, another of about 35,700,000 by the worsted mills, and a third of about 109,700,000 by the carpet mills, leaving a balance of about 150,000 pounds which was used in the manufacture of felt. The figures for this year represent a total advance on those for 1890 of nearly 45,500,000 pounds.

The Carpet Industry

The carpet industry forms one of the most important branches of wool manufacture in this country, its wonderful development being due principally to several American inventions—namely, the adaptation of the power loom to the weaving of ingrain carpets; a power loom for weaving Jacquard Brussels and Wilton carpets; certain machines for weaving tapestry Brussels and tapestry velvet carpets; and a power loom for weaving Axminster carpets.

By applying these inventions American manufacturers turn out annually tens of thousands of miles of carpet, including ingrains, Brussels, moquettes, tapestries, velvets, Smyrnas, Axminsters, Wiltons, and rugs—floor coverings alike for millionaire and mechanic, palace and tenement. At Yonkers, New York, is the largest moquette carpet plant in the country. In Philadelphia, the home of the largest ingrain carpet mill in the United States, more floor covering is turned out annually than is made in any other single mill in the world. American carpet mills to-day are supplying all but ten per cent of the home demand, thus reversing the conditions that prevailed years ago when the home mills supplied only ten per cent of the home demand, the remaining ninety per cent coming from foreign mills.

Our total export trade in carpets in the course of a year is represented by the output of the mills of the country for but a single day—350,000 running yards, valued at about $175,000. American manufacturers can compete with those abroad only in the sale of surplus products; and so great is the demand at home that the surplus makes a comparatively small showing. Looking at the carpet industry as a whole, never have so many carpet and rug looms been in operation in this country as at the present time; and never has labor been so steadily employed.

One branch of the industry is threatened with destruction. The large importation of straw mattings from China and Japan is responsible for a decline of nearly forty per cent, in the last few years, in ingrain carpet manufacture. In 1893 the output of ingrain carpets was fifty million yards. In 1900 it had fallen to only thirty-three million yards. In 1892 only eight million yards of matting were imported. In 1900 more than forty million yards of matting of foreign manufacture were sold here. Lower wages abroad are the cause of this condition of affairs. The Chinese weaver of mattings is paid five cents a day, the Japanese weaver ten cents a day, the American weaver of ingrain carpets two dollars a day.

American rugs are in great demand. American carpets of all kinds are now woven in one piece, and—despite the flood of Oriental rugs that yearly pour into the United States—are making their way into the homes all over the land. In 1900 there were nearly 9,000,000 square yards of rugs made.

Carpet Weaving

There are two varieties of carpet ordinarily manufactured, pile carpets and woven ply carpets. The former have, as their distinctive feature, a surface of raised loops, cut or uncut, while the latter have a flat surface, like other knitted or woven fabrics. Among the better known varieties of pile carpets manufactured in America are Wilton, Axminster, Brussels, tapestry, moquette, and velvet. Wilton and Brussels carpets have a cotton or linen chain, a linen filling and a warp of colored worsted yarn. They are made on the same kind of loom; the worsted warp forming the pattern in each case being raised into loops, on the face of the carpet, by wire points, successively inserted and withdrawn, as the weaving progresses. The principal difference between the two varieties of carpet is that in true, or body, Brussels the loops of the pile are left uncut, while in Wilton they are severed by a sharp edge on the lifting wires. In other respects the process of making these two varieties of carpet is the same: Wilton, however, has generally about fifty per cent more wool than Brussels. The variety known as tapestry carpet, more properly tapestry Brussels, differs from body Brussels only in the materials used. It is made with a cotton chain, a linen or jute filling, a jute yarn backing and a worsted warp. The warp is lifted by wire points, as already described, and, in weaving, develops the pattern "printed" in the yarn. Velvet carpet holds the same relation to tapestry as does Wilton to Brussels—the wire points used to raise the warp into loops have a cutting edge that severs them into so many straight piles: it also contains a greater percentage of wool. Axminster and moquette carpets, although resembling the former varieties in the piled surface, differ very essentially in materials used, and also in the manufacturing processes employed. Both are made on looms of very similar description. The peculiarity of moquette carpet is that the pile surface is formed by cutting off short pieces of woollen yarn and fastening them to the warp threads as the back is woven. The back is composed of heavy jute and cotton, and the pile yarn does not appear on the "wrong side." True Axminster is an imitation of Turkish carpet, having a linen or hempen warp and a chenille filling. The surface, of course, partakes of the peculiarity of the filling, which is made by weaving together four warp threads of wool, or three warp threads upon a soft filling thread, thus producing the characteristic "fluffy" appearance, which is imparted to the finished carpet. Ingrain carpet is made in two piles, consisting of a worsted or cotton warp and a wool filling. The surface is flat, or unpiled, since the weaving is not interrupted by the use of wires, or other devices to raise the warp threads.

CHAPTER XXVIII

SILK MANUFACTURE

The Silk Industry—Silk Mills, Machinery and Operatives—Making Silk Ribbon—Looms—Velvets and Plushes

The Silk Industry

THE silk maker's art, transplanted from Europe, has become thoroughly domesticated in the United States; while the manufacturers' capital and enterprise have been devoted to improving and cheapening all processes of manufacture and lowering the price of silk goods. Thus silk manufacture in this country has become established as a permanent branch of the textile industries. Setting forth the reason for the powerful development of this industry, a vice-president of the Silk Association says:

As reasons for the rapid as well as powerful development of the United States silk industry, notwithstanding the competition of well-introduced imported goods and the splendid organization of the importers, and in spite of the mistrust which was felt by consumers for a long time against the domestic goods, we find:

1. The natural capability of the American merchant and manufacturer, his common sense, enterprise, and self-confidence.
2. The capital which is always ready to support enterprise in this country in the form of extensive and liberal credits.
3. The support which is given all these undertakings by the people, by the city and state governments in form of tax privileges, donations of lots, putting up mill buildings, and renting same at a low rate of interest; even in some cases by subscribing a certain amount of the necessary working capital.
4. The intellectuality of the American technician, who through his inventions of time-saving machinery, which are simply constructed and easy to handle, is, perhaps, unequaled. The operative also is moderate and his common-sense makes him especially fit for the manufacturing business.
5. The easy intercourse between manufacturer and dealer which enables the first to get fully and promptly acquainted with the needs and wants of the consumer.

The product of the silk-worm is so intimately associated in our minds with warmer climates than ours, in Europe and Asia, that it is difficult to realize that now the United States ranks first among the nations in respect to the quantity of silk manufactured. Even France has no mills to compare in size with the great American establishments which have been built since the first little factory was started by John Ryle, the father of the silk industry in this country. These mills now supply four-fifths of the entire home demand. In 1900, their output amounted to more than one hundred million dollars as against a yearly silk production thirty years ago of only five million dollars. Sixty-five thousand wage-earners are employed. The total number of silk factories is about five hundred. Of the silk stuffs consumed in this country, we make from eighty to eighty-five per cent of the piece goods and fully ninety per cent of the ribbons sold over our counters.

As to the relative position of France and the United States in silk manufacture, it may be stated that while the value of the annual production in France—$122,000,000—is greater than the value of production in the United States—$92,000,000—France at the same time consumes a trifle less raw silk than this country, the figures being 9,000,000 pounds for France, and 9,760,000 pounds for the United States.

To-day, the greatest raw silk market among the cities of the earth, next to Shanghai, is New York. More raw silk is consumed here annually than is consumed in all France, the largest silk-consuming country of Europe. In the finer fabrics, such as church ornaments and chasubles, and specialties for women's wear, the United States has not yet been able to compete with France, the principal reason being that most of the foreign specialties mentioned are made on hand looms, and their production in the United States on power looms would not be profitable. In 1900, American manufacturers imported not only $49,000,000 worth of raw silk, but also $26,000,000 worth of manufactured silk goods.

The countries that lead in silk culture and in the quantity and value of exports to the United States, are Japan first, China second, Italy third. The American manufacturers, as inferred above, import practically all of the raw silk used. As for American export trade in silk manufacture, there is none, and experts declare there never will be as long as wages are so low abroad and as long as the cost of production is so great here.

Silk Mills, Machinery and Operatives

During the last decade larger silk mills have been built and equipped with every modern appliance for heating, lighting, power, and manufacturing; smaller mills have been consolidated into the larger establishments, thus lessening the general expenses.

Paterson, N. J., pre-eminent as the home of the largest mills and, in this industry, the manufacturing centre of the United States, producing twenty-five per cent of all the silk used in the entire country, owes its position, first, to its proximity to New York, the principal market for the sale of silk; second, to the early start of the power manufacture at this point; to the abundant waterpower furnished by the Passaic River; third, to the large supply of labor skilled in the hand processes of silk manufacturing, which was attracted thither from Italy and other European countries.

With American machinery an ordinary silk weaver accomplishes results equal to those of the most skilful and experienced weavers in other countries. With marvellous facility the character of the work in American factories can be changed day by day, from yarn to piece-dyed weaves, from simple to complicated silks, and from light to heavy. No better evidence of the progress made in the development of American looms could be presented than the statement that of the forty-five thousand looms in operation here, less than two hundred are hand looms. American looms are conceded to be the world's best, and American dyeing and finishing machinery ahead of that in use in foreign mills.

In throwing machinery marked progress has been made in recent years, in the way of increasing labor efficiency, space and processes, saving waste, and other economies. Winding frames now produce perfectly wound spools at high speed. In spinning, in all the newly equipped plants, the endless belt is used instead of bands. This endless belt system, purely an American invention, is now used in silk factories abroad, and has been adopted by the technical schools of England and Switzerland as the best method of spinning organzine. A machine for this belt-drive system has been invented, by which the spinning, doubling and twisting of organzine can be done in one process, thus lowering the cost of production.

Altogether, American improvements in throwing machinery have resulted in a saving of forty per cent in floor space and of twenty per cent in the cost of production over the old system.

In weaving, the power loom has entirely superseded the hand loom, which speaks well for the skill of American labor. The looms now in use are of the highest efficiency, equipped with mechanical devices for saving time, labor and materials. Improvements have even been made in the great Jacquard loom, in the way of saving cards and increasing speed. One of the latest triumphs of American skill in the art of weaving is the perfection of a silk-velvet ribbon loom, which produces the best quality of ribbon at extraordinary speed.

In silk manufacture many more women than men are employed, the proportion being 34,000 women to 24,000 men. Nearly 6,500 children are also employed. In the mills in Pennsylvania alone 4,000 children toil. In the leading State in silk manufacture, New Jersey, employment is given to 24,000 persons, including, however, less than 2,000 children. Of the skilled operatives, principally weavers, 15,000 are men and 13,000 women. Nearly 700 children under sixteen years of age are classed as weavers, but naturally the greater number work as spinners, winders and warpers.

Making Silk Ribbon

If the reader has ever visited a ribbon mill, he may have exclaimed: "Surely this is where rainbows are made." From the office of the receiving clerk, where the raw silk arrives from Japan, China, Italy, and France, to the shipping department where the finished ribbons wound on hundreds of spools are packed ready for the "trade," may be found many more hues and shades than can be seen in a rainbow. In the mill are ribbons by the roll, rack, and roomful; red, pink, and yellow ribbons winding through looms; white, green, and blue ribbons, creeping their way through grooved machines; ribbons on the floor, in the air, in the tresses of the loom-girls; garlands and clouds of ribbons—and more a-making at the rate of a mile a minute.

The testing of the raw silk is the first step in the process of making silk goods. It arrives at the mill in bales—the softest, silkiest stuff, cream color. The bales vary in weight, but the smallest is worth at least five hundred dollars, while the value of some run as high as fifteen hundred dollars. From the receiving room, in a ribbon mill, the raw silk goes to an expert, called a "throwster," who separates the skeins into two parts—"organzine" for the warp, and "tram" for the woof. "Organzine" consists of two single threads of raw silk so twisted that there are sixteen turns to the inch; while "tram" is the union of two or more threads of raw silk so twisted that there are five turns to the inch. From the throwster the silk goes to the dyer. The next step is the extraction of the lisse, or cotton thread, from the skein. The skein is then put on a winding-machine, where the threads are run onto shuttle-spools, six hundred spools on one machine receiving the threads simultaneously. There are ten girls to each machine, each girl having sixty spools to watch.

Great delicacy of touch is required to manipulate the threads, which must be knotted together every time they break, and as a single fibre is like a cobweb and about the color of daylight, touch rather than sight is required to pick up the broken ends and knot them together again. After spooling the silk, the process of doubling begins; two, three, or five threads being twisted into one, according to the quality of the goods ordered, and the thickness of the warp required. This done, the quills are threaded or filled, and thus is made the woof which works across the warp, on the same principle as the shuttle in a sewing machine carries the thread and sews the cloth.

Looms

The Jacquard loom, in use in silk ribbon mills, has an attachment of heavy cards, through which holes for each thread have been punched; a box with many needles, pointing outward; and a revolving cylinder, every quarter revolution of which presents a new card to the needles; the whole forming a remarkable mechanical process, by which each thread is worked separately, as many as four thousand cards being used in some patterns. On the Jacquard loom are made ribbons that contain designs, such as hat-bands, silken trade marks, and fancy decorations. The process of weaving these designs into the ribbons is extremely complicated.

The ribbon girls prepare the thread for the loom, but there, for a time, their work stops. That is, they have nothing more to do with the silk till it comes from the loom in the form of ribbon, which they wind on reels ready for packing. Hence the ribbon-girls, after all, have no direct part in the making of ribbon. They weave piece goods, such as plain and brocaded silk for dresses, sashes, linings, and grenadines, but by intervention on the part of the labor organization they are debarred from the ribbon loom.

There is wisdom in the restriction, for the machinery is heavy, very hard to adjust, and requires a man's muscles.

A young Viennese has invented a device for simplifying the process of weaving silk designs—a machine that may, indeed, revolutionize the silk-weavers' art. The name of the inventor is Szczepanik. By utilizing photography for weaving purposes, Szczepanik can now, in a single quarter of an hour, accomplish what has taken the designer months, or even years, to complete, according to the size of the design. At present a design that is to be woven must first be resolved into squares. In the case of a large gobelin, the designer must fill up millions of such little squares before it is possible to puncture the pasteboard cards which are indispensable in the Jacquard loom. In his photographing apparatus, the Viennese inventor employs ruled screens containing the necessary intersections. These screens are on glass plates, prepared by photography, and are said to be the largest photographic negatives made. Each such screen contains a million squares corresponding with those which hitherto the designer, with infinite labor, covering a period perhaps of months, has filled in. Szczepanik proposes to photograph any pattern that may be selected directly on the sensitive plate. Two minutes' exposure, it is claimed, will suffice to produce an image on the sensitized paper showing the points of intersection needed in the Jacquard card. Bathing, developing, and fixing will occupy a quarter of an hour more, and then the design is finished. The young inventor claims that an electric Jacquard loom, as perfected by him, will weave a silk pocket-handkerchief in less than a minute. Within three minutes, the purchaser of the handkerchief can be photographed by an apparatus in the loom itself, the design-plate can be prepared by the same machine, and in half an hour the purchaser will be able to take away a silk handkerchief with his own portrait woven in it.

Velvets and Plushes

Though the consumption of velvets and plushes in this country is not as great as that of other wares, one ambition of the American silk manufacturer in recent years has been realized; that is, he is now manufacturing velvet on a paying basis. American mills are even supplying more than fifty per cent of the velvet used in this country, a statement which shows that the problem of successful production is being solved.

Plush manufacture in this country is a development of recent years. Previous to 1884 all plushes were imported. In that year American manufacturers for the first time put a satisfactory furniture plush on the market. Since then American furniture plush, mohair and car furniture plush have all successfully competed with foreign plushes; so much so that foreign manufacturers have been compelled to reduce the price of their goods in this country forty per cent. Seal plushes are used extensively in the cloak, cape, cap and trimmings trades.

CHAPTER XXIX

THE CLOTHING AND FUR INDUSTRIES

Clothing Manufacture—"Sweating," Home and Factory Systems—Foreigners in the Clothing Trades—Women's Clothing—Dressmakers—The Fur Industry—The Seal "Catch"—The Fur Companies of Canada

Clothing Manufacture

AT THE beginning of the Civil War, the government was suddenly confronted by the necessity of providing clothing for hundreds of thousands of men. This gave an impetus to the wholesale manufacture of ready-made clothing, even stronger than that furnished by the introduction of the sewing machine. At first, the clothing was made principally by journeymen tailors, who were skilled workmen, each one making an entire garment. In 1876, however, a radical change took place. The task system was introduced—principally as the result of the great influx of Russian Jews.

The whole number of clothing manufacturing establishments in operation to-day is placed officially at 48,000; but clothing is manufactured in hundreds of tenements and in small shops in the rear of dwellings, statistics for which it is impossible to gather. Among the wage-earners employed in all branches of textile clothing manufacture, three in every five are women, more than 300,000 of them being engaged to somewhat less than 200,000 men, and to about 16,000 children. These are the average numbers for all branches, not only including men's, women's and children's clothing, but also shirts, men's furnishing goods, hosiery and knit goods, and hats and caps.

Nine men and boys in every ten wear ready-made clothing. That the multitude patronizes the clothier, leaving the few for the tailor, is shown by the fact that clothiers dwell in palaces, while tailors still live in back rooms. The tailor makes one suit for one known patron; the clothier makes a thousand suits of the same pattern, color, and material, for as many unknown customers. The great centre of the industry is New York, where the capital invested is three times greater than in Chicago, which ranks second.

The annual manufacture of nearly $900,000,000 worth of clothing has called for thoroughly organized methods in the conduct of this great business. Each worker in a clothing factory does only one thing, day after day, and a dozen different men may have a hand in the making of a single garment. The services of the designer, who is a high-salaried man, may be compared to that of the architect in the building trades. Then comes the artist of the knife and shears; the cutter, who cuts a half dozen or more "coatings" at a time; then a tailor, who sews certain parts of the garment only; then another tailor, who sews another part, and so on. Vest makers there are, who make nothing but vests, and "hands on pants" and buttonhole makers, each having his "specialty" and doing nothing besides.

The specialization of the manufacture of men's and children's clothing has reached a point at which even the contractors make only one class of garments. A coat may be made in New York to go with a pair of trousers made in Philadelphia, and with a waistcoat from Boston. When the several garments are completed, they are shipped to the central firm, and are there "assembled" into a suit. The "finishing" is almost entirely done in the tenements. It is estimated that one-half of the coats are made under the "task" system, which will be described presently. The factories classify men's and children's clothing as coats, vests, pants, knee-pants, and children's coats. This specialization has led to the invention of special machines for cutting almost any number of thicknesses of cloth, and to the improvement of the sewing machine—which was largely responsible for the rapid development of the ready-made clothes system—and to the use of steam and electricity.

"Sweating," Home and Factory Systems

The "sweating" system and the "sweat-shop" are terms familiar to all who know anything whatever about labor conditions among the clothing workers of the great cities. It is the object of more assaults by reformers and philanthropists, perhaps, than any other system of labor. The "sweating" system is not known as such by the wholesale manufacturers or dealers who are responsible for it. By them it is called the "task" system. It was made possible, or it was the inevitable result of letting out work to persons, who performed it at home. The wholesale firm lets the job to a contractor, who, in turn, sublets the work in small lots to other contractors, or directly turns it over to the employés in his little shop, or to persons who do it at home.

The evils of the system are inherent, and could not be eradicated without the abandonment of the system itself. Of course, the tendency is to lower prices and lower wages, and when the first contractor sublets to smaller contractors, and two profits must be made out of the work before the employé can expect a cent, there is very little left for wages. The steady lowering of wages, in effect, when they have not been lowered in actual amount by the task, is one of the most startling and discouraging facts connected with clothing manufacture. At the beginning of the "sweating" system a task consisted of eight or nine coats a day. In hard times, the contractor would tell the employés that, in order not to cut down wages, the task would have to be increased. And so, coat by coat was added to the task, the wages for which were never increased. This method of getting more work for the same wages was followed with adroitness, until the task reached as high as twenty coats for a day's work, although it often required twenty and thirty hours of labor to complete it.

Before the task, or sweating, system was introduced, a journeyman tailor received about $2.50 or $3 for making a ready-made coat, all of the work on which he did himself. Now, under the task system, five or six different persons work on different parts of the same garment. There is the operator, who gets about $18 for a nominal week's task; the baster, who gets $16; the finisher, who gets $11; and the presser, who gets $12. Last of all there is the girl who makes buttonholes and sews on buttons, who gets $4.50 a week. The week's task may be two or three weeks' actual work. Economically, the system is wonderfully successful. The owner of a sweat-shop requires little capital and pays little rent. A shrewd man having found out where his employer gets his work, goes to the wholesale firm, and underbids him. This reduces the cost to the manufacturer, and also reduces the earnings of the employés. But soon, perhaps, some worker in the sweat-shop will resort to the same tactics, and underbid his employer; and so on indefinitely, wages being decreased, meantime, while the task is made greater and greater.

The over-supply of cheap and unskilled labor is supposed to be largely responsible for the sweating system, as the cities are flooded with men and women unable to do any kind of skilled labor, and quite willing to undertake even a laborious task at small pay. The system of sweating, however, is gradually being replaced by the factory system, which produces better clothes, and pays better wages, and, at the same time, has proved fully as profitable as the objectionable system of the "sweat-shop."

The term "sweating system," according to the United States Labor Department reports, has a general meaning, but is specifically used to describe a condition of labor in which a maximum amount of work in a given time is performed for a minimum wage, and in which the ordinary rules of health and comfort are disregarded. It is inseparably associated with contract work, and it is intensified by subcontracting in shops conducted in homes.

Such conditions prevail to a distressing degree in localities having a large, herded foreign population, and among people known for excessive industry and thrift—virtues otherwise considered indispensable to prosperity and happiness. Recently arrived foreign working people when crowded into big cities are most helpless, and in order to live are willing to submit to almost incredible exactions. It is thus that this form of labor soon outcompetes and displaces all other forms, and becomes the standard for the particular industry in which it is introduced.

The "task," or "sweating," system was the natural product of a metropolis like New York, overcrowded with impoverished labor; while the "factory" system, which is supplanting it, even in New York, is developed in the smaller and less crowded cities. It is generally known as the "Boston" system, although quite as familiar in Philadelphia, Chicago, Baltimore, St. Louis, and other centres. Its inherent principle is the fullest possible subdivision of work: on the principle that the same amount of work can be accomplished at less expenditure, while permitting the payment of better wages, because the greater specialization enables the worker to accomplish more. While under the "task" system five workers may be engaged in the making of a single coat, in some factories it may pass through the hands of one hundred workers. This makes it possible to have a large number of unskilled persons working under the direction of a few skilled overseers. The thing to be done by any one worker is so limited that he soon acquires great facility, and can thus earn more than under the sweating system. The advantages of the factory system are numerous. Wages are paid regularly, the hours are reasonably short, and the working places are in far better and more healthful condition.

There is still another system of making clothes which is even more objectionable than the "sweating" system. This is known as the "home" system, where the individual workers take their tasks home. Very few of the garments are finished in the shops, but are taken home and completed. Into many of the dirtiest tenements of the city cloth for trousers and coats is taken in whole pieces, and remains several days in the midst of filth, often becoming infected with disease. This system is older than the sweat shops, having been found particularly economical, as saving the expenses of a shop. Even women of means were willing to take in sewing, in order to earn a little "pin money." The system has had a most demoralizing influence upon wages and labor conditions; but, fortunately, it is, also, yielding to the factory system.

Foreigners in the Clothing Trade

The clothing trade in its expansion has felt the influence of immigration more than any other. In custom work and factory production the percentage of foreigners is larger than in any other occupation. Owing to political and ethnological conditions abroad the immigration of Jews has been enormous, and Italians have also flocked in myrids to our shores. Of these new citizens thousands take to the tailoring trade, thus enabling establishments in this line to turn out a vast increase of products. It is interesting to note how the principle of division of labor acts here. In ready-made or factory work less than one man in four is a tailor. Instead of requiring four or five years to learn the trade of custom tailor, the majority now take but two or three months to master such simple work as operating, pressing, sewing buttons and filling, although more time is required to become expert. Thus the field is open to immigrants, and is rapidly filled. Nearly all the immigrants land in New York City, which is the centre of the clothing trade. Fully one-half of the ready-made clothing of the United States is manufactured in New York City. In case of trouble, organizations of employés in other cities are met with the threat of transferring the plant which numbers them on its pay-roll to New York. In New York City the industry is practically in the hands of the

Russian Jews, who have displaced the Germans and Irish. One branch of this work, however, that of the finishing or hand-sewing on coats and trousers, is done by Italian women working in tenement houses. Tenement house work is not increasing. Legislation and agitation of the unions have caused the contractors to put their machines into buildings especially erected for that purpose. Still, in the so-called "home-finishing" Italian women do ninety-five per cent of the work, as they are content to receive twenty-five to fifty per cent less returns than those formerly earned by other nationalities. In Chicago the clothing workers are distributed more equally among the different nationalities. The Swedes, Bohemians and Jews make up one-quarter of these workers, the Poles claiming fifteen per cent and the Germans five per cent of the whole number.

The characteristics of the different nationalities in this trade make an interesting study. The position of the Jew is unique. He is not suited to hard manual labor. His instincts lead him to speculation and trade. His individualism unsuits him for the life of a wage-earner or the discipline of labor organizations. So the Jew takes to such light occupations as sewing, cigar-making, and shoe-making. Jewish women are employed less than women of other races, and their children are very generally educated, being kept in school until fifteen or sixteen years of age, and many going to higher institutions of learning. The Jew's idea of a labor union is an organization, very large and strong, to meet a single specific emergency. Their point gained, and the abuse remedied, the union usually ends. The Jew being fond of metaphysics, and interested in general principles, is apt to go into socialistic theories and neglect practical problems.

In Italy tailors earn only about one-half the wages received by the Jews in their former countries and about one-fourth of the wages paid for the same grades of work in Western Europe. The Italian is, therefore, able successfully to compete here with the Russian Jew, and far more able to compete with the German or Englishman, and there are indications that the Italians will soon form the majority of the clothing workers of New York. The Italian and his wife and sister will work in a shop together, while the Jewish woman will not work in a shop after she is married. The Italian, like the Jew, is energetic and thrifty, and will work hard with little regard for the number of hours spent in labor.

The Polish clothing workers are chiefly women. The Polish farmer, coming here, clings to work requiring hard labor, being successful in factory work, where hard automatic labor is required. In Chicago, for instance, where large numbers of Poles are engaged in this class of work, the Polish women and girls are employed in the clothing shops. Owing to the opposition of their priests, the Poles do not join the labor organizations. During various strikes, Polish shops have largely continued at work, keeping their contracts with their employers. It is in their shops that the hardest "driving" is done. They send their children to work early. Among the best people in the clothing trade in Chicago are the Scandinavians, including the Swedes, Norwegians and Danes. They work on trousers and waistcoats under contractors of their own nationalities. They do not work more than ten hours a day, as a rule, usually in large shops with steampower. Their standard of living is high, and they are very generally well educated. Among them the proportion of women who work is large. In the Swedish shops there are about five women to one man. In the Polish and Bohemian coat-shops the proportion is about two women to one man. In the Jewish shops the sexes are about equally divided, although the women are generally not Jewesses.

Women's Clothing

The manufacture of women's clothing, although now carried on almost as extensively as that of men's, was very much behind in development. At first only the outer garments, like cloaks, were ready-made; but about half a century ago the making of women's clothes began to follow in the general lines of manufacture. At first only the very cheapest garments were produced in quantity; now almost everything, from the slightest garment to the most costly dresses, is ready-made. Almost all of the countless articles of dress classed as "lingerie" are made in the factories, sweat shops, or homes. The most remarkable development in this branch of manufacturing within recent years is the manufacture of shirt-waists. The "task" system is not followed as much as in manufacturing men's clothes, but most of the work is known as "piece" work, and is done in small shops. A noteworthy change is the increase of manufacturers. Many employés have become small manufacturers, as the limited capital necessary proves a powerful attraction to the ambitious workers, especially among the women. The making of women's suits has also become a very extensive branch. It is specialized as fully as the manufacture of men's clothing, and the work demands a far greater degree of skill. Waists are made in one shop, the skirts in another, and other parts of the suit in still other shops. As a rule, ten persons are engaged in the manufacture of a single shirt-waist.

One establishment, a shirt-waist factory, in Newark, New Jersey, is called the "model factory," not because it is the largest or the most expensively built, but because of the general benefit to the employés from its construction and management. In appearance it is more like a public library than a factory. White curtains hang at every window, while the general effect is carried out with thick walls, heavy timbers and hardwood floors five inches thick. The main stairway and elevator are in a tower detached from the main building by brick walls. The inner brick walls divide the factory into three separate buildings, thus preventing any large loss by fire, and affording easy means of exit for employés in time of danger. There are two iron fire stairways outside the building, and all other inside stairways are inclosed with separate brick walls. There is a recreation room with a hardwood floor for dancing, where the girls, at noon hour, may amuse themselves, a piano being furnished by the firm. There are health lifts for those who choose to exercise, and magazines and papers for those who wish to read. A large dressing-room is provided, where all are required to hang their outer garments, instead of in the work rooms. Here also are a number of couches, where girls who may be taken ill can rest. Medicines are provided by the firm; bath rooms, soap and towels, so that baths may be taken at any time.

Dressmakers

Dressmaking establishments in the United States are as numerous as the leaves on the trees. It is impossible to count them all. The number of such establishments, as officially given, is 15,000, with 47,000 employés, and an annual product valued at $50,000,000. These figures, however, cover only the returns from the larger establishments, where many hands are employed.

Tailor-made suits for women have caused the dressmaker to look to her laurels. Of course the ready-made suits for women are not so desirable for a merchant to handle as clothing for men, because the fashions change so often. Ready-made suits cost from $7 to $100, a neat costume being obtainable for about $25. The cost of making up material to order is not apt to be less than this. Skirts are made in four lengths: 40, 41, 42 and 43 inches, the bust measures being 32, 34, 36, 38, 40 and 42 inches. These suits are altered to fit the purchaser, at a small charge in the city, but free in the country. Serges, venetians, ladies' cloth, cheviots, poplins, coverts and other materials are used. one large manufacturer in New York supplying seventy-five per cent different styles. The designer gets from $50 to $100 per week. But the dressmaker has not been driven from the field. Apart from the very rich, who must have their own individual elaborate "confections," the average woman prefers a gown, in the fashioning of which her own taste may be exemplified and her own selection and combination of material allowed. It requires originality and the artistic instinct to become a good dressmaker, but the field is always a large one. Good dressmakers, who go out, earn from $2 to $4 per day in the cities. Even a small town will support at least one good dressmaker. There are branches of the trade. For example, "making over" is one of the most profitable. Making dresses for growing girls is another, success in which is always remunerative. And in making childrens' gowns, the unconventional and original dressmaker has a large field.

A new field for woman's work is opened, and she may earn a goodly stipend as a professional mender. In cases where a regular seamstress might be thought beyond the means of the household, a mender is often welcomed and finds plenty to do. The stock-in-trade need be but a capacious work-basket, well-equipped. To mend well was considered an accomplishment by ladies of the highest classes years ago. Perhaps the advent of the sewing machine lessened the respect for hand-sewing as an occupation. In the large cities girls are taught in the public schools to mend and repair, and this gives them a means of support later, if they follow it up. A young woman who started in this industry in New York City had a pleasing success. She left her cards at the large stores and called for mending work at stated times. Her prices ranged from five to ten cents a pair for stockings, two cents each for sewing on buttons, with other repairs in proportion. Her work grew until she had to employ a messenger boy and hire several assistant menders. Other young women secure a few households and find their time well taken up and their purses heavier by attention to this branch of work.

The Fur Industry

The fur industry is one that offers material for the novelist, situations for the playwright, and themes for the poet. Washington Irving, in "Astoria," immortalized the heroic attempt of his friend, the original John Jacob Astor, to place the American fur trade on a footing independent of the Hudson's Bay Company. Theophile Gautier declared that Cinderella's slipper was not of glass, but of fur. Historians, too, have found the fur trade worthy of their pens, notably in the histories of Canada, New England, New York, Virginia, Maine, England, and Russia. In cold figures this industry makes but a small showing compared, for example, with the boot and shoe trade. And to put its modest annual output, valued at less than twenty-five millions, against the enormous value of the production of clothing proper, gives it, relatively, small importance. The less than five hundred establishments handling fur goods, the less than 10,000 hands employed by the manufacturing branch of the business, the less than $6,000,000 paid yearly in wages—in these matters fur is an industrial dwarf, especially when compared with such giants as beer, brass or biscuits. It is in northern seas that one realizes that neither biscuit, nor gold, nor lumber, offer to men occupations so surrounded by romance, sentiment and hardship as fur. All the comfort of furs, indeed, is enjoyed by those who wear them. In securing this comfort for the consumer, men to the northward have endured every hardship, have imperilled their lives, have frozen and starved.

In a fur factory one of the sights is that of a number of men treading in tubs in their bare feet. They are performing with their feet, an operation similar to that of the cook's hands when kneading dough. It seems that a barefooted man is the best machine that has yet been found for drying and softening skins. In each tub there is a quantity of hardwood sawdust. As the man treads, the sawdust absorbs any oil which the fur until now may have retained. Several stages of the process, however, have preceded that of the treading. The skins have been cleaned of fat, dried on frames, washed with soap, dried again, shorn of long hair, and shaved to a state of smoothness, the two last-named operations requiring expert hands. After all these operations comes the treading process. Then the skin is given ten or twelve coats of dye, in succession, then more washing and drying with sawdust. After a visit to a fur factory one may readily understand how it is possible for one woman to wear thousands of dollars worth of furs at one time.

A summary of the principal branches of the industry and of the principal allied occupations includes: the "catch" by fishermen and hunters, the transportation of the skins, the great auction sales in London, and the fur fairs at Leipsic, and at Nijni-Novgorod and Kiakhta in Russia and Siberia. Then there are the manufacturing furrier, the fur dealer, the jobbers of furs, dealers in hatter's furs (see hat manufacture), firms that supply the special machinery used in the fur factories, and "farmers," who make a business of raising skunks and other fur-bearing animals. At the end comes the taxidermist, whose skill may be seen in museums of natural history and in private collections—and in the windows of many furriers.

In the fur trade, New York is to America what London and Leipsic are to Europe; that is, the principal market, more than half of the fur business of the whole country being centred here. In two or three of the Western States, principally Minnesota, there are a few large establishments. In furs and manufactures of fur, the United States imports annually about twice as much as it exports. A direct report from a leading New York furrier says: "The business is in a flourishing condition and our employés all seem happy, especially the skilled workmen. We dress our own skins, saving any duty (as raw skins come in free), and make them up ourselves, so we are direct manufacturers—*i. e.* the buyer or customer does not in our case pay any middleman a profit."

The Seal "Catch"

The most important animal in the fur industry is the seal, as its skin is the most popular. Between the first and the fifth of May the seals begin to straggle in from the sea, all intent upon homemaking. The first to arrive at the Prybilov Islands, in the Alaska regions, are the bulls, who proceed to establish themselves in so-called homesteads about ten feet square, after the fashion that men in Oklahoma locate claims. These are the breeding grounds. Before twenty days have passed all the available space is taken. Now begins the season of strife, when belated bulls covet ground in possession of the early-comers, and proceed to use tactics somewhat similar to that of the human "bouncer." Mighty, then, are the daily fights, combats which end either mortally for one or both of the contestants, or in horrible mutilation. Finally, as many, perhaps, as one-half of the total number of seals on the island, having been unable to secure a home on the breeding ground proper, must live apart from the rest, as bachelors. It is skins of these bachelors which are made later into coats, muffs, gloves, caps and other apparel for those who can afford to wear them.

In the morning, early, while the bachelors still slumber, a squad of natives steal up between the rookeries and the shore. The seals awake and are confronted by humankind, their arch-enemy. Affrighted, they would take to the water—if they could. Retreat is possible only in the opposite direction, inland. So they begin their lumbering, cumbrous flight toward the villages. This exactly coincides with the plans of the natives, who follow closely on their flanks, driving not hundreds but thousands of them like a great herd of cattle, not too fast, however, but rather slowly, as the animals must not get overheated, a condition which would injure their skins.

In the hands of the natives are long clubs. When the clumsy, valuable creatures at last reach the killing grounds, the chief of the killing gang picks out, or "blocks off," about 125 seals at a time, indicates those which, because of age or wounds, are to go free, and then down upon the heads of the luckless chosen ones come the clubs of the killers. And so day after day until thousands of the young bulls have been massacred. Meantime the skinners have been doing their work with sharp knife and practiced hand, separating the skin from the body. Now comes the turn of the white man. He rolls up each skin, ties it with cord, sprinkles it with salt, packs it in a cask. About three hundred casks, each one containing forty or fifty skins, are then put aboard ship, and away they sail to San Francisco.

It should be explained that the exclusive right to take seals in the Alaska Territory was leased by the United States Government in 1890 to the North American Commercial Company of California for the term of twenty years. Thus until 1910 this company will pay the government an annual rental of $60,000, and $2 tax for every fur seal taken. The number of fur seals which this company is allowed to catch is restricted, say to 15,000 or 20,000 in a season. Other fur seals are caught, principally on Copper Island, which is close to Kamchatka, and belongs to Russia; but the fur of these seals is not of uniform quality, and is not nearly as valuable as Alaska seal. From 40,000 to 50,000 is the average of the Copper Island catch.

Nearly all of the young male seals killed under government supervision on the Prybilov Islands are taken in the month of July. This catch of seals is practically limited to animals three years old, and they are taken when in their best condition. The regulations determined by the Court of Arbitration at Paris were that pelagic or ocean sealing should not be permitted at any time within a zone of sixty miles around the Prybilov Islands; that no seals should be taken either in Bering Sea or the North Pacific Ocean between the first of May and the thirty-first of July; that firearms should not be employed in taking seals in Bering Sea. Subsequently pelagic sealing was prohibited by the government of the United States, and it is now carried on only by Canadian vessels. The skins of seals taken on the Prybilovs under government supervision are salted and shipped in small bales as far as San Francisco, where they are re-salted, packed in barrels and shipped direct to London. It is understood that no distribution of skins is made until after the entire catch has reached London. The inferior grades of skins procured by pelagic sealers can not legally be disposed of in the United States.

The Fur Companies of Canada

Although the rifle and the traps of the hunter and the gradual advance of population have restricted the range of the fur-bearing animals of the north, Canada still continues the great fur producing region of the world. The old company of fur traders that established itself on the shores of Hudson's Bay more than two centuries ago still controls the traffic. More than one-half, it has been estimated, of the furs exported from Canada are handled by this company. Its agents, ever penetrating into the trackless regions toward the shores of the Arctic, have maintained a steady supply of pelts for the market of London. The territory in which the trappers of the old company used to find fur animals most abundant and profitable has long since been conquered by wheat fields. Formerly its hunters and traders ranged from the shores of the great bay to the south and west. Now the railway, the wheat grower and the cattle raiser have taken possession of all those portions of Canada. Its present supply of furs comes from the country far to the north, along the valleys of rivers flowing into the Arctic Ocean, around the myriad of lakes in the forests of the far Northwest, and eastward toward Labrador. When all of the provinces of British America were confederated the Hudson's Bay Company gave up its privileges in Rupert's Land for a large amount of money and certain grants of land. It was a fair bargain, such as the shrewd managers of such a company would be expected to strike with the British Government; but it put an end to a great monopoly, and opened the Canadian woods to all trappers on an equal footing. The business of the Hudson's Bay Company still continues large, and it is the richest corporation handling furs in the world to-day. Its outposts and trading stations are still on the shores of the bay and along the banks of many rivers, and its vessels still pay their annual visits to the depots where furs are gathered and stored. Furs have also lost in value, because they are less in vogue than formerly. The sales of the company in London in 1901 amounted to $1,150,000, which was less by $400,000 than the sales of the previous year. It has been estimated that the sales of all the other fur companies and individual traders of Canada do not quite equal those of this single corporation.

Many of the fur-bearing animals have disappeared or become exceedingly rare. The bison or buffalo has gone, save as a curiosity in natural museums or zoological gardens. His place is inadequately taken by the "wood buffalo" of the Athabasca and Peace Rivers, which has a heavier wool than the plains buffalo. The sea-otter has also become so rare as to be considered as out of the fur market. Only one skin was sold in 1901 by the Hudson's Bay Company; and this single rare pelt was sold for $540, while in 1900 one skin brought $1,200. These figures show both the increasing rarity of such furs and, at the same time, the decreasing demand for them. The boats of the Hudson's Bay Company now resort to the far distant reaches of the Saskatchewan, Athabasca, Slave, Mackenzie, Skeena, and Stikhine Rivers, in the chase of fast disappearing animals. One of its chief occupations at present is fitting out hunting expeditions and furnishing guides and tents to the sportsmen.

London has been, ever since the establishment of the old company, the principal fur market of the world. The list of furs to be bought there still shows that the Canadian pelts dominate the market.

The fur now most highly prized is that of the silver, or black, fox, whose black fur is tipped with silvery white. In 1900 a fine skin brought nearly $3,000—the highest price ever paid. The average skins range from $50 to $100. The fur of the sea otter is next in value. In color it varies from dark chestnut to deep brown, according to age, and is very soft and fine. Of other furs from Canada, the pelt of the blue fox—the favorite fur of Catherine de Medici—is in great demand, and is worth about $30. The cross, gray, white, and red foxes are also highly prized, and vary in value from $5 to $50. The fur of the north Canadian marten is known as "American sable," and is almost indistinguishable from the Russian sable. They are worth from $5 to $20 each. The ermine is still one of the most salable furs.

In the increasing rarity of the best fur-bearing animals, recourse is being had to animals of every sort that have any fur at all. The skunk skin has become a fashionable fur, and even the rabbit furnishes thousands of pelts to the fur market yearly. The rabbit fur, when dyed a deep brown, becomes in the furrier's shop "electric seal." The skins are first dried in the sun or by artificial heat in the cabins of the trappers. No chemicals are used. The raw pelts are then packed for export. Canada exports almost all of her pelts undressed. The yearly export from the Dominion amounts to about $2,400,000. It is estimated that about $1,000,000 worth of furs remain in the country for yearly consumption, and the Canadians even import a large quantity of furs that can not be found in their forests, such as Astrakhan, tiger and leopard skins, and even skins of rabbit, wombat, and wallaby from Australia. The Canadian Government encourages the fur trade by making raw skins free of duty, and levying only fifteen per cent tariff on dressed skins.

CHAPTER XXX

HAT, HOSIERY AND LINEN INDUSTRIES

Hats and Caps—How a Felt Hat is Made—How a Silk Hat is Made—Milliners—Hosiery and Knit Goods—Linen Manufacture—Linen Thread—Men's Furnishings —Collar, Cuff and Shirt Manufacture and Laundering —The Troy Operatives

Hats and Caps

THE manufacture of caps and hats is classed among the woollen industries, though the processes of manufacture are entirely different from those followed in the ordinary woollen mill. Fur is now the principal material used. The hat you wear was probably once a rabbit running wild in Australia, for the soft coat of the rabbit is a favorite with "felt" hat makers. Millions of rabbit skins are sent from Australia every year to satisfy the American demand for "soft hats." France, Russia, Germany, and England also supply American hat manufacturers with the fur of the rabbit and the hare. Thousands of men are employed making soft hats in Danbury, Connecticut, the greatest fur hat centre in the country. Vast quantities of headwear of this class are made also in Yonkers, New York; in Newark, New Jersey, and in a hundred other places.

The manufacture of wool hats is properly a part of the felt manufacturing branch of the woollen goods industry, as the hats are made by a process of felting, a very simple but ingenious process. As it comes from the card in a continuous loop, the wool is wound upon a double cone, which is so rotated as to wind it in a zigzag manner. When a sufficient quantity has been thus wound, the double cone is divided in the centre, and two "hat bodies" are the result. Each "body" is then subject to individual treatment, the various processes of felting, dyeing, stiffening, blocking, finishing and trimming being subdivided among many hands. This industry is decidedly on the decline, the amount of capital and number of wage-earners having fallen off fifty per cent in ten years, as the result of the use of fur instead of felt as the principal material.

Cloth is also used in this industry for outing hats and caps. The American straw hat is worn the world over. The first person who had the temerity to wear a straw hat in the lobby of the Opera House, in Paris, was an American artist. Following his example, all Europe has learned the comfort of straw headwear in summer, and it has largely displaced the silk hat, even with evening dress.

How a Felt Hat is Made

The manufacture of felt hats—and reference is made now to those of which fur is the material—used to be done slowly and laboriously by hand. The process is now almost entirely accomplished by machinery and with the utmost rapidity. The process is one of the most interesting to be found in any branch of industrial work. The felt is made at the same time with the hat itself, the two processes being practically simultaneous. The first machine employed is called a "devil."

Various kinds and qualities of fur required to produce the sort of hat wanted are put into this machine, which pulls the fur apart and thoroughly mixes up the fibres. The mass is then carried to a blowing machine, which agitates it continually by light currents of air. All foreign matter is eliminated by this ceaseless winnowing, and falls through a set of sieves, which also serve to separate the more valuable pieces of fur for further treatment. This part of the process is continued until the fur is perfectly free from extraneous matter, and it is taken from the blowing machine in so fine and soft a lap that it will hardly bear a touch of the fingers. Next comes the process of hat-building, which is done on a special machine known as a "former." The fine lap of fur is parcelled out in boxes, each representing one hat. Of course, the weight and quality of the hat govern the amount of fur in each parcel, the range being from two to six ounces a hat. The "former" is a revolving cone made of brass or copper, and is pierced with a number of small holes through which an exhausting fan blows air. Small jets of water are continually thrown upon the mass to give it consistency. The fur is fed to the revolving cylinder through a tube, and the current of air draws it into the "former" and spreads it evenly over the surface. This operation takes place in a tight box, where the embryo hat is soon formed into a cone and removed by hand. After this it is rolled and pressed, first by hand, afterward by machinery, in order to "felt" it and to reduce it to due proportions. The hat is then stiffened and made more durable, by being seized and treated with an application of shellac dissolved in alcohol. The "derby" requires a stronger solution than the soft hat.

The next step is to shape the felt cone into a hat. This is done by pressing in a mold which forms both crown and brim at one process. The hat is then dyed and given its final color. After this comes blocking, which gives the finishing touches in regard to shape. All inequalities are removed by sand-papering or pouncing, which is done while the hat is turned rapidly on a revolving block. The slight nap thus raised is ironed down, so that the fur all lies in one direction. Then are added the "sweat" band, the lining, ribbon, and binding. Another blocking completes the process. The inventions of three men, Thomas Blanchard, H. A. Wells, and John T. Waring, are the basis of the modern manufacture of fur hats.

How a Silk Hat is Made

The beaver hat of old has given way to the silk hat of to-day, which is principally interesting as being one of the most popular styles of headgear ever devised. Few branches of manufacture require greater degree of skill than the production of silk hats, although, in description, the process is a simple one, and necessarily performed by hand. The "barrel" of the hat is composed of cambric, which is steeped in a strong solution of shellac, and then dried upon a stretching rack, at a temperature between 130° and 140°. A piece of sufficient size for a hat is modelled into shape on a specially prepared block; the ends being pasted together, and the top, or "lid," being secured in place by pasted cambric strips. The rim is set on after the upper part of the hat is completed. For this purpose a hole is cut in a square of cambric, of the exact size of the outside circumference of the hat, so as to permit of sliding it over the cylinder into place, where it is securely pasted, in the same manner as the lid. This square rim is then cut into the required oval shape by a machine or by hand—the greatest care and skill being required to prevent all error—after which the hat is ready for silking.

The cloth used for covering the hat is an expensive quality of silk plush, exclusively manufactured in France, the nap of which consists of long and fine fibres of silk. It is cut so that the silk threads shall overlap, when the cover is in place, and the attachment to the hat is made with strong glue composition. With careful cutting in the first place, and skilful joining of the ends around the hat, all traces of the seam may be hidden by a careful ironing. The covering on the top and rim is placed with the same care, and the under part of the rim is finished with silk cloth. The brim is now curled, first by heating, then by working into shape by hand—this is another process requiring great skill and experience—and the hat is completed, except for binding the braid around the edges of the rim; setting on the band. and inserting the lining.

Milliners

The first requisite for the successful milliner is taste. Possessed of this the young woman should enter some good work-room, or a school where millinery is taught. In the workroom she will learn the cost of materials while she is learning the trade. Girls earn six or eight dollars per week when they have finished their course of training, and upon promotion earn from twelve to fifteen dollars. Many young women go out by the day making hats, working from nine o'clock until five, and earning from two to four dollars per day. Some milliners are teachers, getting a dollar and a half a lesson in the mission schools in cities, or, when they have their own classes, fifty cents a lesson from each pupil, or one dollar for a private lesson. That the milliners' trade is a desirable occupation for women is evinced by the career of many women who have entered it. In Boston, for example, there is a firm of two sisters, who make trimming a specialty. They think it pays better to have customers bring their own hats, although supplying them if desired. Another specialty of theirs is making over old hats, which they find very remunerative. They carefully study the characteristic physiognomy and carriage of each customer, and by their tact and skill have built up a large business. At the head of the millinery department of a large Boston establishment is a woman. She is buyer and designer, and makes two trips to Europe each year. She designs every bonnet and hat in the store, and has complete and sole charge of the workroom and salesroom. She attributes a large share of her success to her ability to dispense with memoranda, relying on her memory for filling special orders. She says she finds her designs everywhere. They are suggested to her by the theatre, by architecture, statuary, pictures, and posters. Colors come to her observation from mosses, smoke, autumn leaves and berries, old gardens, vines, sunsets, birds, shrubs, hues in druggists' windows, and other striking objects. Another successful milliner, a college graduate, says it is one of the best fields for women adapted to it. She has built up a large business, enabling her to pay $2,000 per year rent for her shop. The salary of a milliner employed by others sometimes reaches an incredible sum, and fortunes are often made by women who are proprietors of millinery establishments.

In the millinery and lace goods industry, including millinery custom work, the invested capital, as officially reported, amounts to nearly $40,000,000. The number of millinery factories, so called, is 600, while the number of millinery shops where custom work is carried on exceeds 16,000. In the millinery factories 17,000 wage-earners are employed, making a yearly product valued at $30,000,000. In the custom-work millinery shops 34,000 persons are engaged, producing hats and bonnets for women of an average annual value of $70,000,000.

Hosiery and Knit Goods

Greater progress has not been made in any branch of textile manufacture than in hosiery and knit goods. By hand knitting, only one hundred loops could be formed per minute; by the earliest knitting machine the number of loops possible in the same time was increased fifteen fold; to-day the automatic machines will make as high as four hundred thousand loops, and at the same time produce a finer web, shaped into any form. Nine hundred concerns, located in every State, are manufacturing goods in this country, and eighty-five thousand persons are employed. The industry is new in the South, but in the Middle and Western States it has thriven for fifty years. New York is the leading State in respect to value of product. The chief centres of manufacture are Philadelphia; and Cohoes and Amsterdam, New York.

One of the most interesting processes of manufacture in this industry is that of knitting a stocking or sock by machinery. This is briefly as follows: The yarn is first wound on bobbins of a length to fit the machines, and from these it is reeled off as required. There are two machines employed in the work, both constructed on the same general principles, although differently adjusted for the special work by a modified form of Jacquard cards, so familiar in looms. In the first machine, the "cuffs" or tops of socks are separately knitted in a continuous piece, having raised welts to mark the end of each, so that they may be cut apart by hand in the evenest manner possible. The leg and foot part of the sock is knitted in a barrel-shaped machine having a number of needles—generally about 200, or one for every stitch—in the circumference, and disposed in the length of the cylinder, their movements being accurately controlled by a Jacquard chain, so as to produce the decreasing diameter of the ankle toward the foot; to make the turn at the heel, and to add a third thread, for extra strength, at the heel and toe. The knitting of the sock begins at the cuff, which is joined at the point of section, already mentioned, and placed upon the "transfer cup," a cylindrical machine carrying a number of steel quills, fine or coarse, according to the size of the stitches used; one quill being inserted in each stitch, in order to permit knitting on the remainder of the sock. Into these quills, therefore, the needles of the knitter are fitted at the beginning of the work, taking up the work, as it were, at the point of completing the cuff.

The same operation is followed for all weights of yarn, as well as for different materials—cotton, wool, worsted, merino or linen. The cotton yearn is usually prepared for knitting by a special process, which has for its object the production of the peculiar silky lustre possessed by machine-knit cotton stockings. Briefly described, it consists in combing the carded cotton, so as to remove the shorter fibres, to the assurance of greater strength and durability; then spinning it into fine, round, even threads, which are singly run quickly through burning gas jets, to remove all "fuzz." Two of these "gassed" threads are next twisted together, making a lisle yarn, which is reeled and then stretched on frames. The process is completed by a chemical treatment, giving greater durability and added lustre, which is improved, rather than diminished, by repeated washings. Plain-colored socks are dyed after knitting in the plain white, but the mixed and striped patterns are dyed in the thread. After dyeing, they are dried and pressed on form boards; being then placed between paper boards and put under a fifty or sixty ton weight, greatly to the benefit of the lustre and finish.

Linen Manufacture

Until very recently, the attempts to establish linen manufacture as an industry in the United States were spasmodic and unsuccessful. The reason is to be found in the fact that no fibre is produced here suitable for spinning. This difficulty greatly hampers the manufacturers. Although a large quantity of flax is grown here, its cultivation is for the seed rather than the fibre. Hence, not until American farmers find it profitable to raise the raw material will the linen industry obtain a firm foothold in the United States. As a consequence, the eighteen American establishments engaged in linen manufacture depend almost entirely upon foreign importations for the raw material. But though the industry is not extensive, giving employment, as it does, to less than 4,000 wage-earners, the prospects are, at present, brighter than at any past time. There is a promise of profit to the manufacturer who can supply the demand for linen carpet-yarns; for the vast quantities of linen thread needed in the shoe industry; and for the almost unlimited demand for towels. As a matter of fact, American manufacturers have found profit in the three fields just mentioned ever since 1897, when the tariff rates were readjusted, the duty on yarns being lowered to a revenue basis, and the duty on manufactured goods raised. Towelling, the most promising product, is now made in many of the large cotton mills.

The fact still remains that the manufacturer of the general run of linen products, finds his margin of profit small and precarious, and the market for his goods limited. The processes of manufacture require great skill and care, and are, therefore, costly. The market is narrow, because of the greater demand for articles of cotton, wool and silk, especially in the hundreds of uses to which ordinary cloth is put. Thus the linen manufacturer is limited to the products for which linen is indispensable—fine fabrics for the dining table, thread and twine where strength is required, and for the best quality of towelling.

At the present time flax is largely grown in the United States for seed, the straw, of inferior quality, when used at all, going to the tow mills or the paper mills, and being worth from one to eight dollars a ton, the average in different sections being not more than from two to four dollars. In the older States, the area under present cultivation is very small and steadily decreasing; in the newer States, or States where agriculture is being pushed steadily westward from year to year, the area under cultivation about holds its own one season with another. Cultivation for fibre is beginning to attract attention, however, and the Department of Agriculture is trying to re-establish this important industry.

Linen Thread

The people of the United States use as much linen thread as the inhabitants of all the other countries of the world combined. As in the woollen, glass, and a dozen other industries, the bulk of the linen thread business, of the distribution at least, is partially controlled by a combination. This is the American Thread Company, operating ten plants. In the mills of the combination, and in the four or five large independent mills, about ninety per cent of all the linen thread used in this country is manufactured. Instead of making the yarn here, it is more profitable to have tow spun in Ireland, and to import the yarn. Nearly all the flax used in American mills is imported.

The following testimony regarding labor conditions in the thread mills was given by the president of the American Thread Company before the Industrial Commission: We pay our labor weekly. We do not adopt a sliding wage scale, nor make the payment of labor dependent upon business success, nor impose fines or penalties. At Holyoke, Massachusetts, we have factory tenements sufficient to accommodate about one-eighth of the persons employed there. The relative rate of wages has advanced and employment has become more regular since the organization of the thread combination. In a way, the social condition of our labor has improved. By this I mean that the general situation of employés with reference to the amount that they can earn, the conveniences which are within their reach, the necessaries which they can provide, and the comforts and luxuries which are possible, has improved. In one respect, however, the social conditions of labor in our line has not improved. Fifty years ago a large proportion of employés came from native families of farmers and persons of more or less independence of position and means. That class of employés has considerably diminished.

The number of persons employed in the thread industry has largely increased notwithstanding that improvements are continually being made in machinery, and that the work is largely done by machinery. All such improvements lower price, consequently increase output, and so create an enlarged necessity for labor. Our employés, on an average, work for nearly 300 days in the course of a year. In Massachusetts they work 58 hours a week; elsewhere 60 hours a week. We do not employ Sunday labor. With reference to the workday movement, it is my opinion that if a man wishes to work, he should be permitted to do so, and to work as many hours a day as he likes. Few good workmen will take a holiday, or will ever wish to shorten hours unless they can do so at the expense of their employers.

We have never tried coöperation, premium payments, profit-sharing, or industrial copartnership. Our employés prefer a satisfactory, definite payment rather than a less amount, with a possibility of an increase dependent upon the success of the business. Workmen are suspicious of their employers. Under an arrangement of the kind referred to, they would always be in doubt whether they were receiving everything to which they were entitled. In saying this, I make no reference to a class of very superior employés who, under a profit-sharing system, would receive large payments. Such men would have the intelligence to see it, and would be sure to take care that their interests were looked after in a way that would be satisfactory to themselves.

Men's Furnishings

In the early forties a Baltimore carpenter fitted up a furnishing goods store for a man who afterward failed, obliging the carpenter to take the stock in settlement of the debt. That carpenter was Mr. Winchester, who later became the manufacturer of the firearms which have made the name famous. Forsaking carpentering to sell off that stock of furnishing goods, he became one of the first in the country to make a business of manufacturing shirts. From the start which Mr. Winchester thus helped to give the men's furnishing goods industry, it developed rapidly. To-day it has many branches—shirts, collars, and cuffs; underwear; neckwear; suspenders; and a dozen other articles, each group of articles forming a distinct department of manufacture, and each having its own special machinery.

Collar, Cuff and Shirt Manufacture and Laundering

This is indeed the most extremely localized industry in the United States, since all but fifteen per cent of the total production in the United States comes from Troy, New York. There is a story to the effect that the wife of a Troy blacksmith made the first detached collars and cuffs, and that a Methodist minister of Troy began the manufacture of these "novelties" about the year 1825.

The great majority of wage-earners employed in collar and cuff factories are women, who number about 15,500 out of a total of 17,000 hands. Few children are employed—less than 200. The greater number work under the piece system. Much of the work is done at home, and consequently there is not a town within thirty miles of Troy wherein a portion of the female population is not engaged in some branch or other of collar and cuff manufacture. In Albany, also, many women and girls are employed. Regular carriers, or stage drivers, transport the goods to and from the factories. It is said in Troy that the operatives seem to have collars and cuffs bred in the bone. This is natural, as many of them have been trained for years to perfect some small detail that may result in a superiority characteristic of a particular brand. Nearly all the great manufacturers maintain branch offices in the larger cities, and spend large sums of money for advertising.

In the manufacture of collars, cuffs and shirts, cotton forms nearly ninety-five per cent of the cloth used, leaving only five per cent of linen. One third of the total value of the products is represented by shirts. The result of the use of machinery in shirt making is that it now costs less to make a shirt and stitch it, put in all the buttonholes and put on the buttons and get it ready for the laundry, than it does to launder it, tie it up, put it in a box, and get it ready for sale.

The manufacture of some of the simplest things very often requires the most complex and difficult work. As a pin passes through six or nine hands before it is completed, so a turn-over collar represents a series of complicated processes in its manufacture. The making of a standing collar is much more simple. The manufacture of cuffs is similar to that of collars. Although there are two general classes of collars, the standing and the turn-over, there is an endless variety of each class, every manufacturer having his own styles, which vary in some slight degree from all others.

The first step in the process is the selection of the material, linen and muslin, to get the exact quality, strength and weight desired for any particular style. The material is then sent to the cutter, the webs of cloth being stretched upon a table in the number of layers or thicknesses desired, and held in position by weights. Then the patterns are arranged and the cloth is cut. The back and front are cut at the same time, the interlinings requiring a second operation. The facing of a standing collar is usually of cambric muslin, except, of course, in the case of an all-linen collar. The interlining is cut in one piece and doubled.

The next step is that of stamping, performed by girls with machines known as "stampers," which put upon the collar the name, brand, and size. The different parts are then arranged and pasted, and the article is ready for the "turners." Up to this stage the interlining is outside. The pieces are stitched at the top and sides, and the turners then reverse the collar, an operation which requires a great deal of skill and experience. If the turner works at home, the collar is then brought back to the factory, where the final stitching is done and the buttonholes are made. The turn-over collar is composed of two parts, the top and the band. The band is composed of three pieces, front, back, and interlining, and these are generally cut by stamping dies. The most delicate work is necessary in fitting the top and band, as the curved line of one must exactly coincide with that of the other.

The laundering of collars and cuffs is now one of the regular processes of manufacture. Most factories have their own laundry, the machinery of which has recently been brought to perfection. Starching and ironing are done by machinery. The final process of smoothing is done by hand in order to insure a perfectly smooth surface and highly polished effect. After this, the goods are carefully examined for defects, for they sell largely upon their appearance, and are finally boxed tastefully for the market.

The Troy Operatives

Nearly all of the establishments in Troy are either owned or controlled by men who were at one time employed in the factories, and whose enterprise and energy have advanced them to the position of managers or owners. The whole interior aspect of the factories is that of cheerfulness and cleanliness, and one could scarcely find a greater degree of neatness in a fashionable millinery establishment. The men, women, and girls employed are intelligent as a class, and those who do piece work earn good wages. Even the girls make from ten to twenty dollars a week; while it is no uncommon thing for the more skilled among the men to earn from eighteen to twenty dollars a week. Two-thirds of the cost of a collar is the manufacturing expense, and one-third is the cost of the material; hence, for every dollar spent in collars, sixty-six cents goes into the pockets of the employés.

Men are employed only in cutting the goods and shipping. These skilled workmen make, by the piece, as high as thirty-five dollars a week; others only fifteen. But from sixteen to twenty dollars a week, for fifty weeks in a year, is a fair average estimate. To acquire the trade, a boy serves an apprenticeship of three years at various salaries; three dollars a week for the first year to eight dollars for his third year; and at the end of his third year a bright boy is able to do all the work of cutting.

The women perform the various operations of running, turning, banding, stitching and buttonholing; and their wages run from six to sixteen dollars a week, by the piece, according to individual skill and industry. Much of the operation of turning, an item of importance, is done in the homes, as before mentioned; and many a wife and mother can earn little comforts for her family by turning collars after her housework is done. The women generally own their own machines and so are independent. Generally, to train a machine hand, the manufacturers take a bright girl who has been working by the week at one of the hundred small jobs, buy her a machine, and teach her how to run it. She then pays back the cost of the machine in small weekly payments, and so the manufacturer gets a new operator and the employé a chance to increase her wages.

CHAPTER XXXI

LEATHER, RUBBER AND SHOE INDUSTRIES

The Leather Industry—Tanneries—Preparation of Hides—Tanning Processes—Currying—Finishing—The Boot and Shoe Industry—Export Trade and Prison-made Shoes—Shoe Factories and Machinery—Process of Shoe Manufacture—Saddlery and Harness—The Glove Industry—Process of Glove Manufacture—The Rubber Industry—Manufacture of Rubber Articles—The Rubber Supply

The Leather Industry

THE rude and clumsy shoes worn by the working classes of Europe appear to us not only outlandish, but mean and uncouth. The reason is that the American people of all conditions in life are better shod than any other nation. This is due to the development achieved by our scientific and business experts in tanning, one of the industries in which America has been able to overcome the handicap of low wages abroad, and in which American manufacturers, while paying higher wages, compete successfully with foreign manufacturers. Yankee ingenuity has furnished an improved and scientific method of tanning. By this new chemical process a glazed kid has been produced that has driven French kid from the country and has even secured a foothold in France; for the American glazed kid has these three advantages over the imported: it is more durable, it withstands exposure to the weather better, and it is cheaper. Not the least of the advantages is the fact that French kid sells for seventy cents a square foot, while glazed kid is sold at twenty-five cents. It was supposed at first that this new chemical process would apply only to goat skins, but experience has shown that it can be applied to leather of all kinds. Further development of the leather industry depends, moreover, not upon mechanics, but upon science to accelerate and cheapen the tanning process, and here lie great opportunities for chemists. Thirteen hundred tanneries are engaged in making the leather that goes literally into the American's pocket-book; into his shoes, boots, gloves, and riding breeches; into the harness on his horse; into the books in his library; into the farmer's implements, the mechanic's tools, and the manufacturer's machinery.

The hide of the ox, the cow or the horse is in the soles of our shoes, in the harness, in the belting. The skin of the calf is in shoe-uppers and in books. The skin of the sheep or the goat is in whips, aprons, cushions, gloves, and the shoes of our little children. The skin of the hog is in our travelling bags and saddles. The skins of dogs supply half the gloves we wear; the skin of the porpoise many of our shoe-strings. To the tannery come also the skins of the deer, alligator, hippopotamus, buffalo, kangaroo, shark, walrus, rhinoceros, and elephant. Thus thousands of men in the four corners of the earth and up and down the pathless sea are catching, killing, skinning, that we may have these conveniences. About fifty thousand persons are engaged in the tanneries of the United States, and the total capital invested is about $174,000,000.

Leather and its finished products forms the fifth of the great groups of national industries. It includes the leather itself in its many forms, tanned and curried, patent and enamelled, and morocco; also the finished products, the most important of which are factory-made boots and shoes. Products second in importance are saddlery and harness, trunks and belting. The United States is the only country in which factory production of boots and shoes has driven out the hand-made article. Altogether, the development of the entire leather industry is the result of American enterprise, both as to machinery and methods. All the great leather manufactories are equipped with numerous appliances for manipulating the hide during the various stages through which it passes from the lime vat to the leather stretching and measuring machines; also in use are many patented presses and compounds for tanning, tawing and depilating hides and skins—most of these appliances and processes being American inventions. The number of establishments is not as large now as in years past, because of the combination of the majority of the tanneries. Since the formation of the combination more women and children have been employed in this industry than ever before. Wages have increased six per cent. Pennsylvania has long been the leading State, due chiefly to the fact that an abundant supply of hemlock bark for tanning (sole leather) is near at hand.

Tanneries

In the tanning industry many radical changes from old methods have been introduced. The leather manufactory is now equipped with numerous appliances for manipulating the hide on its way from the lime vat to the stretching and measuring machines. There are many patented processes for tanning and tawing, as well as for depilating hides and skins. The bark mill has been the subject of many improvements, to the great advantage of the tanner using oak, hemlock, or union tannages. Former defects are overcome by saw grinders or cutters. The resultant material is so leached that the utmost of the tannin is extracted. In the handling of the hides, the reel, the rocker handler, and the skeleton drum have greatly simplified the work and reduced its cost. The processes following the removal of the leather from the bath have also been much improved by mechanical scrubbers, power rollers, scouring and stuffing wheels, and stretchers.

Formerly oak and hemlock bark furnished all the tannin, but now there are several substitutes, tannages being made not only from hemlock and oak barks and their extracts, but also from gambier, sumac, and quebracho, and from chemicals. Mechanical devices have shortened the time required for tanning. In the case of kid, hyposulphite of sodium added to the chromium compounds makes the tannage more permanent, besides reducing the time consumed in the process. This has proved a most important discovery to the trade.

Preparation of Hides

The processes employed in the tanning of hides differ, in the first place, as the specific quality of the hide, which is to say, as the physical characteristics of the animal yielding it; in the second place, as the use it is intended to serve. Sheepskin has larger fibres than other common shoe leather, yet, because the fibres are arranged in parallel lines, especially under the legs and flanks, it is not suitable for producing very strong leather. However, because of its flexibility and properties of readily absorbing color dyes and special finish, it is almost universally used for fancy articles, satchels, pocket-books, and the like. Goatskin has most of the advantageous qualities of sheepskin, but, because the fibres are shorter and generally interwoven, the leather has a much stronger grain and greater durability. It is suitable for vamps, quarters and tips in men's shoes, as well as for slippers, low shoes and general trimmings, and, owing to improved processes of tanning, is supplanting calfskin in almost every part of shoe manufacture. The qualities of goat leather depend on whether the skin be from wild or domestic animals, and also upon the climate in which they lived. For these reasons we have the several well-known species of goat leather, such as "Tampico," "Curacoa," etc. Calfskin is unequalled for tips, vamps and quarters, when finished on the flesh side, and is useful for nearly every part of a shoe, when finished on the grain. All of the hide is suitable, except the flanks, where there is a decided tendency to looseness. Owing to improved processes in tanning, several other varieties of hide are now in common use for shoe manufacture, notably horse, kangaroo, porpoise, seal and alligator. The hide of a horse furnishes only a single small piece of leather, from the flank, about three feet long and about half as wide. It is commercially known as "Cordovan" leather and furnishes most of the tan and russet stocks. Alligator leather is made only from the skin taken from the underside of the reptile, that on the back being composed of hard, brittle scales. Kangaroo, like horsehide, has a strong flexible texture; is almost impervious to water, and has a grain twice as thick as that found in any other skin of its size and weight.

Tanning Processes

When the hide is removed from an animal it is prepared for transportation to the tanner generally by being salted in order to arrest tendencies toward decomposition. The first stage of the preparatory process in the tannery is soaking in soft water, below 70° F., and milling, until the natural softness and flexibility are restored, and all blood is expelled. As soon as this end is attained, the hide is ready for removal of the hair, which with green hides is accomplished by "liming," and with dry hides by sweating. In the former process, the hide is immersed in a bath of milk of lime from three to six days, with the result that caustic action loosens the hair sheath, and renders the hair readily removable. Sulphide of soda, or of arsenic, has been mixed with the lime, greatly facilitating the process by forming sulphide of calcium and acting as a solvent on the hair itself. The sweating of dry hides is accomplished by hanging in a closed room, whose temperature is about 70° F., the result being that incipient decomposition attacks and liquefies the hair sheaths, thus loosening the hair. After either the lime or sweating process, the hide is ready for the beam, on which the hair is scraped off, generally by hand.

The tanning process, which has for its object converting the hide into leather, consists of immersion in a solution of tannin for an extended period. Tannin is produced by grinding the bark of the oak, hemlock, cork, and several other varieties of tree, although oak and hemlock are most commonly employed in this country at the present time. In the manufacture of sole leather a liquor produced from either bark is used, the product being named accordingly; while a third variety, known as "union," may be produced with a liquor of both. The object of using such solutions is to cause the tannin to unite with the substance of the hide, thus increasing its weight as much as fifty or eighty per cent. For this purpose free sulphuric acid is frequently added to swell the hide, when hemlock liquor is used. A weak tanning liquor forms the first bath, the strength being increased as soon as the chemical affinity of the hide for the tannin is satisfied. As the process progresses, and stronger liquors are used, the acid formed by fermentation of sugars in the tannin causes the hide to swell, or "plump," thus increasing its physical absorption capacity, and insuring a greater weight for the finished product, with a greater quantity of vegetable substance in actual union with the original animal tissues. Should the strongest and most concentrated liquors be used first—they contain from 5 to 6.5 per cent of tannin and have a specific gravity of about 1,060—the result would be the formation of an impervious tanned layer on both surfaces of the hide, retarding further penetration of the liquor and preventing the desired "plumping" effect. As a consequence, the strength is gradually increased through a period of between four and seven months, at the end of which period the hide is completely converted into leather, its weight being increased by the absorption of tannin to the limit of its capacity. The tannins from some sources have a greater capacity for increasing the weight of leather than those from others. The process is also economical, in that the tannin does not change its essential properties, nearly the whole residue being recoverable from the solutions. After tanning, sole leather is finished by glossing several times with brass rolls, the leather being further dried after each treatment. Various schemes have been employed for shortening the period of tanning, by the use of an electric current, and by various mechanical devices. However, the older processes are still the most general, being considered also the most reliable and economical.

Within a few years the process known as chrome tanning has engaged considerable attention, and been used extensively for calf, kid and cowhide leathers, although with little success for sole leathers. Its most general use is in the tanning of leather for uppers. Briefly described, the process consists in the use of baths of chromium salts solutions, either the one-bath or two-bath method being employed. The one-bath process consists in subjecting the leather to a single bath of neutral solution of chromic oxide; the two-bath process of using, first, a solution of bichromate of potash, chromic or muriatic acid, followed by a reduction bath of hyposulphite of sodium, sulphuretted hydrogen or some modified combinations with hyposulphites. A mordant bath of tannin generally precedes, in order to impart the desired coloring, which can not be obtained from chrome dyes, although other processes are now occasionally employed. The principal advantages of the chrome processes are the soft, pliable and close-textured character of the leather and its ability to withstand the effects of water. It has also an immeasurable advantage in point of time consumed, a few hours only being required to convert the prepared hide into leather.

Currying

The tanning completed, the processes of currying, splitting and retanning generally follow, for the purpose of bringing the leather to the desired point of perfection. Currying includes all the processes of softening, dressing, polishing, "slicking" and finishing, which make the leather pliable and elastic. The rough, or "crust," leather, tanned by a vegetable process, is often softened by agitation in a bath of borax water. It is also filled with grease to keep it soft, after which it is in condition for succeeding processes. With leather intended for uppers of shoes the hide is generally split from head to tail, at a certain stage in the soaking process, by being pressed through rollers against a moving band knife. This leaves the grain, or hair, side of full size, as being the most valuable for leather, while the flesh side, thus cut away, may be ragged and require trimming. Both sides are then returned to the tanning vats, where, on account of the untanned portions being directly exposed to the action of the liquor, the process is more or less rapid, according as the leather is thick or thin. When this retanning process is finished the currying proper begins with "stuffing," or the insertion of grease or oil, by immersing the hides in a mixture of various oily substances, alternately lifting them out and dropping again, on a drum studded with protruding pins. It is then set out on hardwood tables with stone and steel hand tools, called "stickers," and, when perfectly smooth, is hung up to dry. The desired thickness is also attained by "shaving" the fleshy particles with a hand or machine knife. "Pebbling," or roughening the surface to imitate some particular varieties of leather, is done by finishing on metal rolls having the desired designs cut or engraved on their circumference. Only leather for some grades of shoes or for fancy articles is thus treated, glove leather and general shoe leather being finished smooth.

Finishing

The process of blacking the leather consists in making a preliminary coating of logwood water, which, after drying, is followed by finishing into embossed, smooth or pebbled leather, as desired. The blacking or finishing is applied by machines or by hand, followed by treatment in the glazing or rolling machines, which complete the work impracticable by hand. The preparation of the so-called "patent," or enamelled, leather is somewhat more complicated. A warm preparation of lampblack and linseed oil is evenly spread on the flesh side of the skin. Having been allowed to dry thoroughly for several days, it is smoothed by machine or by hand with powdered pumice, which leaves only the "root" of the coat perfectly smooth. Another coat of a mixture of fluid black and turpentine is then laid on and allowed to dry. After drying the skins are allowed to settle in piles for several weeks, being then tacked up and varnished. A baking follows in a moderate temperature, which is gradually raised during two or three days, after which the leather is sunned for about ten hours, with the result of oxidizing the varnish and completing the process. Chrome tanned leathers are varnished on the grain side, and particular care is necessary to insure firm adherence of the first coat. This quality of enamelled leather is superior on account of the flexibility, which is not possessed by that prepared by the older process. Bark tanned leather must be washed in a "tumbling wheel," in order to remove superfluous tannin and soften sufficiently for enamelling.

The Boot and Shoe Industry

The boot and shoe industry supports one hundred and forty thousand factory hands, and furnishes a livelihood for tens of thousands of salesmen in shoe stores and on the road. Although nearly every State and Territory has its shoe factory, still "ye olde-time cobbler" plies his trade in his small way. One man in a modern factory, however, with machines that almost think, can turn out more shoes in a day than a dozen men on the bench in times past. And though the shoemaker in the factory makes but a part of a shoe, never a whole shoe, he earns from $12 to $24 a week, or more than the old-time shoemaker earned on the bench after serving a seven years' apprenticeship. There are only a few corporations engaged in shoe manufacture, the majority of the concerns being partnerships. New England is to the boot and shoe trade what Pennsylvania is to the coal industry, what the Southern States are to cotton-growing. The shoes worn by two out of every three inhabitants are made in New England; for ever since 1860, when the introduction of sewing machines for sewing soles to uppers was invented, New England has manufactured nearly two-thirds of the total output of American shoes. The greatest shoemaking State is Massachusetts. Of a total of sixteen hundred factories in the country, this State has nearly seven hundred, and the value of the goods turned out constitutes fully fifty per cent of the total value of the country's output. In all the New England shoe factories higher wages are paid than in factories in other sections, and the individual workman makes more shoes in the course of a year than workmen elsewhere. Brockton, Massachusetts, has in recent years supplanted Lynn as the largest producer of boots and shoes, having an output of $19,844,397. This exceeded the output of Lynn, in 1900, by $3,013,664. Haverhill, Massachusetts, ranks third, although her output shows a decrease of $905,912. Business for 1900 was below normal. And just before that time one of the largest shoe manufacturing establishments of Lynn removed to Boston. In New York State, especially in New York City and Rochester, the industry has attained great prosperity. Many fine shoes for men are made in Newark, New Jersey. Philadelphia has also added a large manufacture of shoes to its other industries. Cincinnati, St. Louis, Chicago and various towns in the West, as far as the Pacific Coast, maintain large and successful shoe factories.

A number of shoe factories in European countries are now using American machinery. Germany, especially, is placing large orders, and one American concern is not only shipping machines to Germany, but in the heart of Frankfort it has set up a small factory with American superintendents and several American workmen. The rolling machine was the first practical mechanical substitute for hand labor. Since its introduction there has been a constant progress in shoe machinery, until, to-day, there is a system involving more than 100 operations, forced by competition upon the trade in general. Fewer hands produce a given quantity of work. In operating the lighter machines many women are employed. Children in many cases do the work formerly done by women. The total amount of wages is therefore reduced. It is now the custom for many boot and shoe manufacturers to purchase from cut-stock dealers an equipment of outer soles, inner soles, taps, heels, etc., already prepared. It follows that a smaller number of employés are found in the sole-leather department of many establishments.

While sixteen hundred shoe factories are reported officially for the entire country, over twenty thousand shops make shoes to order. But the yearly value of all the custom-made shoes is less than one-twenty-fifth of the value of the factory output, and the number employed in these shops is only about one-tenth the number of hands employed in the factories. So almost completely has machinery crowded out hand-made shoes, so thoroughly has the industry been revolutionized since 1860, that it is now possible to obtain at any shoe store footwear of every variety quite as satisfactory as the made-to-order kind, and at a much lower price.

So great is the variety of ready-made shoes that wholesale dealers are obliged to carry immense stocks, some houses in the sale season having more than $1,000,000 worth of boots and shoes in a single building. In marketing shoes, attempts are being made to eliminate the jobber or middleman, so as to make necessary but one selling profit, the dealer's. Many manufacturers have even opened stores of their own in all the large cities, thus retaining for themselves the dealer's as well as the manufacturer's profit. This, of course, affords the manufacturer opportunity to sell a better shoe for a given price or to make a larger profit, as he chooses. There has not yet been formed a combination to control the shoe industry. Such a combination, even if it were possible to buy up every shoe factory now in the country, could scarcely retain control; for machinery has so reduced the cost of production that hundreds of manufacturers would open small factories as competitors, putting shoes on the market at prices as low as those of the combination. The fact that the Western, Middle, and Southern States employ a larger capital than the New England States is owing to local conditions. Many of the manufacturers in those States dispose of a larger proportion of their products directly to the retailer. The retailer gets a longer credit than the "jobber." Manufacturers selling to the retailers are likewise obliged to carry in stock a large quantity of manufactured goods, to be used promptly upon emergent demand. Then again the manufacturers of the Western, Middle, and Southern States are compelled, as a rule, to buy their raw materials in larger quantities.

Export Trade and Prison-Made Shoes

American imports of leather do not include shoes. Practically no shoes are imported. American shoes, on the other hand, are finding their way to the feet of the inhabitants of foreign countries, at the rate of about one and one-half millions pairs a year. Great Britain ten years ago recognized the fact that the best shoes in the world were made in America, the Yankee shoes having all the beauty and grace of the French shoe without its flimsiness, and all the stability of the English shoe without its clumsiness. The principal markets for American shoes, besides Great Britain, are Australia, Canada, the West Indies, Mexico, and Central America. A large trade is also being developed with Cuba. In fact, there is no reason why there should not be a large foreign trade in American shoes. The supply of the domestic product of hides and skins is constantly increasing. Manufactures of leather can compete both in quality and price with foreign markets. American tact and ingenuity have adapted styles of footwear to the demands and fads of other countries. In 1901 the exports amounted to $5,-526,290. If all the factories in the United States were to run at their full capacity for seven months in the year, they could produce all the shoes used at home and exported in a given year, their maximum yearly capacity being nearly 400,000,000 pairs.

Thousands of boots and shoes are made by convicts in various prisons. In the consideration of this form of labor we are confronted by two facts. In the first place, the State can afford to conduct its penal establishments without making money out of them. But, in the second place, work of some kind must be found for the convicts. In the manufacture of boots and shoes there are many advantages for the authorities of prisons, who are looking for remunerative work for the men and women in their custody. There are so many operations in making a shoe that all classes of convicts may be employed in this industry. In some States prison labor is leased to shoe manufacturers. In others the business of shoe making in prisons has been conducted on the State's account, and very often with poor results. Labor organizations have opposed the employment of convicts in this field, as having a bad effect on the market and thus affecting wages, convicts working nearly every week day of the year.

Shoe Factories and Machinery

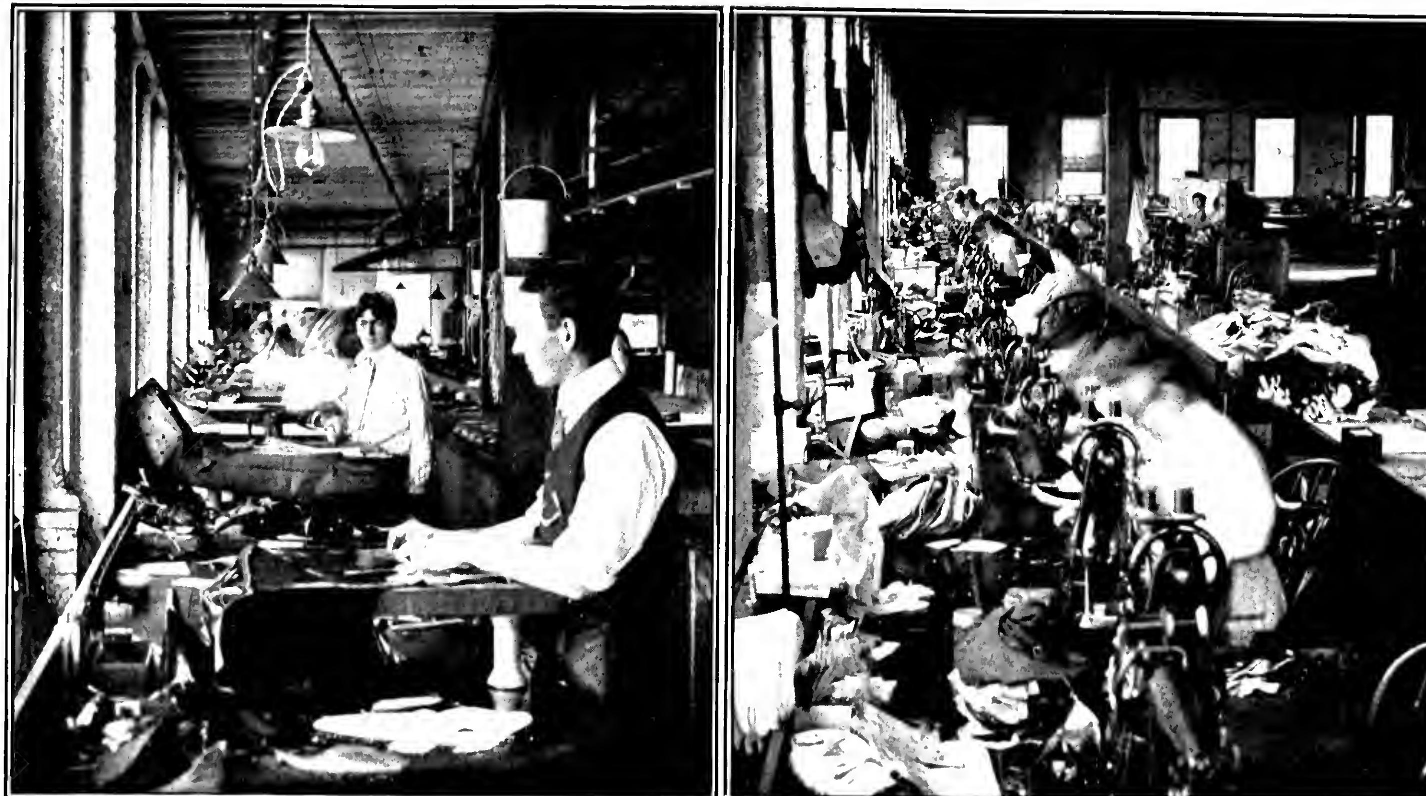
A visit to a shoe factory reveals some of the marvels of the machinery world. Here is a machine that will sew the soles of nine hundred pairs of shoes in a day. Here is another which, with the same speed, not only sews the soles, but trims the heels. In a welt machine the sole is sewed to the welt. The buttonhole is a thing of comparatively small importance in the shoe, but the buttonhole made by hand represents time-consuming, laborious work. The buttonhole machine, which is used on shoes as well as on shirts, collars, and the like, is capable of making ten thousand buttonholes in a day.

A shoe factory in Lynn once illustrated the results of the minute distribution of labor by making a pair of shoes in twenty minutes. To bear witness that the feat was actually accomplished, the shoe-mill owners called in a notary public, who watched the operation, as a judge watches a horse-race, watch in hand. Twenty-six pieces of leather were used, as well as fourteen pieces of cloth, twenty-four buttons fitting the same number of buttonholes, twenty nails, eighty tacks, two box-toes, two steel shanks, and twenty yards of thread. The usual process of manufacture was followed, and it required sixty different operators and forty-five machines; but in less time than the cobbler would require to sew on half a dozen buttons the pair of shoes was ready for the feet of the wearer.

In no branch of manufacture has there been greater and more radical improvements, both in methods and results, than in the making of shoes. It is possible, with the use of machinery, to produce stronger and more durable shoes, because the parts can be more securely joined together, than by the most skilful hand work. Also, because the machines employed at different stages of the work can stretch the leather much more perfectly and more evenly than could the strongest and most expert cobbler, it is possible to produce a greater variety of permanent shapes and sizes, to suit all kinds of feet.

Process of Shoe Manufacture

On account of the necessary use of intelligence and experience, the first process in the manufacture of a shoe, that of choosing and cutting the



OPERATIVES IN A SHOE FACTORY

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leather, must be done by hand. This is true on account of the natural properties of the hides, which invariably possess a vast difference in the quality of the leather taken from the various parts, also, such individual peculiarities as render all rules only generally correct, and the necessary subject for a trained judgment. As a rule, the backs and hind quarters of a steer's hide furnish the material most suitable for outer soles, as possessing the necessary toughness and closeness of grain: while the leather from the shoulders and heads goes for insoles, and that from the belly for heels. In judging and cutting up a hide, however, the workman must be able to discern, by sense of touch, the "soft spots," which in calfskins, for example, usually occur at the ends of the thigh bones, and, in many varieties of hide, at places in the line of the backbone, although at precisely the same spot in no two individuals. Long experience is also necessary to enable the cutter to know for what parts of a shoe the several qualities of leather are most suitable. The same is true of the different kinds of leather: thus goatskin and gray kangaroo leather are most suitable for the toppings, while "waxed" calf is nearly indispensable for tips and vamps, leaving the inferior grades for lace stays, tongues, etc. These points thoroughly determined in each case, the hides are marked out into squares and cut up; the numerous parts of each pair of shoes being cut and sent in one package to the various machines.

The work of making the several uppers is divided among many sets of workers, one set preparing the top linings, another stitching the facing and tongues, another the backstays, another sewing together the two complete pieces of the top, and, finally, the vampers, completing the work by joining the top to the vamps by several rows of stitches. The upper is stretched over the last by the lasting machine, being firmly clutched by four heavy iron "hands," two on either side, while a pair of iron "jaws," at either end, stretches the leather lengthwise. In this position the upper is mechanically tacked upon the insole and the last, and is now ready for the several stitching machines. The first of these is the automatic welter, whose function it is to firmly stitch the insole and upper to the encircling strip of leather, about one inch wide, known as the "welt," which is a distinctive feature of machine-made shoes. To accomplish this end, without the use of nails, it is necessary to employ a machine having two heavy curved needles, somewhat resembling the beaks of a parrot, which are able to perform the operation in spite of the peculiar relative positions of the two parts. One needle acts as an awl, the other, having a barbed head, draws the thread through the welt and overlapping edges of the upper, into a channel cut out around the edge of the insole, and out again—this operation would be impossible with a straight needle—the securing tacks being automatically drawn as the sewing operation proceeds. The shoe is now ready for the attachment of the outer sole, except for the preliminary process of "filling in," which is performed briefly, as follows: The edges of the overlapping upper are first trimmed down even with the inside edges of the welt. Then a strip of steel is laid along the instep from the heel, with a piece of leather, to give the necessary stiffness, and the hollow space along the ball of the foot is filled with skivings of sole or scraps of upper leather, with specially prepared felt or a preparation of ground cork and rubber cement. The objections to the use of skivings is the annoying tendency to squeak; hence, the cork filler is generally preferred for high grade shoes. The filling completed, the whole bottom of the shoe is daubed over with a sticky cement, upon which the outer soles are pressed fast, preparatory to trimming. The trimming machine shaves the edges of the sole around to the shape of the outside of the shoe, also cutting a channel around the bottom, so as to hide the stitching, thus giving the smooth finish. The process of stitching the soles to the welt is accomplished with the same kind of a curved-needle sewing machine as is used for welting, about 200 lock stitches with 13-cord thread being made in each sole.

Another sewing machine of recent invention, which is coming into increasingly extended use, is that known as the "double clinch machine"; its operation consisting in fastening a section of wire, taken from a coil, driving it through the leather of both outsole and insole and clinching it at both ends, at the same time making and closing the stitch channel as the work progresses. The result of superior flexibility and comfort is thus attained much more completely than by some of the other methods of stitching in common use.

The stages now required to complete the shoe are the levelling of the sole and the attachment of the heel, both of which are rapidly accomplished by machinery. The heeling machine contains a nail hopper, from which the required number of nails are fed into position, so that by the swinging of an arm all are driven home at a blow, and the shoe is complete, except for some final finishing and smoothing.

One of the greatest improvements in the practical manufacture of machine-made shoes is found in the great multiplication of lasts of all possible sizes, both as to length and breadth, which is the result of years of experience and observation. The principal points considered in the production of improved scientific lasts are concerned with questions of the stress of the foot, changing the shape of the shoe, and tending to cause wear at different places. An exhaustive study of these conditions confirmed the conviction that the old-fashioned lasts were defective in numerous particulars, and, as a result, we have at present highly elaborated models, shaped to provide for nearly every possible requirement of use. The improved hinged last, largely used in shoe factories, can be removed from the shoe without that injury to the shape which was frequent with the older styles.

Saddlery and Harness

There are fourteen million horses and over two million mules in the United States. These must be supplied with harness and saddles. To meet this demand nearly thirteen thousand establishments in one hundred and sixty cities are required. Over $43,000,000 is invested in these establishments, and over twenty-five thousand hands produce annually about $60,000,000 worth of horse-collars, bridles, reins, saddles, and other harness. Cincinnati is the leading harness-making centre of the country, St. Louis ranking second. The remaining principal cities are New York, Chicago, Louisville, Newark, and Baltimore.

The Glove Industry

The manufacture of leather gloves and mittens is carried on in nearly four hundred factories, giving employment to about 15,000 persons. The majority of the establishments are conducted on the individual plan of organization. The industry, for the most part, is centred in New York—particularly in Fulton County—this State having sixty-three per cent of the whole number of establishments in the glove and mitten industry. Sixty per cent of the Fulton County establishments are located in Gloversville. Nearly all the factories in Fulton County are owned by local men who have risen in the trade from the cutter's table to the proprietorship. Everything tends to make the industry local. The expert laborers own their own homes, and the manufacturer is able to depend on the farmers' families for a great deal of work.

Glove making is mostly done by women, with the exception of the operation of heavy machines for wax-thread work and palming, and the cutting and preparation of the skin. Almost all of the persons employed are piece-workers. Much of the work is and always has been done at the homes of families, the members of which are unable, from the stress of other duties, to take employment in a factory. So general is this custom of home-work that many of the large manufacturers in Gloversville and Johnstown, New York, employ teams to distribute and collect the work of the home-workers.

All stitching on the backs of gloves is done in factories before they are sent out. The price of making varies from twenty cents per dozen for the cheapest gloves to one dollar per dozen for full outseam grades. A general average of earnings is about ten dollars per month, although there are many women who average seventy-five cents per day. There is not so much work sent out to farms as was formerly the case, as many of these workers have moved into the glove-making towns and are taking work daily from the factories. The number of female operatives in the factories is somewhat less than formerly. The total earnings of farmers' families in glove making is about $125,000 per year. A girl can learn to make common gloves in a week. All the silk and thread is furnished by the manufacturers. Only the high-priced work is made in factories. Our American manufacturer is able to reproduce the best points of all the foreign makes and combine them with his own. In men's fine gloves, for instance, he can produce an article quite as good as those of any foreign manufacture, the American glove being more durable and better fitting. Improved facilities for tanning, coloring and finishing have made this possible, together with the great immigration of expert glove makers and leather dressers from Europe. The manufacture of ladies' fine gloves has not been largely attempted, owing to the difficulty in obtaining the finest grades of skins, which are generally monopolized in Europe. Lower wages in Europe also hinder competition here. The American workman prefers to turn out the cheaper grades of gloves because he can cut and make more during the day than if he were employed on the finer grades, thus increasing his earnings.

The ordinary grades of gloves, as well as many of better quality, are largely made of leather from sheep or lamb skins, which are peculiarly susceptible of being worked into many different colors and textures, according to the manufacturing processes employed. Heavy gloves are variously made from buckskin, horse leather and cowhide. The finer grades of gloves are made from the leather of the goat, kid, lamb, antelope, calf, chamois and reindeer, as well as from the hides of South American and Mexican deer and Arabian sheep. Among the better known glove leathers are the "jacks," from the hides of Para deer, and the celebrated "Mocha," from a variety of sheep native in Arabia, Abyssinia, and the region around the headwaters of the Nile, which takes its name from the circumstance that this variety of skin was first imported with a shipment of Mocha coffee in 1877. Most imported skins come in the form known as "fleshers," from the fact that they have been split, so that, after the removal of the grain, the flesh side may be used for bindings.

Process of Glove Manufacture

The first step in the manufacture of gloves is "hand-staking" the hide in a frame constructed of two upright and two horizontal bars, arranged to hold it firmly, while the stretching is done by pressing with a blunt spade-shaped tool, having round corners and a handle to be held under the arm. Oil-dressed hides are then split by a special machine, and shaved to the required thinness either with a moon-knife or a dowling chisel; in the former case being hung upon an elastic pole, in the latter, laid, flesh-side up, on a marble slab, so as to allow the knife edge to work down all inequalities.

Gloves are cut by either one of two processes—block-cutting and table-cutting. The first consists in laying the leather on a block of hard wood, set end up, placing the die upon it and cutting out the shape with a sharp blow of a maul. In the second, the hide is dampened and stretched to the limit over a table, after which the length of a glove is cut off and stretched to width, the fingers and opening being cut out with die and press. Table-cutting is preferable, as producing a more elastic glove and a closer fit, although block-cutting is very suitable for the heavier and cheaper grades that are not required to fit snugly. European workmen, on account of their superior training, and consequently greater expertness, are usually employed as table-cutters, although, because of the difficulties of the operation, no more than one in three apprentices ever becomes excellent; the required nimbleness of the fingers and quickness of movement being inherited, rather than acquired, even by the longest experience. The sewing and finishing of a glove is divided among a number of workmen, each of whom performs only a part of the operation. The first are the "silkers," who embroider the backs; being followed by the various "makers," who sew the fingers, insert the thumbs, "welt," or hem, around the wrist, and "point" in the ornamental lines on the back. The process of cleansing the glove, begun with the insertion of the fourchettes, between the fingers, may be followed by stitching from the end of the long seam toward the little finger, or from the point of the index finger to the end of the long seam. The completed glove is stretched over a metal hand, and "layed off" by treating with steam to give shape and finish, after which it is ready for inspection, sorting and forwarding to the stock room.

The most notable of the glove-making machines is named in the census report as the multiple-needle machine, for stitching the back of gloves, which sews two, three, four, and even six rows at the same time. The automatic trimmer, which is attached to the head or needle bar of the machine, was introduced in 1893, and has greatly facilitated the making of outseam gloves, and it also trims the leather much better than do shears. Among the other machines which have given satisfaction are the ornamental stitch, the zigzag stitch, and the overstitch, the latter being used to close the edges of the seam from the outside.

The Rubber Industry

Comparatively little use was made of rubber before Goodyear was led by his genius to the discovery of a scientific treatment of the crude article which gave to the world a new, commercially available product, of extraordinary value in advancing the arts of modern civilization. Rubber has now become a vital necessity, its production assuming vast proportions, and its importance to Americans can be judged from the fact that one-half of the rubber manufactured throughout the world is consumed in the United States. The rubber factories in the United States use yearly over sixty million pounds of rubber, turning it out again in a thousand different useful articles. Thirty thousand persons in over two hundred and fifty factories in America are supported by the various branches of rubber manufacture, and their wages are seventy per cent higher than the wages for similar work in any other country.

The principal combination in the rubber industry is the United States Rubber Company, which controls five plants and is capitalized at $50,000,000. Its earnings amount to $4,000,000 a year. One of its important items of manufacture is two hundred thousand pairs of boots and shoes each day. Its product of all classes of goods represents two-thirds of the rubber business of the country. The combination next in importance is the Rubber Goods Manufacturing Company, also capitalized at $50,000,000. This company controls fourteen plants and earns $2,000,000 yearly. With the exception of boots and shoes, it makes all kinds of rubber goods.

The five important divisions of the rubber industry are: (1) footwear, (2) mechanical goods, (3) clothing, (4) druggists' sundries, (5) hard rubber.

Over thirty per cent of all the manufactured rubber is in boots and shoes. This single branch of the industry gives employment to more than fourteen thousand workmen. The value of the actual output of rubber shoes and boots in a year is more than $40,000,000. The largest factories are in Massachusetts, Rhode Island, and Connecticut. While the United States turns out two hundred thousand pairs of rubber shoes a day, Europe produces another thirty thousand pairs. Americans manufacture also $350,000 worth of rubber shoes. The annual value of tires of all kinds is $22,000,000; mechanical rubber goods, $13,000,000; horse coverings and like goods, $12,000,000; rubber-covered wire, $10,000,000; hard rubber goods, $6,000,000; mackintoshes, etc., $6,000,000. Millions of bicycle and carriage tires are also manufactured. To-day the carriage or light wagon that has not a rubber tire is considered old-fashioned. Rubber tiring, indeed, ranks next in importance to hose—the miles of hose in gardens, railroad cars, and a hundred other places where water, steam, and gas are used. Then comes rubber belting, packing, and matting. Notice the rubber mats on floors and stairs, on shore and aboard ship! the mats under ice pitchers, the mats on the cigar stand for change! Typewriter manufacturers need rubber in immense quantities for the rollers; billiard tables require a quarter of a million dollars' worth of rubber every year; the carpet sweeper takes one hundred thousand dollars' worth; the tiny pieces of rubber sunk into lead pencils for erasers would weigh tons if collected in one pile; the rubber rings on the jars of preserves represent a huge fortune, one company alone using several hundred thousand pounds a year in such rings; and there are immense values in rubber in the shape of rubber balls and rubber stamps. Baseball and football players alone use a million dollars' worth of rubber every year. Trenton is perhaps foremost in rubber manufacture, having more rubber manufacturing concerns than any other city in the country. The ten principal companies, with their extensive plants, constitute one of the city's most important industries. The mills are engaged almost exclusively in the manufacture of mechanical rubber goods.

Many factories are busy making rubber clothing, principally mackintoshes. One factory in Cambridgeport, Massachusetts, is said to have a daily capacity of 1,500 garments. Several companies make a specialty of druggists' sundries, the principal articles being atomizers, syringes, bandages, air-cushions, and water bottles. Still other companies make harness trimmings, ink wells, rulers, penholders, fittings for pipes, etc.—these being classed as hard rubber goods. These articles seem unimportant when considered alone, but the output of a year requires the work of at least three thousand persons and a capital of over four million dollars.

Manufacture of Rubber Articles

Modern processes have made possible such a cheapening of rubber articles—particularly boots and shoes—that they are now within the reach of all classes. This result is due both to the use of labor-saving machinery and to such improvements in manufacture as ensure the production of high-grade rubber in the largest quantities.

Rubber is a product obtained by proper treatment of the milky sap, or "latex," of such tropical trees as *siphonia elastica* and *siphonia braziliensis*, which represent a genus largely distributed throughout South and Central America, Africa, Asia and numerous tropical islands. Although, as science has demonstrated, it may be produced from any plant—such as common milkweed—having a sticky milky sap, commercial quantities may be obtained only from tropical countries. Like other vegetable products, its quality differs according to the place of derivation; the best rubber being that shipped from Para, South America. The sap is gathered, either by tapping or felling the tree, and is prepared for market by a process of "fumigation." This consists in holding ladles filled with the liquid over a fire of brushwood or palm nuts, covered with a clay funnel, until, by the action of the smoke, it is reduced to a semi-solid mass. The lump thus made is slit open and dried in the sun, until ready for shipment. This process is a slow one, producing only five or six pounds a day. The first step in the manufacture of commercial rubber consists in a process of purification, whereby dirt, bark, stones or other foreign substances are removed. To this end, the lumps of crude rubber are immersed in a bath of pure water, heated by steam for from three to twenty-four hours. Being then cut into slices, the larger impurities are removed by hand, after which the rubber is crushed and ground between several pairs of corrugated metal rollers, followed by as many washings in strong water jets, to remove smaller foreign particles. It is then dried and stored, preparatory to vulcanization.

By vulcanizing the rubber is meant the process of eliminating its native stickiness through a properly conducted mixture with sulphur; all qualities, from "gum elastic" and soft rubber to ebonite, or vulcanite, being producible according to the quantity of sulphur used. According to the Goodyear process, which is most commonly employed for this purpose, masticated rubber and sulphur are mechanically mixed and then subjected to the action of superheated steam, at temperatures between 248° and 302° F. At the same time, the desired qualities of color, softness, etc., are imparted by adding litharge (lead monoxide), chalk, lampblack, or white lead. The rubber product thus produced has the familiar properties of resisting compression, of tenacity, of the ability to remain unaffected under all temperatures, from 22° to 248° F., and of insolubility in most ordinary solvents.

In the manufacture of boots and shoes the compounded rubber is rolled and pressed into a homogeneous mass, which is then worked into the form required—usually by spreading on tricot cloth, or ribbed woollen or cotton tissue, by passing through a calender. Each separate piece for the boot or shoe is made by passing through a different calender, which marks the sheets with the desired pattern—soles, uppers and other parts—and these, being cut out, are cemented together over a smooth last. The articles thus completed are then varnished with an asphalt lacquer and revulcanized for several hours at a temperature of 260° F. The process by which rubber boots and shoes may be built up from a number of pieces—a shoe usually containing seven or eight, and a boot at least twenty-three—is not only a vast improvement on the former method of making in one solid piece, but provides the additional advantage of permitting as wide a variety in shapes and sizes as with leather footgear, with the consequent lessening of all uncomfortable tightness and the tendency to overheat the foot.

One superior point in modern rubber manufacture is that all waste of old shoes, tires, and other articles, as well as the scraps left in the process of manufacture, may be worked over and used again. The process of renovation consists, briefly, in pulverizing the rubber waste and findings in masticating machines; then passing it over magnetic plates, to extract all metal particles, and through a sifter, to remove other dirt; finally, boiling it in an acid solution, to destroy all fibrous matter. It is then ready for refining, after a thorough washing and drying.

The Rubber Supply

In addition to the great army of rubber workers, there are regiments that toil in the forests of the tropics gathering the natural rubber. In the Central American States, workmen no more spare the rubber tree than do our lumbermen in California preserve the mighty redwood; they cut trees down ruthlessly, with no regard for the future. Rubber in its crude state is a sap, and should be gathered as is maple sugar sap, by tapping the tree, not destroying it. The method the Peruvians and the Central Americans pursue in collecting the rubber, therefore, is very much like killing the goose to get the golden egg. In western Africa, in India, and the Indian Archipelago, hundreds of dark-skinned laborers are toiling to supply civilization with rubber. Two-thirds of the rubber product of the world, however, comes from the borders of the Amazon, in Brazil. Ships leaving Para for New York often carry cargoes of rubber valued at $2,000,000.

As the future production of rubber in the tropics is being threatened by the excessive tapping of the wild trees by the rubber hunters, American business men have begun to wonder how it will be possible to supply the future demand. It has been stated that, should the Pacific cable be built, its construction would consume the entire available supply of rubber in the United States to-day. The remedy for the destruction of the wild tree is the fostering of the cultivated rubber tree. The cultivated tree, when once planted, grows as rapidly as the wild tree, and will produce a regular crop after it reaches a certain age. Hence an American company has been formed for the purpose of planting rubber trees. This corporation owns a plantation of 7,500 acres of land on the line of the Nicaragua Canal, between two of the largest rivers in Costa Rica, and here the company will begin operations in rubber tree culture. Doubtless the time will come when the rubber companies will control and manage along the lines of scientific forestry the sources of their crude rubber supply.

CHAPTER XXXII

GLASS AND CLAY INDUSTRIES

The Glass Industry—The Glass Trades—Foreigners in the Glass Trades—The Window Glass Industry—The Plate Glass Industry—Art Glass—Pressed, Blown and Molded Glassware—Process of Manufacturing Blown and Molded Ware—The Clay Working Industry—Clay Workers—Brick, Tile and Terra Cotta Manufacture—Pottery Products —The Modern Potter

THE GLASS INDUSTRY

IN spite of low prices, profits in glass manufacture are now greater than ever before. The workmen themselves, by improved methods of manufacture, have doubled their output, and hence are receiving better wages. In the manufacture of flint glass there are two great combinations—The National Glass Company, a consolidation of nineteen plants, with a total capital of four million dollars, and the United States Glass Company, which comprises thirteen plants, with a capital of five million dollars. The larger of these combinations, the National, controls seventy-five per cent of the capacity of all the flint glass works of the country.

Pennsylvania stands at the head of the glass-working States—first in plate and window glass, table, and fine blown ware, second only in fruit jars and bottles. This Commonwealth has a general production valued at three times that of any other State. In some of the Pennsylvania glass mills may be seen furnaces capable of holding one thousand tons of molten glass, and of making four hundred and fifty boxes of window glass in twelve hours. These mills produce fifty per cent of all the glass made in the United States.

The most salient feature of the glass industry is the prevailing substitution of the tank for the pot furnace for melting glass. In 1890, they were largely regarded as experiments, but are now firmly established in general use. They have rendered possible a larger production and a more uniform quality of the product, especially of window glass, and bottles and jars. The cost of a plant of the tank system is, of course, much greater than that of the pot system. Nevertheless, taking everything into consideration, it is much more economical. And it is more regular in operation. The continuous tank has been introduced in the manufacture of bottles and jars quite as widely as in the making of window glass. More extensive is becoming the use of continuous and intermittent or day tanks in the manufacture of common tumblers and jelly glasses, "opal ware," lantern globes, lamp founts, chimneys, shades and globes, in addition to novelties and special products in pressed and blown glass ware. This industry in its growth has always followed the supply of fuel. The lessening of the gas supply in Indiana has forced the industry to look for new fields. The gas fields of southeastern Kansas, West Virginia and western Pennsylvania, and the coal fields of Indiana and Illinois, are attractive territories. But the larger factories in Indiana are now equipped to run with gas produced from coal. The cheap fuel oil of California, and the enormous demand for a glass package from the fruit packers, have led to a great development of the industry on the Pacific coast.

During 1900 the total value of imports of glass represented a valuation of somewhat over $5,000,000, while the total exports were somewhat less than $2,000,000. The largest item of importation was on unpolished cylinder and common window glass, representing a total of nearly $1,556,000, a sum which very nearly represents the average for the last thirty years; showing that, despite the vast growth of the industry in this country, the demand is about the same for the foreign product. Polished crown and cylinder sheet glass represents a total importation of some hundred dollars less than $540,000, of which not quite $300 worth was silvered for mirrors. Under bottles, carboys, vials, etc., is subsumed a total value of over $464,000, while plate glass follows closely, with a value of not quite $250,000, for all varieties—fluted, rolled, rough, cast polished and silvered. Under the plate glass item about $12,500 represents silvered mirror plate. Glass for optical instruments, plates, disks, etc., represents a valuation of about $125,000, leaving a grand total for all other heads to sum up something over $2,100,000 of the total amount for imports.

Of exports, the total valuation is given at nearly $2,000,000, but of this window glass represents only a little over $36,000, leaving the remaining $1,900,000 for the general heading. These figures show the vast consumption of glassware in this country, which leaves small surplus for exportation. The trade in bottle and other wares not included in these lists are mentioned under the several heads.

The Glass Trades

Glass is a silicate mixture fluid at a high temperature. In this condition, and in a semi-fluid state, it is ductile, and can be brought into any desired shape by casting, pressing, rolling, blowing, drawing, spinning, or welding. Many interesting facts concerning methods of glass working are given in the reports of the Labor Commissioner of Pennsylvania. The chief methods are casting, pressing, and blowing. Casting and rolling usually combine one process, which consists in pouring the molten glass, in its fluid state, from the pot upon an iron casting table of suitable dimensions and passing over it a ponderous iron roller. The roller is practically a press, which, in passing over the deposited mass of fluid glass, flattens it out into a sheet. The cast sheets are rough glass, and, after being annealed, are ground with fine sharp sand, and afterward polished, both operations being performed by revolving disks moved over the glass. After being polished, the sheets are assorted and cut into suitable sizes, according to quality. Pressing glass is an operation closely allied to the process of casting. An interiorly plain or figured mold takes the place of the casting table. As ordinarily performed, the process of pressing consists in gathering a suitably sized quantity of fluid glass from the pot or melting tank with the punty or gathering iron. By rapidly revolving the punty, the adhering glass is gathered in proper quantities and dropped into the mold. After various further manipulations, the mold is opened, and the glass article removed to be fired, polished, shaped and annealed.

Blowing glass is one of the finest, most interesting and fascinating operations of the industry. Glass in its fluid state is elastic, plastic, and pliable, and in this condition is readily expanded by blowing. The technique of the art of glass blowing consists mainly in the dexterous, skilful, and intelligent manipulation of the fluid glass. The glass is gathered from the pot or tank by inserting the head of the blowpipe into the molten mass, rapidly rotating the pipe, and wrapping the adhering glass, in the required quantity, in a pear-shaped ball around it. The blowpipe is an iron tube from four and one-half to five and one-half feet in length, and varying in thickness and weight according to the amount of glass to be used. In fruit jar making, a machine has been invented to take the place of the old method of blowing. It has greatly lightened the work and lessened the cost. Many American firms now manufacture blown glass equal to the best Venetian in color and finish, and superior to it in durability.

Glass cutting, as usually practiced on vases, bowls, decanters, pitchers, and general glassware, belongs technically to the art of refining glass. Fine, artistically cut glass, limpid as pure spring water, rivalling the diamond in brilliancy, and, like that precious gem, reflecting the prismatic tints of the sunlight, is the highest achievement of the glass maker's art. The marvellous glass work of certain New York firms is the culminating wonder in this industry. They have developed unthought-of possibilities in shape and color. They have revived forgotten arts of coloring, invented new processes, and applied the finished product to many new uses.

In the window glass industry fully twenty-five per cent of the pots of the country are idle because of the dearth of competent workmen. At the same time the demand for window glass is constantly increasing, because of the activity in the building world. So general and so gigantic are the orders and contracts for new buildings, that the demand for window glass promises not to abate for years to come. Meantime the demand for competent workmen is far beyond the supply. This means that good wages can be earned, and that steady employment is assured for all young men who enter this trade.

In the making of glass jars, machines have been invented in recent years which have taken the place of the old method of blowing. These machines are operated by skilled workmen, and the tax upon their physical strength while operating the machines is much less than under the old method of blowing. Jars made on the machines are said to be more perfect and in every way superior to those made by the old process, and the cost is considerably less, enabling the manufacturer to market them at a lower price. A greatly increased use has resulted, glass jars having, to a large extent, taken the place of tin cans and stone jugs. The introduction of these machines, therefore, has improved the quality of the goods, increased the quantity used, reduced the manual labor required, and increased the wages earned and the number of people employed.

Foreigners in the Glass Trades

A remarkable illustration of the effect of immigration upon trade-union restrictions of output may be observed in the case of the glass workers. Taking the flint-glass trade, we find that in some departments there is the limited system, and in others the unlimited. Hardly any foreigners are included in the unlimited branches of the work. The skill here is of a very high degree. Besides that, the speed is so great that the immigrants can not endure it. Piece work prevails, the men working in teams, and earning $6 to $8 a day. The trade longevity of the men is affected by the arduousness of the toil. In other branches of the industry agreements with other groups of employers formerly obtained, and the quantity of the output was limited. Immigrants flocked to non-union establishments and worked on the unlimited plan, forcing the union, for self-protection, to remove the restrictions on its members. The increased production, with the removal of the union limitations, amounted, in one case, to 100 per cent, and the increase of earnings to about 15 per cent. A discriminating initiation fee, so effective in other instances, is employed by the flint-glass workers to protect themselves against immigration. The fee was established at $3 for Americans and $100 for foreigners. The latter assessment has been reduced, however, to $50. This discrimination is not efficacious unless the unions have a monopoly of the business. Where there are non-union establishments, the immigrants, unable to pay the large fee, will seek work in them. Among the glass-bottle blowers the admission of foreign blowers is prohibited. Authority rests in the president of the union, however, to make exceptions upon the recommendations of the executive committee. This union does not favor immigration, as they can increase the number of apprentices when necessary, and, when trade is dull, the manufacturers agree to take no apprentices, or at least a smaller number of them. The nominal fee for foreigners is $100, while Americans are admitted at $5. In reality, this high fee has been levied but once, foreigners generally paying $50, or nothing, when entering from a non-union factory.

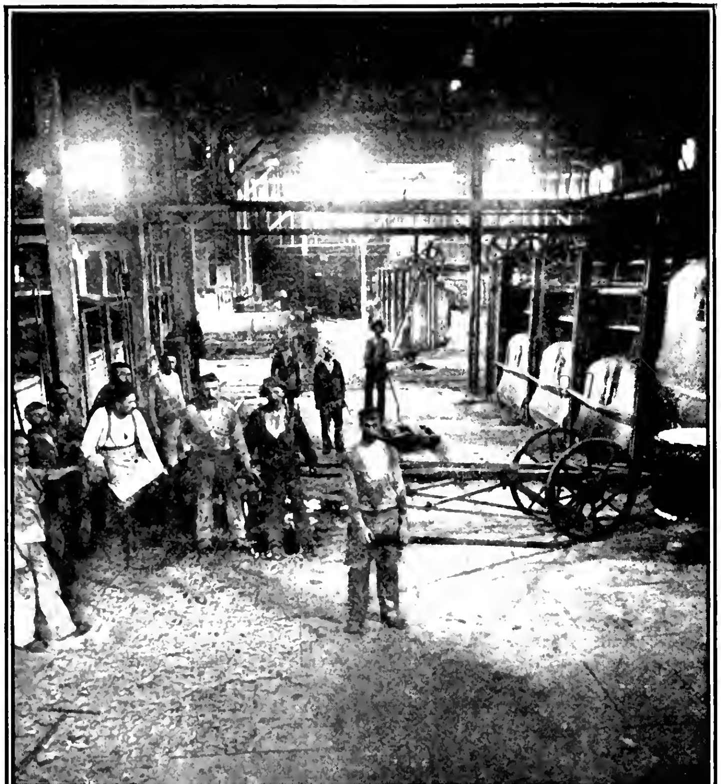
The Window Glass Industry

By window glass is meant blown cylinder glass as distinguished from cast, polished, rough, figured, rubbed, or colored sheet glass, a large portion of which is also used for glazing. The growth of the American window glass industry can be seen by the following figures, in round numbers. In 1880, the value of the product was five million dollars; in 1900, it was eleven million dollars. Of the foregoing, Pennsylvania now produces five million dollars' worth. The principal concern engaged in the manufacture of window glass is the American Window Glass Company, a combination with thirty-nine plants and a capitalization of seventeen million dollars. This company controls about 1,700 of the total of 2,700 "pots" in the United States. Over eleven million dollars' worth of window glass is manufactured in the United States annually. Half this output comes from the factories of Pennsylvania alone.

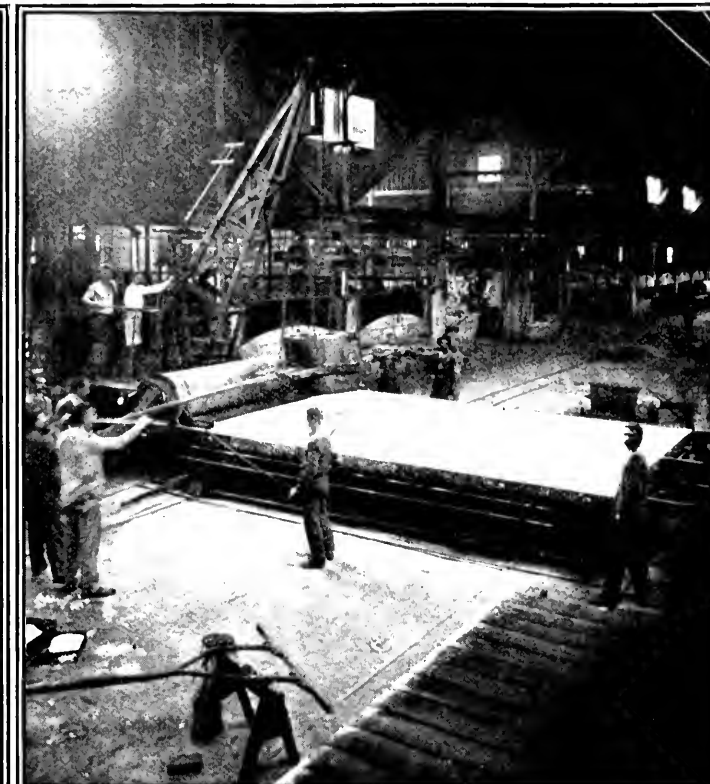
The art of making common glass has remained practically stationary for many centuries, which fact accounts largely for its comparatively recent use in the windows of houses and for smaller utensils, such as drinking vessels. Not until within about a century and a half came the beginning of the improvements, which have brought it to the present industrial and commercial significance, and only within very recent years have the most important advances been made. The process of glass blowing, which dates back several thousand years, at least, is still employed in the manufacture of window glass, bottles and many other vessels. The ingredients of the glass, generally quartz sand, sulphate of lime and sulphate or carbonate of soda, are mingled in the correct proportions and melted in an oven or kiln, heated preferably by gas. This process is a tedious one, on account of the time required to thoroughly heat the mass, but its completion is indicated by the formation of a perfectly limpid liquid. The glass worker then begins operations by inserting one end of his blowpipe into the liquid glass, and rotating it properly, so as to take up an evenly distributed lump of the required size. He begins the formation of a sphere or cylinder of glass by blowing through the tube from the handle end, just as a child forms a bubble of soap at the end of a pipe, at the same time swinging or twisting his blowpipe, so as to control the shape of the rapidly cooling mass, until the desired thinness of the glass, as judged by the size of the sphere or cylinder, has been attained. In forming glass spheres, from which window glass was formerly made exclusively, the artisan begins by raising the blowpipe perpendicularly above his head, in order to flatten the mass slightly, and then, placing it on a support, rotates it rapidly, thus combining centrifugal force with the action of gravity. In forming a cylinder, which is the invariable preliminary in making window glass at the present time, the molten bubble is blown over a pit, or trench; the elongated shape being imparted by a regular pendulum-like swinging of the blowpipe, combined with continual twists of the wrist, until the desired shape and length are secured. The process of blowing either a sphere or a cylinder requires not only the best lung power, but also considerable muscular strength, great adroitness at making rapid movements, and a thoroughly trained eye. Its successful accomplishment is one of the greatest feats of skill in the whole realm of industry, and is well worth the high rate of wages that glass blowers command. Of late years machines have been devised which at once do the blowing and impart the necessary rotative and swinging motions to the blowpipe, although a good part of the work is still done in the old way, owing to the unwillingness of workmen to adopt mechanical methods.

The process of making window glass is simple in detail, although requiring considerable care and skill. The glass cylinder, formed at the end of the blowpipe, is cut away and placed on a suitable rest. The two ends are cut off with a thread of molten glass, leaving an open tube of considerable diameter, which, by the use of a diamond, is slit down its entire length. The slit tube is now placed in an oven of a temperature to cause it to gradually open of itself, and, at the proper point, the flattening is accomplished by passing a wooden tool, like a rake, over the surface thus exposed. The sheet is then slowly cooled, or annealed, in the falling temperature of the oven; at the end of six or eight hours being ready for cutting and shipping. Among the other common products of glass blowing are watch crystals, which are formed by cutting small circles from a glass sphere, and curving their edges inward to fit watch bezels of various diameters. Glass tubes, so commonly employed in chemical laboratories, are also blown, although by a somewhat different process. The blower begins by forming a perfectly cylindrical mass at the end of his pipe. At a certain point, it is caught by an apprentice on the extremity of a rod called a "pontil," whose flat end has been covered with molten glass to cause adhesion. The two then walk in opposite directions, stretching the glass, until it has attained the desired diameter. The tube, thus formed, is then detached from the blowpipe and pontil, and, after cooling, is ready for cutting into lengths.

One of the most notable facts in connection with the window glass industry is the increase of co-operative establishments, owing to the scarcity of skilled workmen during several successive years. Moreover, the strict rules of the glass workers' union limited the immediate prospects of relief, by the admission of new men, with the result that the skilled workmen has come to largely dominate the industry. A number of glass making companies are thus of a co-operative or semi-co-operative character; some of them having been started on money advanced by the union, and deriving much of their actual support from the same source. In order, therefore, to produce the desired annual amount of work, as well as to secure the services of properly skilled workers, co-operation has in many cases been the only solution. It obtains the full interest of the workers, and ensures against their being tempted away by other establishments. Particularly among the Belgian workmen there are several establishments conducted entirely by the men in the factory. In no other branch of the glass industry is this result so immediate; since in no other of the allied trades is there such a strongly organized union.



THE GLASS INDUSTRY—DRAWING A POT FROM A FURNACE



GLASS WORKS—CASTING

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The Plate-Glass Industry

In the manufacture of polished plate-glass, great advances have been made during the past twenty-five years, American works being now capable of making plate of all dimensions for glazing, silvering, and commercial use, and to supply fully the entire domestic demand. The amount invested in this branch of the glass industry exceeds eight million dollars, and the value of the product is nearly five million dollars. Practically the entire domestic demand for plate-glass is supplied by the factories of Pennsylvania, Indiana, and Ohio.

The manufacture of plate-glass, which is coming into increasingly general use, particularly for the show windows of stores, in mirrors and in many private houses, is conducted by an entirely different method. Briefly described, it consists in pouring the molten glass into a mold; rolling it to the required thickness, and, after slow cooling, or annealing, has hardened it sufficiently, polishing its surface. As the manufacture is usually conducted, the annealing is a slow and tedious process, generally occupying about three days in a gradually falling and carefully gauged temperature. The mold, after filling, is placed in a flattened reverberatory furnace—that is to say, a furnace having a domelike roof, so as to reflect the heat upon the floor—which is heated to nearly the melting point of glass. The fire is then allowed to die down gradually, slowly cooling the furnace to a point at which it is safe to remove the plate, the whole operation requiring about three days.

Within a very few years a radical improvement has been made in plate-glass manufacture by the successful introduction of the continuous annealing "lehr," in place of the slower and more costly furnace process just described. The lehr, which is generally about 200 feet in length, consists essentially of a continuous covered, smooth, level bed of specially prepared clay, which, beginning at the first furnace, heated to about the melting point of glass, passes through five "stations," or furnaces, each, in succession, having a somewhat lower temperature. The mold, after resting in the first, or hottest, furnace for a sufficient period, is slowly moved along through the four succeeding stations, gradually losing its heat, until the rod lehr is reached, and the plate, thoroughly "set," is ready to be taken off, ground and polished. The entire process consumes only three hours, as against three days, when the annealing furnace must be allowed to cool. It is also cheaper to construct and operate. According to authoritative estimates, a lehr, capable of annealing the product of ninety-six pots, or ninety-six plates of glass, per day, would cost $20,000 to build, displacing ninety-six three-plate kilns, which cost about $1,000 each to build. Since it also occupies far less floor space than an old-style plant of the same capacity, a building for a ninety-six-plate lehr would cost about $6,000, instead of $30,000 for a ninety-six-kiln plant. Annealing lehrs, as now constructed, are amply sufficient for the manufacture of all the common sizes of glass plates, about ninety per cent of the output; only the larger ones requiring the old-style kiln. It is only a question of time, however, before they will be made of dimensions sufficient for all sizes of plate.

Another valuable improvement is found in the March transfer polishing table, which combines the advantages of reducing the temperature of the glass, while polishing, by circulating water below it, thus permitting a much higher speed in the grinders, with a device for polishing the under side of the plate, without the frequently disastrous operation of removing it from its plaster bed and turning it over. This transfer table is also movable from grinder to polisher, effecting a considerable saving in time, while ensuring the greatest security in handling

The plate-glass industry in the United States was obliged to compete with European manufacturers for a number of years at exceedingly disadvantageous terms. The manufacturing interests of Europe were closely allied on regulation of prices and production, with the result that they were able to compete seriously with Americans in their own market, making prices on polished glass imported here even lower than those quoted in England. During 1900, the prices on imported glass in America were at least thirty-six per cent lower than in England, while, in the case of French glass, they were frequently as much as fifty per cent lower. These facts are accounted for when we consider that the United States is, in reality, a "dumping-ground" for the surplus of European manufacture. Such conditions persisted, in spite of the fact that the output of plate-glass in European manufactories was, in 1900, only little over fifty per cent of its total producing capacity, while the total production in America had increased eighty-five per cent in the decade ending 1900: and there was no exportation of the product. From published statistics it has also been conclusively shown that the average of wages paid in this country is about two hundred per cent higher than in England, and about three hundred per cent higher than in Belgium, which is the largest plate-glass producing country of Europe. At the present time fully sixty-six per cent of the workers in American factories are of native birth, such having proved, on the whole, quicker to learn and much more steady in work than the skilled artisans of foreign origin.

The improved machinery adopted in this country, making possible the use of smaller pots and the casting of smaller and thinner plates, will certainly reduce the cost per square foot within a few years, while the increasing adoption of tank furnaces will enable the size of plates cast to be regulated at will.

Since the use of natural gas is an advantage, almost a necessity, in all branches of glass manufacture, it is only logical that the principal manufactories are located in the great gas regions of the country. Of the thirteen large plate-glass plants reported by the census of 1900, eight are in Pennsylvania, mostly in the region of Pittsburg; three are in Indiana, and one each in Missouri and Ohio. The total capacity was 53 furnaces and 1,100 pots, giving an average annual output of nearly 32,000,000 square feet, which represents an advance of over 600 per cent during the twenty-four years' successful prosecution of the industry in America.

Art Glass

The manufacture of cathedral, art, opalescent, ribbed and wire glass, during late years, has steadily and rapidly advanced. The production of stained and colored glass has been greatly augmented by the artistic efforts of La Farge and Tiffany. This country now excels in opalescent glass; and German artists, in the very home of art glazing, carry large stocks of it and use it in their best work. There are several other specialties in which the United States takes the lead. These are fine cut lead glass, fine blown table ware, rolled colored sheet glass, Favrille glassware, and those latest evidences of our inventive faculty—wire netting imbedded sheet glass, which is stone, storm, and fire proof—and Luxifer prisms, ribbed so as to throw light at any desired angle, and used for lighting interior rooms with indirect illumination, vaults, cellars, and the portions of large rooms remote from the windows.

The manufacture of the so-called "cathedral glass," rough-surface, colored glass for church windows and general decoration, and of the semi-opaque variety, known as opalescent glass, has greatly increased in the United States, both as regards quantity and quality. At the present time, by far the larger part of the domestic trade is supplied by the American manufacturer, and a large foreign market is already available. In 1890, nearly 9,000,000 square feet of cathedral glass were produced in the United States, the total value being over $560,000. Regarding the amount exported, no complete figures are given, although four establishments report total direct exports of nearly $13,500. Most of the exported product goes to Germany, France and England, although, on account of the superiority of coloring and general superior quality, American ware is constantly earning increased favor in all art centres.

Pressed, Blown, and Molded Glassware

To American genius belongs the credit of having invented and perfected the modern art of pressing glass mechanically in portable hinged molds, thereby increasing the output fully five hundred per cent and wonderfully decreasing the cost. The substitution of lime glass in place of the costlier lead glass, about 1860, gave to the pressed glass industry that impetus which brought it to the front all over the world. The United States now supplies not only the native demand for this ware, but exports in large quantities to all parts of the world.

Pressed ware has come to be familiar and important in many kinds of glass articles, most particularly in table ware. From the time of its first manufacture, the aim has been to produce articles having as close a resemblance as possible to cut glass ware, although of late years the tendency has been to multiply lace, flower and other fancy designs, particularly such as are ornamented with gilt borders. The process differs from ordinary glass working in the fundamental principle, at first universally ridiculed by glass workers, that molten glass can be pressed into molds of many varieties of shape, as readily as many other substances. One of the most important contributions to the success of the industry was the substitution, in 1864, of bi-carbonate of soda for soda ash (sulphate of soda), which, with the proper proportion of the materials in the batch, can produce a material equal in purity and beauty to the finest lead glass. In addition to its beauty, this grade of glass is also cheaper than lead glass, and may be worked more quickly, with the further advantage of lowering the cost of the finished articles. Mechanical improvements within the last decade include the substitution of a rotating table, operated by steam, compressed air, or electricity, and by devising means for elaborating the old wind system for cooling the molds and working parts between operations. Fire polishing and finishing are among other notable changes recently effected.

Most pressed glassware is manufactured in the same works as handle ordinary blown ware, except bottles; the bulk of the industry being, accordingly, reported from Pennsylvania, Ohio, Indiana, West Virginia, and New York; while Massachusetts, Illinois, Maryland, New Jersey and Colorado furnish the remaining small percentage. On account of active competition, two close consolidations have been formed, resulting in agreements to control and reduce prices, while maintaining a fair rate of profits. The greater majority of the workmen in these lines are also members of the glass workers' unions, which are among the strongest and best-supported labor organizations in the country. The principal product of the pressed glass industry is table ware of all kinds, of which no less than 55.7 per cent was made in Pennsylvania, principally in the Pittsburg district, leaving 23 per cent for Ohio, and the remaining 21.3 per cent for the factories of West Virginia and Indiana. Table ware is the largest export item of the presssed and blown glassware industry, by reason both of its superiority in design, color and finish, and of the purity of the glass used. A large trade with Canada has been conducted for a number of years, while Australia is rapidly developing a market, having received from one manufactory alone at least 1,500,000 in a single year.

Jelly glasses, pressed tumblers and goblets represented an output of over 102,500,000 pieces in 1900, coming from twenty-eight establishments in five States, and representing 11.8 per cent of the total value of glass and blown ware, other than bottles, as compared with 11.1 per cent for table ware. Of this output, Pennsylvania furnished 36.4 per cent of quantity and 39.5 per cent of value; Indiana, 35.7 per cent quantity and 31.4 per cent value; Ohio, 19.7 per cent quantity, 9.6 per cent value; the remainder coming from Maryland and West Virginia in about equal proportions. Decorated lamps, representing 8.8 per cent of the total value in blown and pressed ware, came from twenty-seven establishments in six States; Pennsylvania furnishing 65.6 per cent total value and 56.4 per cent total quantity; Ohio second, with

23.7 per cent of total value. Lamp chimneys, representing 15.9 per cent of the value of all blown and pressed ware, were manufactured in six States: fully 90.4 per cent coming from Indiana, Pennsylvania and Ohio. Of this output, Ohio furnished over 4,000,000 dozens; Pennsylvania nearly 3,000,000 dozens, and New York over 600,000 dozens, out of a total of 7,500,000 dozens. Recent years have seen a great advance in the quality of the glass used and the immense variety of designs. Under the general head of lantern globes, pressed and blown shades and electric bulbs is included about 14.6 per cent of the total of pressed and blown glassware.

Cut glassware is an important item in many factories, the product in 1900 representing nearly 135,000 dozen pieces, and a total valuation of over $672,000. The bulk of the production is from Pennsylvania and West Virginia, the latter State being first in the number of pieces manufactured. The larger part of the industry is conducted in establishments whose sole function is working the finished products of the blower or presser. Of the forty-five establishments engaged in glass cutting in 1900, New York claimed 21, Pennsylvania 13, Illinois 4, Connecticut 2, and Massachusetts, Rhode Island, New Jersey, West Virginia and Michigan one each. The former practice of importing the blanks from France is almost entirely abandoned, on account of the great superiority of the American products. The total annual value in this branch of the glass trades represents over $1,380,000.

Process of Manufacturing Blown and Molded Ware

The process employed in the manufacture of bottles, fruit jars, medicine vials, glass milk cans, lamp chimneys, and a number of other common articles of household and general utility, is to blow the molten glass into an appropriately shaped mold, so that the desired shape, including raised lettering and fancy designs may be impressed upon it. The manufacture of bottles and jars is the oldest branch of the glass industry in America, and was for many years conducted in connection with the production of window glass, as is still done in a few establishments to the present day. The current tendency toward specialization, however, has caused the work to be increasingly taken up by concerns doing nothing else. This, with the introduction of improved machinery, has greatly facilitated the speed and quantity of manufacture.

Several improved processes have, in comparatively recent years, been devised to dispense with the blow-over, and also to facilitate the operation by reducing necessary handling to the minimum. By the Arbogast method the screwed neck is first pressed to finished form, after which the body of the jar is formed by blowing; leaving the jar complete, so far as shape is concerned, when taken from the mold. This, of course, demands the use of two molds and some extra preliminary handling of the glass: the required amount of "metal" being taken from the furnace on a pontil, or punty; dropped into the press mold and separated with shears; a plunger, operated by hand, pressing the neck to finished form and making a wind cavity to aid the blowing, after the dependent mass has been inserted in the blow mold. This process was also used, to some extent, in the production of candy and drug jars, and of various sizes and styles of wide-mouthed bottles and table ware, the body in each case being greatly increased in size by blowing, previous to insertion into the mold. A still later improvement, which dispenses with handwork in transferring the glass from one mold to another, consists of a rotating table, combining a series of five or more separate, duplicate double molds, each containing an outer blow section having a ring integral with it, and a telescopic press section, rising within the blow section to receive the glass and forming a press mold with the neck of the blow section. The glass being dropped into the combined mold, the table is rotated, so as to bring it under the plunger, which presses the neck and wind cavity, ready for blowing at the second rotation of the table. The combined mold having been dropped, meantime, the glass blank is left exposed within the blow section, and the bottom plate being then inserted, the inrushing air is able to expand the glass to the shape of the mold. On the third rotation of the table, the finished jars are removed, and sent to the annealing oven. Several similar devices are in common use, all embodying the basic principle of pressing the neck previous to blowing the body, and, with the combined use of electrical motive power and blowing by compressed air, have greatly increased the speed of manufacture, lowered the per cent of breakage, and reduced the cost of products.

In the manufacture of narrow-neck bottles there has been little advance in the direction of using machinery, although promising experiments are already under way. The process now employed is substantially the same as has been in use for many years: the glass bubble is given a preliminary shape by several alternate swingings and rollings on the mawer, after which the blowpipe is inserted in the mold and the forming completed. On being removed from the mold, the bottle is taken to the "glory hole," where the end of the neck is reheated, so that the ring or lip may be formed by use of a special finishing tool. Some later improvements have perfected a finishing machine, but it has not come into use. Tumblers and lamp chimneys are made on very similar machines, which, briefly described, consist of a circular table revolving about a central column and carrying a series of duplicate molds, usually six in number. The process, after the placing the lump of glass in the mold, which is then closed, consists in placing and clamping the blowpipe in position; a rubber hose leading the air from a variable pressure compression pump. The rotation of the table admits air into the pipe, blowing up the glass in the molds, after which the products are ready for the finishing processes. Lamp chimneys are treated somewhat like bottle necks, with the "glory hole," followed by a finishing and crimping machine, to supply the proper contour to the top.

To sum up, the bottle-making industry has so greatly increased in the past ten years, that it is now the largest if not the most important branch of glass manufacture, the value of the product being about sixteen million dollars annually. In the last fifteen years the production of fine art glass lamps has grown to considerable importance. These lamps are made in beautiful color combinations, variously decorated, with globes and founts to match, and range in price from \$2 to \$100. Pennsylvania leads in the manufacture of lamps, and Indiana in the lamp chimney industry, the value of the total output of the factories being \$4,000,000. It is interesting to note that the total value of the output of lamps is less than that of lamp chimneys—only three million dollars. Every housewife knows why, for she buys many chimneys during the life of each lamp.

The Clay-Working Industry

Clay products may be divided into two great groups: (1) Brick, tile and terra cotta; (2) pottery products. The value of the products of the first class represent three-quarters of the value of all clay products. Brick, tile and terra cotta, used as a general head, embraces electrical conduits, sewer pipe, drain tile, flue linings, stove and furnace fittings, glass melting pots, chimney tops, etc. Pottery products include yellow, Rockingham, cream-colored, white granite and semi-vitreous ware; porcelain and art pottery.

The increased proportion of apartment and steel-frame buildings has caused a transference of demand from the common brick to terra cotta and the more fancy products. Both in structural work and in paving there is noticeable a rapid extension of the use of clay products, and the demand is still increasing. The plastic character of clay allows it to be molded into attractive and novel designs, and it is, of all building material, the most fireproof and durable. In the United States all varieties of clay products are made, although the quantity of the highest grade of china is not large, most of it being imported. There are, however, two or three successful establishments whose work is artistic and very popular.

The tendency noted in the reports of the Geological Survey toward the investment of greater capital in the clay-working industry, and the consequent more intelligent manipulation of the raw material and marketing of the finished product, is due largely to the efforts of the technical associations, both State and National. While the small hand-yard will probably always exist, its usefulness will be confined to small towns and thinly settled communities. The clay-working industry is unqestionably destined to enjoy a wider field of usefulness, especially in view of the rapid destruction of our forests, which will necessitate the greater use of clay products as structural materials.

Clay Workers

In the clay industries there is an attractive field open to young men, with promises of great reward for efforts properly directed. In many branches of this industry little improvement can be noted over old processes and old methods. Take the matter of the preparation of raw material, for instance, and we find nothing of recent discovery which excels in results the old-fashioned tempering wheel and wet pan. For mixing clay and putting it into good shape, nothing has supplanted these. The great demand is for quantity. This is secured by the granulator and pug mill, which run at a high rate of speed, and have come into almost universal use in the preparation of clay for building purposes and for paving brick. The output of these machines is sometimes 205,000 brick in eight hours. The quality remains about stationary, everything being sacrificed for the sake of speed. Improvement in quality is much to be desired. There is a serious need of practical economy in this industry, fuel being enormously wasted in most brickyards. Often the refuse from the arches or furnaces contains from twenty to forty per cent of unconsumed coal, proving the necessity for better methods of manufacture. All these facts suggest the opportunities that are open to young men who will make a specialty of this branch of manufacture.

Brick, Tile, and Terra Cotta Manufacture.

In Philadelphia the year 1902 was one of progress and profit for brickmakers. In the early nineties, twenty-four million dollars were expended each year in real estate operations, and included the building of 6,300 houses. But this was before the advent of the modern skyscraper and its steel and iron construction. In 1893, Philadelphia had about eighty-four brick plants, producing 450,000,000 brick of every kind and description each season, and the supply always kept ahead of the demand. At the present time the Quaker City possesses only thirty-three yards, with a capacity of 250,000,000, or perhaps 275,000,000. The output for 1902 reached a total of 225,000,000.

In Pittsburg, one firebrick yard employs two hundred and seventy-five men. The bricks are used for linings of furnaces, and the larger steel and iron works consume hundreds of thousands monthly. Another firm, working exclusively on tiles, keeps nearly thirty men at work the year round. A number of plants that make vitrified, waterproof, and other varieties of brick, employ a large force of men during the season. Taking ten of the plants within a radius of three miles of Pittsburg's city hall, seven hundred and thirty-five men are employed. The average wages of this class of workmen is about two dollars a day. On the outskirts of the city are other and larger plants. The output of the Pittsburg building-brick concerns, for 1901, was estimated at 50,000,000. These bricks are sold at the yard for about five dollars per thousand, and the revenue derived from this manufacture alone is enormous.

Brick manufacturers throughout the eastern States are receiving the benefits of the present prosperous times, and there is barely sufficient brick on the market to meet the demand for building purposes. One brick-making plant, which turns out more than 60,000 bricks a day, finds difficulty in filling the orders that are being received. A kiln of brick can be dug from the clay, carried through the machinery in the factory, and burned ready for the builder in about six days.

Ever since an American manufacturer won from European tile-makers a gold medal for tiles, the tile industry in the United States has paid. Ninety per cent of all the tiles used to-day in this country are made here.

Pottery Products

Three causes are given for the slow growth of the pottery industry in the United States: first, the lack of skilled workmen in manufacture; second, the dearth of workmen of artistic education and taste available for the making of the finest wares; third, the inadequate number of technical schools for the training of workmen in pottery. With the exception of the finest French china, American manufacturers are producing all kinds of articles in clay equal in quality to foreign products, and they are finding ready sale for their wares, from the coarsest and least expensive, to goods of the utmost delicacy and of very artistic finish. Wonderful opportunities for capital and energy are offered in this field. The industry is capable of a development far beyond the point it at present has attained, for hardly fifty per cent of the domestic crockery in the United States is made here.

American manufacturers made the first solid porcelain bath tubs about eight years ago, and to-day they are not only supplying the enormous home demand for such tubs, but are sending these and other sanitary wares abroad. So superior are American-made goods of this class over the foreign article that practically no sanitary wares are now shipped here by foreign manufacturers. In sanitary ware the improvements have been very marked, and the United States is undoubtedly far in advance of any other country both in the methods employed and in the character of product. Goods that it was thought could not be made in this country ten years ago can now be made with ease.

As for crockery ware, the process of manufacture is long and tedious, and is attended with many risks of failure. Each piece has to pass through thirty or forty different hands, from the day it is started to the time when it becomes the finished article 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, or burning, is considerable. A mistake in the kilns, or an error in judgment as to the amount of heat required, the knowledge of which is only acquired through experience, results in an absolute loss, since, of course, the damaged ware can not be used a second time. In Ohio, four standard grades are made—C. C. (cream-colored), white granite, porcelain, and china. Only one exclusively china pottery exists in Ohio, but there is a tendency to run exclusively into this branch of the industry.

Recently a new class of art pottery, called Feroza faience, has been put upon the market, the product of a Zanesville, Ohio, company. It has more the appearance of having been made from metal than from clay. The process which produces the rich bronze-like appearance characteristic of the ware is a secret, discovered by one of the experts experimenting in clays and colors for the company. The shapes given to the ware are artistic and unique. Its surface is uneven, and has the appearance of having been hammered out, resembling in this respect the Japanese metal ware.

In a glance at the work of our potteries one must be attracted to the most beautiful of all faience—the Rookwood, known and admired the world over, and justly esteemed the most artistic as well as the most valuable of our native work in clay.

The Rookwood pottery was founded in Cincinnati, in 1880, by Maria Longworth. After many discouragements, the ware advanced in artistic excellence and public esteem, until, in 1890, the pottery became self-supporting. The ware is for the most part made of Ohio clays, in varied and graceful shapes. The decorations are done by artists, most of whom are graduates of the Cincinnati art school. They are allowed the utmost liberty in their work. No two articles are alike, and all decorations are under the glaze, which is of extreme depth and transparency. The Rookwood pottery is unique both in its character and the manner in which it has been developed. There is no other institution like it. The great display made of this ware at Chicago, in 1893, excited the admiration of the world; both English and French potters were compelled to acknowledge that they had never produced anything like it. The exhibit at the Pan-American, at Buffalo, was, of course, much finer than that at Chicago, the scope of the work having been greatly enlarged by the discovery and application of many new tints, while its artistic excellence was much advanced.

The greatest contribution to the total of pottery products is the white table and sanitary ware made in such large quantities in East Liverpool, Ohio, and at Trenton, New Jersey. The value of these grades is approximately $10,000,000 annually. 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 one hundred potteries in the State. New Jersey is second, with a product worth twenty-six per cent of the products in the whole country. The number of pottery firms in this State is between forty-five and fifty. New Jersey is the largest producer of sanitary ware, and was the first to introduce the solid porcelain bath tub. Ohio and New Jersey, in each of the last three years, produced seventy per cent of the total pottery products of the country.

The Modern Potter

The modern pottery is generally of considerable size, built around the massive chimneys of the kilns. The interior is a busy place. The soot of the ordinary factory is here replaced by a fine white clay dust, and the whirring of machinery by the clatter of dishes. The work begins in the clay bins on the ground floor. Here the materials are weighed, mixed, reduced to a liquid, and, after the removal of impurities, they are then returned to the solid state and kneaded. The clay can now be kept indefinitely, if a proper degree of moisture be retained. Age really gives it temper. It is said 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's wheel, one of the oldest of mechanical contrivances, is still used in almost its original shape. Round ware is made by a machine called a jigger: flat ware by a jolly. Other shapes are put in molds, in whole or parts. 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, another firing is necessary. Decoration is sometimes applied on the biscuit under the glaze.

The advent of the electric light led to orders on the clay worker for the making of porcelain insulators, these now being a staple product of the potteries. One pottery in Ohio confines itself exclusively to the making of common playing marbles, varying in size from one sixty-fourth of an inch to four inches in diameter; and turns out an average of 100,000 a day.

In New Jersey, as early as the year 1816, works for the production of porcelain and pottery were established. Some years later a number of potteries were started in Trenton, owing to its geographical location and transportation facilities, and to these were added many varied branches of the art of manufacture of useful and ornamental vessels, bricks, tiles, and other productions, until to-day Trenton is by far the most important pottery centre on the continent. Forty complete plants, the capacity of each indicated by the number of kilns, nearly all of which are located directly on canals and railroads, give a most interesting appearance to the town. Here are employed fifteen thousand men, women, girls, and boys, The capital invested in the pottery industry in this city amounts to about $7,000,000. The quality and variety of the decorations, especially in dinner and toilet wares, have a grace and finish that has forced the foreigners to change their old and heavy methods of decoration, and in numerous instances the foreign manufacturers have directly copied American shapes and designs.

At the Trenton potteries, most of the employés work on the piece-work system. A few women are employed to do the lighter work around the pottery and in the decorative departments. Very little machinery is used in the processes. A few improvements have been made in the way of machinery, but they are very slight, and it may be said that the industry as a whole is dependent upon the skill of the employés in working the clay and molds.

CHAPTER XXXIII

THE CHEMICAL INDUSTRY AND ALLIED PRODUCTS

The Chemical Industry as a Whole—The Manufacture of Chemicals—Paint, Oil, and Varnish Manufacture—Paint Works Employés—Manufacture of Powder and Explosives—Manufacture of Fireworks—Manufacture of Cartridges—Starch Manufacture—Manufacture of Perfumery, Cosmetics, and Toilet Sundries—Soap and Candle Manufacture—Soap Factory Employés

The Chemical Industry as a Whole

THE chemical industry and allied products ranks eighth as a grand division of manufactures. The products include the manufacture not only of chemicals, but the proprietary and patent preparations of drugs, medicines, and compounds, expressed and other oils, non-mineral paints, explosives, fertilizers, dyestuffs and extracts, salt, petroleum refining, and many similar industries.

Nearly 1,800 establishments in various parts of the Union are actively engaged in the production of substances and compounds, properly designated as chemicals. A capital of nearly $240,000,000 is invested in various branches of the business, while nearly 50,000 wage-earners are afforded constant employment, earning a total of nearly $22,000,000. Taking the chemical industry and all the allied industries as a whole, the combined capital represented is nearly $500,000,000, the number of wage-earners 100,000, and the value of products nearly $600,000,000.

The amount of capital invested in the chemical industry seems out of proportion to the value of the products. It should be explained, therefore, that the conditions of chemical manufacture make necessary larger areas of ground than in other manufacturing industries. A sugar refinery, for example, may be built story on story, as high as the refiner chooses. But chemical works, like iron and steel works, keep close to the ground to accommodate engines, furnaces and grinding mills. One story only is the usual height of a chemical factory, and the works must therefore spread outward, not upward. Again, there is more or less danger, as in a fireworks plant, and the risk is reduced to the minimum by spreading out in a number of buildings, so that in case of accident only one building will be destroyed.

A layman visiting a chemical factory sees what appears to be merely a lot of battered pots, wabbling machinery and primitive furnaces. Yet under the visitor's feet, over his head, and all around him are the most costly appliances. An experienced observer would see that the furnaces were of the latest construction; he would know the value of the copper vessels, coils, and stills; he would understand that flues existed under the ground. Furthermore, he would comprehend the uses of many things, such as the thousands of fire-bricks, chimneys reaching skyward, innumerable iron castings, powerful engines, numerous chambers, tanks, and towers, all of lead for the making of acid; expensive steam boilers and pumps, all sorts of grinding mills, vitrified chemical earthenware, proof against the strongest acids; apparatus and stills of platinum for sulphuric acid. Such is a chemical factory—half scientific, half mechanical.

Over twenty industries are dependent upon the products of chemical works. Printing ink manufacturers send in large orders; and so do artificial ice manufacturers, and manufacturers of glass, paint, oilcloth, soap, and paper; tanners need chemicals; and the textile mills, the oil refineries and fireworks establishments would all have to cease operations if the chemical manufacturers closed down.

The Manufacture of Chemicals

In several branches, such as the making of dyeing and tanning extracts, and of potash and pearlash, there has been a marked falling off in quantity of product in the last ten years, the result largely of the cheapness with which certain dyestuffs are produced in Germany; also of improved processes in the manufacture of potash, covered by patents owned by foreigners who do not manufacture here. The latter fact is due to a defect in American patent laws, which has already operated to the disadvantage of several home industries. The same condition is found in England in even greater degree, and furnishes an eloquent argument for revision of the statutes touching patents. In France the laws specify that a patent may be revoked if it covers articles manufactured exclusively abroad and imported into that country, to the exclusion of domestic competition. On the other hand, a notable cause of the superior advantages the Germans have over us is that it is the custom among them to employ trained experts in their laboratories to superintend manufacturing processes and conduct original experiments. The six largest German coal tar color firms alone employ 500 chemists and 350 technical men and engineers, while the total number employed in all chemical industries in the United States is less than 300.

In late years the manufacture of pure chemicals has been greatly modified and improved by two innovations—the use of electricity in a number of applications and the introduction of the contact process, or catalysis. The latter process, briefly described, consists in adding to two or more substances another that can either cause mutual reactions, or shorten the time required therefor, without undergoing discoverable change itself; in other words, without appearing in the final product. Thus, the process of making oxygen is greatly facilitated by adding manganese peroxide to potassium chlorate. Under ordinary circumstances, either substance can give off the gas, under the action of heat, but their combination enables the result to be achieved at a much lower temperature, with smaller danger of explosion. As a result of the process, the chlorate is transformed into chloride, while the peroxide remains unchanged. Similarly, when nitre gas is added to sulphur dioxide in a chamber with atmospheric air, the process of producing sulphuric acid is greatly hastened. The explanation is that the nitre gases are true oxygen carriers, but because their contained oxygen is in much more active condition, they rapidly give it off to the dioxide and quite as rapidly reabsorb a similar amount from the atmosphere. The contact process is employed in the manufacture of chlorine, chlorates, aldehydes, acetone, carbon tetrachloride, and numerous other common organic products used in industrial, pharmaceutical and commercial chemistry.

Paint, Oil, and Varnish Manufacture

Not many years ago the amount of taxes paid by each farmer, in certain counties, depended upon the appearance of his barn. If the barn was unpainted his taxes were low; if painted, his taxes were at least doubled, and if the paint was red the tax was higher than if the paint was yellow. To-day paint is cheaper than the lumber which it preserves, and the farmer may give his barn all the colors of Joseph's coat and still his taxes will not be higher than his neighbor's, whose outbuildings have never known paint.

In the paint, oil, and varnish industries from eighteen thousand to twenty thousand persons are employed, receiving between nine and ten million dollars yearly in wages. These figures apply only to the manufacture and sale of the products mentioned. They are small when compared with statistics regarding the great army of artisans and painters all over the country who actually apply the paint, oil, or varnish to everything, from a building to a toy. Nor do the figures include the great armies in the mines and in the mills wherein the earths and ores are ground. To all these contributory branches of the industry of many colors must be added those engaged in the manufacture of the millions of tin cans used annually, and the trade in brushes.

The varnish industry thus far has refused to enter into the schemes of the promoter of combinations—an occupation which has created the word "combinator"—and still remains in the hands of perhaps one hundred and fifty separate, independent concerns, who produce from fifteen to twenty million dollars' worth of varnish annually. The paint and oil branches, however, each have their combinations, one company, with a capital of thirty million dollars, practically controlling the output of American white lead; and the National Linseed Oil Company, with a capital of thirty-three million dollars, controlling forty-seven plants and the greater part of the annual output of over five million dollars' worth of linseed oil.

Merchants engaged in the trade, in almost every large city, have their paint, oil and varnish club, where matters of importance to the trade are adjusted during the courses of a luncheon.

In the manufacture of white and red lead Pittsburg leads all cities. With manufactured lead, such as is required by painters every day, selling at a wholesale rate of $110 to $125 per ton, one can readily see that when carload shipments are made considerable money changes hands. At least five hundred carloads of lead are shipped from Pittsburg every year.

There are 650 establishments in the United States engaged in the manufacture of paints, varnishes and colors. Of this number, 419 are engaged in the preparation of paints, 181 in the manufacture of varnish, 15 in the manufacture of bone-black, lamp-black, etc., and 32 in special classes of work, such as the manufacture of red and white lead, oxide of zinc, etc. The entire industry represents an invested capital of over $60,000,000, claiming a total output of nearly $70,000,000. Among the special products and materials common to this industry may be mentioned 123,000,000 pounds of white lead, 169,000,000 pounds of dry colors, 17,300,000 pounds of putty, and 60,000,000 pounds of zinc oxide. There are also used, in the manufacture of mixed paints and varnishes, 36,600,000 pounds of gums, 310,000 gallons of wood alcohol, 39,700,000 pounds of white lead, 16,000,000 gallons of linseed oil, 6,500,000 gallons of turpentine, and 10,000,000 gallons of benzine. The output of mixed paints in 1900 reached the figure of 17,400,000 gallons, while for the item, "paints in oils," 310,000,000 pounds were mentioned. Varnishes of all varieties represented an output of over 15,000,000 gallons, while liquid dryers represented nearly 6,600,000 gallons.

Paint Works Employes

Dangers of many kinds used to lurk in paint mills, threatening the health and sometimes the life of the workmen. All the modern mills, however, are specially constructed and have apparatus and rules devised to minimize these dangers, rendering the workers proof against white lead and similarly poisonous substances. The following account of the conditions of labor in a large paint and varnish factory, where the work of industrial betterment along the most advanced lines was applied profitably, though under conditions more discouraging and unfavorable to the work than the average factory has to contend with, is given by an official of the company:

Our Cleveland plant, where we have carried the work of industrial betterment the furthest, is located in the dirtiest and most crowded sections of the city. Besides this, the nature of our product—paint—is such that its manufacture is antagonistic to the advanced methods of industrial betterment. The raw materials we handle would seem to oppose any attempt at improving the state of affairs. Few manufacturers have as many obstacles to encounter in this respect. We are also subject to keen competition that keeps our profit down—and out of our profits we pay the expenses of providing comforts and conveniences for the employés. Yet in the face of these conditions we have found it perfectly feasible to carry on the work, and that it *pays* us—pays from the dollar and cents point of view as well as the altruistic. We find that we can increase the capacity of our factory, get more and better work out of our employés and out of our machinery. We find less friction between the departments, more enthusiasm, greater co-operation and less sickness; and we get a better product.

The foundation upon which all our co-operative features rest is that of order and cleanliness, extending not only to the floors and machinery of the workrooms, but to the employés as well. We have provided a number of large wash rooms throughout the factory, including lavatories, shower baths and lockers. To provide a plentiful supply of clean towels we have our own steam laundry. Employés are encouraged to use the shower baths and do so very freely. In our dry color department, in order to guard against lead poisoning, frequent bathing is compulsory, while as a further safeguard each man is provided with an entire clean change of clothing every day. The result is that where previously the average time a man cared to work for us in the dry color department was about one month, he now stays as long as we want him, and that where at least every other man was previously affected by the lead, not more than one in twenty is affected now.

Two floors in one of our buildings are used exclusively as lunch rooms and kitchen. The factory men use one room. The girls, office force and foremen the other. The same fare is served, at cost price, in both rooms. The employés take turns in waiting on table. Whenever night work is necessary during the busy season, special dinners are served at the expense of the company. The lunch rooms are by no means self-supporting, but we could not be induced to discontinue them.

As far back as 1887 we organized an employés sick and death benefit society, to which all employés of the company are eligible. The membership includes over ninety per cent of the Cleveland factory employés and a very large per cent of the entire staff. A large part of one floor in a new building is used as a clubroom for the factory employés, for meetings, and as a place of rest and recreation. We publish a monthly magazine for the entire staff of the company. It is edited and printed in our own printing department, is open to contributions from all employés and contains information, instruction, news and illustrations about the business. It is one of our best paying features. A convention of salesmen, officers and managers is held for one week each year for the purpose of discussing the company's goods, outlining the policy of the company for the ensuing year, explaining the new advertising plans and methods, reviewing the work of the past year, and discussing all topics relating to the sale and manufacture of our paints and varnishes. The annual banquet for all employés is given at the same time. Similar banquets are also held at our various branches. Every year, for the last twenty years, one day has been set aside for a general outing of all employés and their families. Thanksgiving Day has been observed for many years by presenting each employé with a basket containing a turkey and a quart of cranberries.

One of the best results of this work is the increased length of time the employés remain. Among our hands are many in the rank and file who have been with us over twenty-five years, and we have made it a custom to present a gold watch and chain to every one who has been with us in any capacity for that length of time. It is not a reward for faithful service, but rather a badge of honor. The company has a system by which it solicits criticism and suggestions, keeping a record of them, and at the end of the year rewarding those who have made the most useful suggestions. The motto of the company, "Do it now," is hung under each clock in the entire plant. All the water used for drinking purposes throughout the factory is filtered. Our opinion of the work of industrial betterment, is that the care and improvement of the animate machinery is at least as important to the manufacturer as the care and improvement of the inanimate machinery. The three most important matters for attention should be health, morals, and education; because a more vigorous employé can do more work, a more conscientious employé will do more conscientious work, and a more intelligent employé will do more intelligent work.

Manufacture of Powder and Explosives

Under the head of commercial explosive substances are generally included the items of black gunpowder, blasting powder, smokeless powder, pyroxyline, or guncotton, nitroglycerine and dynamite. This industry is carried on in nearly one hundred establishments in twenty-one States, representing an invested capital of nearly $19,500,000, employing four thousand five hundred wage-earners, and producing a total of nearly 216,000,000 pounds of explosives, valued at about $17,000,000. Over fifty per cent of the total product is black gunpowder, the output of which is over 123,000,000 pounds made in 47 different establishments, despite the increasing use of smokeless powder in heavy ordnance and small arms. This is because gunpowder still holds its own, as a propellant in most arms of the older patterns, as a priming charge with smokeless powder, for use in fuses and fireworks, and for saluting purposes. The formula usually followed in preparing it is to mix together seventy-five per cent of potassium nitrate, fifteen per cent of black charcoal, and ten per cent of sulphur. Consequently, the annual production consumes over 8,600 tons of nitrate, nearly 175,000 bushels of charcoal, and about 1,300 tons of sulphur.

The older method of making powder—powdering and mixing the ingredients in bronze stamp mills, dampening and graining by rubbing through sieves—which was very dangerous, resulting in about six per cent of explosions to the total output per year, has been almost entirely supplanted by the use of wheel mills and drum pulverizers, involving the highest safety, efficiency in operation and quality of the product. One of the most valuable adjuncts to the industry has been the manufacture of potassium nitrate ("India saltpetre") from sodium nitrate ("Chile saltpetre") by metathesis with potassium chloride, which was first adopted at the Dupont works in Delaware in 1868. Another variety of powder, known as "blasting powder," was manufactured in 1900 to the extent of nearly 98,000,000 pounds, having a value of nearly $4,000,000. There were thirty-seven establishments reported in this line, nineteen of them being in the State of Pennsylvania, and over 1,100 wage-earners were employed. The principal difference between this product and ordinary gunpowder lies in the fact that the cheaper and more plentiful sodium nitrate, largely mined in Chile, is used instead of potassium nitrate; the average of varying recipes giving the ingredients as seventy-four per cent nitrate, sixteen per cent charcoal and ten per cent sulphur. The brown prismatic gunpowder, formerly in nearly universal use for heavy ordnance, has in late years been almost entirely displaced by smokeless powder. Practically none is manufactured at the present time. By the usual formula, it is made with seventy-eight per cent potassium nitrate, three per cent sulphur, and twenty per cent of underburned charcoal made from peat or straw, or burned with some carbo-hydrate.

Smokeless powder, as at present manufactured for military purposes, is a cellulose nitrate, a single substance chemically pure and in a state of uniform nitration. It is prepared by dipping one part of cleaned cotton, by weight, containing about fifty-seven per cent of moisture, in nineteen parts, by weight, of mixed acids—fifty-seven per cent sulphuric acid, 28.2 per cent nitric acid and not more than two per cent of nitrogen tetroxide, or peroxide —yielding a nitrocellulose compound with from 12.45 to 12.80 per cent of nitrogen. The initial temperature of 25° C. is raised to 36° C., and there maintained for about an hour, after which the cotton is wrung, washed, and steamed to remove the acid; freed from water by extraction with alcohol, and converted into a gelatinous mass by kneading in a machine, with a mixture of two parts ethyl ether and one part ethyl alcohol, by weight, for each three parts, by weight, of nitrocellulose. The mass thus produced is further kneaded and worked, to perfect the mixing, to strain off unconverted portions, and to shape and dry the grains. In 1900 smokeless powder was manufactured in nine establishments in seven States, two of them belonging to the United States Government. The total production was over 3,000,000 pounds of powder, in the preparation of which there were consumed 14,000,000 pounds of mixed acids, 1,600,000 pounds of cotton, 2,600,000 pounds of alcohol and 1,400,000 pounds of ether. The total number of wage-earners employed was 730, and the total value of the product $1,700,000. Owing to the rapid adoption of this variety of explosive for military and sporting purposes, the industry is growing with great rapidity.

Probably the best known of high explosive substances is nitroglycerine, which ranks among the nitro-substitution compounds, having glycerine as a foundation, instead of cellulose. In general, the method of manufacture follows that of pyroxylin, although the proportions and after-operations differ considerably. For one "run" in the nitroglycerine converter, 1,500 pounds of mixed acid of the greatest obtainable concentration, and in proportions of three parts, by weight, or 61.9 per cent of sulphuric, and two parts, by weight, or 34.5 per cent of nitric acid, are mixed with from 210 to 230 pounds of glycerine. The result is a reaction between the glycerine and the nitric acid, the nitro-substitution process converting the $C_3H_5(OH)_3$, or glycerine, into $C_3H_5(NO_3)_3$, in which, as may be seen, an atom of nitrogen supplants the hydrogen in combination with two more atoms of oxygen. The sulphuric acid serves principally to take up and retain the water produced in the reaction. When the process is completed, the materials are run into a tank, where they separate into layers, according to their several specific gravities, allowing the nitroglycerine to be run off into washing and purifying tanks, and the spent acids to be taken off to be re-worked. The dilute sulphuric acid is generally concentrated in iron pans and used again for nitroglycerine manufacture. The manufacture was conducted at twenty-two establishments in six States in 1900, 105 wage-earners being employed in making about 35,500,000 pounds of the product. The larger part of this output was consumed in various industries and in the manufacture of dynamite, blasting gelatine and smokeless powder, only a very small proportion being sold and used pure.

Manufacture of Fireworks

Of the one million dollars spent every Fourth of July in celebrating American independence, more than six hundred thousand dollars, represented by fireworks, come from a factory in the heart of Staten Island. This is one of the largest plants of the kind in the world. Locally it is known as the "fireworks farm." The more ground a fireworks farm covers, the less the danger. This one covers a square mile. The one hundred buildings within the inclosure are nearly all fire-proof—corrugated iron over steel frames, with cement floors—for each contains more or less powder. There is seldom more than a thousand pounds of powder on the farm, however, at one time. The company has bought all the adjoining land, the nearest dwelling being a quarter of a mile away; not because the laws relating to fireworks factories are absurdly stringent, but because of the desire of the owners to be positively on the safe side. Nor is the rate of fire insurance exorbitant. The risk is "extra hazardous," but the rate is no higher than, for instance, upon storehouses for hay and straw.

Throw away your cigar and step inside the inclosure. You look down a central avenue nearly a mile long, with buildings at regular intervals on either side, as in a village street. In these buildings three hundred men and women make two-thirds of all the fireworks used in the United States. The principal materials used in making all forms of pyrotechnics, from the smallest cannon crackers to the largest exhibition pieces, are—first, strawboard; second, explosive compound consisting of gunpowder, saltpetre and charcoal; third, tissue paper. The process of manufacture includes these three principal stages: First, making the strawboard tubes or cases; second, filling the cases with explosive compound; third, covering the cases with tissue paper. The first and last stages are very simple; the intermediate stage, that of filling the tubes with explosive compound, is very dangerous. Strange to say, this most dangerous part of the work is done in the only wooden buildings on the farm. Of these there are fifty or sixty, standing about thirty feet apart. Each building is about the size of a small hall-bedroom, and in each is one man and one "filling machine." In thus separating the buildings and the workmen the danger is reduced; in case of accident only one building would be wrecked, only one man would come to grief. It should be added that, despite the large amount of powder and dangerous chemicals handled daily in all parts of the plant, there has never been a serious accident.

Manufacture of Cartridges

The manufacture of brass cartridges for modern firearms is accomplished entirely by machinery, and at only one or two points in the process is it necessary to use the hands upon the product. One of the largest cartridge factories in the country, situated at Bridgeport, Connecticut, has a capacity of nearly 500,000 complete rifle cartridges per day, when working full-handed. It supplied a large proportion of the ammunition used by the United States Government during the Spanish War: one single contract alone calling for several millions of the "pear-shaped" United States Army and Navy Cartridge, now used almost exclusively for infantry small arms. Large cartridges for breech-loading cannon were also supplied in quantities. The brass used is brought to the factory in sheets, each having an even thickness of 3-100 inch. These are cut into strips thirty-five inches long by three inches wide, which, after being thoroughly oiled, are fed to the punching machines. From each strip forty disks, somewhat larger than a twenty-five-cent piece, are punched out by a peculiar double punch, the same stroke serving to detach each disk from the surrounding metal and to force it into a cuplike shape, one inch in diameter and one-half inch deep. The shell thus begun is "drawn out" to the proper length by the successive action of four more punches, a corresponding decrease in diameter being imparted in the same process. In the manufacture of the modern "pear-shaped" cartridge, the mouth of which is about one-half the diameter of the cap or head, the shell must be subjected to a further drawing process, in order to reduce its mouth sufficiently to fit the long slim bullet. The object of producing this peculiar shape is to secure the effect of increased pressure on the bullet, due to compelling the exploding force to pass through a diminished aperture.

After drawing, the shells are subjected to an annealing process, being placed in perforated iron cylinders and slowly brought to a white heat over a charcoal fire. It is essential that the heating be done carefully, in order to avoid too great rapidity, which is liable to render the metal brittle. While still hot, the shells are plunged into a bath of sulphuric acid and water, which removes scale and oxide, and are then thoroughly washed in pure water to eliminate all traces of acid. This process completed, they are trimmed in a circular cutter, to remove the rough edges, and are then rimmed, being now ready for loading.

In addition to the shells, intended to contain the explosive powder, and the bullet made to fit into its mouth, the completed cartridge is provided with another essential part—the priming cap. This is a small cap containing an explosive paste, and of a size to fit exactly into a hollow in the head of the shell, called the cup-anvil. The priming caps are made by a process resembling certain stages in the manufacture of the shells, the blank disks being punched at the rate of forty-five per minute from strips of copper. In several successive machines the caps, thus cut and punched, are smoothed and burnished, "vented" and completely shaped to receive the priming. The caps are charged in the priming machine, an exceedingly exact and delicate device, which performs the work, with little or no danger of explosion, and are immediately fitted to the shells. The cartridges are then loaded by being placed in holes on a rotating circular plate, so that each, in turn, passes under the opening of the powder hopper. By a precisely similar device the bullets are inserted, each one descending through a chute and entering the opening of the shell, which is then tightly crimped about it.

The process of casting the bullets consists of several stages. The lead is first cast into bars forty inches long and 3-100 inch in diameter, which are cut into small sections in the cutting machine, each piece being forced into shape under high pressure. Trimming completes the bullet, which is then ready to be encased in a copper jacket. The object of the copper jacket is to prevent melting of the lead in the heat of friction, induced by the enormous speed of 2,550 feet per second, the average for modern fire-arms. When thus properly protected, a rifle bullet can penetrate fifty-four pine boards, of seven-eighths inch thickness, nearly four feet, if fired five feet from the first surface; will pierce through one-half inch of solid steel and kill at a distance of about one mile and a half. Completed cartridges are tested with the chronograph, exactly as are rifles, the firing force being thus accurately determined.

Starch Manufacture

Men know that starch makes their linen of proper stiffness, and women know that starch has its uses in the laundry below stairs; but probably neither remember that starch is used also in the candy they munch, in the bread that comes from the bakery, in the paint on the house, in the paper around the bundle, in textile manufactures in calico, in bunting, and in wood filling. Whence comes starch? Somewhat from rye, barley, oats, buck-wheat, rice, millet, peas, beans, arrowroot; but principally from corn, wheat, and potatoes. In the starch factories using potatoes, corn or wheat, thirty-five hundred persons are employed, producing between two and three hundred and forty million pounds of starch annually, valued at more than nine million dollars. The total capital invested in starch manufacture is between eleven and twelve million dollars. The bulk of all the starch used is made from corn. About twenty corn-starch factories employ nearly twenty-five hundred persons and have an aggregate capacity of over thirty thousand bushels of corn a day. In the potato starch factories, of which there are sixty, only seven hundred hands are employed, and these work only about three months in the year. In the few wheat starch factories not more than one hundred hands altogether are employed, the total capacity being not much over one thousand bushels of wheat per day. The principal starch factories in the country combined in the early nineties, and operate under the general name of the National Starch Manufacturing Company, with ten and a half million dollars capital, and twenty-two plants. The principal factory is at Oswego, New York. There is another combination in this industry called the United Starch Company, which controls three plants and has a capital of six million dollars.

In making starch from corn, the cereal is first cleansed and steeped for thirty-six hours in water charged with sulphurous acid, for softening. The grains are "cracked" with French burr mills, and "threshed" three times.

The mass is then rolled, and the excess of starch liquor removed from the germ, and after being semi-dried, is fed into the "germ separators." From the separators the germ and the starch liquor are fed upon "shakers," where the starch liquor is removed from the germs, and the germ is freed from starch by washing with water. The germ is subjected to hydraulic pressure, and afterward steam-dried, screened, and ground to a fine meal. The meal is then heated and fed from the "cooker" into a form which drops the meal on a cotton cloth. The ends of the cloth are folded over and then the "cake" is compressed. The formed "cakes" are then hydraulically pressed, sixteen at a time, and ninety per cent of the oil is thus removed. The oil is "filter-pressed" through cloth or paper, and allowed to settle for several days in iron tanks, barrelled and sold. The "oil cake," with ten per cent of oil, is used as a cattle food, chiefly in Europe. The shells and other unground parts removed from the bottom of the germ separator are termed the "first grind." This is fed upon silk "shakers," and drained, the starch liquor going to the starch supply tank, and the drained "first grind" fed into burr mills, when the starch adhering to the shells is removed. The feed, or "second grind," is fed upon silk shakers and drained of starch, the drainings going to the starch supply tank. The feed, passing through a set of wringers, for the final removal of free starch, is then mixed with the solids from the "steep water," and the gluten is hydraulically pressed, so that forty-five per cent of the adhering moisture is removed. After the feed is broken by threshers, steam-dried until the moisture is reduced to twenty per cent, it is again threshed and again dried until all but about ten per cent of the moisture is removed. It is then ground to a fine meal, and sold as "gluten," "buffalo-maize" and "golden-feed." The washings of the second grind on the second shakers are run into "cone settlers," and the concentrated "starch liquor" is sent to the starch supply tank. The starch is fed to the starch tables, where the starch settles and the gluten runs off at the end of the table When the tables are sufficiently filled, the starch is scraped and taken by "carriers" to tubs or "breakers" and mixed with water to the proper consistency, going then to another set of tables.

From these tables the "carriers" feed the starch into breakers. When broken to the size of hen's eggs it is run into kilns, where it remains twelve hours at a temperature of 140°. The starch, containing about ten per cent of moisture, is powdered and bolted. Pearl starch is not milled after drying. Glucose starch, or 24° Baumé, is treated with muriatic acid and pumped into the "converters," where the pressure is raised to thirty-five pounds and held at this for twelve minutes, or until the desired sodine test for glucose, containing fifty-five per cent of dextrose, is obtained.

After the proper treatment glucose is obtained, which is drawn into barrels and sold at one to one and one-half cents per pound. Starch made from potatoes undergoes a very much more simple process, as there are no by-products worth saving, except the pulp. When farmers can get about a dollar a bushel they sell for direct consumption. The yield of commercial starch varies from ten to sixteen per cent of the weight of the potatoes used.

Manufacture of Perfumery, Cosmetics and Toilet Sundries

Manufacturers of perfume produce not only sweet-smelling articles in liquid form, but all the multitude of perfumed toilet articles, such as tooth powder, face powders, cosmetics, pomades, oils, and sachet powders. Any one of the branches of this industry includes at least one house which is doing business, as it were, on a foundation laid many years ago, its product having long enjoyed the reputation of being the best in the market. To compete successfully with these old established firms, especially with a new article, requires a large capital and an enormous amount of advertising. Take the case of tooth powder! The best known mixture of the kind was patented during the Civil War, and put up in packages for local trade by the inventor's own hands. To-day that tooth powder can be bought in every drug store and every department store in the country. The firm has a large factory in New York, manufacturing tooth powder only, and one hundred thousand dollars a year represents the profits divided among the father and two sons. In most of the toilet articles manufactured and sold in enormous quantities to-day there is from twenty-five to one hundred per cent profit.

There are 266 perfumery establishments in the country, employing about three thousand persons, and the annual production of the great variety of articles included in the manufacture of perfumery and cosmetics is valued at over $7,000,000. The imports of perfumery are slightly in excess of our exports.

In this industry the greatest care, taste, and experience are demanded of the manufacturer. Operatives therefore must be carefully chosen. A slight mistake in certain processes may mean a loss of hundreds of dollars. Chemists, especially, are always in demand in the different branches of the industry.

Less than one-fourth of the perfume used in the United States is imported in its manufactured forms. Accordingly, while there already exists in this country an extensive industry in the way of compounding perfumes, the production of raw materials is extremely meagre. A few American plants already yield perfume oils on their native ground, and many others ought to receive attention from this point of view.

Soap and Candle Manufacture

To be clean, a nation must accomplish something more than the building of reservoirs and aqueducts; it must construct soap factories. There are nearly six hundred soap and candle factories in the United States, wherein eleven thousand persons are employed the year round. Soap makers' daily wages amount to from $1.75 to $2.25; and soap makers' helpers receive from $1 to $1.50 a day. In the course of a year the soap manufacturers pay out between four and five millions of dollars in wages. American factories produce soap as good as any made in France or England, and that the people of all these countries so believe is shown by the fact that the United States imports only about one-third as much soap as it exports, the amount being about five hundred thousand dollars for imports and one and a half million dollars in exports. In the manufacture of soap the principal fats and oils used are tallow, palm, poppy, linseed, hemp seed, and olive oil. The average annual value of the production of both soap and candles in this country is $53,000,000.

Soap Factory Employes

The betterment of conditions surrounding workmen in soap factories is by no means the least prominent feature of the general progress made in this industry. The methods adopted by the Procter & Gamble Company in dealing with its employés in their soap factory are described in the following letter from the general manager to the United States Department of Labor:

> Under our system of profit sharing, all employés who have been in the employ of the company for not less than three months, are entitled to receive a profit-sharing dividend upon their wages equal to that declared upon the common stock; that is to say, an employé who receives wages of $500 per year, receives a profit-sharing dividend equal in amount to that received by the holder of $500 worth, par value, of common stock of the company. The profit-sharing dividend is paid at the same time the dividends are paid upon the common stock. The company reserves the right to refuse the profit-sharing dividend to any employé for cause, but the amount of the dividend to which he would have been entitled is distributed among the other employés. The dividends usually have been at the rate of twelve per cent (for two years they were twenty per cent) per annum. We consider the system a success, and believe that the extra interest and care shown by the employés have more than earned the amount of money that has been paid them in dividends. The company has also established a pension system, whereby we pay one-half of the amount necessary and the employés contribute the other half. The employés' contribution is taken each year from the profit-sharing dividend. All employés who have been in the employ of the company for ten years, and then become disabled from any cause, are entitled to receive a pension of seventy-five per cent of their average wages during this last year of employment, which amount, however, shall not be less than six dollars per week. In order to make the drain on the pension fund as light as possible, the company, as far as possible, gives employment to pensioners at such light work as they are capable of doing, and pays them what such work is worth. The amount necessary to bring their income up to what they would be entitled to under the pension system is taken from the pension fund. Any employé of the company who is injured from any cause while in the employ of the company, receives his regular wages until such time as he is able to return to work. No charge is made against the employés for this accident insurance.

CHAPTER XXXIV

JEWELRY, GOLD AND SILVER WARE, AND MUSICAL INSTRUMENTS

Jewelers, Goldsmiths and Silversmiths—Diamond Cutters—Ring Making—The Watch and Clock Industry—Machine-made Watches—The Trade in Watches and Clocks—Manufacture of Musical Instruments—Violin Making—The Piano Industry—How a Piano is Made—Piano Attachments—The Organ Industry

JEWELERS, GOLDSMITHS AND SILVERSMITHS

ONE of the most valuable scrapbooks in New York, considered as a document of historical worth, is owned by an employé of the city's leading jewelry establishment. As a salesman, he made a tour of the courts of the world, and was received by every crowned head, and by every president, viceroy and governor; and from all he took orders for jewelry to be supplied by the house he represented. The house received appointments, by royal letters, as jewelers, goldsmiths, and silversmiths to every court in Europe and Asia, and to the Emperor of Brazil. In the scrapbook referred to are autograph letters, photographs, invitations, and orders from each of the world's rulers. This book is proof that the art of American jewelers, goldsmiths, and silversmiths is appreciated the world over.

In India, the jeweler sometimes represents the highest caste in a certain religious sect; the goldsmith is next of caste, and the silversmith third. It has come to pass that the high-caste jewelers, goldsmiths, and silversmiths of the western commercial world may be found not far from Union Square, New York, and no longer is it necessary for American dealers to import foreign jewelry or silverware. Those of the "caste" here produce wares superior to any made abroad.

The men employed as goldsmiths and silversmiths to-day are artists of distinguished ability in many directions. They have educated themselves with special reference to entering the field of precious stones and metals. They are graduates of schools of art, and have studied in the galleries and museums of Europe. They can draw or model from life; they can use the brush either in oil, or water, or mineral colors; they are not mere copyists, but artists of creative ability. And the beautiful products of their cunning yield them returns at least equal to those of the best book and magazine illustrators.

Referring to the art of the silversmith of to-day, a member of the most prominent firm in this field in New York says:

There is no art in which the hammer plays so important a part as that of the silversmith; for there is no metal which lends itself more readily to the influence of the simple hammer than silver. Even gold, though scientifically more malleable, does not compare with silver in this respect. Just in proportion as the silver workers of all ages have forsaken the hammer in favor of the chisel or the mould of the caster, so has the artistic excellence of the work produced declined. There is an adjunct to the hammer, however, among the silversmith's tools, which, after all, relies for the effect it produces upon the hammer itself; this is the chasing tool, which is essentially merely a punch of varying shape and size, with which the surface of the metal is modeled under the influence of percussion. Workmen, however, have to be trained and taught to forget much which it had taken them a lifetime to learn, while the artistic temperament which luckily goes so often hand in hand with skilled craftsmanship, has to be fostered and encouraged.

These modern workmen have, with true artistic instinct, recognized the value which, from a decorative point of view, may be added to their work in silver by a judicious employment of colored stones and jewels. The word "judicious" is used because it is apparent that these jewels have been introduced not as mere units of pecuniary value, but mainly as color suggestions.

For many years tableware has been made in such attractive forms that the table of the wage-earner may be dressed with sugar-bowls, tea-urns, and a score of other articles which, while inexpensive, are both useful and beautiful. These articles are plated ware. Electro-metallurgy makes such low priced goods possible, and artisans in Connecticut, New Jersey, Rhode Island and other States, do the work. In the production of original and artistic designs, the manufacturers of plated ware articles have closely followed the best workers in the solid metal.

Diamond Cutters

Of precious stones this country is not the largest producer, but no nation is so large a consumer. The greatest precious stone market in the world is New York. Diamond cutting and polishing is centred in New York and Brooklyn as a separate industry, and we have no need to draw upon Amsterdam and Rotterdam, where the industry has reached its highest development. Indeed, diamond cutters from Holland are constantly seeking work in American establishments. Persons engaged in the diamond industry are greatly interested in a new invention of American origin—a machine for cleaving diamonds. This part of the work, hitherto always done by hand, forms a special branch, requiring the greatest delicacy and skill in the art of working diamonds. It is important, of course, that the stone be cut with the least possible loss, and an accomplished cleaver is paid well for his skill. Thus far, however, the utmost skill attained has never been able to preserve certain parts of the diamond crystal. The machine in question appears to accomplish this most difficult task. A new and ingenious use has been devised for the diamond by a citizen of St. Louis. It is no other than the addition of several small diamonds to the common spoon fly for fishing. The flash of the diamond is irresistible, especially to trout. It is declared that trout will bite at this bait at any time of the year.

Ring Making

What becomes of all the finger rings? This is a difficult question to answer. Rings are made to the extent of millions each year, and still the demand "goes on forever." There are three ways of accounting for this. Our immigration is enormous. The immigrants, getting a little money, throw away their old brass and silver rings, and buy gold ones. Then the natural increase of our own population swells the demand from year to year. And, lastly, some rings, of course, go into the melting pot. The demand for children's rings has also added to the output. Figures in this industry are really startling. Taking into consideration the whole country, the estimate is from two to four million rings produced annually. Gems and settings included, the value of this annual output is $10,000,000. A calculation has been made which states that it would require a finger four miles long to accommodate a single year's output, and their weight would have to be measured by tons. Children's rings, which started at grades selling for one or two dollars, now frequently cost as much as $15 each; higher priced ones being made to order.

No other country vies with the United States in selling rings in this country. Except for a few quaint or curious designs, there is practically no importation. The manufacture is centred in New York. Almost all of the work is done by machinery, the business having become a science. Machines make the band, and add the chasing and ornamentation. The settings are still inserted by hand, but such is the perfection of the tools of the present, that one man now accomplishes the work formerly requiring six. Of course, the designing never will be done by machinery. In the way of grouping, chasing, etc., there are more than 10,000 different styles of rings in the market. The sale of rings is affected by fashions in stones and shapes. A remarkable example of the change of fashion in stones may be seen in the career of the opal. Time was when this stone was deemed so unlucky, that it could not be given away. Jewelers had trays of them untouched for years.—A gift from a queen, however, must be accepted. It is said that Queen Victoria began to give away opals as presents, and thus started the fad for them. Now opals are in great demand, being set with diamonds, rubies, garnets, and other stones. With the ancients the opal was considered lucky. The finest opals are the Hungarian, some of them being valued at prices ranging from $2,000 to $4,000 each. The rarely found opal from our own State of Washington ranks next in quality. Nearly all of our opals come from Australia. There the opal is not a globular deposit imbedded in quartz, but is found in flat sheets in the shape of oncroppings on other mineral deposits. The blue opal comes from the rainless section of Australia, while the pink opal comes from Queensland; the prices of these two qualities being about equal, running from $8 to $15 per carat, according to size and quality after cutting.

The demand for other gems in rings remains constant. Diamonds, pearls, turquoise, rubies, emeralds and sapphires are still reigning favorites. The amethyst is also used.

In the department of settings, the change of fashion is incessant. In women's rings, the shapes known as "marquise," "clusters," and "circlets," are popular. The "marquise" design is of a narrow elliptical form with sharpened ends, the centre being a diamond, sapphire, ruby or opal, with edgings of other gems. "Circlets" are plain or chased bands, thicker in front, where the settings are. Small stones are generally used with this design. For men, "belcher" rings, seal rings, and snake rings are fashionable designs. Jade and jasper are in vogue for stones. The "sapphire carbuncle" is also popular. The "belcher" ring is a thick, rounded gold band, thicker in front where the stone is set. Antique designs, with the owner's initial or coats of arms, are favorites, selling from $10 to $25 each. The snake ring is again in demand. Designers earn from $40 to $50 per week. A great many Frenchmen and Italians, working independently, submit their designs, and get from $2 to $5 for those accepted. In a factory sometimes as many as a hundred dozen of a single promising pattern are made up.

The Watch and Clock Industry

The manufacture of watches and clocks embraces a dozen different trades. There are certain workers who prepare jewels, some who make dials, others who temper hair-springs, while a large number give a mirror polish to the steel, and many are occupied as gilders. In our driving civilization the timepiece becomes a vital necessity. To supply this need requires the highest type of skilled labor. Watchmakers must possess trained eyes, steady nerves, and the deftest of fingers. Their tools must be absolutely perfect, in order to secure uniformity in the different parts of the works. If your watch fails to keep time after persistent regulating, it may be because one of its infinitesimal parts varies from the proper size by one five-thousandth of an inch. Watchmakers say that no two watches in the world are exactly alike; each watch, like each human being, having a separate individuality. As the life of a watch is at least fifty years, it would seem that many persons must be the owners of more than one watch, for new watches are bought every year to the value of $12,000,000.

The factories of the principal American watch concerns are in Boston and Waltham, Massachusetts; Elgin, Springfield, Rockford, Illinois; Trenton, New Jersey, and Lancaster, Pennsylvania. Even in Switzerland, the capital of the watch world, the manufacturers have adopted certain American methods and machinery, and carry on a large trade with the United States. Among the Swiss, watch making may be said to be a national trade. All the male members of hundreds of families have been watchmakers for generations back. Not so in America, where watch-making machinery, to a large extent, has taken the place of the workman. In American watch factories, all the parts—plates, wheels, pinions, etc.,—because of their uniformity, are interchangeable. The retail dealer is thus enabled to supply parts at a comparatively trifling cost. Usually a record is kept at the factory of the size and grade of each watch movement, so that duplicate parts may at any time be obtained by simply quoting the movement number.

It will be noticed that the list of watch manufacturing towns given in the preceding paragraph does not include certain Connecticut towns whence comes the cheap American watch, so well known the world over, at a price within the means of miner, mechanic, and day laborer. Some of these "dollar watch" companies also make more clocks than watches, and are classified in the industrial world as clock concerns. The principal clock-making State, then, is Connecticut, having within its borders the majority of the great clock factories in the United States. The best American watches and clocks are deemed so perfect, that when the hands fail to meet at XII, on time with the sun, we are tempted to believe that the sun, not the watch or clock, is wrong. The latest novelty in watch making is the "register dial," in which the hands and the Roman numerals are replaced by the actual figures, as in the case of carfare registers. The figures appear in the centre of the dial; and instead of a pair of hands meeting at noon, for example, the dial registers thus: 12.00.

The history of systematic watch-movement making by machinery covers half a century. The industry practically began in the United States, and has been developed here to its present high condition of excellence and supremacy. The manufacture of watch cases began a little later. Massachusetts leads all the States in the production of watch-movements. She was the pioneer in the industry. Illinois follows as a good second. We find the largest manufacture of watch cases in New York, Pennsylvania and New Jersey. The adaptability of women to the delicate operations of automatic machinery is nowhere more extensively manifested than in the watch-making industry, the number of those employed constantly increasing, while the number of men has decreased. No children are employed in watch factories, except in the State of New Jersey, where there are a very few thus engaged. The percentage of wages to total wages is largest in Illinois. The average value, at the shop or factory, of the watch movements made in the United States is $3.31. The component materials used in the industry are wholly of the "partly manufactured" kind, such as brass, silver, steel, and other metals and alloys. Low-priced or dollar watches are made almost wholly in clock factories as a by-product. But that this by-product is valuable is shown by the fact that it includes more than 1,200,000 watch movements annually, worth more than $566,000, and more than 703,000 watch cases, worth over $74,000. In the manufacture of watch cases, although there is a large, absolute increase in the number of women employed, yet there are relatively few when compared with the women in watch factories, the manufacture of watch cases requiring fewer wage-earners than the making of watch movements. A small number of children are employed in this branch. There is no "contract work" done in making either movements or cases.

Machine-Made Watches

While the Swiss still manufacture a great many watches, they remain in the field only by having introduced American machines and American methods, which is a recognition of our superiority in this industry. Machine-made watches are preferred by a great many to hand-made watches. With the perfection of automatic machinery the most delicate processes are accomplished with complete uniformity and finish. The effort has been to make not only a cheaper watch, but a more accurate timepiece, and the great system of interchangeable mechanism in manufacturing has thus been promoted. In the factories of the great watch companies in Connecticut and Illinois, thousands of operatives are employed, making the more than 150 parts contained in a watch, by 3,700 processes, most of which are accomplished by automatic machines of ingenious design. All parts of a watch movement are made here, and also all the machines used in the manufacture. Many of these machines are not patented.

The number of mechanical appliances in the manufacture of watches exceeds those of any other industry save the department of electricity. Frequently one operator alone can run six or seven machines. A marvellous device is the Church completely automatic machine; it makes four hundred balance-staffs per day, each with a diameter scarcely larger than that of a No. 9 sewing needle. The Church automatic cutter and the crown wheel cutter are other improvements, as well as the machines for making the minute screws and stud pins, and vibrating balances and hair springs. By another system, springs can be tested and graded. It takes nearly 150,000 of a certain kind of screw to weigh a pound, so tiny are they. The finest screw for a small-sized watch has a thread of 260 to the inch, and weighs one hundred and thirty thousandths of a pound. The largest round hairspring stud is four hundredths of an inch in diameter and about nine hundredths of an inch in length.

In the finishing department of a watch factory the highest skilled labor is required. Here the movement is adjusted and tested. The balance in most modern watches is required to make 18,000 vibrations per hour. The change of one beat will cause an error of four and four-fifths seconds at the end of twenty-four hours, showing the delicacy of the tests and the necessity of "demagnetizing" all the parts of the escapement.

Some watch movements and cases are made by clock companies as a by-product. The cheap watch is sometimes called a "clock-watch." Its cheapness is owing to automatic machinery and the factory system. In this type not much finish is possible. Nearly all the parts are stamped out, and the testing and adjustment are not perfect. Still, they are fairly good watches. The manufacture of these cheap watches is limited to Connecticut and New York, one establishment turning out, at a maximum, 2,000 per day. And yet the supply does not equal the demand for the home and foreign markets.

Few, if any, watch cases are now made by the better class of watch-movement establishments. The manufacture of watch cases is a special department of industry. Watch movements and watch cases are made for each other, according to standard sizes. There are some very ingenious automatic machines used in the making of watch cases.

There is one very popular "filled" case that costs only one-half the price of a solid gold case. Other cases are made of silver, nickel, German silver, and gun-metal. There are some very low-priced grades made of brass, nickel-plated. The case should be stiff, and so made as to keep out dust and moisture.

The Trade in Watches and Clocks

The gross output of the fifty watch and clock factories of the United States is about $12,000,000. The materials in use represent $2,500,000, and the item of labor, superintendence, clerical work and advertising, make up the balance. Connecticut leads the States in clock making, employing about 3,000 persons in this industry. Illinois leads in watch making, the manufacturers of that State employing about 4,000 persons. New York is second in watch making and third in clock making; Massachusetts holding the second place in the latter branch. There is a large and extending foreign trade in American watches. Additions to our territory have tended to increase this foreign trade. American watches are sent chiefly to two countries, the United Kingdom and Canada. Next in the order of prominence come the exportations to Japan, Austria, South America (except Brazil and Argentine), Africa, Brazil, British East Indies, Asia (without India, China and Japan), Mexico, China, and the West Indies. In this country the American watches have practically forced all others out of the market, except watches worn for ornament or for nautical and engineering uses. For the latter there is still considerable demand, and they are imported from Switzerland, England and France, but the decline of the importation of watches is continuous. Many foreign countries have high tariffs, which discriminate against the manufactories of the United States. But wherever the American watch has secured a hold, its importation is rapidly increasing.

The importation of foreign-made clocks, except those principally desired for purposes of embellishment, has also materially declined, while the export trade is annually increasing.

Manufacture of Musical Instruments

The manufacture of musical instruments comprises these three principal classes: (1) pianos; (2) organs; (3) miscellaneous musical instruments. The operations of the three industries overlap, however, for in many establishments both pianos and organs are made, and certain factories make half a dozen different instruments.

The three musical instrument industries are each very much subdivided into smaller special industries, turning out the various parts of an instrument. In many cases both organ and piano parts, or piano and small stringed instrument parts, are made in the same establishment. There are several plants in the country turning out piano and organ keys. In the State of Connecticut, for example, there are three such factories in one county, using for this purpose more than a hundred tons of elephant ivory per year. Leominster, Mass., is an important centre for the manufacture of piano cases, although nearly all the wood used is brought from other States or imported from abroad. There are several establishments which make a specialty of sounding-boards, piano actions, cast-iron plates, hammers, piano legs, piano felts, etc., New York City having 22 such plants in operation. Many piano "manufacturers" are assemblers only, buying from specialists nearly all of the parts used. In the manufacture of these specialties Massachusetts takes the lead. In the field of small instruments a specialty has also been made of drum-heads and banjo-heads, gut and wire strings, etc. The successful manufacture of musical instruments requires experience, and was of slow growth in the United States.

There are made yearly in the United States about $4,000,000 worth of band instruments, violins, mandolins, guitars, banjos, music-boxes, zithers, strings and materials.

In the matter of wind instruments, American manufacturers have achieved triumphs that have led to large sales and have resulted in checking the importation of instruments from abroad. Wind instruments are manufactured in Elkhart, Indiana; Worcester, Massachusetts; Chicago, and a few other places, where thousands of skilled artisans are employed, supplying every kind of instruments used by bands, orchestras, and musicians generally.

The number of violins made annually exceeds 1,500, valued at more than $100,000. Nearly 80,000 mandolins, the same number of guitars, and nearly 20,000 banjos are also produced. The extent of the manufacture of music boxes alone can be judged from the fact that the average annual value of the output is three-quarters of a million dollars. The importation of wind and string instruments has decreased, as the result of the enterprise of manufacturers in this country. In the output, besides the instruments already named, may be named violoncellos, harps, clarinets and flutes, concertinas, accordions, dulcimers, drums, tambourines, trumpets, bugles, saxhorns, and other brass and German-silver instruments. Some of our woods are particularly adapted for use in the construction of musical instruments involving the use of wood, as they have great resistance against climatic effects. Chicago seems to lead in this industry.

Violin Making

A violin made by the best modern masters is equal in all respects to the ancient ones. There is no lost secret in making violins. Those turned out in America to-day are as good as any known to history. New wood has been found unfit for use in the construction of a violin. It lacks the requisite tone quality and vibratory power, on account of the moisture contained in it. No artificial drying process will suffice; it must be done by lapse of time. Even baking the wood is not sufficient. Artificial processes rot the wood of its life, and soften its fibres so that it is practically worthless. Old rafters and beams, or antique bedsteads, from old houses, form a good material for the constructor. Violins contain eighty-two or eighty-four parts, the latter when back and belly are each made in two pieces. The parts are as follows: One belly or front plate, one back, six sides (sometimes called upper, centre and lower bouts), twelve linings, six blocks, thirty-six purflings, one bass-bar, one sound-post, one scrole, one peg-box, one neck, one finger-board, one finger-board nut, one tail piece, one tail piece button, one tail piece nut, one tail piece string, four pegs, four strings, one bridge. These are all needed in a perfect instrument. There is nothing arbitrary in the shape or construction of a violin. Every piece of material, every line, and every process of adjustment, is the result of experience. Even the sound holes, shaped like a small f, or an old-fashioned *f*, must have that special form, as any other would interfere with the vibrations. These vibrations are at the bottom of all musical instruments.

For use in the manufacture of the various parts of violins, the best woods are spruce, maple, sycamore, pine, lime and pear, as they have been found to possess the best vibratory powers. Not only must the wood be of the best quality, but each plate must be of the exact degree of thinness and curvature.

The bows are made of horsehair. The strings—contrary to popular tradition—are made from the small intestines of sheep and lambs. The month for making strings is September. Strings must be of a uniform thickness to be suitable for use. The thicker the string, the deeper the tone. The highest notes are caused by the most rapid vibrations. The bow has made the violin the first of all musical instruments. It makes it possible to produce and sustain the varieties of tone peculiar to the instrument; a single bar of music may be bowed in fifty-four different ways. Purfling is the name of the delicate inlaid lines that run around belly and back, near to the outer edges. This is only ornamental. The sound post is last to be put in position, which is done through one of the sound holes, by an appropriate tool.

The Piano Industry

We have come to think of a home without a piano as being almost as dreary as a home without a child. It takes more than twenty thousand persons, a great majority of them skilled workmen, to supply the United States with pianos. Nearly $40,000,000 is invested in the business by about two hundred and fifty manufacturers. Their combined product amounts to about ninety thousand pianos each year. Five of the manufacturers operate the largest plants in the world—two in New York, and one each in Chicago, Baltimore and Boston. The remaining piano-making centres are Philadelphia, Buffalo, Rochester and Cincinnati; Norwalk, Ohio; and Erie, Pennsylvania. An interesting fact is that while one rarely, if ever, sees a foreign piano in public use in this country, a number of American instruments are constantly used by great musicians in concerts in the very centres of music in the Old World. Probably not a single manufacturer in the United States, or in any other country, is now making square pianos. It is also probable that the percentage of manufacture for some time to come will continue to be about ninety-six per cent upright, and about four per cent grand, pianos.

The business of renting pianos is carried on in every city in the Union. The profits of renting are such that many firms now rent even brand new pianos, making more on their investment than if they sold the instruments outright. The cost of hiring a piano is so small that almost any one who can play the instrument can have one.

The United States has made many contributions to the manufacture of pianos, chiefly the cast-iron frame perfected by Jonas Chickering and others. and the method of overstringing patented by Steinway & Sons. Both of these improvements have been very generally adopted here and in Europe. The art of piano making has been brought to great perfection here, being favored by the abundance of wood suitable for sounding-boards and piano cases.

The majority of the skilled workmen in piano factories are either foreigners, principally German, or the sons of foreign-born parents. As in the case of watch making in Switzerland, six or seven years are required to learn the trade, and few American boys are willing to work so long as mere apprentices, especially as in other fields a boy can earn good wages while working his way up to the grade of skilled mechanic.

How a Piano is Made

While it is true that the musical tones of a piano are produced by hammers striking steel wires, and there is much metal in its make-up, yet the making of a piano is largely a matter of cabinet work. Not less than thirty pounds of glue, and about a gallon of varnish, are used in fashioning the ordinary upright piano. One-half of the six months required for the construction of a piano goes in varnishing and gluing, and setting and drying the glue and varnish. Apart from the iron plate there are no screws, bolts or nails, all the parts being held by glue. Screws might work loose in their fittings, and rattle.

A piano contains about a dozen kinds of wood, the lumber alone in a great factory representing a small fortune. The lumber must be cut and seasoned with the greatest care. It is first "quarter-cut" and left under cover for months or years, to season. And when brought to the factory the various woods are still further seasoned for weeks or months in drying rooms heated by steam to 130° or 140° F. The first step in the manufacture is making the "back," which, in the ordinary upright, consists of six vertical posts of elm or ash, six inches by three inches, reinforced by crossbars of maple. Along the top of this is glued the heavy rock-maple pinblock or wrest-plank, which is covered with five layers of the best seasoned maple veneers, each three-sixteenths of an inch in thickness. In this pinblock are sunk the 230 tuning-pins, in a piano such as the Weber upright. These must bear the six-ton pull of the 230 strings, without the slightest yielding. Between two of the posts are the handles used by the movers. In front is the sounding-board. These sounding-boards are of spruce, being made of a dozen pieces glued together side by side and secured with cross-ribs of spruce. The strips of spruce are carefully selected, somewhat harder strips being used in the treble than in the bass, as they give greater vibration. The sounding-board of a piano tapers from treble to bass, or from three-eighths of an inch to one-quarter of an inch. The sounding-boards are dried in hot closets, at 110° F., for about ten days before the ribs are put on. The bridges are glued on the side opposite the ribs, a short bridge for the bass strings and a long one for the treble. The bridges are made of eight thicknesses of rock-maple glued together, edges up, and capped with a thick rock-maple veneer. Steel pins hold the strings on these bridges, the treble bridge alone having nearly four hundred of these pins. The sounding-board is glued to the back, and reinforced with strips of maple glued around the edges. The tone quality of a piano depends largely upon the shape and quality of the sounding-board and the position of the bridges.

Over the sounding-board comes the bronzed iron plate, weighing several hundred pounds. This is fastened to the heavy timbers of the back by fifty screws and bolts. This whole mass, back, sounding-board, and iron plate, is brought under a steam drill which bores 230 holes in the pin-block for the nickelled tuning-pins. The notes have one, two, or three wires, according to their position, and each wire must have its own tuning pin and possess great strength. A piano is tuned about fifteen times before it gets to its final tuning just before delivery to the buyer. The instrument should be kept in a room of uniform temperature.

Next follow the gluing on of the sides, the fitting in of the key-bed, panels, legs, pedals, etc. These have all been separately made ready in the shops and "finished" with veneer and varnish. All the surfaces in the best pianos, such as the Weber, are "double veneered," the layers of mahogany or walnut used for the veneers being sawed in strips of varying thickness, from one-twentieth of an inch to one-quarter of an inch. Thinner veneers are used by makers of other pianos, but do not stand the test of wear. Sawed veneers of mahogany cost ten cents per square foot, and the finest satin wood veneers cost as much as sixty cents a square foot. Each part of the piano is varnished six times, and later receives further treatment until the surfaces are left in perfect lustre.

Coming to the striking mechanism, the keys involve very delicate work, each one having its own individuality, and being suited to its particular place and no other. The eighty-eight keys are cut from a single board of white pine. The keyboard is fastened to the key-frame, and, after treatment, the ivories covering the fifty-two white keys are laid on, the ebony for the black keys being put on later. The boards are set aside for two months and then the ivory planes are scraped and polished. The key-frame is removed and the keyboard is now sawed by a band saw into eighty-eight separate keys, which are smoothed separately and adjusted.

Now comes the action, a detailed description of which would be too technical. In an upright piano the mechanism is vertical, in a grand piano it is horizontal, each one of the eighty-eight notes having a similar apparatus.

About twenty pieces of wood, levers, blocks and bars, held by springs and bands and brass plates, are put in motion every time a key is struck and a tone produced. After the action is put in, and the hammers and keys inserted, the adjusting, regulating and finishing requires much expert work. The tone regulator devotes his attention mainly to the hammers. The instrument then goes to the fine action regulator, and afterward to the fine tuner. He is an expert who tries to improve, if possible, the pitch and quality of the tone, in spite of the many preliminary tunings.

Piano Attachments

A remarkable development may be noted in the growth of piano players, piano-playing attachments, and self-playing pianos. The first are cabinet keyboard players, which may be removed at pleasure. Self-playing attachments are placed inside the piano case, and operate upon the action rather than upon the keyboard. They are not detachable at pleasure, although they do not interfere with the playing by hand. In self-playing pianos the attachments are made a part of the piano at the factory. Perforated sheet music is used in nearly all of these devices, the motive power being supplied by the feet or by electricity, and the action being either pneumatic or wholly mechanical. Fifty-five patents for pneumatic piano keyboards have been granted in the United States.

There are thirty companies manufacturing instruments of this kind in the field, one company having a capacity of 800 instruments per month, and exporting to London. Another company now makes six different varieties of piano players, piano-playing attachments and self-playing pianos. The demand for these is steadily increasing. The popularity of the pneumatic piano player operated by the feet is due to the fact that it contains devices by which the performer is able to control tempo, volume of sound, and accentuation of particular notes or passages.

The Organ Industry

In organ building the chief improvements have been the "voicing" of pipes, to improve their tone quality, and the perfection of various mechanical arrangements. In the large instruments electrical and water motors operate the bellows, Pneumatic and electric actions have superseded the system of wooden trackers. It is thus possible to place the keyboard whereever the organist desires, and to have an echo organ in parts of halls or churches at a distance from the main organ.

The pipe-organ industry is distinct from the manufacture of reed organs. In number, the pipe-organ building establishments form about one-half of the organ factories, but in the value of the products the reed organ industry is by far the more important. The making of pipe organs is largely conducted in small establishments. Most of them are made in Boston, Massachusetts; Chicago, Illinois; Brooklyn, New York; Weston, Massachusetts; New York, N. Y.; Erie, Pennsylvania; Philadelphia, Pennsylvania; and Hagerstown, Maryland, although about forty other towns share the industry.

The reed organ, although not invented here, has been so greatly improved in this country that it may be called an American instrument. From the "Seraphine" and the melodeon to the "suction" or "American organ" was a long step in advance. The substitution of suction for blowing was such an improvement that the making of melodeons was discontinued in this country. Hamlin's improvements in "voicing" also helped to perfect the "American organ." The West, with Chicago as a centre, is the great reed organ producing territory. The cheapness of pianos has somewhat reduced the sale of reed organs.

Mr. Gally's self-playing organ or "organette" was the first to gain much sale in the United States. A perforated paper music roll is used in this instrument which is played with a hand-crank. Such improvements have been made by the companies now in the business, that at present the performer controls both "tempo" and volume of sound, and is enabled to give his own interpretation to any selection. Pipe organs are now made on the same principle. One company, at least, manufactures an instrument which is a combination of a self-playing organ and a piano player.

One large organ company employs about two hundred and seventy-five persons, a large majority of whom are of native birth, of old New England stock. Improved machinery and new methods of construction have gradually reduced the number of persons formerly employed by the company, until now the same output is maintained with a decrease of nearly one-third of the number of hands.

The labor in organ making is subdivided and grouped. All work to be performed is given out under the order card system. The cards are specially devised and arranged to meet the requirements of this particular art, which is one involving an enormous amount of detail. All cards are issued from the central office, and are returned to the same for record when the work done by their authority has been completed. This record shows at once the status of each job, thus enabling the office to take action upon any particular job if exigencies should require it. Cards for jobs requiring a time endorsement, or the time actually spent in their performance, and for the purpose of obtaining cost of production, are of different colors, according to the nature of the work. Special order cards are also extensively used for all purposes that do not come within the sphere of the regular routine work.

In certain departments in organ factories specially devised machinery is employed, notably in those of key and reed making, and in the cutting of the reed chambers. Key making requires some ingeniously constructed machinery, and in reed making there are in use automatic machines, each of which performs several delicate manipulations with speed and accuracy. The machines that cut the reed chambers are beautiful in their construction, and marvellous in their execution. Owing to the peculiar division of labor and methods involved in this particular manufacture, those employed in some departments are paid by the day. Piece work, however, is the general custom, and good wages are earned.

PART II

TRADE AND GENERAL BUSINESS

CHAPTER I

THE AMERICAN FINANCIAL SYSTEM

Grand Divisions of the Financial System—Statistics of Financial Conditions at the Beginning of 1903—Mints and Assay Offices—Operations in the Assay Offices—Employés of Sub-treasuries, Mints and Assay Offices—The Manufacture of Gold and Silver Coins—Bureau of Printing and Engraving—The Manufacture of United States Bonds and Paper Money—Paper for Notes, Bonds and Stamps

Grand Divisions of the Financial System

IF THIS age of consolidations could bring all the banking and allied financial institutions of the United States together in a single building, this is what a visit to that building would reveal: In the basement would be the money manufacturing plants—the United States mints, where gold and silver bullion is turned into eagles, dollars, half-dollars, quarters, and dimes; and the United States Bureau of Printing and Engraving, where "greenbacks," gold and silver certificates, National Bank notes, and United States bonds are printed from carefully engraved plates. On the ground floor of the building would be the United States Treasury Department, and the nine sub-treasuries, where the products of the mints below would be passed over the counter. Taking the elevator to the floors above, the boy would call out for our guidance: "Second floor, all off for 4,300 national banks. Third—this floor for 5,000 State banks. Fourth—1,000 savings banks. Fifth—Clearing Houses of New York, Boston, Philadelphia, Chicago, St. Louis, and 75 other cities. Sixth—Morgan's, Drexel's, Peabody's, and 5,000 other private banks and loan and trust companies. Seventh floor—5,000 building and loan associations." And we might even add another story, to contain all the money and exchange brokers, all those engaged in metallurgy as connected with coins, all the shops for the sale of old and rare coins, and all the departments wherein are handled all the revenue and postage stamps and other bits of paper that are as "good as gold."

Such would be the tenants of this colossal structure, all dealing in one kind of merchandise—cash or its equivalent. Under this roof would be represented the banking and the money-managing system of the United States. The army of employés, from cellar to roof, would number fully two hundred thousand. No one person, working twelve hours a day through the period allotted to a natural life, could count, dollar by dollar, the cash and "paper" that would be stored in the steel tills of this building at any specified moment.

The following statistics convey an idea of the extent of the operations of the principal institutions comprised in the country's financial system:

STATISTICS OF FINANCIAL CONDITIONS AT THE BEGINNING OF 1903:

National Wealth	$94,300,000,000
National Bank Individual Deposits	3,209,000,000
Deposits in Savings Banks	2,750,000,000
Number of Savings Banks Depositors	6,666,000
Deposits in State Banks	1,700,000,000
Deposits in Private Banks	132,000,000
Loan and Trust Company Deposits	1,526,000,000
New York Bank Clearings	74,753,000,000
Total Bank Clearings	116,021,000,000
Gold (including certificates in circulation)	939,000,000
National Bank Notes out November 1	380,500,000
Money in Circulation	2,250,000,000
Circulation per capita	28.43
Gold in the Treasury	559,300,000
Gold Production, 1902	78,666,000

THE UNITED STATES TREASURY AND SUB-TREASURIES

The largest accounting office in the world is that of the Auditor for the Post-Office Department in Washington. Four hundred bookkeepers are employed in this single office. And yet this office is only one of hundreds of others in that division of the Treasury Department which acts as the nation's bank. The work of all other divisions of the department is to collect, care for and disburse the public money. Once the public revenues are received, the next duty of the Department relates to their safe custody. There is usually in the Treasury, in the shape of available assets, a sum in the neighborhood of $800,000,000. Of this sum about $300,000,000 is available for government expenses, the remainder being held on deposit against outstanding certificates and Treasury notes. The safe-keeping of these funds devolves upon the Treasurer of the United States and nine assistant treasurers. The Treasury proper—in charge of the Treasurer—is in Washington. The nine sub-treasuries—each in charge of an assistant treasurer—are in New York, Chicago, Philadelphia, Boston, Baltimore, New Orleans, Cincinnati, San Francisco, and St. Louis.

In addition to this, there are nearly 450 National Banks, designated as depositories, which are permitted to hold a certain amount of the public funds. Each of these banks must deposit security in the form of Government bonds, with the Treasurer of the United States, a balance is "fixed," and when that balance is passed, the excess must be sent to the nearest sub-treasury. The assistant treasurers in the nine cities named, and the National Bank depositors, are the disbursing offices of the nation. They disburse yearly between $300,000,000 and $400,000,000. Every cent of the vast sums thus paid out is subject to an accounting by the auditors of the Treasury. There are six such auditors, who audit and pass upon all accounts, but their final action is subject to the decision of the Comptroller of the Treasury, in questions of law and regulations governing the payment of government funds. Thus we have, as the custodians of the nation's funds, first the Treasurer of the United States, who may be said to correspond to the cashier of the bank; the assistant treasurers, who may be called assistant cashiers; the National Bank depositories, the officers of which may be considered as paying and receiving tellers; the Comptroller, who corresponds to the legal officer of a bank; and the auditors, who are its bookkeepers.

Mints and Assay Offices

Operations in the mints of the United States employ 1,200 persons, the working force ranging in position from those whom the Treasury Department classes as mere laborers, to persons of the highest scientific attainments. There are chemists, artists, and engravers, some of them of great distinction in their respective fields. All the medals ordered by Congress are made by men in the mint service. This service begins at the mouth of the gold and silver mines, and ends at the doors of the Treasury vaults. The crude bullion from the mines, the base metals from mountains and from river placer, pass directly into the hands of officials who ship the products to the assay offices. With the exception of the office in New York, all the assay offices are located as near as possible to the mining centres, in Denver, Carson City, Deadwood, Helena, Boise City, St. Louis, Seattle, and Charlotte, N. C. At these offices the crude bullion is melted and assayed; its value is thus determined and payment made. Then the "product" is shipped to the coinage mints in Philadelphia, San Francisco, or New Orleans. Here the bullion is refined and turned into standard metal. The metal, as it is run into ingots, must contain nine parts of gold or silver, and one part of copper. These ingots are then passed to the coiner, who rolls them into strips the exact thickness of the coins desired. The blanks for the coins are cut out of these strips, by a powerful machine, as easily as the cook cuts biscuit out of a layer of dough. Then the blanks are delivered to the stamping-room, where every kind of coin, from the bronze cent to the gold double-eagle comes forth, bright and shining, and is now "legal tender."

The coinage of the mints at Philadelphia, New Orleans, and San Francisco during the year 1901 amounted to 176,999,132 pieces, of the value of $136,340,781. Of this $99,065,715 was in gold, $24,298,850 in silver dollars, $10,966,648 in fractional silver, and $2,009,568 in minor coin. Eighty millions of dollars was coined in 1901 at the San Francisco mint. This broke all mint records of the world. It was $4,000,000 greater than the output of the Philadelphia mint in 1881. It was far ahead of any known record of any foreign mint.

A branch of the United States Mint, known as the Seattle assay office, was located at Seattle in the year following the great discovery of gold in the Klondike and Alaska. This is a most valuable institution to the people of the State and of Alaska, as the mining interests are of paramount importance, particularly in Alaska. Receipts at this office since its establishment exceeded all expectations.

Operations in the Assay Offices

To the assay offices, as before stated, is brought material consisting of gold and silver bars, uncurrent, old and mutilated coins, both of foreign and domestic issue; solid silverware, and various lots of jewelry. Lots of less than $100 in value are not accepted. The charge for assaying a lot worth $100 is $1.25. Nothing is so deceptive in weight as gold. The average man can not lift a bar of gold of the size of a loaf of bread. The deposits are melted separately. They are then poured into a mold and stamped with a number. From each are taken two chips for the assayer. A tiny portion of each chip is weighed upon scales capable of weighing a hair. The weighed sample is called an "assay." It is wrapped in a little tiny fold of sheet lead and put in a little cup of bone ash in a red-hot oven. An oxide is formed of the lead and base metals. This is absorbed by the "cupel," or conical bone ash cup, so that nothing but gold and silver remains, a tiny deposit in the little cup. This deposit is weighed, and its weight subtracted from the weight of the original assay equals the weight of base metals in the sample. The deposit being composed of silver and gold is now separated into the two metals by nitric acid. A final residuum of gold dust remains. The gold fineness of the sample is thus determined. The assay office, having in this manner determined the value of the deposit, the same is paid in bars or cash to the depositor, minus the charge for assaying. The operation of assaying does not take more than two hours, the value of the deposit being returned to the depositor in two days. When the deposit has thus been paid for it belongs to the government, and is sent to the refining department. Many deposits are melted together in fixed proportions of gold, silver and base metal, in crucibles holding about three hundred pounds. When melted, the mass is molded in large flat molds full of holes, so that the sulphuric acid may afterward dissolve the silver and baser metals from the gold, about 1,000 pounds of sulphuric acid being used in each great cast-iron kettle. Sulphates of all the metals save gold are formed. The solutions are siphoned into tanks lined with lead at the sides. At the bottom are slabs of copper. The sulphur unites with the copper, and the result is sulphate of copper, which is ready for the market. Sulphate of copper is also called "bluestone." A silver sand remains, which is washed and placed in hydraulic presses, taking the form of round cakes, each containing about 1,000 ounces, and valued at about $600. After being oven-dried, the silver is melted, further refined, and molded. Samples are assayed, and when they contain 999 out of 1,000 parts of silver the bars are paid out by the cashier. Going back to the gold left in the kettles, a soft, reddish deposit, we see that it is washed with hot water, pressed and dried. It is then melted and cast into bars of about $4,000, $5,000, or $8,000, and paid out by the cashier or sent to the mint for coinage. So pervasive is the gold dust arising from these operations that floor-sweepings, ashes and the working clothes of the artisans are burned and assayed for a further gold residuum, which is sold to outside smelters. The total value of a year's sweepings will often amount to $30,000. The employés soon come to regard gold and silver in bulk merely as commodities, not thinking of the money value. The presence of $75,000,000 in golden bars does not worry or excite them in the least.

Employes of Sub-Treasuries, Mints and Assay Offices

In the assay offices throughout the country there are hundreds of expert chemists and scientists who look after the interests of those who have mines. The man who makes a fortunate discovery of gold or silver does not have to go to a private concern to have his wealth tested. The nearest government assay office will do that for him without fear or favor. When the assay is made the poorest miner feels that he has been justly dealt with; but this feature of the work is only one of many others equally important. The government has its corps of mining engineers and experts, who examine new mining regions and report upon their observations. The compensation of those employed in the mints and assay offices and sub-treasuries is entirely dependent upon their ability. Entrance to the service is usually restricted to the lowest grades, where salaries range from $600 to $900 per year, and the higher grades are then filled by regular promotions. The prospect of promotion varies greatly, but in a general way the honest, faithful workman who shows interest and ability in his work will be rewarded in time.

In the different sub-treasuries throughout the United States appointments are made from the eligible civil service list whenever necessary. All applicants have to be twenty years or more of age, and for any important position experience is demanded. Rigid tests of character are applied. In this service are employed such clerks and officers as are found in banks, including tellers, assistant tellers, bookkeepers, and bond, coupon and check clerks. There are also chief officers, chiefs of divisions, superintendents of buildings, detectives, messengers, hall men, porters, janitors, engineers, watchmen, and unskilled workers, classed as laborers. In the mints and assay offices experience counts for much, and a technical education must of necessity be possessed by the applicant for any of the very important positions. The positions of assayer and assistant assayer are open only to those who have graduated in metallurgy, mechanical engineering or chemistry from technical schools. These graduates pass first into the apprentice departments, and after serving a considerable time in this way are eligible to appointment in the regular service. In the laboratory departments there are expert mechanics and skilled workmen, annealers, adjusters, bullion samplers, melters, millwrights, coin-cutters, gold and silver reducers, and foremen in cleaners' and acid rooms. The workmen have in this line opportunities for using their talents to great advantage.

The Manufacture of Gold and Silver Coins

The coining of money, especially of gold and silver, is an immensely interesting process to the majority of people. The gold coins used in the United States are made of alloy, nine parts gold and one part copper, while the English coin alloy consists of eleven parts gold to one part copper. The metal is obtained mostly from mines, being valued according to the percentage of silver found native in it—thus Alaskan gold brings from sixteen to seventeen dollars per ounce, while California gold, containing from ten to twelve per cent of silver, is valued at from seventeen to eighteen dollars per ounce. The mint will also purchase gold from private parties, "depositors," in the shape of old jewelry settings, watch cases, etc., which is melted, refined and paid for according to purity. A large proportion of these old gold articles come from pawn shops. The metal obtained from both sources is melted and cast into ingots, which are stored away in vaults, until needed for coining. About $135,000,000 worth is thus treated every year at the Philadelphia mint, while an average of only $45,000,000 worth is made into coins. In this operation, as in most of those succeeding, a peculiar fact is that remarkably small precautions are taken in the matter of admitting visitors, while the workmen employed seem to represent only the average grade of skill and intelligence. The metal is melted in long crucibles, from which it is dipped and poured into steel molds, each forming two ingots. After filling, the molds are raised to a long steel table, the ingots being released, while still red hot, and held, six at a time, in tubs of water for cooling. The next process in preparing the metal for coining is to run the ingots through rollers, which form them into bars six feet in length. The bars thus formed are too brittle to be subjected to the coining machines, and must, consequently, be annealed, in order to derive the required toughness and ductility. In this process, they are first baked for a precisely determined period in ovens whose heat is kept very nearly at the melting point, and are then cooled slowly.

The gold bars are now ready for the cutting presses, into which they are fed continuously between punches that cut out the round outline of each coin, known as the "planchet," at a high rate of speed. The planchets are dumped, several thousand at a time, into the cleaning cylinder, where most of the grease and dirt are removed from their surfaces, and are then subjected to the action of various acids, for the purpose of rendering them perfectly clean. It is due to the remnants of acid that the face of a coin retains the familiar gloss and color through the early period of its existence. When it is worn off in use, all kinds of dirt and grease readily collect upon and obscure both. After being thoroughly cleaned, each planchet is weighed separately, in order to ascertain that its weight is exactly that required by law, no more and no less. This work is performed by a corps of girls, seated before long tables holding delicate balance scales, their duty being to sort out the blanks into various labelled boxes, according as they are found to be overweight, underweight, or correct. If too light, the blanks are remolded, and begin the whole process over again; if only slightly overweight, they are filed down to the required point. The difference of 1-500th of a grain is noted on the scales, and leads to discrimination against the piece in question.

Preparatory to receiving their final form as finished coins, the planchets are "milled," which is to say, subjected to the action of a machine that forms the raised collar around the circumference. The blanks are fed into this machine through an upright flat brass tube, which conducts them to a point at which, by lateral pressure around the edge, the metal is forced up evenly to form the collar. In the coining press the milled planchet is held in position between two punches that come together with great force, stamping both faces of the coin and corrugating the periphery. This machine finishes the coins at the rate of ninety per minute. When the coins are completed, they are carefully counted, placed in canvas bags and stored in vaults until needed for circulation. In addition to the millions of dollars stored in the shape of coin, there are vast quantities of gold and silver bricks and bars in the vaults.

Bureau of Engraving and Printing

Close to the Washington Monument, at the national capital, there is an enormous red brick building, known as the Bureau of Engraving and Printing. Sixteen hundred persons are here employed, making out paper money, postage and internal revenue stamps, and bonds. It is the best equipped plant of the kind in the world, and the largest. It contains certain rooms to which visitors are never admitted. Here are conducted secret operations known only to a few persons. The government would show citizens through these rooms gladly, if it were not for the fact that the occupation of certain citizens is what is known as counterfeiting. Within precincts kept sacred, therefore, "distinctive paper" is made, which it is unlawful for any other concern or individual to manufacture or even to possess. Thus, under the strictest supervision of the government, is manufactured the paper upon which national bank notes and "greenbacks" are printed. Then, too, the inks are the best that science can produce, and the workmanship is the marvel of experts in the same line the world over. In the bureau, yearly, are printed nearly 20,000,000 sheets of United States notes, certificates of deposit, bonds, and national currency to the value of about $500,000,000. All this in addition to a billion internal revenue stamps, and more than three billion postage stamps.

The Manufacture of United States Bonds and Paper Money

The manufacture of United States bonds and greenbacks is a complicated and expensive process, giving constant employment to an extensive corps of designers, engravers, printers, and several other varieties of skilled craftsmen, all of them experts in their own lines, besides an army of clerks and "laborers." There are also in use several secret processes, and not a few highly complicated machines, which few persons are ever allowed to see and still fewer understand. All this elaboration of detail has but one object—to obtain such a degree of perfection in the work as will render counterfeiting impossible. Very largely for the purpose of accomplishing this end, elaborate designs are adopted, particularly in the familiar scroll work, which is a distinguishing feature of American paper money. The work of engraving the dies or plates is divided among a number of engravers, each of whom has his specialty, such as vignetting, lettering, script-engraving or ornamental work: in order to insure the greatest possible perfection none of them is employed in any other department of the work save that in which he is an expert. The complicated schemes of scroll work are engraved by a machine, known as the geometric lathe, which, by an ingenious and elaborate system of cams and patterns, can trace rosettes and lathe-work borders with absolute accuracy of detail. The machine used in making dies for greenbacks and government bonds is the most perfect of its kind, being able to do work that is utterly impossible with any other device. It is readily adjustable, so that the character and design of the scroll work may be varied, as desired, while its movements are practically unlimited.

Each separate portion of the note or bond is engraved on a special steel die, which is then suitably hardened. The designs on each die are then transferred by pressure to rolls of soft steel, which, after hardening, are used to make the multiple printing plates, the rolls being forced against the plate by enormous pressure, which is able to force its raised design into the metal, thus making an engraving negative. These plates are deposited in the custodian's vaults until all is ready for printing, when they are fixed in the press.

Paper for Notes, Bonds and Stamps

The paper used for notes, bonds and stamps is drawn by requisition on the Division of Loans and Currency, which has it in custody, each piece being carefully counted several times. These precautions are followed because all paper used for currency notes or bonds is especially made for the government, and has a peculiar quality and texture. In preparing it for the printing presses, it is first wetted, so as to reduce it to a convenient consistency, and, after the impression has been made, it is dried and pressed, being again wetted when a new color is to be printed, or when the note or bond is "backed up." The presses, once started, are not stopped, day or night, until the entire issue of bonds is printed, the men working continuously in three shifts of eight hours each. The presses used are hand affairs, of the same general type as are used by all engravers, and the greatest skill and care is required to adjust the plates and paper, as well as to do the work of printing. The same processes are followed in the manufacture of revenue and postage stamps.

The fibre paper on which currency notes are printed is manufactured especially for the government by a Massachusetts concern, under the surveillance of a special agent. It costs forty-three cents per pound, being made from the choicest rags, prepared by a secret process. The short silk threads, which are its most distinguishing mark, are introduced at a certain point in a manner unknown outside the factory, and to the present time unimitated; forming, in fact, nearly the greatest insurance against successful counterfeiting.

In the Division of Loans and Currency of the Treasury Department, the sheets of fibre paper used for money and for bonds are counted and examined, and the utmost care must be exercised to see that they contain no flaws. This work is done by women. To the eyes of the untrained person there is no perceptible difference in thousands of sheets of this paper, but the expertness of the employés is proved by the number of rejected sheets annually returned to the manufacturers. Even greater expertness is shown by the counters of mutilated money. All of these, too, are women, for it has been found that women are much more clever at this work than men. They must be absolutely accurate, accounting for every dollar that comes into their hands. Much of the spoiled cash that comes into the Treasury for redemption is in such a condition as to appear utterly hopeless to the novice. Sometimes it has been chewed by babies or goats, sometimes passed through washing and ironing machines or partly burned.

When shipped from the paper mill, each sheet in every ream of paper has been counted twice, in order to give assurance of correctness. However, when issued from the vaults in Washington, in obedience to a requisition from the Bureau of Engraving and Printing, they are counted another twenty-eight times by the corps of women clerks. If, after this exceptional care, a single sheet be found missing or not accounted for, all employés in the handling and counting rooms are obliged to remain until the matter is explained and rectified. If the whereabouts of the sheet is not discovered, the clerks in the room to which the loss has been traced are obliged to make good among themselves the destined value of the sheet. Thus, if it is intended to use a certain sheet for printing currency notes to the amount of $80, this sum must be paid out of their collective wages by the employés. This rule promotes care and attention to details. After leaving the presses, the sheets are again counted twenty-four times; after which they are sealed in packages of 1,000 sheets each; are dried; again unpacked and smoothed in a powerful hydraulic press, and deposited in wooden cases. The cases are conveyed to the Treasury Department building in an iron-clad wagon, accompanied by armed guards. So stringent are the rules that every sheet and fragment of paper shall be traced from the vault to the press, and back again to the Treasury building, that no employé is allowed to leave any department, in which it is handled, without a pass certifying that he or she has accounted for all paper handled.

CHAPTER II

THE BANKING BUSINESS

The Banking Power of the United States—The Operation of a Bank—Daily Banking Routine—The Bank President—The Duties of the Bank President—The Bank Cashier and the Books—The Paying Teller—Receiving and Note Tellers and Bookkeepers—Bank Clerks and Promotion—Savings Banks and Depositors—Operation of a Savings Bank—The Clearing Houses—Operation of a Clearing House—Building and Loan Associations—Operation of Building and Loan Associations

The Banking Power of the United States

OVER thirty per cent of the banking power of the world is represented by the banks of the United States, exclusive of savings banks. Curiously enough, however, the amount of money on deposit in savings banks in the United States, represents thirty per cent of the similar liabilities of the savings institutions of the world. An important part of this great banking power, the National Banks, are under the watchful eye of an officer of the Treasury Department, the Comptroller of the Currency, whose duties are quite distinct from those of the Comptroller of the Treasury. Subject to the supervision of the Comptroller of the Currency, are all the national banks in the country, distributed in districts in every State and Territory, from a single one in Nevada to 350 in the State of New York. Five billion dollars is the approximate amount of the resources of all these banks—about half of which is represented by individual deposits, and the other half by loans and discounts. Since 1863, when our national banking system was established, over five thousand national banks have been organized, only about seven per cent of which have failed. The banking system, indeed, is to the national life what the arteries are to the human body. Through these important veins flows the life blood of the nation—money.

Some idea of national progress is afforded by the figures brought together by the Comptroller of the Currency in his annual report. From the close of 1894 the total resources of the national banks rose from $3,423,474,-873 to $5,435,906,257 on February 5, 1901. Here is an increase, in about six years, of $2,000,000,000, or about sixty per cent of the entire wealth of the country employed in this form in 1894. This is only a part of the growth in wealth in the form of bank deposits shown by available statistics. The total resources of State and private banks and loan and trust companies advanced from $4,138,990,529 in the summer of 1895 to $5,841,658,820 in the summer of 1900. Here, within five years, was an increase of about $1,700,000,000, or more than forty per cent.

The Operation of a Bank

A bank is not only an institution in which money may be deposited for safe-keeping and convenience in drawing out, as wanted: it is in a very real sense a medium of circulation. By law, a bank must have a paid-up capital of at least $50,000, but it is allowed to engage in financial transactions involving sums several times in excess of its capitalization. It is able to do this by virtue of the money carried on deposit by its customers; this fact involving that the greatest judgment and ability be possessed by its executive officers—especially by the president. It is, thus, for the best interest of a bank to secure the greatest possible number of substantial depositors. For, although very many persons having check accounts draw them down very rapidly, the rule is that the aggregate balance constantly carried is sufficient to warrant good-sized financial operations on a conservative basis. All that the depositors ask, on the other hand, is that their money be in safe keeping, and constantly accessible by check. They will, therefore, patronize that bank which has the widest reputation for caution and sound financial policy in all its operations, knowing that whatever use it may make of their money, in exchange for the conveniences afforded them, it will be perfectly safe.

A large part of the financial operations of the average bank is in making loans, principally in sight drafts, although time notes are accepted on good collateral; in discounting notes, when properly accredited, and in taking such bonds and mortgages as are judged safe and profitable by the executive department. In the matter of general loans and note transactions, the bank fills a very essential place in the community. As frequently happens, a perfectly sound manufacturing or mercantile concern may not have sufficient ready money on hand to carry through some necessary transaction, such as the purchase of materials for manufacture, or of goods to be disposed of to its customers. Hence, in order to do what trade demands, it must give a note payable at a certain date at a specified rate of interest. The creditors, although fully aware of the value of this "paper," have quite as much use for ready money. Hence they either sell it to a professional note broker or else have it discounted at a bank direct. The bank will purchase the note at a rate commensurate with reasonable profits in interest on the day of its redemption. Furthermore, it may again serve the business community by discounting a draft on a purchasing firm of good standing, when it is accompanied by a bill of lading; thus enabling the consignor to come into immediate possession of the amount due him, less the interest accumulating before the day on which it may be collected from the consignee. It is thus to the business interest of a business house to have a regular account with some bank, in order to enjoy the privileges deriving from an understanding of their credit and financial standing. Even in discounting a note or draft for a customer, a bank is frequently able to profit beyond the actual cash value collected on the specified date, since it seldom happens that the money advanced is actually taken out at once. It is merely added to the depositor's credit and is accounted by him as "cash on hand," while it may not be drawn out; thus continuing in possession of the bank as part of the available balance for other transactions. The bank merely leaves it optional with him, whether or not he shall draw upon the credit advanced to his account, while the bank, for sake of a specified rate of interest, will assume the risk until the date of collection.

Very frequently a bank is called on to advance money on securities, such as stocks, bonds, etc., for some depositor, who is required to give a sight draft for the amount, with interest. In such a case, the loan may be extended at the discretion of the president, so long as the market value of the securities warrant, or until the bank is in need of funds. Such transactions, furthermore, require the employment of a stock clerk, whose duty it is to keep informed on the state of the stock market, particularly as it affects the value of the securities held by the bank, thus providing against loss in the event that they have to be sold to cover the amounts advanced. How large a part of the business of some banks is covered by consignments of securities, may be understood from the fact that a large percentage of Wall Street brokers constantly deposit blocks of stock, received after the hours of delivery, and to be held overnight for the payment of one day's interest; thus covering the amounts paid by them in check for the stocks, by credit for twenty-four hours on the bank's books. When the securities are paid for by the buyer, the bank counts a small profit and the depositor has been insured against loss.

Banks also invest their ready surplus in such securities as seem best in the eyes of the president, preferably government bonds and reliable railroad stocks. Thus, in 1898, one firm of bankers offered $1,000,000 premium to the government for one-half the bond issue of that year. That is, they offered $101,000,000 for $100,000,000 in bonds; calculating an enormous profit even at these figures. While it is in every sense desirable that a bank's investments should be of the safest possible description, in order to maintain the confidence of the public, and prevent a disastrous run, as the result of a panic or of some false report, it is imperative that it carry on a certain amount of loan and credit business, if only for the purpose of attracting larger deposits. The business world is able to discriminate between a loose policy in making advances and a wise liberality. Thus, while either prodigality or unreasonable rigidity will cut off a substantial percentage of available support from customers, a thorough "business administration" will attract the best class of deposits. This is particularly true in small communities, where the local interests are more closely united than in great cities; the prosperity or depression of one industry affecting others, hence also the amounts deposited in the bank.

Ten dollars of surplus are greater, in the eyes of a bank director, than one thousand dollars of capital. The law requires each bank to set aside a percentage of its net profits each year until a surplus equal to twenty per cent of the capital has been accumulated. The bank's books are examined periodically by an authorized examiner. Each bank pays State and local taxes; and a tax on the amount of government notes it takes.

Daily Banking Routine

In the conduct of a great bank the day's work proceeds on a line of routine that continues practically unchanged from day to day. The first work undertaken in the morning is the opening of the mail, which is usually enormous; often requiring the assistance of nearly the entire clerical force to sort out the various letters and distribute them to their destined departments. This work accomplished, the sorting and entering of checks received from the Clearing House is begun, each check being distributed alphabetically and entered upon the proper book, so as to have each depositor's account balanced for the day's work, when the bank is opened to the public, about 10 A.M. When, as is generally the case, the bank acts as correspondent for banks in other cities, the checks on such banks are sorted alphabetically, and entered against their accounts; such packages being periodically forwarded with statements. The bookkeeping department involves the use of numerous books of immense size; one man generally keeping his own book, which may include, for example, customers' accounts from A to D, or from E to K, or may be even less inclusive, according to the number of depositors and the amount of check business done daily. From these books are drawn the balance or "skeleton" ledgers, which are kept literally to the hour, in order to enable the paying-teller, note-teller and discount clerk to discover immediately the condition of any account. A daily balance sheet is also drawn, for the information of the president and directors, these and numerous other books kept by the bank, including accounts of remittances, collections, loans, etc., vastly increase the duties of the department.

The Bank President

Upon the shoulders of the President falls all the responsibility of administering the affairs of the bank, attracting and holding a desirable class of customers, and passing upon the merits of all applications for loans and discounts. It will be seen, therefore, that he must be a man of exceptional characteristics, as well as of the widest business experience and the soundest judgment. He needs good social qualities and polished manners, in order to meet and attract wealthy depositors, yet he must possess that measure of dignity which shall command their respect and confidence. In brief, he must be a gentleman in the best sense of the word, one who can meet men on their own ground and yet display the reserve and self-possession of the man of assured position. In the double duty of administering and representing the interests of his institution, he must be a born diplomat. He must also be a keen business man, persuasive and convincing, when seeking to obtain a new customer, stern and uncompromising, when the credit of even a personal friend will not justify a loan. Unless the President can inspire confidence in his business abilities, his bank will need few bookkeepers. His relation to the customers of the bank is somewhat similar to that of a physician to his patients. It is, at least, a confidential relation, and, like the doctor, he must steel his heart against the sufferings or troubles of others. At times he is a monarch absolute, his decision being the arbiter of the fate of the anxious—he can blast a hope or rescue from disaster—and his velvet-carpeted office is a stage upon which are played many tragedies peculiar to modern commercial conditions.

The Duties of the Bank President

According to the business policy of the president will be the prosperity and reputation of his bank. He may be a speculator by instinct, taking grave risks, which, even when successful, create a sentiment of distrust among careful business men. Or he may be so extremely cautious that his own directors will be dissatisfied with the slow growth of the bank's surplus. It is better to err in the latter direction, however, although the ideal business man is found about midway between the extremes. Thus many a bank has been wrecked, or kept in operation only by assessing its stockholders, by the President's mistaken policy of "sending good money after bad," in the vain attempt to keep a tottering debtor on his feet. Among the most experienced financiers of the present day, it is the almost invariable policy to enter a bad loan against profit and loss, rather than to extend credit by another dollar, after an obligation has failed to meet requirements. A careful president, however, will not always trust to his own judgment, no matter how correct it may have proved. He will constantly seek the advice of his vice-president, cashier, and directors, whose opinions on loans and securities will largely determine his action. Whatever his policy in this regard, he will always exhibit the "paper" and securities offered for discount at meetings of the Board, and will submit statements of the expenses, earnings and general conditions, so as to retain the confidence of his colleagues at all times.

Meanwhile, the president's salary is $15,000, or, more likely, $20,000 a year, which still is less than the salaries of railroad or insurance presidents, although his responsibilities are frequently quite as great as theirs. He is often chosen to the office on account of the high business qualities he has displayed as a clerk or assistant in the bank, although as frequently he has been an outsider, one of the Board of Directors or a well-known financier. The advantage of choosing a president "from the ranks" is that he is thoroughly familiar with the routine of that particular bank, although, as is frequently objected, such training tends rather to blunt the keen sensibilities and to narrow the vision of the business man. However, the question is decided by the directors, who work according to the facts in a case. An outsider elected to the executive office in a bank usually acts as vice-president until he has become thoroughly equipped to assume the duties and responsibilities of the presidency. Frequently also a vice-president serves with the president, in order to share his responsibilities and constantly serve him with his advice and experience. Often the cashier assumes this advisory function, in addition to the ten directors, who, according to law, must each own at least ten shares of the bank's stock and be a resident of the United States.

The Bank Cashier and the Books

The cashier of the business bank ranks next in active importance to the president. His duties, while of an advisory nature, are quite different from those of the president. The president must understand the routine, but the cashier must keep the routine in order. He must be acquainted with the most minute details of all operations, must have unfailing patience and infinite tact. He is practically the chief clerk, and he must know the peculiarities and the ability of each man under him. The clerical force is the machinery of the establishment, and the cashier, as the engineer, must keep that machinery in such order that it will run smoothly. Despite every effort, however, there sometimes comes a hitch. It may be only a loose screw, but it stops the machinery, and not another move can be made until that screw is found and riveted into place. The books of one of the great New York banks, one night, would not balance. It is a rule in such institutions that not a single clerk may leave the bank until the balance has been "struck." Hence the entire clerical force sometimes works far into the night. In the particular bank now under consideration, and on the particular day in question, the books would not balance because of an error, not of a million—the bank had handled many millions that day—but of one cent. Five o'clock came, six, eight, ten, midnight, and still the tired clerks checked each other's accounts to find that one cent. At last, just as the day dawned, the one cent was found; the books balanced. A check had been cashed during the day for $1,000.01. Every time this check was counted, in the attempt to find the missing penny, it was put down as simply $1,000. Until at last the paying teller shouted: "My memory is better than my eyes. I remember giving a man a thousand dollar bill and a cent." And all the men whom he had kept in their cages all night were invited to breakfast as his guests.

One case is recorded in which the books of a certain bank—it was a savings bank—were "off" $10,000 continuously for ten years. The error was not discovered until the eleventh year. It then took weeks to find that the bank, instead of being $10,000 poorer than it ought to be, as expected, was $17,000 richer, all because of errors in amounts due depositors.

The Paying Teller

In a business bank, the person next in active importance to the cashier, is the paying-teller. The one thing that will enable him to "hold his cage" is a faultless memory. The bank allows him a certain sum annually for inaccuracies, for errors in paying out money. But no allowance is made for lapse of memory. The paying-teller cashes thousands of checks in the five hours between ten and three. He must know at a glance whether the signature on each is genuine. Thus in a large bank, the paying-teller must memorize, as it were, thousands of signatures. He keeps a book containing the autograph of every customer, but in cashing a thousand checks a good teller will refer to the autograph book not more than once or twice. Have you ever stood "on the line" at a paying-teller's window? You may have noticed that the young man in the cage looked first at the face of each person presenting a check. The paying-teller who looks only at the face of a check, may some day make a "bad payment." This is, he must be a student of the human face as well as an expert in signatures. The paying-teller can break the bank quicker than any other employé or official. There is more than one such bank clerk who has as much as five or six million dollars in his own keeping. Half of this is locked up in the reserve vault—but any paying-teller so inclined could contrive to walk out of the bank with the other half. He may have given the bank a bond; but a bond seldom covers more than a small percentage of the actual amount of cash in his keeping. The paying-teller may know of an embezzlement a long time before its discovery by others. And he is the only man in the bank who could possess such knowledge exclusively and for so long a time.

While it is obviously impossible, in these days of expert forgers, that a paying-teller should always be able to detect a bad check by the signature, he can learn much as to its value by observing the face of the person presenting it and carefully fixing it in his mind. By thus systematically cultivating a memory for faces, the teller has frequently been instrumental in securing the arrest of forgers and swindlers who otherwise might have escaped. The paying-teller must also certify checks, when so requested by customers, and in this duty it is necessary, not only that he knows the signature to be correct, but that he keeps himself carefully advised as to the state of the account against which it is drawn. Frequently, in cases of doubt, he refers the matter to the cashier or the president, thus shifting a part of his vast responsibility to their shoulders, although, as a general rule, he acts entirely on his own judgment. In discharging the highly responsible duties of his office, it is necessary that the paying-teller exhibit a constant courtesy, even though mingled with a wise firmness. Indeed, no officer of the bank needs these qualities more than he, unless it be the president; since both are brought into constant contact with the public and actively represent the interests, credit and good name of the institution.

The receiving-teller has similar responsibilities, but in lesser degree, and as his duty is solely to take in money, he need never look at the depositor's faces. One of the receiving teller's assistants is remarkable in that never a mistake occurs, never a cent is stolen, never a secret of the bank revealed. It is a machine. It tabulates the checks as fast as the teller receives them. And at the end of the day it gives instantly the total amount represented by all the checks received during the day. It has a keyboard somewhat like that of a typewriter, with numbers instead of letters. The check is laid on the machine, keys are struck corresponding in number to the figures representing the denominations of the check, the amount is registered on a card—

but how that machine then adds up a long column of figures, only a machinist can explain.

Receiving and Note Tellers and Bookkeepers

The note teller, next in importance, is one of the most important functionaries of a large bank. His duties include the presentation of notes and drafts, as well as the issuance of certificates of deposit, all of which require a high degree of tact, watchfulness and business ability. In many banks his work also includes the duties of scrutinizing and passing judgment on securities offered for loans, deciding on their value, and keeping himself constantly informed as to the quotations given for them on the Stock Exchange. While ordinary good securities represent a loan value as high as seventy or eighty per cent, and Government bonds as much as ninety-five per cent of their face, it is necessary to keep posted on market conditions, since some unforeseen occurrence may depress the values immensely in a single day. Similar care must be exercised in the discount department, where time loans and discount paper are handled, in order to detect forged securities or those of doubtful value.

There are other tellers, bookkeepers, and clerks, but the duties of these are well known to thirteen million persons in the United States who carry bank accounts. An interesting fact concerning the bookkeepers, however, is that the handling of their cumbersome books require muscle as well as brain work, containing as they do from 1,500 to 2,500 pages. The books are made to order and cost $75 or more each.

Bank Clerks and Promotion

National and State bank officers and clerks are paid higher salaries, as a class, than the corresponding employés of savings banks. While the president of the business bank receives from $15,000 to $20,000, the president of the savings bank receives only half as much. This same proportion applies to the salaries of the cashier, tellers, and other important officers and clerks. In a savings bank, the officer known as the secretary corresponds to the cashier in the business bank. The secretary earns from $4,000 to $6,000. Other salaries paid in savings banks, are $3,500 to paying tellers; $3,000 to receiving tellers; $1,800 to bookkeepers. It is safe to add from twenty-five to fifty per cent to these last-named amounts, in estimating the salaries of employés in large business banks.

Promotion in a bank comes slower than in the railroad service, and slower than in the ordinary mercantile establishment. In a bank, unless the young man is of exceptional ability, unless he has unusual force or originality, he must wait for some very healthful superiors to inherit a fortune or die. Ability of the highest order, however, is as scarce in the banking world as elsewhere. Business ability, however, is not the only quality that counts in securing promotions—a man, who shall represent a bank in any important capacity, must also possess such tact and innate refinement of manner, as shall attract and conciliate on all occasions. We will occasionally hear bank clerks complain that no one has a chance of promotion, except through favoritism of those in authority, but by far the most common reason is that unsuccessful aspirants, while honest, capable and faithful, exhibit a nearly hopeless inability to "take on polish" sufficiently to warrant their appointment to positions involving personal contact with customers and clients. A man may prove himself efficient as a runner, in securing the settlement of notes and drafts, but his manners may be so offensive as to turn business men from dealing with his bank. In short, in order to secure promotion, a man must be a gentlemen in the best sense of the word: he must be a man possessed of such tact, courtesy and consideration for the feelings of others, as shall enable him to come in contact with them without wounding or antagonizing. This quality is becoming increasingly important in these days, when social qualities play so large a part in every business relation.

Savings Banks and Depositors

In savings banks the great majority of the depositors—fully seventy-five per cent—are wage-earners. The remaining twenty-five per cent is made up of the middle class, the very rich and the criminal classes. The last named needs an explanation: The burglar or the swindler who succeeds in getting away with cash booty, believes in putting the "goods" in a safe place. A savings bank is more trustworthy than a hole in the ground or a hollow tree: and how is the bank to know that a certain depositor, known as "John Smith," is a criminal, a fugitive from justice? Any one may make a deposit in a savings bank, and no questions are asked. In New York a large proportion of the savings bank depositors are foreigners—chiefly Italians, Germans, Hungarians, and Poles. It is recorded that a keeper of a corner fruit stand, an Italian, whose earnings were acquired a copper at a time, has $20,000 on deposit in a savings bank. The "bosses" of bootblack stands often have more money in bank than the customers whose shoes they polish. One bird fancier, with a small shop on Fourth Avenue, showed a customer passbooks containing entries aggregating $95,000. A savings bank, under the law of certain States, is not allowed to receive more than $3,000 from any one depositor. But this law is easily evaded, by making deposits in the names of wife, mother, sister; three thousand dollars for each. When the family members give out, passbooks are obtained in the names of various friends—in all cases being careful to open the account as a "trustee" for the person named.

In the 1,000 savings banks in the United States, the deposits amount to $2,600,000,000, representing the savings of 6,300,000 depositors, the average for each being over $400.

The rush of deposits in the savings banks of New York City in 1902 was remarkable. For the first time in the banking history of the city, the billion dollar mark was reached and passed. More than two million depositors in New York had an average of $453 each in bank. At the same time Great Britain's depositors averaged $97; those of Prussia, $156. All Austria-Hungary had but twenty per cent more depositors than New York, with but $220 each to their credit. All mankind can boast but six billions in savings bank deposits to our one billion in the New York savings banks alone, while the deposits in all the savings banks of the United States are about one-half as much as those of all other countries of the world.

Some of the banks now pay four per cent interest, a rate higher, in the average, than that yielded by "gilt-edged" railroad bonds; even at three and one-half per cent these deposits in New York savings banks earn $35,000,000 profits in one year, most of which is paid to wage-earners and their families.

Operation of a Savings Bank

Apart from the facts that interest, at about three or four per cent at most, is paid on depositor's accounts, and that money may not be drawn out by check, the business of a savings bank is conducted on the same general principles as in a regular check bank. That is to say, the amounts received on deposit are handled by the officers to the advantage of the company and the depositor by investing in good securities, government bonds, mortgages, or even on such loans as appeal to the judgment of the president and his advisers. One important difference, however, is that the amounts deposited represent the surplus, rather than the "working capital" of the people dealing with the bank, so that, although, in times of depression, the drawings are often heavy, the amount on hand remains approximately constant. This gives a larger margin for financial operations, and forms the real basis for the often-quoted financial superiority of savings institutions.

The Clearing Houses

The story of the New York Clearing House cannot be told in mere millions. It must be told in the language of billions. One incident in this narrative of dollars and cents, involves even that incomprehensible word, trillion; for the total of the clearings that have passed through this wonderful money establishment, from the day in 1853, when the house was first opened for business, to September 30, 1902, is exactly $1,503,425,193,722.60. When it is considered that this total of over fifteen hundred billion dollars is figured down to 60 cents, the great marvel is not the magnitude of the figure, not the sum of one trillion five hundred billion; the real marvel is that infinitesimal grain of sand, counted in with this boundless continent of dollars—that sixty cents. Think of the work of the clerks who did the counting! There are clearing houses in all the great banking centres of the United States; but no one of them does business on a scale so positively gigantic as the one in New York.

The New York Clearing House is perhaps the most important business organization in the world, its transactions exceeding those of the Clearing House of London—a city that is regarded as the world's financial centre, or at least was so regarded until recently, when New York was accorded that distinction by many observers of financial events.

Operation of a Clearing House

The home of the New York Clearing House was constructed for the purpose for which it is used. Along one room are placed four parallel lines of desks; sixty-eight altogether, the number of desks representing the number of banks included as members of the clearing house. At each desk sits a man, called the settling clerk, representing his bank. In front of him stands a messenger, who carries exchanges from his bank. At ten o'clock the signal is given, and each delivery messenger passes to the next desk in front of him, and delivers the packages of exchanges he has against that bank. He is followed in turn by another messenger. These packages, as fast as they are received by the settling clerks, are listed on sheets. In ten minutes the exchange is made, and immediately the messengers carry away the exchanged packages. As there are some two hundred and fifty thousand checks sometimes passing through the clearing house in one day, their examination, one by one, would be a physical impossibility. The next step is for the settling clerk to send the manager of the Clearing House a memorandum of the amounts taken for his sheets. Each bank receives credit on the balance sheet for the amount of the checks delivered by their messenger. The amount carried away is charged to them. The resultant balance, of course, is either debit or credit. If a debit balance, it must be paid before half-past one of that day. The credit balances are paid after that hour. No credit balances are paid by the Clearing House until all the debit balances have been paid. Banks do not keep accounts with each other. The clearing house is the one place where they settle. They are either debit or credit at the clearing house. These balances are required to be paid in legal tender notes, United States gold certificates or clearing house gold certificates. A cashier's check or evidence of debt is not received in payment of these balances. The settlement must positively be made each day in money that is good anywhere.

The association is free from responsibilities for the contents of sealed packages or bags received at the clearing house. All reclamations for errors or deficiencies must be made by one o'clock on the following day by the receiving banks directly against the banks whose marks such packages bear, All checks, drafts, notes, or other items returned to the clearing house as not good, or mis-sent, must be presented the same day to the bank from which they were first received, which bank must immediately refund the necessary amount in specie or legal tender notes. Were this not so, bogus checks might be passed through the exchanges, and a bank brought heavily in debt to the clearing house. But by the requirements of the constitution of the clearing house, a bad check may be immediately returned to the bank by whom it was sent, and they must refund the amount of that bad check at once. Checks, notes, drafts, or other items, not exceeding five thousand dollars, returned for informality of indorsement, which sometimes happens, may be certified and passed through the clearing house again the following morning. Thus we see the New York Clearing House was established to afford a central and convenient place where each bank member of the association could send all exchanges against every other member, and to that centre pay all resultant debit balances, and from it receive all credit balances. The successful execution of this plan did away with the labor and expense attendant upon the presentation of items at the counters of the several banks, as well as the great risk of loss in handling large sums of money if payment was demanded at time of presentation.

Building and Loan Associations

Every industrial centre in the United States now has its building and loan associations. The growth of these organizations is due entirely to the encouragement of American workingmen. Mechanics, and those engaged generally in the trades, discovered that the closer their connection with a building and loan association, the more prosperous, more thrifty they were. The advantages of connection with such associations, accruing alike to employers and employés are: first, home ownership, and the sense of responsibility which accompanies such ownership, and which has the effect of making workingmen reluctant to strike save when there is grave provocation; second, a business training and a personal interest in community affairs, which the home owners would not otherwise receive. The result is that loan associations exercise a decided conservative influence on industrial life. Just how widespread the influence of the associations is, can be deduced from the fact that their membership in the United States numbers 1,200,000, and that there are more than 5,000 such societies, not counting the National Associations. The total assets of the 5,000 associations amount nearly to $600,000,000. In Pennsylvania alone, where this kind of mutual benefit society originated, there are 1,200 organizations with assets exceeding $112,000,000.

In Philadelphia, in 1837, was formed the first building and loan association in the United States. The Philadelphia plan, and the Dayton plan, comprise the two principal systems under which the organizations operate. Under the Philadelphia plan the associations are of a fraternal character, hold only occasional meetings, have no permanent offices, and its officers either give their time and services gratuitously, or receive only nominal pay. Under the Dayton plan, the associations are operated on a basis which is not at all fraternal, and is entirely commercial; that is, on an out-and-out business footing. The original object of building and loan associations was to enable a man to purchase land and build a home through the payment of the ground rent.

Pennsylvania has long been the leading State of the Union in the number of building and loan associations, but recent statistics show that Ohio leads in point of membership and number of depositors. The last State report shows a membership of 288,000 for Ohio, while Pennsylvania has only 282,000. The total assets in Ohio are $105,500,000. The first Ohio report was published in 1890, and the assets at that time amounted to $59,600,000. The vast increase and progress made since then is readily seen. Other State reports show correspondingly satisfactory results.

Operation of Building and Loan Associations

Although as has been pointed out by many investigators, who quote long lists of sad experiences, there have been numerous disastrous ventures in the line of building-loan schemes, the practical development of the enterprise is generally bringing it down to a thoroughly reliable business basis. Recent developments show the hopeful feature of moving further away from the delusive "fraternal" or co-operative basis, which never works well in any financial matter, to a sound policy that brings the conduct of loans more definitely under the general head of banking. Thus, one of the largest concerns of the kind in New York State carries on a most successful and beneficent business by accepting deposits of cash, so much monthly, for a term of years, with a guarantee of unusually large profits on compound interest at maturity. With this money, which represents an equivalent of the depositors' account carried by an ordinary check bank, it is enabled to undertake extensive loans on mortgages, payable, generally, at rates equal to or less than normal rental. Such mortgage accounts, maturing at the end of a term of years, leaves the mortgagee in possession of his home. Of course, in undertaking such a contract, the mortgagee is paying interest on the matured value of his holdings, which is to say the actual assessed value, plus the interest for a term of years, plus regular monthly payments on the principal, with interest adjusted; the whole being summed up and secured by a mortgage on the property. Some building loan companies require mortgagees to subscribe for shares of stock to be paid for by monthly payments, and having a matured value equivalent to the difference between the assessed value of the property plus the interest for a term of years, and the matured value represented by the mortgage lien. Others take a contract that a certain sum, generally $10 per thousand, shall be paid monthly for a term of years. By either plan, of course, the company profits largely, although, by virtue of careful and business-like management of moneys, each subscriber is charged little if any more than he would necessarily pay on straight mortgages, with final payment of principal, within the same number of years. This useful and growing branch of the banking business contributes directly and generously to the independence of persons of small means, and, with its further development in coming years, will likely be one of the most potent factors in enabling such persons to lay up means for old age. It should be distinctly remembered, however, that these benefits will be possible only as the enterprise is put upon a sound and careful business basis, and as the element of co-operative management, with the desultory services of unsalaried officers is abandoned, as it must eventually be.

CHAPTER III

THE BUSINESS OF WALL STREET

The Wall Street District—The Wall Street "Lamb"—Employment for Young Men in Wall Street—Boys in Wall Street—The Stock Exchange and How it is Conducted—The Consolidated Exchange—The Produce Exchange—The "Curb" Market—Wall Street Brokers—A Broker's Expenses—"Bucket Shops"—Operation of a "Bucket Shop"—Stock Speculation—Produce Speculation

The Wall Street District

THE district known as Wall Street embraces more wealth in proportion to area than any other space of similar dimensions in the world. Considering even the mere thoroughfare known by that name, and extending from Trinity Church to the East River, the same assertion holds good. This latter limit is the one mentally placed by the great majority of our people upon the financial heart of the country, that throbs with the daily ebb and flow of millions, infusing life into all our vast enterprises. The Wall Street region includes the large majority of New York banks and other financial institutions, including savings banks. It is the great centre of the insurance companies, life, fire and marine; of the great trust companies, which command thousands of millions of capital, and are the custodians of many of the largest and most wealthy estates in the country. Finally, the region known as Wall Street has virtually a contingent population of three millions, which is just about the census record of the thirteen original States. In addition to the financial institutions, as above stated, Wall Street has banks with large capital connected with all foreign nations. China, no less than the comparatively contiguous London, is represented by banking institutions here. Wall Street has been very aptly described as the "business pulse of the nation," and that is what it is, in the truest sense of the term. Let there be any activity in mercantile or manufacturing circles, and it is immediately reflected in the Stock Exchange and the other exchanges, where values are dependent upon business activity and financial confidence. On the other hand, causes that influence the outside world unfavorably have a depressing effect in Wall Street, and the prices of securities and products take a lower turn.

Wall Street is not a gambler's paradise. There is no place in the business world where more hard work, closer calculation, keener insight into affairs and philosophical and conservative conclusions are required, than in the offices of its bankers and brokers; there is no class of men who watch events more closely than the operators in its markets. It is true that men have taken a gambling advantage of opportunities afforded by this great market, but these are not the men who have made it reflective of business prosperity. How would our one hundred and ninety-five thousand miles of railroads have been constructed without Wall Street? These great pioneers of development, prosperity and civilization would have remained exceedingly limited in their extent and scope if the bonds to build them had not been negotiated by Wall Street financiers. Think of the fertile lands that have been thrown open and the corresponding increase of wealth! Look at the army of well paid employés connected with the railroads themselves, who, together with those who work in the interdependent trades—railroad building, car building and railroad supplies of every description—amount to nearly two millions!

Not only is Wall Street indispensable to this country, but foreign nations also are feeling the benefit of its operations. The London Stock Exchange, and the Paris and Berlin Bourses would suffer if the New York Stock Exchange were to be closed for more than a day; the progress of great industries dependent on them would languish just as surely as our own railroad, telegraph and other enterprises would suffer in the failure of the great financial fountain from which they draw their invigorating tonic. Enterprise everywhere would be depressed as if seized by a sort of financial paralysis.

The Wall Street "Lamb"

Are the opportunities for young men in Wall Street as great or as numerous to-day as in years gone by? Mr. Henry Clews, whose long career in Wall Street renders his opinion of great weight, gave the author of this work the data for the greater part of this chapter.

The start in life for a young man is much easier to-day than it was a quarter or even a half century ago. Parents who were intent on getting a son a start in an office in former times were obliged, in most instances, to pay fifty dollars the first year for the privilege. At the end of the second year he received fifty dollars, and fifty dollars advance for every year afterward until the end of the fifth year, which completed his apprenticeship. He was then employed according to his value as estimated by his ability and the use he had made of his five years' experience. The young man of the present day enjoys the distinction of entering upon business without any idea of apprenticeship, and instead of his parents having to advance money to his employers, the latter give him from three to four dollars a week to start with; and before he has been in business two years he demands seven, ten, or even fifteen dollars a week.

The young man who expects to succeed in Wall Street should begin the study of the stock market at the outset of his career. It is difficult to lay down absolute rules for the study of a subject that is constantly presenting new conditions. One invariable rule there is, but it requires large capital and patience. It is this: Buy only what you can put up good margins upon, then follow the precept of Baron Rothschild: "Buy only when cheap and sell when dear." The veriest financial infant can see the force of this. Yet even this precept has its weak points. How can a person be absolutely certain that a given stock is cheap or dear at a given time? You say, by comparison. But if he compares the price with what is was at any past period he must also be able to state all the facts which existed at that period having any bearing on this stock; and since these facts may run into the hundreds as to number, and into all parts of the country as to place, our learner has a heavy contract on hand. Then, too, he must bring to bear a clear judgment and a resolution such as soldiers exercise when they charge batteries, and he must be prepared that this so-called "safe" road to success has its stumbling-blocks as well as others, though not so dangerous. Young men who follow this simplest of all Wall Street rules are not tempted to defalcation and—suicide. He who trusts to mere rumors and upon them bases his studies of the stock market quickly fits himself for treasons, stratagems and spoils. For rumor is always uncertain, and the longer it survives the more untrustworthy it becomes. But to study facts leads to generally accurate conclusions, and hence to wise transactions. How is the student to obtain facts? From trustworthy sources. Young men will do well to avoid the slippery tips of professional pointers, and seek the advice of those who, by their position and experience, have established a reputation as authorities on financial topics. Instead of paying the regular commission charged in first-class brokerage offices, too many young speculators make the error of going to places where cheaper terms are offered. They forget that in paying the greater cost of transactions with reputable brokers they are also securing the benefit of advice that is as near to being expert as any advice can be in Wall Street. Obviously, one does not become a physician merely by adding M.D. to his name, nor an editor by occupying the editorial chair.

The young man who studies real values must not be content with that alone. He must also study the facts that, in stress and storm, make real values fluctuate as wildly in manner, if not in amount, as those of the most fanciful securities. By the study of real values is meant crops, harvests and so on. The fact of large harvests in 1891 in this country, coupled with the fact of poor harvests in Europe the same year, led to the conclusion that our grain would be in demand for foreign shipment, and that the earnings of our railroads would be increased. Hence judicious students bought stocks for a rise. Then the fact that stocks rose and kept on rising, coupled with the fact that the general public were buyers, and with the additional fact that the public prefer not to buy at all unless prices are high, led these same judicious students to sell the same stocks during the prevalence of the high prices. Now the wise conclusions at which these students arrived, after the study of the facts, made money for them, first as bulls and then as bears.

Every young man should keep an eye on the veterans of the "Street."

In time of panic the older men, after a long interval of retirement in their homes, will suddenly appear in Wall Street, hobbling on their canes down to their brokers' offices. Then they buy stocks to the extent of their bank balances. The panic usually rages until enough of these cash purchases have been made to afford a big "rake in." These "Foxy Grandpas" of the Street then retire for another period. If young men would learn to watch the speculative signs of the times, as manifested in the periodical appearance of the veterans at their old haunts in Wall Street, they could make money at these intervals. For on the eve of a panic the veterans are sure to be seen, like spiders creeping from their webs just before a rain.

Find out which stocks they purchase, put up a fair margin for yourself. You can hardly fail to realize handsome profits. This habit is not unduly encouraged, however, any more than the habit of following points which are supposed to emanate from big operators, and which too often end in loss to young speculators. For under these conditions young men are likely to become slavish in their thoughts, having their minds entirely subjected to others who are supposed to think for them, consequently failing to cultivate the self-reliance that is indispensable to success in Wall Street.

Employment for Young Men in Wall Street

As to the kind of young men who are most likely to succeed in Wall Street, it is impossible to lay down any general qualifications excepting that of temperament, by which is meant a natural bent for the business of finance. As in many another line of work, those who are not rich seem to make progress the quickest. The sons of independent gentlemen, who have great expectations, make very poor clerks, and do not develop into good Wall Street men. Their expectations seem to dwarf the ability that might develop under the more favorable auspices of being obliged to paddle their own canoes. They have not a sufficient incentive to work because they know that all they require for their natural wants will fall easily into their laps. Such young men, instead of being a help to an office into which they happen to have been thrust (often through friendship or favoritism), are a hindrance and a stumbling-block in the path of promotion for other young men. More of this species of youth are seen in offices in Wall Street than in any other field of work. After ineffectual attempts to reform and remodel them they are often asked to resign, as the drone bees are rejected by the rest of the industrious swarm. There are some exceptions to this, but it takes a large amount of good sense to counteract the conceit instilled by the idea of financial independence from birth.

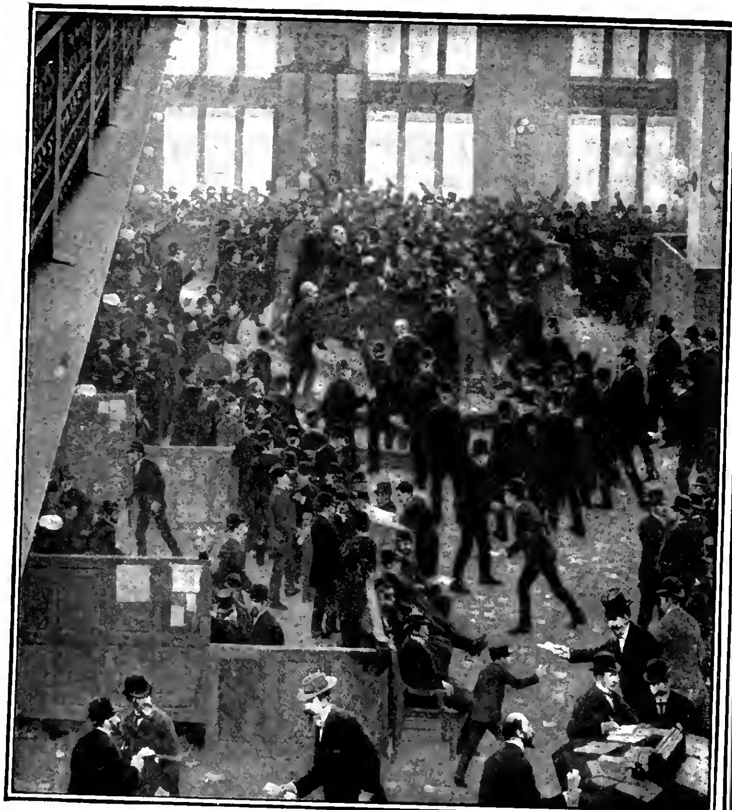
The matter of a college education and its utility in Wall Street is a matter for debate. Mr. Clews' opinion is that college education is erroneously regarded by some people as a substitute for business training. But there could be no greater mistake in the beginning of a business career. For the training which a young man receives in college, in many instances, fits him for a professional career only, and not for a practical business life.

To put a young man fresh from college in an office on a level with one of the same age, who has been trained in business methods since he left the common school, is demoralizing to both. Time and experience are bringing many persons over to this opinion who were formerly greatly in favor of college education. Even professors and presidents of colleges, though reluctant to admit it—since many of them would lose the source of their livelihood—are discovering that the college is inadequate to form the minds of youth for the struggles to be encountered in the arena of modern business.

Boys in Wall Street

There is plenty of opportunity for bright boys to find employment in Wall Street offices, and to rise as high on the ladder of financial business as their capacity and industry will warrant. The daily work required of them affords a splendid training for future advancement, and lends color to the statement that some of our financial magnates owe their success in life to their experience as offce boys. The Wall Street office boy usually begins as a "runner," which is to say, one whose duty it is to deliver stock that has been previously purchased on the Exchange. As a rule, stock purchased on one day is delivered on the day following, the deliveries ending at 2:15 P.M. Thus, as frequently happens, the stock may not be delivered at the office of a broker until the hour is almost up, and only a few minutes remain in which to deliver it to the buying firm. Such a contingency calls not only for the greatest alertness and despatch on the part of the runner, but also for intimate acquaintance with the Street, and the location of practically every broker's office in its confines. The boy must also be able to know precisely which firm he is to visit, thus avoiding the mishaps caused by going to the wrong man. Should a delay occur by which a batch of stocks are not delivered on the day, it is frequently necessary, when the deal is a large one, for the broker to hypothecate it to a bank, in order to preserve his own credit; the amount thus advanced on his account being charged at the legal rate of interest for twenty-four hours. Thus the failure to deliver, if found to be due to his fault, will seriously endanger the runner's chances of keeping his position: he will be found to be a far too expensive office adjunct.

The intelligent boy, ambitious of promotion, will also be careful to exercise the strictest care and exactitude in all dealings for his firm, and, knowing that faithfulness alone is the price of ultimate success, will prove himself honest, even when intrusted with thousands of dollars at a time. Of course, self-interest has much to do with the cultivation of this desirable quality—indeed, is there any relation of life in which it does not enter?—but it confirms the beginner in the conviction that honesty is the first condition of financial success. He learns that with him, as with the wealthiest operator on the Street, betrayal of a trust means far more certainly betrayal of his own interests. Another important trust confided to offce boys in brokers' offices is the certification of checks at the banks on


THE NEW YORK PRODUCE EXCHANGE


A STOCK BROKER'S OFFICE, WALL STREET

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which they are drawn, previous to depositing them. This practice is invariable on the Street, and generally occupies the time between 2:15 and 3 P.M. This is another job demanding quick work, and it is a frequent practice among the boys from various offices to divide their checks, so that one goes to one bank and another to another, thus expediting the work, and seldom losing a check in the process. After banking hours the boys are usually set to the interesting task of making comparisons, or checking the several different quotations on the same securities made on the Exchange by different brokers. In this work he goes to each office in succession, submits the items of quotations of securities made by that firm, and receives their verification, or notes the disagreement, for future adjustment. This necessary task performed, he returns to his own office, and usually closes the day by accompanying his employer to his safe-deposit vault, carrying bundles of securities, often valued at hundreds of thousands of dollars, in his satchel. Such a routine of work is an invaluable practical training in the ways and methods of financial business, and must fit a bright lad for bettering his position, as opportunities offer. A college graduate or the son of a wealthy father may consider himself above the necessity of thus "serving his time," but, except in rare and exceptional cases, he neglects it to his own cost, and can blame no one but himself, if he fails in a business whose details he does not fully understand.

The Stock Exchange and how it is Conducted

The bulk of the interests of the money world are centred in the stock market. What the London Bourse is to Europe the New York Stock Exchange is to America. The membership of the Exchange numbers only eleven hundred, having fewer members indeed than many of the city's social clubs, which in respect to its organization, the Exchange resembles. Only, contrary to the custom followed by clubs, the man who wishes to become a member must first pay his initiation fee—that is, the price of his seat ($60,000 to $80,000 in the New York Stock Exchange), and then be elected to membership by the Committee on Admissions. The names of applicants for admission are publicly announced on the floor of the Exchange, together with those of the nominator and seconder in each case. These latter are required to state in committee that they would accept an uncertified check for $20,000 from the candidate, which seems to be the highest indorsement possible in Wall Street circles. As for the candidate himself, he must truthfully make answer to questions as to his age and citizenship; as to whether he has ever failed in business; as to the amount of his indebtedness in such case, and he must present full proofs of satisfaction from his creditors. He must also state whether his health is good, and whether or not his life is insured, with reasons in case he carries no insurance, as well as the kind of business he proposes to do. Wilful misrepresentation on any material point will forever bar him from membership on the Exchange. After examination, if the candidate is rejected, he must sell his seat. If accepted, he must sign a paper releasing his seat from all claims. If he fails in business, his seat is sold for the benefit of his Stock Exchange creditors.

Operations on the floor are conducted by these four groups: first, individual speculators who trade on their own account; second, brokers who lend money for banks; third, commission houses which buy and sell stocks and bonds for persons not members of the Exchange; in other words, for the entire public; and, fourth, specialists, who are also called floor brokers, and oftentimes dollar brokers, and who execute orders for commission houses.

Commission houses are of two classes: those that conduct one home office and many branch offices connected by private wire, and those that conduct a local and mail business.

The Consolidated Exchange

The full name of this branch of the business of Wall Street is the Consolidated Stock and Petroleum Exchange of New York. Its nickname is the "Little Board," to distinguish it from the "Big Board," its opulent neighbor, the Stock Exchange. The Consolidated has 1,550 members, trades on Stock Exchange quotations, and recognizes the latter as the primary market. The quotations are posted on a 100-foot blackboard, within half a minute after they are made on the floor of the Stock Exchange. The Consolidated trades in lots as small as ten shares, and the members therefore have a large following of small speculators, while the aggregate of the transactions attains large proportions. The largest day's trading in its history was May 1, 1901, when 579,000 shares were bought or sold. The association built the building on Broadway which it occupies, at a cost of $415,000. It maintains a staff of employés to whom it pays salaries amounting to more than $25,000 a year. A death benefit fund is maintained. To the beneficiaries of thirty-five members of the Exchange who died during 1901 it paid the sum of $235,000.

The Produce Exchange

The largest of all the commercial exchanges in New York, in respect to membership, is the Produce Exchange. The members of this institution number nearly 3,000. The Exchange owns its home in Broadway, valued at $3,000,000. It pays its employés salaries aggregating $75,000 annually. It has a large gratuity fund, from which payments are made to the heirs of members, who have "died in the harness." The objects of the association are to provide and regulate a suitable room or rooms for members' use; to inculcate just and equitable principles in trade; to establish and maintain uniformity in commercial usages; to acquire, preserve and disseminate valuable business information; and to adjust controversies and misunderstandings between its members. The name itself indicates the character of the trade transactions on the floor. Such transactions include grain, seeds, beef and pork, lard, petroleum and its products, tallow, grease, and oleos, butter, cheese, hay, straw, hops—in fact, everything that comes under the head of marketable produce.

The "Curb" Market

It is a common experience to hear some Wall Street man or other described as a "curb-stone" broker, with the further information that "he has his office in his hat." This is a somewhat contemptuous, and by no means intelligent, way of describing a class of man who is, at once, a permanent and significant factor in financial operations, although, so far as the words go, it may be perfectly correct. Curb brokers are men who make a specialty of dealing in stocks not listed in the Exchange, hence not to be bought or sold on the floor. They are very often not members of the Exchange, and, when dealing in their specialties, of course, act entirely independent of it. Their operations are carried on in the street—generally on Broad Street, in front of the Mills Building—where a crowd of them may be seen on almost any day in the year shouting out their desires to buy or sell blocks of numerous well-known, although unlisted, stocks, and going through all the antics to be seen on the floor of the Exchange itself. They form, in fact, a sort of informal stock exchange, without officers, rules or hours, yet the "members" are very clannish and jealously guard their privilege of dealing in "outside" securities. It is a well-recognized fact in Wall Street that any operations in such stocks are to be conducted by curb brokers, who make a round of the offices, obtaining orders, and no "regular" broker has attempted to infringe on their rights for many years.

At one time the Board of the Stock Exchange offered to provide a room in its building for "outside" transactions, and the recently-founded Mining Exchange made overtures, with a view to absorbing them and their business, but both offers were promptly declined by the curb men, who, to this day, continue their trading out of doors, unless driven by inclement weather into the spacious corridors of the Mills Building. The curb men are fully aware of their importance in handling the securities of numerous large corporations recently formed, and are not inclined to share their profits, either with "regular" brokers or exchanges. In the past, several "regulars" have attempted to enter their field, as a "side line," but have been greeted with the practical jokes common to Wall Street, and practically "frozen out," or, more correctly, driven in again.

Wall Street Brokers

A Wall Street broker's life is one of constant strain and worry. He makes his commission of one-eighth of one per cent for either buying or selling; that is, he makes $12.50 for every one hundred shares, of a nominal or par value of $100 each. Of this much he is sure. A broker's earnings may be any sum from $100 to thousands a day. In a single day during the "boom" of May, 1901, brokers made from $25,000 to $75,000 in commissions. One Chicago house, doing business over a long-distance telephone wire, traded in 300,000 shares in five hours, making commissions amounting to $33,750. But the broker must take risks with his own money; he must borrow large sums from the banks on stock and bond collaterals. A bank may over-certify his check during the day for $100,000. By quarter past two o'clock the broker must deposit in that bank securities covering the amount loaned, or forever after retire from Wall Street. In brief, for every $100,000 worth of stock the broker carries for his customers, he must risk about $10,000 of his own money. He must reach his office by 9:45 in the morning. His first question is: "How is the London market?" for at that time the business day in London is over. The London market prices, to some extent, influence the New York market. Then the customers begin to arrive, the board member goes over to the floor at the Exchange, the ticker begins its golden song, business has begun.

Now until three o'clock the broker is under a continuous mental strain, especially if his capital is limited, or if he is new in the Street. He either can not spare time to eat until after three o'clock, or he has a sandwich and a cup of coffee sent in from a neighboring restaurant, and snatches a bite and a sip between clicks of the tape. He must watch every quotation, must keep his fingers ever on the pulse of the market. A few points up or down, particularly if he is carrying large blocks of stock on a margin, may mean fortune or ruin. A single mistake may result in serious disaster. His buisness is like a pair of scales, he must keep the two sides evenly balanced every moment, or lose money. At three o'clock, when the Exchange closes, his condition, mentally and physically, resembles that of a soldier who has been engaged for five hours in a battle. In this battle for self, fought daily by the brokers on the money field, there are more tragedies than in the battles for country when armies clash.

A Broker's Expenses

A number of brokers are able to keep their office expenses for a year below the sum of $10,000. But these do only a small business, for large transactions involve great risks and, therefore, large capital. A modest office can be rented for $1,200 in the Wall Street district, but customers would find such quarters rather cramped. And as physical comfort has become an important factor in modern speculation, the broker who can not offer the creature luxuries supplied in the offices of his richer rivals is bound to lose customers. The story is told of a man who wished to open a brokerage office and, sending for an efficient manager, said: "How much will it cost to run an office for a year, even if I don't do a dollar's worth of business?" The reply was: "From $50,000 to $75,000."

In every brokerage firm there is at least one member on Exchange, oftentimes two, called board members, while a third member of the firm manages the office. Fully fifteen or twenty firms employ from fifty to sixty clerks.

In the smallest office, five clerks at least are necessary. A canvass of the three hundred representative commission houses showed that their yearly expense bills aggregated $15,000,000.

Nearly one hundred brokerage firms in Wall Street conduct a large part of their business by long-distance telephone, or by telegraph. They are called "wire houses." Fifty such houses have private telephone and telegraph wires to Boston, thirty to Philadelphia, and twenty-five to Chicago. When it is stated that the cost of maintaining a private wire to Chicago is $1,000 a month, and that a proportionate sum is charged for wires to other points, it is not difficult to understand why a private wire is the costliest part of the brokerage business.

"Bucket Shops"

Another feature of the operations in Wall Street is the business of "bucket shops."

"Playing" the stock market in a bucket shop is somewhat like betting on horse-races in a pool-room. The gambler in the pool-room does not see the horses, he experiences nothing of the excitement or pleasure of the actual spectator at the track. So in the bucket shop, the man who risks his money seldom sees the stock which he is presumably buying on a margin. He merely lays a wager that a certain stock will go up. His wager is paid in the form of a marginal payment for the stock. The bucket shop man, in his turn, practically bets the "customer" that the stock will go down. It is a sort of guessing contest, and money changes hands, somewhat as in roulette. That is, if the player wins, the banker pays the money out of the capital of the concern. If the player loses, the banker or concern, pockets the margins.

There are two score or more bucket shops in Wall Street, a few of them large concerns, with ample capital and a large following. One or two are even "wire houses," with connections extending through New England, the Middle States and the West. The theory upon which all such shops operate is that ninety per cent of the traders in Wall Street lose their money, hence the chances for the shop are nine to one that they will win. And they usually do win, and the customer usually loses—excepting at times when the market is exceptionally "strong," or during a great "bull" movement, such as that in April and May, 1901.

Operation of a "Bucket Shop"

A large proportion of the customers of bucket shops know perfectly well that "buying on a margin" involves no trading whatever on the floor of the Exchange, and that the order to "buy" or to "sell" is only a part of the game, meaning that one has taken advantage of the price of stocks at the time to claim the proportionate returns he might have realized had he sold so much stock on the floor. Where one acts at the right time and wins, however, at least a dozen others do the contrary, and lose. The law objects to bucket shops on the ground that they are gambling houses, while the governors of the Stock Exchange discriminate against their proprietors, on the ground that they are conducting an irregular business. Their operations have no effect upon the market, for the simple reason that very few, if any, of their habitués would think of buying securities for investment or for actual trading, had they the money so to do. With Produce Exchange bucket shops the matter is about the same, although, according to the claims of some authorities, a distinct and very harmful effect is produced on the market. The amounts invested on margins are generally small, but customers are frequently required to sign specious and impressive contracts providing for the reception of the grain, supposedly bought, thus giving the transaction a thorough business-like appearance. Since, in recent years, the majority of bucket shops have been cut off from direct reports on Exchange quotations, their information is frequently uncertain, a fact of which the proprietors take advantage to garble and manipulate their alleged returns for their own advantage, thus really playing a swindling game. It has been estimated that the price of fully 250,000,000 bushels of wheat is annually diverted from the channels of legitimate trade, which sum would suffice to add ten cents, at the least, to the value per bushel to the farmer. But it is by no means certain that it would ever have reached him, even were there no bucket shops.

The Chicago Board of Trade and other influential bodies have in recent years taken strenuous measures to prevent the transmission of quotations to bucket shops, and, although long and bitter legal contests have frequently resulted, the courts have upheld the contention that, as betting on margins is gambling pure and simple, it is lawful to withhold the information that forms the real basis of its operations. The trouble, however, may not always be reached by discriminating against outsiders, since, as has occurred, some members of the very boards of the exchanges are in active sympathy with these methods. This fact involves considerable trouble and bitter litigation, in the event of an attempt to suspend or expel the offenders.

Stock Speculation

A Wall Street broker, as before stated, charges a customer for buying or selling a block of stock, or in recording his bids on margins, at the rate of one-eighth of one per cent on the amount involved. This seems an absurdly small percentage—only twelve and one-half cents on $100—and the sanguine novice at speculating is inclined to ridicule the common statement that profits are generally consumed in broker's commissions, leaving the speculator nothing at all. It must be remembered, however, that every stock operation involves both a sale and a purchase, which doubles the commission, and also that the majority of speculators are constantly buying and selling, gaining profits of only a few points on each deal, so that it is exceptional success to do much more than keep even with the commission deductions. Furthermore, one must expect frequent unforeseen "slumps" which consume profits and margins at a fearful rate, so that, if after a few months of speculation one "quits even," or finds himself in possession of his original capital, he is simply the "one in a thousand." The only man that can possibly succeed in speculation, large or small, is he who understands the Wall Street business thoroughly, who is trained to guess very nearly at the causes operating to affect the values of a security; who makes a constant, even incessant, study of the tape and the daily reports; who is content with moderate profits on every deal, and who acts on the moment. In other words, "eternal vigilance is the price" of success in speculation, but even this is of little avail when the speculator is other than an expert in the market. Much abuse is hurled at the heads of Wall Street men, on account of the large numbers of persons who have been utterly ruined financially by unfortunate speculations. This result is due, however, more to the ignorance of the speculators themselves than to the "villany" of the brokers, whose business it is to buy or sell, as instructed by a customer. A large number of unsuccessful speculators have operated on some "system," involving the fundamental erroneous idea that the fluctuations in values take place on some regular principle of rotation, so that, after reaching a certain "bottom," a stock is bound to rise to a certain "top," and *vice versa*. Some of them are so foolish as to base their calculations on charts, showing the rise and fall of a stock through a certain period—these are kept for reference in most broker's offices, and are published for the amusement of customers by one or two firms—assuming that the stock market is something like the weather, a thing to be judged by past records.

As a matter of fact, it is an ignorant error to assume that either "natural causes" or the conditions of demand alone determine the price of a security: "manipulation" is a prominent factor in this result. In this fact we have the real essential difference between the successful and the unsuccessful speculator. The one is "inside," the other "outside." The successful speculator is the stock operator, who, by virtue of his money and influential connections, is able to form a "pool" or syndicate to control the market for some certain stock, raising or lowering the price, so as to make the public buy or sell, as desired. In some cases such pools are formed merely for the purpose of obtaining control of some corporation or other, as in the founding of a reorganization: in others they have no other object than to enable their projectors to profit by forcing fictitious values. Should an outsider desire to share in the profits, he must buy or sell with extreme caution, lest his operations assume such proportions as to move the syndicate to work directly against him, and "freeze him out." The greater majority of large fortunes made in Wall Street have resulted from careful stock operating by men who would never have succeeded as outside speculators. Thus the late Jay Gould, who, it is said, invariably lost as a speculator, owed his vast success to carefully planned operations to obtain control of certain stocks, being able to form sufficiently strong pools to suit his ends in practically every case. It is probably owing to thorough acquaintance with the facts of the business that brokers themselves never speculate, and that they invariably forbid their employés so to do.

The rule that the outside speculator always loses in the end seems nearly invariable. It is a common occurrence to hear stories of men who have built up vast fortunes from small beginnings, in remarkably short periods, only to lose everything at one blow. Thus, many Wall Street men remember the case of a man who came from Maine, some time in 1880, and began speculating with a capital of $1,000. Within a remarkably few months, it is said, he had accumulated a credit of about $950,000. Being desirous, however, of making it $1,000,000, he continued speculations, in the midst of which the assassination of President Garfield, with other depressing influences, forced down the market to such an extent that his entire capital was consumed. His brokers generously paid his carfare home.

Produce Speculation

There is a large and very useful field for legitimate speculation in produce, and its effect is beneficial to the trade in general, involving larger returns for the farmer and enabling large operations to be successfully carried on. The machinery is simple: the farmer sells his grain to the local warehouseman or elevator proprietor, who is enabled to pay him good prices, because he has already sold his future holdings to speculators on the floor of the Board of Trade, or Exchange, who are willing to buy and hold such amounts as he can guarantee to deliver by a certain date, in expectation of good profits for himself. These speculators will, of course, buy or sell at any time, in order to increase their own winnings, and the constant rush of capital for investment in futures will produce an active market. This activity on the floor of the exchange, of course, produces a demand that reaches all the way back to the farmer, and he might also profit by it, if he could keep himself fully informed on the existing and probable demand. The capital thus supplied to keep the grain and produce business in operation is largely drawn upon, not only by the warehouseman, but also by the miller and exporter. Every one of them follows the practice of "hedging," or selling for future delivery, and then buying in again as the contracted grain is ground or shipped. Of course, such a transaction, when successfully conducted, involves large returns in the end, and this fact has tempted many capitalists to buy up the entire output of the country, in order to make a "corner" in the market, and enable them to sell at their own terms. Several successful and immensely profitable corners have been "engineered" in the past, but a very large number of them have involved their projectors in serious financial embarrassment. Such speculators, like stock manipulators, are merely working to create false values for their own benefit, but their operations must not be confused with those of the legitimate speculators, who serve the useful end of bearing the expense of the produce traffic for the sake of such marginal profits as they may derive in the end.

CHAPTER IV

THE WHOLESALE AND RETAIL TRADE

The Merchants of the United States—The Wholesale Trade—Wholesale Drygoods Trade—Wholesale Grocery Trade—Wholesale Seed Trade—Wholesale Hardware Trade—Divisions of the Hardware Industry—The Retail Trade and Success in Store Keeping—Window Trimming—Employés of Stores—Conditions Surrounding Retail Salesmen and Saleswomen—The Art of Selling

The Merchants of the United States

THE wholesale and retail merchants and dealers, representing trade, the channel of distribution of all articles of commerce, hold a place in the general industrial scheme second in importance only to the manufacturers. To make a thing is obviously not sufficient; it must be sold. The merchants and dealers, therefore, form the link between maker and buyer, between the producer and the consumer. There is at present, however, a decided tendency on the part of manufacturers to sell direct to the consumer, opening and stocking their own stores for the purpose and employing a man as manager. This is notably true in the shoe trade. In the tobacco trade, also, the manufacturers have opened retail stores under the name of the United Cigar Stores Company. Again, many of the great brewing companies own a large number of saloons. But this movement has not yet seriously affected the regular wholesale or retail trade.

Our domestic trade, meantime, is in the hands of nearly 50,000 wholesale merchants and dealers, and more than 800,000 retail merchants and dealers. An interesting additional fact is that the "wholesalers" include nearly 300 women, and the retailers 40,000 women. These figures apply only to proprietors and officials of trading companies. Including all the clerks, copyists, messengers, bundle and cash boys, office boys, stenographers and typewriters, packers and shippers, porters and helpers, salesmen and saleswomen, bookkeepers, agents, and others, the total number of persons employed in the wholesale and retail trade is not far short of 4,000,000.

The Wholesale Trade

The wholesale trade includes among its principal branches: drygoods, groceries, seeds, hardware, boots and shoes, cigars and tobacco, clothing and men's furnishings, coal and wood, drugs and medicines, liquors and wines, lumber, and produce and provisions. It is not necessary to give the details concerning each particular branch, since all the products just named are fully treated in other chapters, with the exception of drygoods, groceries, seeds and hardware. The general facts pertaining to the operations of merchants and dealers in these four divisions of the wholesale trade are given in the following paragraphs, and may be taken as typical of the conduct of wholesale houses in general.

The foundation of the business transacted between the great wholesale houses and the retailers throughout the country is credit. The mercantile agencies have reduced losses to a minimum by discovering the exact financial standing of dealers even in the most distant States. Dishonest failures in the drygoods business are said to be the exception rather than the rule. The reason the great wholesale houses can distribute millions of dollars' worth of goods yearly, on credit and with safety, is because the dealers are usually honest and wish to make themselves worthy of trust.

In getting out its price list, or catalogue, alone, each great wholesale house maintains what may be called a literary and printing bureau. The price list fills a book as large as a dictionary, or a government report. It includes everything in the grocery line from a hogshead of molasses to a two-cent cake of yeast. Wherever you live, you may order from this price list—order anything from a car load of the sand of the seashore to a box of cigars; and the first freight or express train leaving New York after the receipt of your order carries your goods.

Wholesale Drygoods Trade

Besides the great wholesale houses, the drygoods trade includes commission houses, or "middlemen," importers, jobbers, and retailers. The last named have intermixed so many different "lines" of goods with textiles, that the drygoods trade now draws upon at least fifty classes of industries. One billion seven hundred million dollars per annum represents the value of textile products alone; herein lies the story of the magnitude of the drygoods business, and suggests the number of persons that are necessarily employed. Centralization, not combination, has been the tendency in this trade, so that the number of separate wholesale houses decreases year by year while the volume of business increases. Centralization, in this sense, means the enlargement of the wholesale houses, and the retirement of the smaller merchants. The sales of a single day by one old established New York dry goods house at present equal in amount the aggregate sales of the first six months of its existence.

Wholesale Grocery Trade

The greatest grocery trade centre in the world is the district between Chambers and Franklin Streets, in New York. Every large city has its grocery centre, to be sure; but neither Chicago, Philadelphia, nor even London nor Paris has quite so large a grocery trade within the same radius, as the American metropolis. The "West Side," as it is called, is to the grocers what Maiden Lane is to jewelers; what a certain stretch of Broadway is to drygoods men; what the "Swamp," in the streets under the Brooklyn Bridge, is to hide and leather dealers; what Wall Street is to stock brokers. Here are between five and ten great wholesale grocery houses doing an aggregate annual business of over $40,000,000. It is said that a single one of these houses does a business of $5,000,000 a year; another $10,000,000; and another over $15,000,000. With these figures true of the central grocery market in the East, the aggregate of business throughout the country is probably a billion dollars.

To this grocery district come the food products of the whole world. Truck farmers of the East, the millers of the West, the tobacco planters of the South and of Cuba, the canneries of New York and New England, the fisheries of the Atlantic and Pacific Coast, the fruit growers and wine merchants of California, the meat packers of Chicago and Cincinnati; jobbers, importers, commission merchants and manufacturers everywhere—all these, and a hundred other classes of industries send their products to the great grocery warehouses of the "West Side." Great and small wholesale and retail houses buy in this market. Here the goods are first collected and then distributed to every point in the United States and to many foreign lands.

Many of the great grocery emporiums have their own manufacturing plants, farms, canneries, dairies, tobacco plantations, laboratories, distilleries, coffee mills—thus supplying their own stock in many lines. Between the store rooms in the sub-cellars, and the top floor, these block-square, eleven story grocery stores, hold a variety of merchandise that is exceeded only by the great department stores. Imagine these great warehouses duplicated several times in each large city of the Union, and it is possible to form an estimate of the importance of the grocery trade. Vanity and the stomach are the two things that open wide a people's pocketbook. With thousands of employés, millions of capital, and a billion of business, the grocery trade caters to the American stomach annually with such items as 100,000,000 pounds of tea, 1,000,000,000 pounds of coffee, 25,000,000 cans of fruit, vegetables and fish; these items being only samples of the grocery business of the country.

The total number of retail grocers cannot be given. That there are thousands of "corner grocery stores" in New York alone, only suggests the great number doing business in all cities and towns of the Union.

Wholesale Seed Trade

The seed trade has increased in the last few years, as shown by the catalogues of the seed firms. The barrel of peas has grown to hundreds of bags, and the few thousand of packets to millions. The large modern seed stores, whether devoted to the local or to the mail trade, are models of convenience and of system. In most of the stores reporting to the Department of Agriculture, fanning mills of the monitor or clipper type are constantly employed in cleaning and grading seeds, and from the cellar to the mailing room everything is so arranged that orders may be filled with accuracy and despatch.

During the late summer and early fall the force is employed in addressing envelopes for catalogues and in packeting seeds in readiness for the busy months. In order books there is an entry for every post office in every State, no matter whether an order has ever been received from that office or not. Thirty years ago one hundred letters a day was considered a large business; to-day some houses receive over six thousand letters a day during the busy season. Firms that twenty years ago employed only one or two clerks, now employ a hundred during the winter months. Throughout the West the seed business has flourished; a Wisconsin firm writes that its business has increased 500 per cent in the last fifteen years. A single warehouse of a western firm now has between seven and eight acres of floor space. Seeds of all kinds can now be furnished at such small cost that even farmers find it cheaper to buy than to raise, and yet the aggregate of the annual business of the wholesale seed houses amounts to millions of dollars.

Wholesale Hardware Trade

In the variety of sizes and kinds of articles carried in stock under a single roof, the wholesale hardware house ranks next to the department store and the wholesale grocery warehouse. Many of the great hardware houses in the country publish price lists, each embracing nearly 50,000 different sizes and kinds of articles. Quantities of each particular article are always carried in stock—everything, from a sufficient number of reels of barbed wire to put a fence around Central Park, to a thumb tack. The great centres of distribution of hardware are Chicago and St. Louis. These, indeed, are the largest hardware markets in the world. In the purchase of such a vast and varied stock, it is not uncommon for a jobbing hardware house to have orders outstanding with as many as 3,000 different manufacturers. If China had used hardware, she would not so long have stood still. The United States has prospered because she has used hardware. This is the hardware men's way of saying, that where hardware is little used, there you will find "hard times." Before a body of persons in a new country can begin to build things, they must have hammers, nails, saws, wire, locks, files, knives, screws, and a thousand other hard wares. Without these things, idleness prevails, and a community goes into decline somewhat as a plant will wither for want of water. Thus it is said that, as is the hardware trade, so is the country.

Divisions of the Hardware Industry

The hardware industry is split up into a hundred branches. Here is a factory which produces nothing but wire nails, a million kegs a year. In the twenty or more wire nail mills of the country, 6,000 persons are employed; capital about $10,000,000; product about $20,000,000. And here is a horseshoe factory, where 2,500 men turn out yearly 800,000 kegs of footwear for horses. About fifteen horseshoe nail manufacturers give employment to 1,500 persons, using a capital of $2,500,000. A number of establishments turn out over $3,000,000 worth of table cutlery a year. Pocket knife manufacturers alone have invested $2,000,000 in factories, employing about 2,500 persons, producing 180,000,000 pocket knives a year, sending a great many to Europe, even into Sheffield, England, which is the same as if American coal were being sold in Newcastle. Then there are manufacturers, 150 of them, with a capital exceeding $3,000,000, who employ 3,000 persons to do nothing but make files—nearly $4,000,000 worth of files a year. Notice that wire cloth in the window and door screens in summer time! One hundred and twenty-five million square feet of wire cloth is consumed in this country annually. Six thousand tons of steel is thus made into window and door screens. In this particular branch of the hardware industry, another $4,000,000, at least, is invested. Again, 1,200 persons earn a livelihood making $2,000,000 worth of scissors and shears in eight or ten factories, the capital invested being about $1,000,000.

At Providence, R. I., mechanics' tools are turned out by the millions; and many workmen in England, France and Germany are using tools made in the United States. The Providence factories make tools so fine that the two-hundred-and-fifty-thousandth part of an inch can be measured. In a town near Philadelphia, 3,000 persons are employed in making saws, using up 12,000 tons of steel in making 30,000 hand-saws every week. In all the saw manufacturing plants the country over, a capital exceeding $8,000,000 is invested. Small farm implements, called "hand agricultural tools," hoes, rakes, forks, etc., are also made by the million. Two thousand persons are employed supplying "The Man with the Hoe" throughout the country with $2,000,000 worth of tools annually.

Perhaps the most important, most extensive branch of the hardware industry, embraces builders' hardware, door locks, etc. Fully 25,000 persons make a living in this corner of the hardware world, where the invested capital and the annual output each amount to about $25,000,000. Over $5,000,000 worth of locks and hinges and other builders' hardware is exported each year. Barbed wire must not be overlooked, for the United States makes ninety per cent of all this kind of fencing produced throughout the world. In Australia, Cuba, or other parts of the West Indies or South America, thousands of miles of fences of American barbed wire are to be seen. Between seventeen and twenty mills manufacture this wire, employing nine or ten thousand hands, using a capital of nine to ten million dollars, the product being valued at twenty million dollars. The exports of all forms of wire amount to over four million dollars annually.

The Retail Trade and Success in Store Keeping

Supposing that a young man, having saved a thousand dollars, has started in the retail business for himself. He will argue that without credit his business cannot grow; that without buying something for which he does not have to pay until he has sold it, he can do no business to speak of, that he cannot expand. But, ask the merchants who have failed, what ruined them?

They will answer, "Credit." It may be credit given or credit received, the result is the same. Credit is for Wall Street, for millionaires and for old established and very rich merchants. The young dealer who sells goods on credit is lending capital without interest. When comes the day on which funds are needed, he has neither his wares nor his money. The young dealer who buys goods on credit, arranges an ambush, sets a trap, digs a pitfall to destroy himself. Again, he may argue that though he pays cash himself, it is impossible in his community or in his particular "line" to hold his customers to "Terms Strictly Cash." In such cases, he should watch his books, his accounts, as carefully as an engineer watches his dials. If he cannot keep to the letter of cash, maintain the spirit of cash by not fearing to ask his customers for money due.

The first consideration of every young merchant should be the matter of organization. Organize your business, no matter how small, is the advice of veteran storekeepers; so that the few or the many in your employ will work without clashing. The duties of each employé should be fixed definitely—and the man who then does more than his duty in an effective way, is the one whose salary you will raise. The best organized business is the one of which the popular verdict is: "It runs itself." That means that the details are carried out on such a thorough scale that the proprietor has time and leisure for the creative, for arranging to expand or to introduce innovations, new ideas. But, contrary to the popular belief, it will be found that it is in the best organized establishments that the proprietor and the various heads of departments work the hardest.

Organization in business is as important as in an army, or on a battleship, or in a municipal government. If you find that mistakes are constantly being made in your shop, in the way of orders, or deliveries, or sales, or prices, don't be too quick to judge the employés, the seeming culprits. You may be the one really to blame, because you yourself have made a mistake that led to all the others; that is, you may have made the mistake of not organizing. If you have to ask in your shop "Who did this—or that," there is something wrong; you have not thoroughly organized your force of clerks or salesmen. To leave no part of the work of your establishment to chance; to have fixed hours of labor; to have a place for everything; to make every detail somebody's—not everybody's—business; to have routine without unnecessary red-tape; this is organization, and as your business grows you will find that progress will only swamp you, unless you give constant attention to reorganization.

The retail dealer should avoid getting overstocked; that is, filling his store with large quantities of goods which are subject to change of fashion or public whim. It is better to order little and often. Nothing so pleases the vanity of some customers as to make them understand that they are the very first to whom a fresh consignment of goods from New York or Paris has been shown. See that you always keep the latest shape, color, size, and the most up-to-the-minute pattern in everything, and offer at least one new thing for sale every day. In this way the young merchant builds up a reputation for enterprise.

The young merchant will soon learn the value of advertising. His competitors will keep his brain busy devising new ways and means of calling the attention of the public to his goods and away from the other fellows. He should take an amount of space in the local papers consistent with the quantity of wares he has to sell. He should change these advertisements daily, setting forth each time the merits of a new consignment of goods or a bargain sale of something particularly useful at that season. His advertisements should be carefully worded, simple and dignified. He should also send out circular letters occasionally—these prepared in a style consistent with the nature of the goods thus offered, and with the class of customers to whom he appeals. At odd moments he might write personal letters to some of his customers, offering them first choice in selection from a new shipment of hats or cigars, or towels or artificial flowers, toys, or what not.

Window Trimming

The appearance of his window should play an important part in the merchant's scheme of success. Even if he has only one small window, let him give that single show space careful thought. Change the goods in the window frequently. Put there the newest and most popular goods. In most cases it is best to display the price as well as the object itself. "How much" is the first question in the mind of a passerby. The retailer will therefore increase his sales by answering the question on a ticket plainly marked and attached to the goods. Pictures, statuary, trophies of sport and curios, or the original drawings from which any striking magazine picture was made—these are all excellent as attractions in a window. Borrow such whenever possible. Those who stop to look at the loving cup won by the local boat crew may be attracted by other things in the window.

In the art of window dressing much taste is required, the keynote being simplicity. The dresser should study perspective. The effect from the middle of the sidewalk, or even from the other side of the street, should be considered. Care should be taken to arrange objects so that the window as a whole may be attractive. To be a good window trimmer one should have studied the principles of decoration, and should have followed a course in ornamental designing, either in an art school or at home. He should be a good colorist and should have a knowledge of form and proportion. The misuse of colors produces a very bad effect. A window should never be sombre, which result is produced by the employment of dark colors. A window should be bright and cheerful. This effect may be attained by the use of light colors. Crooked lattice-work is fatal to beauty. The distances should be measured and marked, so that the intersecting lines may be absolutely straight, when the lattice effect is attempted. Designs should not be over-elaborated. Careful study of things in the mass, of broad effects, is needed, and less attention to minute details. Dressers should remember that the window must form a picture so attractive as to catch the eye of the passerby.

Certain educational associations have prepared short courses for window trimmers and card sign painters, including instruction in the theory and general principles of window trimming. The art is studied from different points of view. Practical demonstration is given. Actual decorating is done, and errors are pointed out and corrected. Thus the student is practically taught to make a window both artistic in appearance and, at the same time, a good business-bringer for the establishment.

Employes of Stores

In the matter of employés, the man who will work for a small salary is not always the man you want to help you build up your business. Cheap men will do cheap work. On the other hand, never pay an employé a cent more than you know him to be worth. Sentiment must not govern your pocketbook at this stage of affairs, for you are keeping expenses down, down. Secure helpers who will take a personal interest in the march of your affairs—those who will have ideas and will help you to believe that two heads are better than one. The young man who is constantly looking at the clock is not the man you want behind your counter or in your office. Nor is the man who has an outside interest, a "side line." The best employé for you is the one who serves but one master.

While the proprietor of the store is the brains for those under him, he should not be averse to showing his employés how to do even the small things. It is important that the smallest cog in a wheel shall do its work well to assure the success of the machine as a whole. The merchant should set the example in the way of hard work, long hours, industry, integrity, economy and promptness—for these are the cardinal requisites to success in storekeeping as in all other fields.

The shop girl is of all nationalities, but the Jewess and the Irish girl take the lead in making clever saleswomen. The Jewess seems to possess an absolute genius for drawing money from customers, while the Irish girl is popular from her ready wit and her adaptability. The characteristic of the good saleswoman is not merely to sell a customer something that she asks for. Any one could do that. It is, rather, to sell the customer something that she had no idea of buying, and in getting rid of old styles at a "bargain." The saleswomen are not inattentive, although they may sometimes appear so. In fact, they are very anxious to make sales, and there is always great rivalry among them on this point.

In the larger shops, the employés are graded. The beginner is the "cash," getting $1.75 per week. She is soon promoted to the position of "packer." From this duty she goes, at the next promotion, to the "bargain table," and is really a newly-fledged saleswoman.

One reason that hinders young women from getting ahead in stores, as in other branches of business, is that with them, in many cases, business is only a makeshift, whereas a boy intends to make it his life work. A woman will succeed in business if she takes it up in the right spirit. Attentiveness is sure to count, and mere eye service is poor policy. Women fall short of attaining the high positions in mercantile life, in many instances, because they do not learn the business as a man is willing to do. A girl is apt to expect a living salary at once, whereas a boy is content to give a certain time to learning business methods and routine, working his way upward until he gets a fair salary. The law prevents the hiring of boys or girls under fourteen years of age in stores. The cash girls, generally fourteen or fifteen years old, must be at their post, in any one of the larger stores, at quarter past eight, their duties being to run errands, carry parcels, and be generally useful. If faithful and energetic, they are promoted to be stock girls and sales girls, or mail-order clerks. The stock girl gets from $5.00 to $6.00 per week.

Conditions Surrounding Retail Salesmen and Saleswomen

Note is taken of the amount of each clerk's sales, and thus his or her value to the firm is ever measured. Customers will call for a saleswoman who has pleased them when they return upon some other occasion, while if negligently served, they will not come back at all, but will choose some other shop. In fact, eye service is a kind of dishonesty, both to the firm and to one's self. Interest in work should not be feigned; it should be really felt. Good saleswomen are ambitious and aspire to promotion. Often an assistant, employed for the holidays, will completely eclipse the old employés, and is at once engaged, or his or her name and address are taken, and he or she is sent for at the first vacancy. In some stores the saleswomen are required to dress in black. This custom was started by the employers because the finery worn by some of the girls, who could spend all their earnings in dress, led to heartaches among those less fortunate, and even proved an incentive to theft. And there were not a few customers who objected to seeing the saleswomen better dressed than they themselves were. Very often saleswomen become buyers, drawing fully as large salaries as men in similar positions. They often become very expert in buying for the millinery, underwear and corset departments. A girl who is attentive, knows the difference between materials, and is willing to learn, is bound to rise. In a store in Chicago the inspectors—or girls whose duty it is to compare the tickets with the goods and stamp them when they are being wrapped—were formed into a class and received regular instruction. They were taught arithmetic, spelling and reading. They improved so much that their salaries were raised. This system might be followed by other establishments with good effect.

A floor walker should have tact and politeness. He is expected to have a general oversight of the salespeople, to see that orders are obeyed, and adjust complaints of customers. He is often promoted, if strictly attentive to his duties.

Wages vary with the character of the goods and the position of the employé. In the hosiery department of some large stores wages range from five to eight dollars per week, in the muslin underwear section, from seven to twelve dollars; salesmen and saleswomen in charge of dress goods get from ten to fourteen dollars; those selling silks, from ten to eighteen dollars; furniture, from twelve to twenty-five dollars; shoes, from seven to ten dollars; cloaks, from ten to twenty dollars, and millinery from ten to twenty-five dollars. The silent heroism that might often be discovered in the lives of patient shop girls, perhaps none too strong or robust, would be a revelation to many people. Frail girls will sometimes support nearly a whole family. Young men, too, frequently save from their earnings enough to start them at college.

The Art of Selling

The question of the popularity of a store often turns upon the method of handling the small details of the business. The stock may be of the same grade, and the prices just as low, the delivery service may be quite as prompt, in two competing stores, and yet one will be preferred by customers to the others. The treatment of buyers is a matter of fact. The lack of courteousness among salespeople is not to be supposed. The rude or disagreeable salesman is so much the exception that he may be left out of consideration altogether. And yet the treatment of the customer by the polite salesman may be objectionable too. As much to be avoided as inattention is over-attention. Some purchasers know exactly what they want when they enter a store. But often, and especially when the visitor is a woman, there is perhaps a desire to look at things with the possibility of buying at some future time, or the intention of making comparisons with some other store. Such customers are apt to be annoyed by the suggestions or assiduity of a salesman, no matter how well meant. They are inclined to regard over-attention as resembling too much spying upon their actions. Where goods are displayed and accessible, such as china, bric-a-brac, books and notions, the customer especially likes to have a good deal of freedom in looking about. The salesman should, of course, be ready to answer questions or to make a sale, but he should not be too assiduous. In a certain prominent department store in Philadelphia, the orders to the salesmen and saleswomen are never to approach a customer until they see that their services are required. This is undoubtedly one of the reasons why this store is one of the most popular in that city. Another cause of the popularity of certain stores with customers is the fact that they have their goods readily accessible and plainly marked with the price. The old custom of private price marks is disappearing. There are many people who, for different reasons, dislike inquiring the price of goods. Some will even go without purchasing an article rather than ask its price. These persons are attracted to a store for the mere reason that its prices are plainly marked. The tactful manager sees all these things and takes advantages of them, thus building up a large trade.

CHAPTER V

THE DEPARTMENT STORES

Economics of the Department Store System—The Social Side of a Department Store—The Conduct of a Department Store—Personnel of the Department Store—Behind the Scenes in a Department Store—General Conditions in Department Stores—Industrial Betterment in Department Stores—The Lot of the Girl Behind the Counter

Economics of the Department Store System

THE department store of the city is the general store of the village in an enlarged and improved form. The village store is an American institution dating back to Colonial days. In the "store" it has always been possible to buy any article of merchandise, of any class, from a shoe button to a furnace. The modern department store differs not at all from the general store of the country districts, save that the city establishment is stocked with more shoe buttons and more furnaces.

American department stores were first known as such in the early seventies. The technical reasons given for the rise of these great bazaars in cities are that the changed industrial conditions following the Civil War led to changes in business methods; that the fall in prices due to the strife of the sixties made close figuring necessary in order to secure a margin of profit; hence, for economical reasons, the assembling of many stores under one roof and under one management. This is the mercantile point of view.

What is the social viewpoint? While the inhabitants of every hamlet and town could drive to one store, and there buy everything or order everything they wanted, the people of cities were obliged to tramp from street to street, and from shop to shop, buying their shoe buttons here, their furnaces there, stockings uptown, furniture downtown. Why not gather all commodities in one place, after the manner of the village store? Merchants of the period asked themselves this question—and it was answered by A. T. Stewart, and Ridley, and Lord & Taylor; by Macy, and Marshall Field, John Wanamaker, Jordan & Marsh, and hundreds of others in the cities throughout the country. Soon it was noticed that just as farmers and their wives and daughters made the village store a general meeting-place, so the housewives of cities met for gossip at the department stores. Now there are shops of the "Meet-me-at-the-Fountain" class in every city, with restaurant, library, reading and writing rooms, telegraph office—all the conveniences of a club-house while you do your shopping.

It is impossible to give even approximately the total number of department stores now prospering in the cities of the United States, but an estimate of the number can be made by multiplying the total number of cities by two or three. Many millions of dollars represent the capital invested, and if all the men and all the women now earning their bread behind the counters of such stores could be assembled, they would probably require a camping ground larger than would be needed for an encampment of the entire standing army of any one of the great European countries.

On one side, the department store is an advantage to the consumer. On the other, it crowds out the small dealer, the one-line storekeeper. The question, therefore, long ago resolved itself into that of the greatest good for the greatest number, and, thus considered, the department store has a decided advantage. In the department store the producer meets the consumer as directly as possible. Here, merchandise is distributed along the line of least resistance. By the consolidation of retail businesses in great stores, the risk of loss and the cost are lowered; fewer clerks are required for the same amount of business; and there is a saving in rent and in the costs of superintendence and bookkeeping. By buying in large quantities, the department store buys at lower prices than the small dealer; by buying direct from the manufacturer the expenses of commissions and reshipment are saved; by being able to pay cash, a considerable discount can be taken advantage of. As a result of these economies the customers are better served than in the one-line stores, and prices are lower. Finally, by the great store system, the middleman is being eliminated, and commission houses and jobbers will soon be trade incumbrances of the past.

The Social Side of a Department Store

A great department store is really a public institution. Many good-sized cities have not a population as large as the crowds that visit in one day a huge modern retailing establishment. These stores are run by men who are "specialists in specialties." The enormous volume of business enables them to cut profits on each sale. Sometimes, to produce a sensation and get the advantage of the act as an advertisement, they will even sell goods below cost. These places are virtually great exhibitions. One is not importuned to buy. Women like to take their time in making purchases, and the big store affords them this opportunity. In a way, the great establishments have become a part of the social life of a city. People are gregarious, and they like to go where they can see and be seen. To many women the big stores are places where they meet their sisters and women who are their acquaintances or friends. As all parcels are sent home, even "more men" are pleased to patronize these huge shops. And it is not at all simply the poor people who visit them. People of means are quite ready to take advantage of bargains all over the world. To the country cousin a great store is a show place, and to them, as well as to many of their city friends, the "sample-rooms," where all sorts of dainties are to be tasted free of expense, are well-springs of delight.

Conduct of a Department Store

Several department stores do a business of $7,500,000 to $15,000,000 annually, and the quality of the goods steadily improves. In the West there is a big store that pays a rent of about $400,000 a year. Another has a mail-order department with a business of $900,000 a year. Several houses send home to their customers more than twenty thousand packages a day, not counting the parcels carried away by the shoppers themselves. In New York, Philadelphia and Chicago there are stores which are visited by one hundred thousand people in a single day. One of these firms spends more than $300,000 a year for advertising. The sales in single departments of each of several stores amount to more than $2,000,000 a year.

The modern department store is a composition of many separate stores, no one overshadowing the others. Great executive skill is required in the management of one of these huge concerns. There is great rivalry between the departments, each trying to push itself forward. Each section must prove its right to survive, or be quickly eliminated. The stern rule of the survival of the fittest is here exemplified. The head of the firm must reconcile all these rival lines of trade, and conduct them under one method, to get the best results from each section, and from the whole concern. There may be several partners, but generally there is one man whom all recognize as the real head. Very often he is a self-made man, who has worked up from the lowest round to the top of the ladder. He has therefore both knowledge of, and sympathy for, every grade. It is largely his ability to choose lieutenants that gives him success in his great enterprise. In the great department stores, however, the heads of the firm do not train and develop their managers and heads of departments. They draw by larger salaries men from other establishments, who have attracted attention by their signal ability. It is not as easy for retail establishments to get good material in the way of clerks as it is for the wholesale houses. A good buyer can command the highest salary. Many men are further stimulated by a percentage of the profits or of increase of sales in the line of goods they control, the bonus often amounting to more than their large salary. A good buyer is frequently paid from $5,000 to $10,000, plus a percentage on the yearly increase of his sales. There are buyers in some of the largest departments who thus receive $30,000 a year, and are welcome to it, so valuable are their services. This only holds good in the great stores, for in the small ones a buyer may only get $25 a week, and no commission.

The question of space is a puzzling one in a great establishment. Each square foot is of value, and must be accounted for. There must be space reserved for "stocking-rooms, receiving-rooms, packing-rooms, work and repair rooms, account-rooms, offices of the buyers, executive offices, cash-rooms, and delivery-rooms." The earning portion of the store must carry all this dead weight. With the omission of all this "dead space," there is a certain amount of flooring to be reckoned with. The head of each department naturally wants all the space he can get. The space is of course not all of equal value in attractiveness. The ground floor is the favorite, and the main aisle on this floor is on the line of the greatest travel. So the most attractive staples are put here, such as silks and dress goods. Less ornamental goods and china or glassware would not be placed here, except, perhaps, on bargain days. On such occasions there is an enormous breakage in the china and fancy glass articles, amounting sometimes to the value of two hundred dollars for the day. But the size of the crowds attracted makes up for this loss. Of course, the departments, from their nature must vary in size. Carpets demand a large floor space, for example, and fall naturally into place. But the space due to many departments can be determined only by their relative earning power. Those which have made a poor showing are cut down in space, or transferred to other locations.

The head of a department, generally the buyer, who can point to an increase over the business of the previous year, beyond the normal, has at command as much space as he desires. Additional space carries with it all sorts of opportunities and responsibilities. Additional expenditures must be made, a new apportionment of salespeople must be planned, window display must be re-distributed, and even the quantity of advertising must be newly divided. There is a sort of impetus or momentum that seems to push a department ahead, when once it has got a little to the fore. The manager hits upon some novelty that pleases the public. Crowds flock to his department. His stock is repeatedly sold out. More capital is allotted to him, more advertising is given to him, and in the show-windows he has his own way. His floor space is augmented, and he obtains an extra staff of clerks. His very advance helps him to do better still, for he can now buy better from the manufacturers, having more money to spend.

Personnel of the Department Store

The manager of a store should have every detail in his grasp. He is the highest court of appeal. His authority is seldom overruled or his judgment questioned. Upon his disposition the reputation of the store among employés depends.

Next to the manager comes the superintendent, who is very seldom a member of the firm, although the manager generally is. The superintendent may get a salary of $5,000 a year. A woman has earned that sum in the position in New York. The pay of assistant superintendents is very much less, a young woman filling the position in a New York department store uptown for about $700. As has been said, the buyer is really the head of the department, assuming the whole responsibility for it, and being allowed much latitude. He must not exceed a certain limit of expenditure, except on special permission. He must neither understock nor overstock. He must have the gift of foreseeing what colors and materials, what makes and styles will be popular for the following season, and he must know how to force his selections into fashion. He can often do a great deal in this direction.

To the buyer of each department come the agents of the manufacturing firms and commission houses, with their samples and their price lists. Some big stores send buyers abroad, often as many as a dozen serving one firm in Europe, Asia and Africa, looking out for rugs, silks, mattings and other goods. The buyer has an arduous task in fixing the scale of prices for the salesmen. He must face the ever recurring problem of making the prices high enough to insure a profit, and small enough to attract the public, and move the goods. Other firms' prices must be watched, and goods must not be marked higher than is the case with competitors. The buyer has no authority, even in his own department, in the working machinery of the store.

The floor-walker, or usher, is supreme in the outer management. He must not only be a living directory, but he must keep the salespeople in proper form as regards dress, deportment, and activity. He must also hear complaints of customers, and see that errors are rectified. For these tact-requiring duties he gets from $15 to $40 a week.

The salespeople, in first-class stores, are paid from $6 to $15 a week. In stores of the poorer class they get sometimes as little as $3 per week. Sometimes a percentage on sales from a particular counter is allowed. The salespeople make up a veritable army, as many as 3,500 being employed at the holiday season in one store. Five hundred of these may be "extras." The errand-boys and cash-girls are paid from $1.50 to $3 a week. Mechanical "carriers" are supplanting these boys and girls to some extent. In some new stores each department has its own cashier and wrappers.

Behind the Scenes in a Department Store

Some important sections the public never sees, although these sections require the services of two-thirds of the staff of employés. There is the stock-room, for example, where the goods from the receiving-room are carefully arranged, ready for the demands of the floor-walker, who wants more stock in a particular department. There are the work-rooms, where hundreds of girls mend, repair and alter, at about the same salaries that are paid to saleswomen. In some of the newest stores the cashier's department is well lighted and well ventilated, but in many establishments it is dark, stuffy and noisy. Although the pay is not very large and the work is very trying, yet the department is a popular one. Absolute accuracy is necessary, which means a good deal when it is considered that money amounting to $100,000 a day is handled in the busy season.

The delivery department employs a great force of men, in some large stores as many as four or five hundred. During the holiday season the men are often worked eighteen hours a day. The delivery department is divided into local, freight and express sections. The parcels are placed upon a long table about which are bins. The parcel is slid along the table until it is opposite its proper bin, into which it is tossed by a young man.

The bin has a number corresponding with that of the driver, who collects from it. With each wagon is a driver's boy, who packs the parcels handed him by the driver, in order of delivery. Some large houses have as many as a hundred and twenty-five delivery wagons. The head of the delivery department must have an accurate knowledge of the whole city, and remember the address of several thousand credit customers.

Each article sold is handled by fifteen different persons; viz., the receiving clerk, the "head of stock," the buyer's assistant, who marks the price, the stock-boy, the "head of counter," the head clerk, the salesman or saleswoman, the inspector, the collector, the packer, the addresser, the assorter, the "bin" boy, the driver and the driver's boy.

One prominent store has more than seventy departments. One hundred miles of steam pipes are necessary to heat it. Its electric light plant is enormous. Its rental value is about $300,000 a year, and its average daily expenses are $5,000.

General Conditions in Department Stores

A great establishment will offer opportunities for progress among its employés, in order to keep the best men. Recurring vacancies must be promptly filled. The firm and the managers and floor-walkers are always on the lookout for evidence of merit, which is generally appreciated and rewarded. A large firm has a direct check on the honesty of all its employés, except, perhaps, the buyer. In some houses the buyer is required to send to the firm a duplicate of each order he gives, for confirmation. This does not refer to travelling buyers. Some houses send out notices that they will be responsible only for such orders for future delivery as shall be sent to them for verification.

The sales-ticket or cash-ticket will identify all of the fifteen employés who have handled the goods, thus acting as a check against dishonesty. The percentage of error in the delivery system is only about one-hundredth of one per cent, twenty thousand parcels being delivered in a day without a complaint.

Credit checks are often sent through special tubes to a separate office, where they are allowed or rejected. So skilful becomes the authorization clerk that he can tell at a glance the standing of a credit customer. The number of these credit customers varies from 10,000 to 60,000, according to the store. The credit department generally consists of the credit man, several assistants, who act as quasi-detectives, and the authorization clerk. The credit man is supposed to know all about the credit customers. He is slow to withdraw credit, save when absolutely necessary. In New York the credit men have a club, where they exchange information. There are also in the large cities retail protective associations. "Bad-pay" customers are reported to these associations, and the members are warned against them. Shoplifters cause a considerable loss, one big house estimating its annual losses from this source at $15,000. Detectives are employed to check this loss. Kleptomaniacs are also an annoyance, though they are seldom prosecuted.

Novelties are always sought after, and sometimes prove vastly valuable. The mail-order system is one of these, making a fortune for the firm first adopting it. Of course is has now been generally introduced. Another idea is the combination of small stores in small cities, which exchange non-selling stocks. Syndicate-buying is a feature of this combination.

The great store is also largely dependent on its advertising and its show-windows. The head advertising man holds a most important position. There is a big store in Philadelphia which spends $365,000 a year in advertising, and several spend half of that. Some proprietors write their own announcements. One advertising man in the employ of a great house is said to receive a salary of $15,000 a year.

It is claimed that the book department shows the department store at its worst. It is said that the salespeople in this department know nothing about their wares, and can not give any advice in reference to them. On the other hand, the proprietor of the great store says that in these days the public knows what it wants, and is quite ready to take advantage of his low prices.

It is generally supposed that the female employés in department stores far outnumber the males. To the ordinary eye, this is the case. In reality, however, the proportion of women is only forty per cent. The girls are all visible, while the men are in the background, or in the basement, or at work in store-rooms above the sales-floors. In the biggest store in New York, for instance, only four floors are given up to the public, while the four upper floors are used for storage, manufacturing and other necessary work. Here are employed fully half of the sixty per cent of men. Between the men and the women the situation amounts to this: The men supply the goods for sale, provide for comforts, maintain cleanliness and order, and the girls sell the goods. With the exception of a comparatively few buyers, milliners and models, the female employés may be classed as saleswomen. The men are of many stations: buyers, floor-walkers, receiving and delivery clerks, packers, handlers, porters, and drivers.

Industrial Betterment in Department Stores

In the matter of comforts, the big stores are the most liberal, the small stores the most backward. It would be difficult to find to-day a big department store which has not complied with the sanitary measures set forth in the law passed for the purpose in 1896. Retiring rooms, lunch rooms, recreation rooms and sick rooms are provided. All the girls are furnished with seats, and what is more, are allowed to sit down when not waiting on customers. Some stores go a great deal further than merely complying with the laws. The most successful firms have learned that good treatment of employés is sound business policy. These firms encourage loyalty, foster a spirit of *esprit de corps,* try to establish a family feeling between employers and employés, making those in each department feel more than a passing interest in the establishment.

Pursuing this policy, the proprietors of the largest stores in New York furnish lunch rooms and luncheon too, that would be acceptable to the best customers. The lunch rooms have, first of all, the quality that ranks next to godliness. Second, tables and chairs are provided so that all may be seated, and none crowded. The salesgirl may bring her own food from home to this room, or she may purchase what she wants from the counter at a remarkably low price. The prices, as a rule, are: Coffee, tea, cocoa, two cents a cup; milk, one cent a glass; roast beef, mutton, lamb, pork, eight cents; vegetables, three cents; pies, cakes, fruit, two cents. Five cents buys all the rolls and coffee a salesgirl, or even a lusty porter, can possibly eat. The food served here is from the same stock that is served to customers in the regular restaurant, at three times the price. The men and girls usually have separate lunch rooms. Forty-five minutes being allowed for luncheon, the employés usually have twenty minutes or more to spare after finishing their meal. They spend this time in the reading or lounging rooms adjoining the restaurant. Here are games, magazines, and a piano. One large New York store has equipped a gymnasium and furnished an instructor for employés. Those who wish may here take fifteen or twenty minutes' exercise, preferably before luncheon. A Boston firm has also constructed a gymnasium for its young women, and here dancing lessons also are given. Adjoining the "gym" at establishments of this kind are a string of bath rooms, eighteen or twenty perhaps, containing porcelain tubs, open-work plumbing, and fitted with every convenience. In a great New York establishment each employé may use the bath rooms three times a week, the men on Mondays, Wednesdays and Saturdays, the women on the intervening days. Thirty minutes is allowed each bather, and to secure the privilege all that is necessary is to apply at the proper desk for a card giving the number of room and the hour at which the bath must be taken. In this same store there are sick rooms for employés, where the firm's own doctors and nurses are in attendance, and where medicines are supplied without charge.

Social life among department store employés is provided by the employés themselves, who organize into associations or clubs. The firms have no objection to these organizations, and, though they give no official recognition of the clubs, and thus assume none of the obligations or responsibilities, they offer every encouragement and material help. The strongest organization of the kind in New York is the "Looking Forward Club," its membership consisting entirely of the female employés of Wanamaker's. It is like an ordinary club, and has been admitted to the National Federation. Mr. Wanamaker provides the members with a club house near the store, rent free. The furniture and fittings were paid for out of the club's treasury. In the summer the members make up a tennis club and play Saturday afternoons in Central Park. Nearly all the girls go to the club house for luncheon, the price of food being as low as at the lunch room in other stores.

Another New York club of the kind is composed of "Big Store" employés, known as the Siegel-Cooper Employés' Association. It has a membership of nearly 5,000. Each member pays dues according to the salary received—from 20 cents to $1.60 a month. This is supposed to make the association self-supporting. There is usually a deficit at the end of the year, but this is made up by a grand ball given in one of the largest halls in the city. The proceeds of this ball usually amount to $8,000 or $10,000. The principal objects of the association are, first, to promote good fellowship among the employés of the firm; second, to provide for the care of the sick and to grant money for funeral expenses in case of death. The most interesting of the social phases of this association is the fact that it affords each woman member a week's vacation in summer, free of charge. The firm pays each woman's salary during vacation week, of course, but if she is a member of the association she need not spend a cent during the period of her rest. Four cottages have been provided at Long Branch, where the women and girls may go and spend the happiest week of their year. The houses are kept scrupulously clean, and there are no irksome rules.

The Lot of the Girl Behind the Counter

As for the salesgirls, their lot is by no means filled with hardships. The girls themselves, as a matter of fact, would rather work in a department store than anywhere else. Economists have questioned a great many girls on this subject, girls who were earning only six or seven dollars a week, and the universal reply was: "We are prejudiced against domestic service—why not? Working in a store is business; in a kitchen, drudgery. In a store a girl has some chance to better herself; if she works hard she can rise to higher positions. But a house-servant, what chance has she? Once a cook or a chambermaid, always one. In a store a girl has but one boss, the manager of her department. In a kitchen she may have a dozen bosses—every member of the family gives her orders. Then, too, here we have seven evenings a week to ourselves; there we would have perhaps one evening which we could call our own. Again, a young man of the right sort will not court a kitchen maid. Certainly, the salesgirl has a much better chance of getting a husband."

The girl behind the counter usually begins her day's work in the store at eight in the morning and ends it at six in the evening. Arrived at the building, she must hasten to her locker, which corresponds to her own number among the employés. In this locker she must deposit her umbrella or overshoes and hang up her coat and hat. Nothing else is allowed in that locker, no package of any kind, not even a scrap of paper. This precaution is taken against fire. An inspector passes down the aisle twice a day, opening every door—in the morning to see that the lockers contain only things allowable, and in the evening to make sure that nothing whatever remains over night.

To avoid the payment of a fine, the saleswoman must not only be in the building, but she must be at her place behind her counter when the bell rings, the eight o'clock bell that corresponds to the workingman's seven o'clock whistle. The fines, which go into a general fund to be used for the benefit of the employés, are deducted from the salaries at the end of the week. For arriving late in the morning, a cent a minute is charged. The chief and most exhausting duty of the girl behind the counter is to please every customer, especially those who ask questions, and yet seldom buy and make the most complaints.

If abuses arise in any instances they are quickly corrected and checked by the "Consumers' League," an organization of women pledged to look after the interests of working girls. The league has branches in all the cities and large towns. The women of the "Consumers' League" keep a "white list" of stores properly treating their employés, and refuse to patronize others than "Fair Houses."

In the holiday or "rush" season, or while "taking stock," the salesgirls in the large stores are obliged to remain after six, some of them till nine or ten o'clock. The Consumers' League demand that the girls thus detained receive supper or its equivalent in "supper money." Many of the larger stores readily acceded to this request. Then the league came forward with a demand that proprietors of stores should provide escorts for girls who are obliged to stay late at night. Boys, said the league members, could be sent with the girls to elevated stations or to their homes. At this request, however, the store proprietors "drew the line." A salesgirl, they argued, was just as safe in the street after nightfall as a domestic servant returning from her Thursday out, or as a newspaper woman going to her home long after midnight.

CHAPTER VI

THE TELEGRAPH AND CABLE BUSINESS

The Telegraph Systems of the World—The Telegraph System in the United States—Constructing a Pole Line for Telegraph and Telephone—Operation of the Telegraph Lines—Various Applications of Telegraphy—Telegraph Operators—Railroad Telegraph Service—Earnings of Telegraphers—Training as Telegraph Operators—The Submarine Cable—Submarine Cable Manufacture—The Cable Making Industry in the United States—Cable Laying—Wireless Telegraphy

The Telegraph Systems of the World

WHEN Professor Morse first introduced the electric telegraph, it was considered to be quite the highest possible achievement of modern science and ingenuity. As has been the case with all great inventions, there were many intelligent people who first doubted its power to convey messages to any great distance, and then confidently asserted that it could never prove more than a curiosity. However, despite that the predictions of would-be prophets have been discredited, and that later achievements of electrical science have immeasurably eclipsed it, as a wonder worker and space annihilator, it must not be forgotten that the telegraph has proved nearly the most potent factor in the march of progress and the unification of nations. At the present day the earth is girdled with telegraph lines, which form a veritable network over its entire surface, making it possible to send a message from any point having a telegraph office to almost any other point in the confines of civilization. Until within a very few years, the cost of telegraphing from one country to another was very high, owing to the fact that the several governments or corporations controlling the lines charged different rates for service; some of them exorbitant. However, since the formation of the International Telegraph Bureau there has been a fixed charge adopted to all points reached by wires, and an agreement whereby all messages will be forwarded to destination, although cipher despatches are refused in several European countries.

This International Telegraph Bureau is the most far-reaching organization in the world, and not far from the most important in several very real senses. Representing, as it does, the concord of several telegraph-owing governments and numerous important private corporations, it is authorized to exercise complete control over all international telegraphic despatches, and in times of war wield full powers of censorship. According to conservative estimates, the lines included in its systems represent well over 600,000 miles of land wires and about 200,000 nautical miles of submarine cable. Over thirty languages, including Turkish, Chinese, Japanese and Arabic, are represented among the nations owning lines included in its control, and no matter in which one of these the despatch is sent, it is repeated, untranslated, as often as necessary, and may go half way around the world in its original form. One condition, however, is made in this matter, and that is that the Roman characters shall be used at all points, in order that messages may be transmitted by the ordinary Morse signals, without confusion. This end was attained in the case of Chinese, only with the assistance of a Danish scientist, familiar with the language, who laboriously selected about 6,000 of the 30,000 characters in general use, and compiled a dictionary giving them equivalents in the dots and dashes of the Morse symbols. A similarly important undertaking was the formulation, under the auspices of the bureau, of an official code, now used throughout Europe for international messages, and including over 200,000 words selected from German, English, Spanish, French, Dutch, Italian, Portuguese and Latin, forming, in fact, a sort of international language which can facilitate the sending and repeating of messages throughout the world. It is required that all operators on international lines shall be familiar with this system.

The extension of telegraphic lines, both cable and land lines, has represented a great expenditure of capital and innumerable hardships. In 1870, when the cable was laid from Hong Kong to Australia, by way of Sumatra and Java, the government of South Australia undertook to string a line from Adelaide to Port Darwin, across burning deserts and entirely untraversed territory. The work was accomplished in two and a half years, despite almost discouraging difficulties from floods and heat and the attacks of savages. Another interesting chapter in telegraphic history is the Danish enterprise of laying a cable from Vladivostock, Russia, at the terminus of the great trans-Siberian telegraph line, to China and Japan. Owing to the probable impossibility of securing permission to enter a Chinese port, the cable was secretly connected to shore and drawn in through sewers. It soon established its usefulness, and has become one of the most profitable lines in the world.

The Telegraph System in the United States

The telegraph business of the United States is nearly all in the hands of the two great companies—the Western Union and The Postal. Thirty thousand persons are employed by the Western Union alone, a number greater than the whole standing army of the United States previous to the Spanish-American war. A few facts about these companies will afford an insight into the widespread usefulness of the telegraph as a means of communication. The capital stock of the Western Union is $97,370,000; its surplus, about $9,300,000; its annual income over $26,300,000; and its expenses over $19,600,000.

The system represents: Stock, $97,370,000; five per cent collateral trust bonds, due January 1, 1938, against which bonds and stocks bearing the company's guarantee of interest or dividends at six per cent per annum have been deposited with the trustee, $8,502,000; four and one-half per cent funding and real estate mortgage bonds, due May 1, 1950, $10,000,000; seven per cent building bonds, due May 1, 1902, $1,150,000; stock of leased lines bearing guarantees of the company held by individuals, on which the company pays dividends or guarantees dividends, $14,334,665; in all, $131,-364,665.

The company has in its treasury about $11,000,000 of assets of outside companies, not regularly in the telegraph business, whose systems are not in any way comprised in its mileage. If, therefore, we should deduct these assets from the above amount of stocks, bonds and outstanding guarantees, the total capitalization is $120,364,665, or $645 per mile of poles and $129.80 per mile of wire. In all parts of the world the company has 23,000 offices, of which 21,000 are in America. It has 972,000 miles of wires exclusive of the Atlantic cables.

The capitalization of the Western Union Company has resulted from the amalgamation of a large number of telegraph companies from the beginning. In early days, the country was exploited by small companies in every direction, and they made their own tariffs. If one wished to send a message from one remote place to another remote place, he had to do precisely what he must do in Europe to-day, that is, send it over a number of government lines in order to reach a given point, and pay what is now called the "transit rate" through each country for that particular class of business. The result was, of course, that there was no unification of service. There was no compact way of reaching any point, and it became evident to the managers of the properties that the only thing feasible was consolidation, and that consolidation would lead to direct circuits, with tariffs reduced because of unification of management, and the obviation of a variety of individual charges for each system.

The Postal Telegraph and Cable Company has $18,000,000 of four per cent bonds. But that does not capitalize all that the lines have cost, which is about $20,500,000. On the mileage given by the company's officials for the United States, its capitalization is $782 per mile of poles and $121 per mile of wire. The Postal Company is the result of various reorganizations of other companies, and has been built upon practically a cash basis. It was organized largely to afford an American ally for the Commercial Cable Co., whose line forms one of the twelve cables connecting America and Europe.

Although it has been frequently asserted that telegraphy is not a growing industry, and that the telephone has virtually killed the short distance business, statistics certainly show a steady growth in point of the number of messages annually. Thus, in 1891, the Western Union Company handled 59,-000,000 messages, while in 1901 the number was 65,500,000, showing an increase per annum of 650,000 in ten years. In the same period the business of the Postal Company had increased from 7,000,000 to nearly 17,000,-

000 messages, a net advance of almost 10,000,000. With this increased volume of business there has been, of course, a necessity for similar expansion in plant, such as the construction and equipment of new lines. Moreover, there appears to be little prospect that tariff rates will ever be materially reduced, since, according to official statements, they are even now so low as to render possible the declaring of four or five per cent dividends, only with the most economical management. Indeed, with the average toll of thirty cents per message, there is a profit of only five cents for the company, the rest being consumed in running expenses. Should the business be taken over by the government, there might be some further reduction, owing to the ability to economize to better advantage, but it is not improbable that such cutting of rates would result in the same deficits as are met in England and other European countries, where the governments handle the telegraphs at a loss of nearly fifty per cent annually. The rates here, however, are quite as low in proportion as have been made possible anywhere, under government control, when it is considered that the full address, date and signature of sender are transmitted free of charge. For long-distance messages the rates are even lower here than in Europe, since there is no need for adjustment of charges for use of international lines, which vastly increase the cost to the sender. For example, the average cost of sending a message 1,500 miles in this country is sixty cents, nearly the record rate for the world for the same distance. The two American companies control between them 1,100,000 miles of wire lines and about 220,000 miles of cable, over which the yearly average of messages sent is about 82,000,000.

Constructing a Pole Line for Telegraph or Telephone

In the construction of a telegraphic pole line, the first consideration of importance is to secure poles of the proper length, diameter and material, to resist the stress and strain that must necessarily be encountered. All these factors are calculated with reference to the particular line: its location, whether in the city or the open country; the number of wires and crossarms to be carried. Thus, the poles of lines running through cities must necessarily be lofty, in order to avoid obstructing light, etc., and are, accordingly, made of Norway pine, which comes in good lengths, although lasting, on the average, only about six years. In cross-country lines, where durability is a matter of prime importance and extra height rather undesirable, the poles are made of cypress, chestnut or cedar, whose average life, in telegraph lines, is ten, twelve and fifteen years, respectively. In choosing tree trunks for poles, the diameters at top and butt are considerations of first importance. Thus, a twenty-five-foot pole should have a diameter of nine inches at a point six feet from the butt end, and be buried at least five and one-half feet in the earth; a fifty-foot pole should have a diameter of fourteen inches at the same point, and be buried six and one-half feet; while a seventy-foot pole should have a diameter of twenty inches and be buried seven and one-half feet. In preparing the pole, the bark is peeled away as soon as the tree

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CHIEF TELEGRAPHER, GOVERNMENT OFFICE, WASHINGTON

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is felled, and the limbs are carefully shaved down, in order that the sap may evaporate. In carefully prepared lines the poles are generally painted, in order to postpone decay as long as possible; occasionally some such preservative processes as "creosoting" or "vulcanizing" are employed, although poles thus treated do not last materially longer. Before the pole is planted, the crossarms, generally of yellow pine, are attached, and the insulator pins, of locust wood, are inserted in holes bored for them.

In ordinary lines the poles are spaced, so as to number from twenty to fifty to the mile, although this matter, like the height, is largely determined by the weight of the wire load to be carried. The holes are generally dug with long-handled shovels, although patent post-hole augurs, and even dynamite, are occasionally employed, the depth, of course, varying as the height of the pole to be planted. The first step in the process of planting is to insert a plank in the hole, so that the earth may not be broken when the pole slides in. The top end of the pole is then lifted by hand, so that the pole hoist, or "dead man," may be inserted under it, and the raising begins by lifting with pikes: the "dead man" being shoved along, so as to act as a support between heaves, until gravity overcomes the balance and the pole slides into the hole. Loose earth and stones are shovelled in the hole and stamped down, so as to provide a secure attachment at the butt. It is customary, in frequent instances, to further reinforce the pole by guy cables secured to stakes or to the base of a neighboring pole, but whether this expedient is used or not, the rule is invariable that the wires must be subjected to no strains other than the weight of their own spans.

In stringing a line, the wires may be put up singly or all at once. In the former case it is merely wound off a hand reel, pulled out to the required tension, and secured to the glass insulator cap. In stringing a number of lines at once, the several reels are placed at the beginning of a section of poles—their ends being secured to perforations in a plank spaced to correspond to the insulator pins on the crossarms. A team of horses is attached to the plank, and the wires are drawn out to the end of the reel. Tension is then applied to each wire between each pair of poles previous to attaching to the proper insulator cap. This tension is always regulated, so as to allow exactly the right amount of sag and obviate all breakage caused by temperature changes or stress of high winds. The successive lengths of wire are spliced by twisting together in any one of several different ways, which involve quite as much experience and expertness as attaching securely to the insulators. In splicing, the ends of the two wire sections are secured by grips, known as "come-alongs," and are drawn together by block and falls into a convenient position for the lineman with his twisting pliers.

Operation of the Telegraph Lines

The telegraph system of the United States covers the whole country, reaching every important centre from New York, on the Atlantic, to San Francisco, on the Pacific; a large part of its line mileage passing through unproductive territories, where the cost of construction has been exceedingly high, and the cost of maintenance immensely higher than in more thickly settled regions. Thus, two-thirds, or about 600,000 miles of the company's wires are in operation east of the Mississippi River, and the remaining third is spread throughout the large unproductive territory to the west, in order to reach the small towns, camps, and settlements along the various lines of railroad to the Pacific coast.

The actual efficiency of the service is shown by the statistics of several States. Thus, in Alabama, for example, there are in all only sixty-two places having a population of over 1,000: forty-four with between 1,000 and 2,500 each; ten with between 2,500 and 5,000, and eight with over 5,000. Yet, there are 405 local telegraph offices and 116 smaller places with telephone connection for the delivery of occasional messages, giving a total of 546 actual offices where telegrams may be despatched to any part of the world. In Massachusetts, where there are 317 towns and villages of over 1,000 inhabitants, there are 405 local telegraph stations, and 355 other places directly connected by telephone; giving a total of 860 stations in the State. Similarly, Pennsylvania, with 425 places of over 1,000 inhabitants, has 1,566 telegraph offices and 707 telephone connections, giving a total of 2,535 places served by telegraph. In the State of Washington, where there are only 36 places of over 1,000 inhabitants, there are 230 telegraph offices and 96 connections by telephone; giving a total of 326 stations. These figures are maintained, in spite of the fact that Alabama has 35 inhabitants to the square mile; Massachusetts, 349; Pennsylvania, 116; and Washington but 70. In the State of Montana, where the average is but one inhabitant per square mile, and only 23 places with a population of over 1,000, there are 160 local offices and 103 telephone connections, giving a total of 263 places directly reached by telegraph. Furthermore, while there are 80,000 post offices in the country, there are fully 40,000 places reached by telegraph, representing a ratio of 50 to 100, which is the record for the world. England, which is next in order to the United States, has the telegraph and post-office stations at a ratio of about 25 to 100.

Various Applications of Telegraphy

What the growth and perfection of mechanical telegraphy may some day accomplish is suggested in a plan made public years ago, which is that the telegraph companies so reduce their charges as to take the bulk of first-class mail matter out of the hands of the United States postal authorities by inducing the people to telegraph their letters. What machine telegraphy has already accomplished may be judged from the fact that, while about 40,000 messages are exchanged daily between New York and Chicago, the Delany system, with two good copper wires, could carry daily 28,000 messages of fifty words each between the two cities.

Among the common applications of telegraphy may be mentioned the "stock ticker," the district messenger call and the fire alarm telegraph, all of which are of American invention and development. The "stock ticker" operates on the step-by-step principle, being based on the inventions of E. A. Calahan, but greatly improved by Edison, Field, Phelps, and others. Among the notable improvements are the use of two lines instead of three, as formerly, and the substitution of a simple self-winding device for the station apparatus in place of the winding weight formerly used. The messenger call telegraph, introduced about 1870, for summoning messengers, police or the fire department to private houses and business offices, is also based on the inventions of Mr. Calahan. But within recent years has been perfected in manner similar to the stock ticker by the introduction of a self-winding device, which is operated in sending out a call. Fire alarm telegraphs have also been the subject of considerable ingenuity. Owing to the efforts of Moses G. Farmer, W. F. Channing, and J. N. Gamewell, they have now been so far perfected that a call sent out from any street corner box is automatically transmitted to all stations in the district, or to the entire fire department; thus giving notification of the urgency of the call. Devices operated by simple thermostat apparatus are placed in many buildings for giving automatic alarm of fire; also for releasing a stream of water to play upon the blaze. The total annual production of fire alarm, district and other forms of telegraph apparatus, attains a total value of nearly $1,200,000, representing the output of eleven States. The number of switchboards is about 10,000, representing a total value of nearly $57,000.

One of the latest forms of telegraph is the Gray telantograph, by which facsimile handwriting, portraits, maps, and other productions may be transmitted and exactly reproduced at a distant station. During the last two years this device has attracted considerable attention, and is being practically tested by the United States Army authorities.

Telegraph Operators

A philosopher once remarked that journalism was a very good business "if one got out of it soon enough." It may be said of telegraphy that it has a similar position among the great industries of the world, offering few prizes in itself, but furnishing better opportunities for promotion to responsible positions than almost any other. The list is a long one in finance, commerce, manufactures and railway management, of men who served as telegraph operators. On this list is Andrew Carnegie, Mr. Hughitt, President of the Chicago and Northwestern Railway Company; Mr. Earling, President of the Milwaukee and St. Paul Railway Company, Sir William Van Horne, builder of the Canadian Pacific Railway, Mr. Oakes, former President of the Northern Pacific. Several of the prominent men in Wall Street served the public at the wire before they achieved private wires of their own. It is certain that the telegraph business greatly sharpens one's wits. The operator must be very alert. Telegraphers get into very close touch with men controlling vast business interests. Many enormous establishments have their own telegraph department. Among these may be enumerated the stock yards, the steel companies, large bankers and brokers and commerical houses, besides the railways. The confidential character of much of the business intrusted to them enables them to prove their loyalty and fitness, and to develop such business ability as they may possess. When they are not busy with the wire they are often employed in other ways involving confidence and trust. Thus it happens that when promotions are to be made the operator is on hand; he has proved his worth, and the new office or duty is given to him. He is now on the ladder of promotion, and is most likely to climb higher. It is an open question what feature of the telegraph service is most apt to bring promotion. Some make the claim for quickness of transmission, some for clearness of copy, some for the electrical or scientific side of the business. But without helpfulness, judgment and discretion, the greatest technical skill may fail in winning promotion for its possessor. Many of the most successful operators have been trained in telegraph offices, where they often began as messengers. On attaining proficiency at the key, any young woman, from seventeen to twenty-five years of age, can earn better pay than in almost any other branch of work. The pay in advanced positions is good, and the operator is fairly sure of his future.

Railroad Telegraph Service

The railroad telegraph service offers great opportunities. Speaking of the value of the training in a railroad telegraph office, and of the prospects of the operator, Senator Chauncey M. Depew says: "When a young man takes charge of a telegraph office, where he has to do with the operating of a railroad, he is in a school where he is taught larger things than those he is doing. Railroad business is not only a business in which men can make their living, but it is a university. It is a profession to be proud of, a profession that supports a million of men on the pay-rolls in the United States."

Nothing more than a common school education is necessary for one to become an excellent operator, the fact being established that a very small percentage of successful telegraphers are collegians.

The cause of the present great demand for telegraphs lies principally in the great extension of railroad lines—thousands of miles of track having been laid during the past year. Moreover, a great number of the trunk lines are adopting the "block system" of signalling, whose extension means a constant increase in the demand for telegraph operators.

During the summer of 1901 there was such a shortage of operators in several cities, that the telegraph companies were obliged to work their employés from three to eight hours overtime per day, and were making strenuous efforts to enlarge their corps to the extent of at least five hundred more operators. This shows that the demand for skilled telegraphers is constant, and that knowledge of the business is a good assurance of employment with the regular commercial companies. This fact should be impressed strongly upon the vast army of people who always seem to be "out of a job," and complain that they "cannot find employment." Within two years the government has appropriated large sums for the equipment of its lines, thus opening a constantly enlarging field of employment for military telegraphers, at the highest wage rates and with assured positions for several years at the least. It is reported, also, that thousands of operators are employed by private firms. The demand in this line is sure to grow from the fact that telegraph companies will run a wire and equip a desk free for private firms if their business is at all extensive, and if they furnish their own operator. As the volume of business increases this demand will continue to grow even more rapidly than in the past.

Earnings of Telegraphers

The salary of the telegraph operator depends upon his ability, as in other callings. The railroad operator's salary ranges from $45.00 upward per month. Commercial operators receive from $35.00 to $150.00 per month, their ability and integrity always deciding the salary. Many railroad operators also act as railway and express agents, and are allowed to enter into other business, thereby making their total income from all sources from $65.00 to $100.00 per month.

The Western Union Telegraph Company, with 31,000 offices, pays its operators salaries ranging from $40.00 to $80.00 per month for nine hours' work each day, and thirty-five cents an hour for extra time, which is often a considerable item. The Postal Telegraph Cable Company, with 7,000 offices, and rapidly extending its lines and increasing its number of offices, pays corresponding salaries to operators.

The Western Union Company is said to be opposed to labor organizations, and after the strike of 1883 required its employés to take oath that they were not members of unions. This is supposed to be its present attitude toward organized labor. The employés, however, are generally satisfied with their lot, and the company is always ready to deal direct with any of them. Wages are not reduced during hard times. Women are paid at the same rates as men, but are not required to do as heavy work.

Training as Telegraph Operators

In regard to obtaining the training necessary to become a telegraph operator, there is a division of opinion: some urging that office experience is best; others arguing the advantages of schools of telegraphy.

Any person, young or old, who desires to master telegraphy sufficiently to obtain a position, had best apply himself to study with some one of the regular schools which teach all branches of the business, or in some local business college offering courses for operators.

For persons who are unable to afford the time for such thorough training in their home city, the several correspondence schools located at various parts of the country offer opportunities to acquire all necessary knowledge by private study, with constant assistance by mail. Several of these include a complete set of necessary instruments and electrical apparatus in the price of the scholarship, so that practical understanding of principles may be imparted along with theory. Such courses are particularly valuable to persons desiring to qualify as telegraphic engineers, offering a thorough training in the theory and operation of complicated modern machinery for multiplex and mechanical telegraphy, also in the details of cable work and the management and repair of all apparatus used in modern telegraphy.

The Submarine Cable

While land telegraphic lines consist of naked wires strung to poles, or put under ground in lead sheaths, like telephone cables, the conditions of submarine telegraphy demand that other, and far different, apparatus be employed. The requirements are embodied in the submarine cable, in which extraordinary precautions are observed, not only to prevent escape of the current into the water, but also to obtain sufficient strength to make possible lowering the line to the vast depths often encountered, and to raise it to the surface again when necessary. Submarine cables are still made on the plan of that used in the first successful trans-Atlantic line. The conducting line consists generally of seven copper wires, six of which are twisted or stranded about the seventh, so as to produce what is, in fact, a perfect copper rope, or cable. A greater number of wires is often used. Around this central conductor is formed a continuous layer of gutta percha, for insulation, and over this is woven a jute filling. The "core," thus completed, is armored for protection against accidents, also in order to give the cable sufficient strength, by strands of steel wire which are closely spun around it by machinery. It is then ready to be loaded upon the cable ship and let down into the depths of the sea.

Submarine Cable Manufacture

The process of manufacturing a submarine cable is delicate and complicated. The central conducting wires are stranded together in lengths of about one mile each, after which the insulating "core" is wound about it. The entire cable length is then immersed in tanks filled with water and electrically tested for leaks. After all flaws have been carefully repaired, the several mile lengths are spliced together. In this process the insulating coat is carefully cut way for about one foot from the end of each cable, and the wires are securely spliced, being then recovered by hand with melted gutta percha. The jute covering is then spun on by what is virtually a knitting machine, forming a continuous network over and around it, and upon this is spun the sheathing of steel wires. No other protection is needed for ordinary service, since the steel wires show power to resist oxidizing influences in the water for almost unlimited periods. However, in some waters it is necessary to wind over the core lengths of thin brass tape, in order to resist the destructive pertinacity of a bivalve mollusk called the teredo. This creature, known also as the "shipworm," has the remarkable faculty of being able to separate and burrow beneath the closely spun steel wires of the sheathing and eat out the gutta percha core, leaving only the skeleton of a cable, which is utterly useless for telegraphic purposes. Brass tape and india rubber, however, seem to be able to resist his efforts.

As each cable is specially made for some particular submarine route, the thickness and strength of the sheathing, as determined by the number and weight of the wires, are carefully gauged to meet the conditions ascertained by surveys and soundings. Thus, those portions of the cable, which are intended for shallow waters, are made unusually strong and heavily sheathed, in order to afford protection against breakers, anchors, and other causes of wear and strain; while the portions intended for the deep sea bottom are made very much lighter, except where intended to run over submarine mountains, valleys and gorges, which must inevitably occasion severe longitudinal strains. In all cases, the "breaking strain," or the weight which will cause the cable to part, must be accurately determined, in order that it may be lowered into deep water without breaking, and be picked up at any time with similar safety.

The armoring or sheathing machines are said to be models of perfection in adaptability of means to ends. As the finished cable comes from these machines, it is coated with tar and passed along on rollers to the tank-house. There it is coiled evenly by hand in uniform layers, or flakes, into the tank, in which it is to lie submerged until the telegraph ship is ready to take it into its tanks. Each flake of the cable is also whitewashed to prevent sticking, and the ends are left accessible, so that electrical tests can be made at desired intervals before the date of shipment. In all modern cable factories, every process is watched with the utmost care, and the cable and its materials are subjected to the most rigid inspection and tests. Experts are kept steadily at work in this department, and also in devising and perfecting machinery, methods and products.

The Cable Making Industry in the United States

The cable making industry has not received sufficient encouragement in America, until within the last few years, to warrant the attempt to produce cables of lengths greater than for crossing bays and rivers. However, the widely agitated scheme of laying a cable line across the Pacific ocean to the Philippine Islands has done much to stimulate interest in the industry, and there will doubtless be a strong movement toward large operations within a moderately short period. Between 7,500 and 8,000 miles of cable will be required for the trans-Pacific line, by way of Hawaii and Guam, and at least 2,000 more to connect with China and Japan. These figures will, of course, be doubled, if a duplicate cable is laid, as suggested, although, according to the suggestions of some experts, the line may be run to Alaska and thence by way of Japan, with a spur to Russia.

One of the most notable cable enterprises so far undertaken in the United States, was the laying of the line in Alaska between Skagway and Juneau, for the use of the United States Signal Corps. Although the total length covered was only about 125 miles, there were many serious difficulties in the way of successful accomplishment of the work. In the first place, the cable was made in Connecticut, and had to be carried in freight cars across the continent to Seattle. Then, in the total absence of a cable ship flying the American flag, to transport and lay the cable, it was necessary to charter an ordinary freight steamer, the *Lakme,* and alter her over for temporary service. Arrived at Skagway, however, where the shore end of the cable was made fast, the work was speedily accomplished inside of three days without hitch or accident of any kind.

Cable Laying

The cable-laying ship contains three large cable tanks precisely similar to those in the works, and into these the cable, run off from shore, and brought on shipboard by a steam winch, is coiled in the same manner as has already been described. The tank men employed in this work develop great skill in guiding each turn of the cable to its proper place in the tank, while running around at almost top speed in gradually diminishing circles with each successive flake. Of course, there are a number of men in the tank who relieve each other in the race, and the remainder of the time help to place successive coils smoothly into position.

The apparatus for paying out the cable, including guides and sheaths, is very simple in construction and operation, although very bulky, occupying nearly all the deck room, save that filled by the cable tanks. The cable passes from the tank through a series of guides and pulleys, over and under grooved iron controlling wheels, to and around the paying-out drum situated at the stern of the vessel, where it is dropped into the sea quite clear of the propellers. The paying-out drum is controlled by a powerful brake, while a dynamometer constantly registers the strain on the cable, enabling the speed of paying out to be accurately adjusted and the exact amount of slack to be determined at any given time. The operation is begun by making one end of the cable fast on shore, and paying out continuously as the ship moves along at the average rate of six miles per hour. Throughout the entire voyage constant tests of the cable, and of any joints made on shipboard, are made by currents received every few minutes from the shore end and shown by measuring instruments, so that any flaw may be immediately located and repaired. If a cable should break in the process of laying, or if a defect should be discovered later on, it may be picked up and repaired on shipboard.

There are over forty steamers afloat whose sole business is the laying and maintenance of the world's vast system of telegraph cables. Seven of them belong to government administrations, and the remainder to manufacturing and cable operating companies; ten ships being owned and operated by the three largest English cable manufacturers. One of the largest cable ships is of about 5,000 tons displacement, with a carrying capacity of 8,000 tons.

It has carried 2,500 nautical miles of deep sea cable in one load, and requires a crew averaging about 200 men, including the electrical staff. Commodious, and in some cases even elegant, quarters are provided for the officers and the cable staff.

Wireless Telegraphy

Very nearly the most surprising achievement of modern science and intelligence is the invention of wireless telegraphy, and the apparently well accredited feat of conveying messages across the Atlantic ocean, through the air. The name of Marconi, the young Italian electrician, is most prominently associated with this new discovery, although Nikola Tesla and several other scientists claim to have invented much more efficient systems. Marconi is the only one, however, who has demonstrated his claims to pre-eminence. His system has already been adopted by the navies of several nations, including some United States warships, and is used on most of the trans-atlantic passenger liners, while the Signal Corps has erected a station at Nantucket for communicating with ships several hundred miles at sea. It has also demonstrated its usefulness as a transmitter of intelligence on several occasions, notably during the latest international yacht races off Sandy Hook, while, from it ability to enable ships at sea to communicate through great distances, it is probable that numerous accidents have already been prevented in fog and stormy weather, as well as enabling needed assistance to be rendered.

Marconi's first successful demonstration of the powers of his invention was made on his grandfather's estate in Italy, where he succeeded in sending messages over two miles. His first demonstration in England was in sending wireless messages thirty-four miles, between Salisbury and Bath, which was followed by telegraphing across the English channel from Dover to Boulogne, a distance of thirty-five miles. This last feat brought his invention into world-wide repute. The wireless telegraph apparatus is simple in the extreme, considering the remarkable results it can achieve. Its essential feature is that it is worked by what are known as Hertzian waves, so-called after the late German professor, Henrich Hertz, who first proved their existence. When the electric impulse from an ordinary Morse key reaches the top of the pole from which the message is sent, it spreads out in every direction, like ripples on the surface of a pond when a stone is thrown into the water. As these ripples spread out into broader and broader circles, until they reach the surrounding shores, so the electric wave bearing a Marconi message spreads in the same way, the mast head corresponding to the point at which the stone fell into the water. If another pole, like the one from which the message emanates, be erected at a specified distance, it can receive the message, and as the wave impulses spread in all directions, it is further evident that if any number of receiving poles be erected within the zone of a particular wave, the message would be received at every one of them. Thus a message sent by one ship of a fleet would be received by all the other ships within the radius of the carrying wave. Messages sent by the ships of nations at war can be received by hostile ships within their zone, but this difficulty is overcome by the adoption by each nation of a private code for use in war time.

The most conspicuous feature of the Marconi apparatus is the mast or pole, one hundred and fifty feet high, from the top of which is suspended an ordinary insulated copper wire, such as is used in electric lighting. This wire runs down the mast to the operating room.

The actual generator of the waves is an ordinary inductor, such as is used for the production of X-rays, and which is capable of giving a ten-inch spark. To each end of the inductor is fitted a sparking rod, each of which carries a brass ball; one of these balls being connected to the wire running up the pole, the other, to earth. With a single addition of a Morse key in the primary circuit, the transmitting apparatus is complete. The immediate and apparent result of the working of the apparatus is a loud crackling spark discharge, between the two brass balls. The more important result is that the vertical wire, at the moment the spark passes, emits waves that go out into space in all directions, as already described. And the wire will continue to emit these waves as long as the telegraph key is depressed. By depressing the key for a short or a long period, short or long series of waves are emitted. The Morse alphabet, used in ordinary telegraphy, is employed.

Marconi's receiving apparatus is what is commonly known as a coherer, an instrument extremely sensitive to Hertzian waves. It works on the principle that metal filings in a glass tube offer resistance to the passage of an electric current, but are able to conduct an electro-magnetic wave. The filings used are of silver and nickel, which metals have been found most sensitive and reliable in receiving the waves. In circuit with the coherer is a single dry cell and a telegraph relay of the ordinary type, the latter being used to close the circuit of a local battery, and work a Morse writing instrument, also an electric bell hammer, which strikes the coherer a smart tap to restore its normal high resistance, after the reception of an impulse from the distant transmitter. To receive a message, it is necessary only to connect the receiving wire to one end of the coherer, the other end of which is joined to earth.

The principal factor in determining the distance to which a wave will travel and be received, is the height of the pole or mast. Mr. Marconi has found that by doubling the height, the distance becomes quadrupled.

This rule does not work with exactness, however, for during the English naval manœuvres, Mr. Marconi succeeded in telegraphing a hundred and seventy-five miles from a hundred and fifty foot mast. At present about twenty words can be sent per minute by this system, this speed of transmission being only slightly less than by ordinary telegraph. The interior of a wireless telegraph station does not essentially differ from any other telegraph office. The telegrams are printed in dots and dashes on an ordinary Morse inker, the operator merely having to read them from a tape.

CHAPTER VII

THE TELEPHONE BUSINESS

The Telephone Systems of the World—The Telephone System in the United States—Qualifying as a Telephonist—Telephone Operators—Conduct of a Telephone Exchange—Earnings of Telephone Operators—Labor Conditions in the Telephone Service

The Telephone Systems of the World

WHEN it is remembered that Professor Bell's invention of the magnet telephone was given to the world only a little over twenty-five years ago, and that only twenty years ago the total of the telephone business for the entire United States was 48,000 subscribers and about 30,000 miles of wire, we begin to understand the rapid growth and present immense significance of the industry. In spite of active and increasing competition in recent years, the original Bell Telephone Company—sometimes called the "Telephone Trust"—still controls the bulk of the business in both local and long-distance lines. In New York City alone 50,000 district messenger boys would have to be employed to carry around in letter form the communications sent in a single day over the telephone wires.

From the beginning the United States has held the leading place among nations in respect not only of the extensive development of the business, but in the employment of modern and improved appliances, tending to greater efficiency of service. According to the latest published statistics, the countries next in order to the United States, as regards the development of telephone service, are the German Empire, having 229,391 stations; Great Britain, 171,660; Sweden, 73,500; France, 59,927; Switzerland, 38,864; Austria, 32,255; Russia, 31,376; Norway, 29,446. The total for all these countries is about 666,500, or nearly fifty per cent less than the number recorded in the United States for the Bell Company alone. The disparity seems even greater when we consider that this company controls over 40,000 private telephone stations, and that the numerous "independent" companies add at least fifty per cent to the grand aggregate for the country. The estimated number of exchange connections made daily in the United States is over 5,600,000, which is an annual total of 1,825,000,000, or an average of seven calls daily for each telephone apparatus.

The Telephone System in the United States

The manufacture and use of telephones has increased immensely in the United States, principally on account of the expiration of several fundamental patents, formerly controlled by the Bell Company and constituting the basis of its monopoly. Beginning with 1894-95, "independent" manufacturing companies and exchanges began to enter the field in competition with the Bell, and within five years were already well on the way to claiming half the telephone business of the entire country. Thus, the latest reports show for the Bell systems 1,500 exchanges, with 1,080,000 subscribers and over 1,250,000 miles of wire lines, employing 33,000 wage-earners and handling about 2,000,000,000 conversations yearly. The total invested capital is about $300,000,000. In the same year, there were reported for all "independent" companies about 2,750 exchanges, with about 700,000 subscribers, and an invested capital of $150,000,000. These figures involve, of course, a corresponding increase in the per capita use of telephones, which is for the entire United States on a ratio of about one to forty, while in California it runs as high as one to twelve, the record rate for the entire world.

The Bell telephone companies were nearly twenty years in creating a demand for 582,506 telephones. Since the beginning of the "independent" telephone movement, however, nearly 2,000,000 telephones have been added to this number; the greatest development, up to this time, having taken place in Iowa, Wisconsin, Michigan, Missouri, Illinois and Ohio, while Pennsylvania, Kentucky, West Virginia, Minnesota, Kansas, Nebraska and the Dakotas have followed but shortly in the rear. Within the past two years, especially, the movement has extended until it embraces all sections of the country, its steady progress being seen in the South and East, as well as in the far West. At all points the Bell companies are meeting with formidable competition. For instance, the independents, where they have completed exchanges in Ohio, are operating more than 21,000 telephones as compared with little more than 4,000 used by the Bell Company, and its licensees in the same towns and counties. The toll service of the independent concerns, also, is almost proportionately larger than the Bell Company's. There are in Indiana 160 exchanges, with an aggregate of 25,000 subscribers and 7,000 miles of toll line; and in Illinois there are now 200 companies operating 252 exchanges, with an aggregate of 30,000 subscribers and 8,000 miles of toll line.

The manufacture of telephones shows an annual average of nearly 800,000 subscribers' sets, with transmitting and receiving instruments, were manufactured in fourteen States, New York leading with over 460,000. In addition to this, over 217,000 interior telephone systems, such as are used in hotels, factories, etc., were manufactured in nine States, Illinois leading with over 203,000. The total value represented for both items was well over $10,500,000. In the manufacture of exchange switchboards, the output of fourteen States represented nearly 2,000 complete apparatus, with a total value of nearly $4,000,000, Illinois leading both in reported quantities, 534, and in value, over $2,000,000. All other supplies, including exchange and subscribers' auxiliaries not specified above, represented a total value of over $1,300,000. The aggregate value of all telephone products and supplies for the year was over $10,500,000.

Qualifying as a Telephonist

Telephony has become a science in the broadest sense, requiring of the practical operative a good working acquaintance with a wide field of electrical knowledge. Indeed, in these days of common-battery exchanges, and more highly elaborated exchange appliances, it is becoming increasingly true that a well-equipped telephonist must have a general acquaintance with every branch of electrical application. Even the repairmen, linemen and other mechanics require sufficient theoretical information to enable them to know what they are doing, and to use their judgment in numerous emergencies that demand more than mere routine work with tools and testing instruments. This fact has been repeatedly demonstrated in the cases of employés who have been sufficiently ambitious to devote their leisure to study, either by private reading or by taking systematic training in some one of the several schools of correspondence that offer courses in telephony. Particularly since the advent of the "independent" telephone companies, a broad field, offering the highest rewards to intelligent workers, has been opened, and, judging from the constant increase in the use of the telephone, it will be still further enlarged in the near future.

Telephone Operators

The growth of the telephone exchange business has opened a new industrial field for women. They find employment as switchboard operators, superintendents and clerks in every large exchange in America and Europe, to the complete exclusion of men, except in mechanical and repairing capacities, and have shown themselves capable of doing expert and rapid work, which must frequently tax their powers of attention and endurance to the utmost. Nor is this fact wholly explained by the cheapness of female labor. As stated by numerous telephone authorities, the superiority of the telephone girl is wholly a matter of voice. An English magazine devoted to telephone interests points out the fact that the vocal chords of a woman are considerably shorter than those of a man, which involves that the voice has a higher pitch. The telephone diaphragm responds more accurately to the high-pitched voice; the magnetic disturbances are more rapid, and therefore more potent, and the currents transmitted to the remote station lose less in transmission. If you listen to an average woman speaking and compare her voice with that of an average man of her own class, you will notice, among other things, that her enunciation of the words is better; also that there is less tendency to cut the ends of words or to drop the voice and mumble the terminations. Her choice of words is better, and there is a natural purity of diction that is distinctive. For these reasons alone it is desirable to employ women at switchboards, where distinctness of enunciation is of prime importance.

The most arduous part of the work of a switchboard operator is in making connections between subscribers' circuits, when, as frequently occurs in the busy hours of the day, the calls come in at the rate of 125 or 150 per hour. The mechanical routine work of answering a call, learning the desired number, plugging the corresponding jack, and "ringing up," must, therefore, be performed with the very greatest rapidity and exactness over and over again with the utmost care, in order to avoid such errors as might produce confusion and vexation. The constant liability to plugging the wrong jack, particularly in using a multiple switchboard, demands that a well-trained eye be acquired, in addition to nimbleness of finger. Another complication, because a source of delay, is in transferring the "trunking" calls, coming from a subscriber asking for a number in some other exchange.

The trunking boards are arranged separately in all exchanges, each one communicating with every operator's position at the main board by means of drops and jacks, as on the subscribers' circuits. On receiving a trunking call, the operator presses a button before her on the desk, thus putting herself into communication with the trunking board of the desired station; announces the number called for, and, in reply, is given the number of the trunking jack to be plugged for connection. The operation is simple, but the call must be handled by at least three girls before the desired subscriber is reached. It also involves delay in ascertaining what trunk wire may be unoccupied and can be used. The "hello" girls at the switchboards are constantly watched by the chief operators and monitors, who are seated at desks, where, by manipulation of switch keys, they can "listen in" on any of the positions. This is done for the purpose of keeping constant watch, to see that all work is progressing properly, and that no girl is carrying on private conversations over the wires. It also affords a means for any of them to communicate at once with the main desk in case of inquiries from subscribers, or to request that her place be supplied by an extra hand, if she is indisposed.

Of course, in a business requiring such constant care and alertness on the part of the ordinary operatives, it is essential that the merely mechanical detail be arranged so as to require as little as possible from them beyond routine work. Thus it is that that ingenious and immensely complicated contrivance, the multiple switchboard, is provided with numerous devices for facilitating the work of the operators. Among these, probably the most important is the "test" circuit, which enables an operator to discover at once whether any one of the possible 6,000 lines is "busy." To discover this she needs only touch the opening, or "thimble," of the jack with the tip of her plug, when, in case the line is busy, a sharp click will be heard in her receiver. This effect is obtained by including the jack thimbles of each line in the circuit of a grounded battery and a condenser, which is "made" whenever a plug is inserted at any section of the board, and will produce the click by an electric discharge.

Conduct of a Telephone Exchange

The telephone traffic is peculiar. It is very light during the night. In the early hours of the morning it does not amount to much, but between ten and eleven o'clock it goes up with a bound. It goes down again at noon, during the lunch hour, when people leave their business places for a time, and then again in the afternoon, at two or three o'clock, it goes up to a very high pitch, and off again toward evening. They must have more operators on duty during the busy hours than during the slack hours; and these facts are taken into account by the managers who regulate the hours of operators.

In New York City alone the New York Telephone Company employs over 3,600 persons. The pay-roll for this force amounts to over $40,000 a week, exclusive of the salaries of officers. According to the testimony of Mr. Bethel, general manager of the company, before the Industrial Commission, the salaries paid to all hands is very liberal, the average being about $12 a week. The hours are reasonable, and the conditions with which it surrounds its employés are the best that any telephone operators in the whole world enjoy. The company has made a point of getting employés of a high character, and to that end has adopted a high scale of wages, and in every way has sought to make its service attractive. It goes to a very large expense in providing retiring rooms, fitting them up properly for the comfort of operators when they are off duty, reading-rooms, locker-rooms, and resting-rooms, where, if a girl is tired, she may lie down and rest for a time; and dining-rooms, where the company furnishes tea, coffee and milk without charge.

Earnings of Telephone Operators

The New York wages are from fifty to one hundred and fifty per cent higher than the London wages, and very materially higher than continental wages. Trained operators in Europe get from about $2 to $6 a week. The trained operator in New York is paid from $8 to $12 a week. When a girl is first employed she serves a period of apprenticeship, learning the business, and is paid a nominal sum—about $3 a week while she is learning. As soon as she is able to go to work she is advanced. There are female employés in the switch rooms getting $15 or $17 a week, wages such as are paid nowhere in the European countries. For linemen, wiremen, inspectors and mechanics generally the European average is about $6 a week, possibly a little higher, but not much. In New York similar grades are paid from $12 to $21 a week.

Foremen are paid from $7 to $9 in Europe; in New York, from $18 to $25 a week. In the higher grades the differences are even greater than these. An exchange manager in New York is paid as high as perhaps the highest engineering officer in some of the European telephone systems. The hours of labor for men are eight hours a day in New York; in Europe ten hours is the general average. Taking the employés as a whole, some work seven hours, some nine, but the great body of the employés work eight hours a day.

Labor Conditions in the Telephone Service

The girls at the boards work eight hours a day. They have various shifts. The service is maintained at all hours, Sundays and holidays, all the year round. One rule is, that the operator who works on Sunday shall have a day of rest, with pay, in lieu of the Sunday on which she works, in order that she may have at least fifty-two days of rest during the year, exclusive of her vacation. A man working over eight hours a day is paid for overtime; the scale specifying regular time, and time and a half time under different conditions.

"During my connection with the company," said one of the managers before the Industrial Commission, "we never have had a strike or a labor trouble of any sort, that I am aware of. We endeavor to anticipate every demand that might reasonably be made, and as a result we have never had a grievance presented from any body of employés. On a few occasions some of our men have, in a proper way, presented some request or other, and we have, on looking into the matter, considered it proper to grant the request. No one, when once employed by us, can be dismissed except for cause, and then only with the approval of an officer of the company.

"We have very few resignations, except when a girl gets married or finds a better position. By better positions I mean, that, through the building up of private branch exchange systems, a demand for a high class of telephone operatives has been created in New York. In one of our exchange districts—nearest the Battery—there are more skilled telephone operators getting good salaries with business houses on private branch exchanges than there are in the central office. A new demand for labor has been created. It is well paid and well treated. That has made a great draft upon our operating force.

"A short time ago, during an epidemic scare, the Board of Health, of New York, sent an inspector to look through the various central offices to see the conditions under which the operatives worked and examine the girls physically, in order that there might be no danger of a spread of contagious disease should one develop. He reported officially that he found all the conditions under which the operators worked most excellent, and that he found no ill health among them."

CHAPTER VIII

THE INSURANCE BUSINESS

The Life Insurance Business—Home Office Workers—Field Workers—Industrial Life Insurance Agents—Earnings of Insurance Agents—Ordinary Insurance Agents—Women as Insurance Agents—Miscellaneous Insurance Business—Fire Insurance Business—Profits in Fire Insurance—Fire Insurance Agents—Marine Insurance Business—"Lloyds"

The Life Insurance Business

THE business of life insurance has made enormous progress during the last twenty-five years, so much so that the rate of growth is greater than for any other form of commerce or financial enterprise. Without going into statistical details, the general data of life insurance progress are summarized in the following table:

Approximate Life Insurance in the United States, Jan. 1, 1903:

Industrial Insurance, Policies in Force	$12,000,000
Ordinary Insurance, Policies in Force......................	3,500,000
Total	$15,500,000

This aggregate of policies represents about 10,000,000 policy holders. No account has been taken in this tabulation of the many pseudo forms of life insurance, better known as assessment or fraternal insurance organizations.

The general business of life insurance is divided into two large groups, the first of which is known as industrial insurance, the second as ordinary insurance. The former may be described as mass insurance, while the latter may be called class insurance. In the former the average amount of the policy is for a little over $100, while in the latter the average amount of a policy is about $3,000. In industrial insurance the aim is to insure the whole family, while in ordinary insurance the object is to insure the head of the family for as large a sum as possible. Industrial differs further from ordinary insurance in that in the former the premiums are collected from the houses of the insured, and the payments are made weekly to authorized collectors, while in ordinary the premiums have to be sent to the offices of the company at least quarterly, but usually once a year.

Of the industrial companies there are at present fifteen, of which three carry on over ninety per cent of the business. These companies offer all sorts of opportunities for employment, for the extension of their business is constant. The industrial companies now operate in nearly all the States of the Union, but their business is usually limited to the larger cities.

Home Office Workers

An enormous business is done by each of the great industrial insurance companies. This involves a great deal of detail, and necessitates the engagement of an army of employés. One company receives on the average 25,000 applications a week. Coming in on Monday, these applications are separately examined and checked, passed upon by the medical examiner, rejected, postponed or ordered for re-examination, and the policies are written, checked off and despatched by the following Thursday. Thus as many as 80,000 applications are received and passed upon within four or five days. After the policies are issued the applications are registered by the 125 clerks of the actuary, all the particulars being written upon cards. Eighteen calculating machines are needed by one company to calculate every month the reserve on the policies issued and in force. The home offce of one of the big companies handles ninety-three millions of cards a year. It takes ten thousand men to write these applications, who collect upon over four million of policies every week, and turn in more than $20,000,000 in dimes annually. One hundred and fifty-six bookkeepers work at the home office, an account being kept with each of the "field men." This company has 16,000 agents' registers and 228 ledgers, and handles nearly 500,000 agents' accounts in a year, receiving and paying out fifty-five millions of dollars in that time, and drawing more than 117,000 checks annually. It deposits 87,000 checks, drafts, etc., in a year. Twenty cash books and twenty-eight check books are in use every day.

The 602 branch offices of this company employ 2,200 medical examiners in 5,314 various cities and towns. In each year there are more than a million and a half medical examinations and inspections. As many as 445 death-claims have been paid in a single day, the average being about 200. In a year the aggregate is over 63,000. This company has, up to the present time, paid nearly 650,000 death-claims. Even for the matter of postage stamps it pays one hundred thousand dollars a year, including the district offices.

The clerical force at the home office is very large. One great company employs 54 stenographers and 300 typewriters. Twenty-five letter books are constantly used. Forty-five sacks of mail matter are sometimes received in one day. More than 550 tons of forms are used in a year, with 6,000,000 envelopes. Seven thousand letter-files are in use. Among the policy holders changes of name by marriage amount to 25,000 each year.

Field Workers

The field operations of a great insurance company are very extensive. The average ordinary premium is $61.95 per policy per annum, payable annually, semi-annually, or quarterly, upon notice. Taking the companies together, they are obliged to make 416,000,000 visits per annum, or 1,328,-000 a day except Sundays. When a claim is presented, the agent goes to the house and takes the claimant's written statement, visits the doctor and gets his certificate, obtains also the undertaker's record, and, finally, carries the money to the claimant. Thus the work at every step is done by the company at its expense. The agents do not, as is sometimes claimed, prey upon the poor. On the contrary, they probably do not earn, personally, as much as the men among whom they solicit policies.

While the life insurance companies employ a very large clerical force, the general duties do not differ materially from employment in banks or other financial institutions or very large business corporations. The only essential differences are in the special departments, such as the actuary's office, the medical director's office, etc. In the actuary's office, a knowledge of higher mathematics is an essential requirement. Applicants for such positions should first make themselves familiar with general insurance practice.

Field training will materially enhance their subsequent value in the several departments of the companies. For the higher executive positions the general conditions governing success and remuneration are identically the same as are met with in all other large financial and commercial enterprises. No definite rule can be laid down, since results depend entirely upon individual effort and ability, but here, too, it is safe to say that field experience is a necessary qualification for the successful conduct of an executive office in the management of large life insurance companies. To men of exceptional ability the remuneration is above the general average, since more than ordinary capacity is demanded for the conduct of a business so intricate and so highly complex as that of life insurance.

Industrial Life Insurance Agents

Life insurance as a business pursuit offers special advantages to young men of intelligence, energy and pluck. A good common school education is required, but no capital is necessary, while good character is an essential, and industrious habits are indispensable.

Young men in the industrial life insurance field start as agents, which implies the double capacity of solicitor and collector. They are provided with the necessary instructions, usually contained in a manual specially devised for this purpose. They are personally instructed by the assistant superintendent, who usually devotes two or three weeks of his time to making the new agent thoroughly familiar with his general duties. These duties, briefly stated, are canvassing from house to house in all parts of the territory under his charge for either industrial or ordinary insurance. After the insurance has been obtained, after the application has been approved by the medical examiner, and after the policy has been issued, the agent is required to call week after week for the premiums at the houses of the insured. Of course, in cities where the companies have been transacting business for a number of years, the new agent is usually able to obtain the privilege of collecting premiums already in force on the books of the company. It is the usual practice to transfer to a new agent from $40 to $60 of weekly premiums, on which he is paid a commission of fifteen per cent. This represents his ordinary salary. In addition, he is paid a commission, which varies somewhat in different companies, but which will average about fifteen times the first weekly premium. The commission paid on new business is usually called a special salary, and the two combined should amount to $15 or $18 a week.

Earnings of Insurance Agents

After an industrial agent has been successful, not only in writing industrial insurance, but also in writing a certain amount of ordinary insurance, the commissions from which naturally increase his earnings, he has every opportunity to be promoted to an assistant superintendency. In this new position he receives a guaranteed salary of $15 or $18 a week, with opportunity for an increase in his earnings by a commission on the net increase made by the agents under his charge and on the ordinary insurance which he may have written on his own account. An assistant superintendent has usually from five to seven agents under his charge. It is his duty to instruct new agents, to inspect the new business written, and in case of sickness or resignation to look after the collections of the regular agents. After an assistant superintendent has held his position for four or five years he is in line for promotion to a superintendency, first perhaps in small districts, later in larger districts, as vacancies occur. As superintendent he has charge of the business operations of the company in a well-defined district, with perhaps twenty-five to seventy-five agents and five or six assistant superintendents under his charge. His salary will average about $40 per week, with opportunities for additional earnings by commission on the net increase made in his district and on the ordinary insurance which he may have written on his own account. A superintendent's salary increases from time to time, and in the course of years the position becomes a very desirable one, while the duties become less arduous, though not less exacting.

Ordinary Insurance Agents

Ordinary insurance is managed on somewhat different lines, although the principle of employment is practically the same. The main divisions of employment are usually those of agent, general agent and special agent. The agent works under the general agent, by whom he is usually instructed in the details of conducting the business. The general agent will educate an aspirant in the intricacies of the insurance contract, explain to him the meaning and import of rate tables and policy provisions. It is very difficult to say what are the average earnings of the ordinary agents, since the variations are very considerable, but companies do not care to employ men who do not at least average $1,200 per annum in salary income. The incomes of general agents are larger, since they are usually men of superior ability, who confine themselves to the writing of larger lines of risks. Here, also, it is impossible to say what the average earnings are, since the variations in income are still greater; but companies would not care to employ general agents who averaged less than $2,500 per annum in salary income, while many of the better class of general agents earn salaries in excess of $5,000 and $6,000 per annum. Of course, the successful management of a general ordinary agency requires capacity of a higher order than is necessary for the transaction of industrial business, but many who have commenced as industrial agents have by slow degrees developed into general ordinary agents of exceptional ability. The choice of either one or the other form of insurance depends very largely upon special conditions, such as social position, personal acquaintance, and perhaps special knowledge and ability necessary for the comprehension of the more intricate and complex nature of ordinary life insurance.

Women as Insurance Agents

Women agents at first restricted their efforts to the field of life insurance, but there are many now who have extended their operations to include fire risks also. Life insurance companies now have a woman's department, under the care of a woman manager, with a very good salary. Such a position, of course, can come to only a few. But the number of woman agents, both in life and fire insurance, is large, and is constantly increasing. It is a widening and a most attractive field. A recently published list of the best income-earning women in the United States included the names of two graduates of Vassar College, who are soliciting insurance. The State agencies have a woman's department, as a rule. These woman agents visit all the better classes of women. Teachers, clerks, bookkeepers and stenographers, business women and wealthy women are all asked to take out policies.

In very many cases wives have taken up their husband's insurance agency, and daughters have gone into their father's offices. Women began to take up this business sixteen or seventeen years ago, and at present there are scores of managers and brokers of the female sex. Their work has received the highest praise from their respective companies. Several of the sixty insurance papers of the United States are owned by women, and one, at least, is managed by a woman who is associated with her father in business. It is said that the various life insurance companies have, all together, about $50,000,000 of insurance on the lives of women, twenty-one women carrying $100,000, several carrying $75,000, and about fifty being insured for $50,000 each. Some women are insured for higher amounts, one carrying $300,000, one $150,000, one $135,000, and several $125,000 each. Life insurance enables a woman to contribute to the future support of her family, or to establish a fund for herself in old age. It may be clearly understood that women would vastly prefer to deal with women agents, and that, therefore, the field of insurance soliciting is a most promising one for women.

Miscellaneous Insurance Business

In addition to the life insurance companies, there are in the United States two thousand insurance companies of the following classes: fire, ocean, marine, inland navigation and transportation. The total amount of insurance in force is approximately between twenty and thirty billion dollars, with premiums amounting to a sum considerably in excess of three hundred million dollars. These companies employ from one hundred and fifty to two hundred thousand persons, and there are always good openings—principally at the bottom. For all insurance companies insist that their offcers and employés in the upper stories of the vast structure of the business shall understand the nature of the foundation. One-eighth, or more, of all the insurance companies of all classes in the United States have their headquarters in New York State.

Besides the regular companies just mentioned, there are hundreds of co-operative or assessment companies and secret or fraternal societies, in which the amount of the insurance upon the death of a member is collected from the surviving members, thus making the matter of actual pay more or less of an uncertainty. The insurance carried by all these societies, including the casualty, or accident, companies, is equal to the amount outstanding in the comparatively few regular companies, thus doubling the sums usually named as the regular outstanding insurance.

The Fire Insurance Business

As in the case of life insurance, protection against fire might be described as a bet. A person bets that his house will be burned to the ground within a year. The company bets that it will not. The party of the first part may never win, even if he lays threescore and seventy bets in as many years. But meantime the party of the second part pockets profits which come from an excess of premium receipts over losses and expenses.

To the directors of fire insurance companies the sound of the fire-alarm bell is ever dreaded. Who knows at what minute the great conflagrations of Chicago, Boston, New York, Philadelphia, Portland, Pittsburg, and recently of Waterbury, Connecticut, and Paterson, New Jersey, are to be repeated.

Insurance men declare that fire insurance can by no means be classed as one of the profitable departments of business activity. Only one company now in existence lived through the last century. That is the Insurance Company of North America.

The great Chicago fire alone cost the insurance companies $92,000,000, and the business of fire underwriting in the United States has been run at a loss for more than a hundred years. In the first two months of 1902 the average daily loss of the fire insurance companies was about $800,000. There was a million dollar blaze at Norfolk, Virginia, followed by a great conflagration in Waterbury, Connecticut, costing several millions, and one in Paterson, New Jersey, costing $8,000,000. The total amount collected annually in fire premiums, by all the companies, is approximately $140,000,000. At the same time, the expenses of each company in maintaining a vast organization, a large staff of special agents and adjusters, are enormous.

The leading companies of the country long ago banded together for mutual and public benefit, forming the National Board of Fire Underwriters. This organization makes every effort to secure good building laws, conducts all kinds of scientific investigations with a view to minimizing the drain on resources through fire waste, and keeps a watchful eye on the fire departments.

The fire insurance companies also maintain fire patrols at their own expense in at least thirty of the large cities; also a number of expert surveyors, whose duty it is to instruct manufacturers as to the best means of fire protection.

Fire, like life, insurance is conducted the country over by many thousand agents, each particular agent being accepted with great care. Young men in the fire insurance business may rise to better things. Many a State governor, judge, senator, and foreign minister began his career as an insurance agent.

Five British companies, having agencies throughout the United States, "write" fully one-fifth of the total amount of fire insurance carried in this country. These foreign companies are the London Assurance, Norwich Union, Phœnix Assurance, Sun Fire, and Union Assurance.

In the distribution of fire insurance held by the companies in the various States and Territories, New York leads with many billions of dollars at risk, the annual premiums amounting to between twenty and twenty-five million dollars. Illinois comes second, with over one billion at risk, and twelve millions in premiums. All the other States fall considerably below the billion mark.

Profits in Fire Insurance

It is claimed by those who are in a position to know that the fire insurance business is not sharing in the general prosperity of the country. In the largest cities losses and expenses have exceeded the premium receipts. In many States the laws are such as to be most injurious to the companies, and in addition to this, various municipalities levy taxes on them. There are license fees and fines. Deposits are required. The annual statements are forced to be too elaborate in detail, involving useless expense. Visits from commissioners, who come to investigate, necessitate heavy payments for examinations. There are twenty States which compel the companies to issue "valued" policies. This means that a man owning a ten thousand dollar house is permitted to insure it for twenty thousand dollars. This, it cannot be denied, is a direct and open encouragement to incendiarism. All that any company ought to be forced to do is either to restore destroyed property, or to pay what it would cost to restore it. Only recently the State of Missouri revoked all the insurance licenses merely because the companies fixed rates which were dependent on the inspection of the property to be insured. Because the companies agreed to unite in enforcing this rule, and in exacting penal rates where glaring defects existed, they were accused of making an "unlawful combination," and alleged "trust." For this attempt at enforcing honesty, the companies were mulcted by the State of Missouri of a fine of $1,000 each. Combinations by insurance companies to the detriment of the public would be impossible. As soon as they try to become oppressive, merchants, manufacturers and farmers will mutually insure each other. There are more than two hundred such associations in existence. Fire insurance being concentrated in a few cities, such as New York and Hartford, they must, through their agencies, apply different rules to different States. Under a Federal commission the rules would be uniform for the whole country. State politics would thus be eliminated to the great benefit of the insurance companies and of the public at large.

Fire Insurance Agents

In every town of any importance there are insurance agents. They are seldom on salary, but receive, instead, a commission on all collected premiums. The agents naturally prefer the company which pays the largest commission. For the sake of the commission they are often tempted to take undesirable risks. In case of loss by fire, the same agent is often the company's adjuster. He wishes to retain the good-will of his customer, and will indemnify him without regard to the exact justice of his claim, at the company's expense. It is undoubtedly true that almost as much is paid every year by underwriters for extravagant and fraudulent claims as for actual losses. There are firms known to the trade as "wreckers," who buy damaged goods and put them into condition for the market. One such "wrecker" in the West recently made $40,000 on a sale of $100,000 worth of wet goods.

The total assets of stock companies in this country is about $360,000,000. The property insured is worth a hundred times this amount. One-half of the insurance capital in this country was destroyed by the great fires in Chicago and Boston, about thirty years ago. Since then the fire departments have improved, fire-proof buildings have been erected, and automatic sprinklers have been introduced. Agents have the companies too much at their mercy. The managers are on fixed salaries. If the managers or officers were allowed a percentage on profits, in addition to their salaries, they would very soon apply the same system to the brokers and agents, and the business would be much more remunerative to the stockholders.

It is, perhaps, not unnatural that property owners, having in mind only the simple process of writing a policy of insurance by an agent of an insurance company and the delivery of it by him to the assured or property owner, should regard the expense of transacting the business as merely nominal.

An explanation of the principles and methods of business of fire insurance, and the duties of agents, prepared by a special committee of the National Board of Fire Underwriters, gives the following facts:

A great number of persons of various qualifications must be employed and remunerated before the policy of fire insurance can be written and delivered by the agent. The percentage of the premium required to pay the expenses of the business (about thirty-five per cent) is quite as great as that involved in the sale of merchandise, such as a piece of calico, for example, which includes the profit to the planter who raises the cotton; to the compress that presses it; to the commission merchant who sells it; to the common carrier who carries it to the mill; to the mill owner who manufactures it into cloth, including his operatives; to the dye and print establishment that prints it; to the commission merchant in the distributing centre of a great city, who sells it; to the wholesale merchant, who, in turn, sells it to the retailer, who, in turn, delivers it to the consumer.

All of these processes require separate remunerations and an aggregate percentage of expense fully equal to that of the insurance business, which requires the agent in the town, who writes and delivers the policy of insurance; the expert who inspects the building from time to time during the term of the policy; the rating expert who fixes the rate, recognizing every point of construction, occupancy and environment; the adjuster who must adjust the losses; the accountants and bookkeepers in the offices of the company; and, lastly, the executive officers who must employ all of these men, supervise their work, and attend to the investment of the assets and reserves of the company, not forgetting office rent, stationery, blank-books, printing, postage, and last, but not least, taxes—the latter seldom less than two and a half per cent of the premium, to be paid whether the company makes money or not. So that it is doubtful if any business involves greater necessary outlay or requires higher executive ability or a broader education as to the methods and hazards of all other occupations.

The expenses of the insurance business will be found to be not far from thirty-five per cent. Of this sum, about one-half, seventeen and one-half per cent, is required for the compensation of the local agents in the cities and towns throughout the country, out of which they have to pay their office rent, and the cost of "conveyances for visiting risks" to inspect them, some of which are located in the country, on farms, for example. This percentage on the average premiums often amounts, after a hard day's labor, in the average town, to little more than the wages of a skilled mechanic. To secure this commission, the agent must inspect each building carefully, write and deliver the policy, collect the premium and remit it to the company and report all the facts of the risk to the principal office, maintaining supervision of it throughout the life of the policy in the interest of his company, to detect and report any change or increase in the hazard.

In addition to this percentage paid to the agents, five per cent of the premium is required for adjusters and special agents, travelling experts, and their hotel and other travelling expenses, for supervising the business, going from agency to agency. In this connection, it may be well to state that money expended for inspecting buildings, calling the attention of ignorant or careless property-holders to faults of management or negligence, to faults of construction, etc., etc., all tending to prevent fires, and especially to prevent large or sweeping conflagrations, is money actually expended in the interest of the public, or, insuring property-owners.

Ten per cent is necessary to pay the official staff at the principal office, clerks, rent, bookkeepers, advertising, postage, expressage, printing, stationery, blank-books, etc. Two and a half per cent is required for taxes. In this connection, it will probably surprise those engaged in other lines of business to learn that insurance companies are taxed, not upon the profit of their business, but upon their premiums, which is equivalent to taxing a merchant two and a half per cent on his sales. It sometimes results that in a state in which the business has been unprofitable, the company actually pays a tax for the privilege of leaving more money in the state than it takes out of it, pays for the privilege of making a loss. There have been years when the fire insurance companies paid taxes amounting to millions of dollars when their total business showed a loss.

The Marine Insurance Business

Marine insurance is a distinct branch of "underwriting," operating on lines quite different from other forms of insurance. One of the largest marine insurance concerns is the Atlantic Mutual of New York, with about twelve million dollars of assets. This has a special reputation among insurance men as being one of the few companies which continues its tried employés either in office or on the pay-rolls until death. Other large companies are the Boston Marine and the China Mutual, both of Boston.

One of the great losses weathered by the American marine insurance companies was the $800,000 paid for the *Oregon's* cargo, when that vessel was wrecked in 1886. In 1893 the steamer *Erie,* with a cargo of coffee from Brazil—coffee worth almost its weight in silver—burned to the water's edge at sea. For this the marine companies paid half a million in insurance. Again, in 1857, the steamer *Central America,* carrying $800,000 of gold from California, went down off the coast of Cuba, and the marine underwriters had to pay for the gold that lay at the bottom of the sea. The disasters of recent years also cost the marine companies enormous sums. Among these losses were the amounts paid for the French line steamship *Burgoyne,* the Pacific liner *Rio de Janeiro,* and a steamer from the Klondike region that foundered at sea, carrying down nearly all her passengers and crew, and a great quantity of gold.

"Lloyds"

What of Lloyds, that vague, non-committal word meaning nothing to the layman and landlubber? There was a tavern in Tower Street, London. It flourished in Queen Anne's day, and was called Lloyds'. The tavern was the private meeting place of shipowners and traders. For shippers generally it was a kind of club. Here they would talk over profits to be made in ships or cargoes—profits in prospect and in reality. In Lloyds' there was a blackboard on which one of the town-criers, the forerunners of the newspaper bulletins of the present time, used to scribble the news of the day. One day a number of shipowners and traders, who were then having their grog in the tavern, wrote their names on this blackboard, and under the signatures one of their number scribbled a pledge that "the above-signed will be liable for the loss of a certain ship during a certain voyage." And thenceforth the blackboard in Lloyds' tavern was a legal document instead of a news bulletin.

This was the origin of the Lloyds system of marine insurance. It is today a favorite system in England, and has been adopted to some extent in the United States. The principal Lloyds here are the United States Lloyds and the New York Marine Underwriters, both of New York. All the perils of the sea are provided for in the Lloyds system. There are time policies for ships and voyage policies for cargoes. The rate for iron ships is no lower than for vessels of wood.

CHAPTER IX

THE ADVERTISING BUSINESS

Publicity and Business Progress—Local and General Advertising—Supplementary Advertising—Periodicals the Best Advertising Medium—The Professional Side of Advertising—The Advertising Departments of Newspapers and Periodicals—Advertising Agents—Advertisement Writers—Women in Advertising

Publicity and Business Progress

THE industries of the United States are divided into hundreds of groups. Each of these groups has hundreds of subdivisions, and in each subdivision dozens of individuals, firms, and corporations are engaged. In each industry and in each division, all those engaged therein have something to sell. How is the public to know the nature of that something, to acquire a knowledge of what it is and what it can do? For it is not sufficient to have something to sell—the public must be informed of the fact. Such dissemination of information is advertising, and upon advertising depends the development of all industries and the continued existence of trade. An expert has defined advertising, in brief, as the effort to cause others to know; and the assumption is that the same effort will cause the ever-reading, ever-wanting, ever-buying public to remember and do.

A conservative estimate of the yearly expenditure for advertising places the sum at $100,000,000. About three-quarters of this amount is paid for newspaper advertising alone—newspapers in this sense meaning every publication known as a periodical, including the weeklies, the magazines, the trade and technical journals and class publications. The remainder of the one hundred million dollars is expended for supplementary advertising, the chief branches of which are stationary and movable signs; booklets and catalogues; posters; billboards; street car racks; exhibits at fairs; circulars, and many other forms of printed and lithographed matter; travelling representatives; window displays and exhibits in the stores of retailers; the distribution of samples; and a thousand and one novelties.

The continued spread of advertising has been influenced largely by the art of color printing. The fact that they are able to print pictures in a great variety of colors at the same rate of speed as in black and white, has induced newspaper publishers to issue supplements and special editions of various kinds. At the same time, the advertisements in the weeklies and the magazines, printed in several colors, possess real artistic merits. Many advertisers have of late years resorted to the use of color printing on colored paper for inserts in magazines. Though there are still certain financial and mechanical obstacles to be overcome in color printing, this field promises great possibilities for the future.

Advertising, indeed, is an absolute necessity. It is the selling agency of a business, the advance agent of the drummer. The tendency of the times is to bring together the producer and the consumer. The manufacturer is no longer the slave of the jobber. All this has changed, and chiefly through the agency of advertising. The jobber has gone to the wall, and even the wholesaler is not omnipotent. Two or three profits are thus saved to the consumer, the manufacturer often eliminating even the retailer. An instance of this sort of thing may be seen in the shoe trade. It is the advertisement that enables the manufacturer to reach the consumer. "Small profits and big volume" have driven out the old theories of business. The printing press has enabled the manufacturer to put himself in touch with the people. Newspapers and magazines have been the great engines of progress. The non-advertiser simply can not compete with the advertiser. The manufacturer or merchant can not afford *not* to "talk to the people."

As for the charge for advertising, the rates are fixed principally by the circulation together with the consideration of the character of the readers and the control of the field.

Local and General Advertising

Local and general—these constitute the two chief classes of advertising. In the local class is included, for instance, department store advertising; while those engaged in the industries which supply the counters of the department store with goods resort to general advertising. In short, local advertising sets forth the wants of the community, or the class of wares which are for sale within that community; general advertising portrays the wants of the nation and indicates the quality or variety of the wares offered to meet such wants. The local advertiser inserts his advertisement only in the papers of his city or county, while the general advertiser places his "ad." in all the periodicals of a certain section of the country, or, for that matter, in the papers in every State in the Union. The great department stores pay to each of the newspapers of the community as much as from $50,000 to $60,000 a year for announcing bargains or special daily sales.

The leading feature of local advertising, however, may be seen in the "Want Ads." In providing facilities for patrons of these want columns, the greater newspapers establish branch offices, for the gathering of the advertisements, in various parts of the city, pressing into service all the local telegraph and telephone lines for the transmission of the "Wants" to the newspaper.

The bulk of the advertisements which appear in periodicals belongs to the general class. It is not unusual for a single manufacturing concern to appropriate from $500,000 to $1,000,000 a year for the dissemination of information relating to an article which can be had of the dealers. The dealers, in their turn, expend proportionate amounts in acquainting consumers with the wares which can be bought in their individual shops. When a new article is to be placed on the market, the very first question is, "How much can be spent for general advertising?" Shrewd business men know that any article which depends for success upon the opening of the public purse must be widely advertised. The greatest commercial successes, indeed, have been achieved through clever and persistent advertising, and countless industries and arts which otherwise would have been little known, have been brought to great prominence everywhere in the pages of the daily and weekly newspapers.

Supplementary Advertising

A word about one or two of the forms of advertising previously referred to as supplementary.

The most ancient form of publicity is the poster. In the beginning, announcements of local events were posted in the village square, or in the town tavern, or general store. In latter days, posters have been used for general advertising purposes throughout the world. A large number of the posters thus used are the work of well known artists and illustrators. Along the lines of the railways, and up and down the principal thoroughfares of cities, on blank walls, signboards, barns and fences, thousands of posters may be seen, many of them being particularly conspicuous because of having natural scenery for a background. The painting of huge bulletin boards, now so common, is another form of outdoor advertising, suggested probably by the poster. Advertisers found that the great sheets of paper which were pasted on walls and fences were washed off by every rain, and hence had to be frequently renewed. The circus and theatrical companies, and others whose advertising in each locality is necessarily of short duration, still use the poster; but advertisers who wish to give year-long publicity to their wares, now use the bulletin boards on which announcements are painted. Such bulletin boards are usually leased by the year, a board sixty feet long by eight feet high costing from $60 to $75 a year. It is said that a sum between $3,000,000 and $4,000,000 is spent annually in this form of outdoor advertising, while at least as much more is spent in bill posting.

Since the development of electric street railways, street car advertising has become a popular form of enterprise on the part of advertisers. Uniformity was given to the size of the card used, by the invention of the curved car rack. Thus it is possible for an advertiser to print thousands of cards and send them all over the country, knowing that they will fit the racks of the cars of any city. As there are perhaps 40,000 street cars in the United States carrying advertising, and as the average charge is about $100 per year for each car, about $4,000,000 is spent in this form of advertising.

But both posters and street railway cards, as forms of supplementary advertising, are insignificant when compared with circulars—which includes all kinds of booklets, pamphlets, and other reading matter.

Periodicals the Best Advertising Medium

That the periodicals are the principal medium of the dissemination of information concerning our industries is well worth repeating. It is said that the very existence of fully 9,000 dailies, weeklies and monthlies (more than one-third of all the periodicals of the country), are utterly dependent upon advertising for revenue. Some of the metropolitan papers carry about fifty columns of advertising daily, and more than one hundred columns in the large Sunday editions. There is hardly a daily in the great cities of the country that does not carry at least twenty columns of advertising. All this space is sold at a remarkably low price, considering the size of the audience reached. The advertiser himself recognizes that the dailies and weeklies, considering the returns, offer the cheapest form of advertising; for the veteran advertiser never forgets the three great facts: namely, that the public wants, that it reads, that it buys. And when the people want, they look to the periodical for information as to how and where they can buy the best on the most advantageous terms.

The newspapers have always given special attention to advertising. Strenuous efforts are constantly made to increase its volume. But before a great amount of advertising could be secured, the circulation had to be increased. The first step was to reduce the price to one cent. At this juncture the advertising agents took advantage of the situation. The department store had to a large extent driven out the smaller shops. Its advertising agent made contracts with the newspapers for a thousand columns at a time, perhaps, but the publisher, in return, had to accept very low prices. Then larger advertisers began to form combinations. Half of the total space occupied by advertising in New York City is filled by less than a score of firms. The dealers in tobacco, whiskey, cereals and books, began to advertise largely and found a new source of revenue. As far as publishers were concerned, the change amounted to a revolution. Nothing was too daring for them. The newspapers counted the commissions of the professional advertising man as so much loss, to be made good by a still greater amount of advertising.

When a given point in circulation is reached, say 300,000 copies, the cost of white paper runs a race with the profits from advertising. The cost for white paper of twenty-one cents a line for advertisements in a certain New York evening paper, with a circulation of more than 300,000, is evidence of the large outlay required in this direction. Increase of circulation thus presented new problems. It is impossible for the publisher to reduce his advertising rates below a certain ratio. Over-circulation also brought with it the additional necessity of an increase of capital invested in the plant. The daily newspaper, while becoming more of a public institution, was gaining no increase of profit. Thus the general public reaped the benefit of the new condition of affairs. "Large business and narrow profits" is now more than ever the cry in the business world.

Years ago the advertising agents, realizing the importance of newspaper advertising, set to work to devise schemes by which the number of newspapers could be increased and hence more advertising secured. They at last hit upon the plan of co-operative newspapers, described in the chapter on the publishing industry. Papers of this class have "patent insides," or "patent outsides," the patent side of the paper being sent to publishers in rural districts already set up so that the cost to the publisher of typesetting is reduced to the minimum. This plan has largely influenced the spread of advertising throughout the country.

As for the magazines, it is said that certain monthlies now "carry" as much as a million dollars a year in advertising. Several magazines have each from 135 to 160 pages of advertisements in each number, and yet magazine advertising is only about thirty years old. It is related that Gladstone often declared that he preferred the American edition of American magazines to the English edition, because the advertisements gave him information indicative of progress and enterprise in the United States.

For the local advertiser, the daily paper is the natural medium, while the general advertiser employs the columns of the weeklies and the magazines. If the general advertiser has a great deal of money to spend, he may also use the daily paper. The magazines are few whose circulation attracts the advertiser. Through the weeklies and the dailies a much larger audience is reached. The magazine field, however, has broadened vastly of late years. There are now three-quarters of a million magazine buyers in the United States and Canada. Many of these buy several magazines, and thus the total number of magazines sold will reach about two million.

In addition to the publications for the general public, all the trade and technical journals carry a very large amount of advertising, all of it of a special nature, each advertisement pertaining to the industry to which the paper in which it appears is devoted. Advertising itself has its own trade papers, twenty or twenty-five such journals being devoted exclusively to the art. These trade journals assiduously direct attention to the advantages of daily and weekly newspaper advertising, and as a rule they publish statements concerning the methods that hold the best promise of success, all such statements being entirely unprejudiced.

The Professional Side of Advertising

The advertising business, in respect to its personnel, is divided into three general classes: First, the "advertising man," exclusively employed by the advertiser; second, the "advertising representative," employed exclusively by the periodical; third, the "advertising agent" who "places the business" for a number of advertisers, acting at the same time as the representative of a number of periodicals and receiving commissions both ways. The advertising man employed by the advertiser places the business of his firm independently of agents, checks the returns, and, in fact, conducts a special advertising bureau, employing a corps of assistants for the purpose. Such an advertising man usually works on salary and accepts no commissions from either periodicals or agents. The advertising representative in the employ of a newspaper or other periodical, works either on a salary or a commission basis. Sometimes he receives both salary and commission. His commission may be from five per cent to twenty-five per cent of the amount of advertising he secures. The amount of his salary depends upon the volume of "business" he brings to the paper. Thus, a man who brings a periodical $100,000 worth of advertising in a year may be paid a salary of $5,000 to $8,000 a year.

The Advertising Department of Newspapers and Periodicals

The great daily newspapers and the great weeklies and monthlies maintain each a large staff for handling the advertising business, under the title of "advertising department." This department is in charge of an advertising manager whose earnings may be anywhere from $2,500 to $15,000 a year. The men under him divide the country into sections or "territories," each member of the staff being given credit and a commission for all the business coming from his particular territory. Each representative travels over and through and across the States assigned to him several times a year, about the same as a travelling salesman for a mercantile house "covers his route." Many of the advertising representatives are college men, and so important has become this branch of the newspaper business within the last decade that a great number of bright and clever men prefer to work in this department, finding that more money can be earned here than in the editorial department. Hence it is not unusual to find a man who was employed last year in the editorial department, working this year in the advertising department.

In the advertising departments of newspapers a carefully made record is kept in all newspaper offices of the number of advertisements and the space filled by them. Great efforts are made to secure business. The columns of other newspapers are watched, and if a house or flat is advertised to let, solicitors are sent to ask for that advertisement and future ones of the same kind, even though only thirty or forty cents may be paid for each insertion. The competition is extremely great.

An unbounded rivalry exists also in the circulation departments. All the advantage of alertness and alacrity in the editorial department may be wasted if the circulation department fails in celerity and promptness. A rival may take advantage of any slowness or inefficiency in the circulating department, and, appropriating the news, may print and circulate an edition of its own, beating its enemy by several hours. This, in times of excitement, may mean a loss of many thousands of dollars, besides the prestige. This has been done on several occasions, much to the discomfiture of the circulation department of the loser. The best work of correspondent and editor may thus be sacrificed. It is indispensable, then, for the circulation department to be wide awake.

In the City of New York more than two and a half million copies of daily newspapers are printed. Subscriptions are not in vogue in New York, the papers being sold to newsdealers, who deliver at the residences. Papers are printed nearly every hour on week days, there being so many editions to prepare. Wagons and automobiles rush with them to central points, where throngs of newsboys are always waiting. In Frankfort street four great newspapers deliver their issues to the newsvenders, and it is a busy spot. The elevated trains are utilized to transport the papers up town. On Sunday a car is filled in three or four minutes, bundles being thrown in through the windows, as well as carried through the doors.

In reference to out-of-town circulation of the New York papers, the situation is a difficult one, but the operation is well handled. The former cut-throat competition being unprofitable has largely been discontinued in this branch of the service. Special trains for a single paper, at the rate of from two to five hundred dollars, do not pay. Nine special trains from New York now run on Sunday, supplemented by wagon service. Boston, Saratoga, Pittsburg, and Buffalo are served with New York Sunday papers by noon. The first editions of the evening papers, on account of their special features, are sold as far away as the points just named.

Advertising Agents

The advertising agent, the man who represents many advertisers and many publications, may be considered both as a professional and a business man; that is, he practices a profession, but he also conducts a business. This business is called "an advertising agency," and some idea of the power and importance of these agencies may be gained when it is stated that one house alone carries a pay roll of $100,000 a year for clerical force. There are, indeed, more than one hundred large concerns doing business as advertising agents, fully half of whom are recognized by the mercantile agencies. Altogether the capital invested by these agencies amounts to millions of dollars. Each great agency has one or more representatives in every prominent newspaper centre, as well as a corps of correspondents constantly on the road.

The advertising agent is, of course, well equipped to handle the advertising business for less than the advertiser can handle it; he has bright, intelligent, original advertising men about him, capable of aiding in the preparation of advertisements, and, of giving advice to the advertiser. He also has capital enough to extend credit to the advertiser upon occasion.

Advertisement Writers

As a natural outgrowth of conditions in the field of advertising we have the advertisement writer. The great spread of advertising, the increasing cost of space, and the fierceness of competition made it apparent to each advertiser that he must try to make a better showing than his competitors. Thus there is to-day a great demand for men who can write advertisements that contain the elements of novelty, attractiveness, and interest. Good advertisement writers are paid large salaries, some houses employing men to write advertisements exclusively for them, while others employ free lances. The leading advertising agencies, too, employ a great number of writers and artists.

The pioneer in this field was very soon getting a salary of ten thousand dollars a year. The entertaining class of advertisements of the present day began with one column in each of the daily papers of the city, then increased to two columns. A soap manufacturer took the next step by engaging an entire page in each of the dailies in the city in which he resided. A rivalry then ensued between merchants, each striving to have his advertisement the largest and most attractive. Full page advertisements are common enough to-day. The evolution was imperative of a class of trained writers, especially qualified for the work of writing advertisements of this class. This work is not only interesting, but is very profitable. Merchants and manufacturers pay from $25 a week to $25,000 a year. Houses that spend hundreds of dollars for a page in a magazine can afford to pay a high salary to a good advertising writer. With all the money spent in newspapers, catalogues, circulars, posters, etc., there is a vast demand for intelligent advertising managers. A common sense knowledge of human nature is required in an advertisement writer, and the ability to state plain facts in the language of the people. Fanciful rhetoric should be avoided. The amount of money spent for advertising will increase from year to year. Therefore it is safe to say that the profession of writing advertisements will be one of the most lucrative of all professions, and a young man may turn his attention to it with reasonable assurance of profit.

So important is the correct and taking way of writing advertisements that it is a wonder there were not long ago established schools for the purpose of giving instruction in this branch of work. To-day one or two such schools are in existence. In them students are instructed how to prepare announcements in the most attractive form, to express them intelligently and interestingly. The development of good judgment in writing advertisements is the aim. The art is taught by mail as well as in classroom.

Concerning frills and high art in advertising, they would much better be omitted. The great mass of people are not looking for high art in advertisements, but for facts, strikingly put. Certainly, advertisements should be made as attractive as possible. They should not, however, be sacrificed for art. Art should not become a craze in advertising. An illustration is meant merely to call attention to the advertisement, and this may be done by the use of display type and blank space. The half-tone, many think particularly objectionable. It is much weaker than a good wood cut. The half-tone requires a specially prepared paper, and thus is not economical. An illustration of the thing advertised is a very good way of catching the reader's eye. Without this he may often pass over the desired object.

The advertisement should be designed first to catch the reader's eye, and secondly, to tell him a story. To gain these points it should be attractively set in large, clear, well-leaded type. Fine type, with no spaces between the lines is not attractive.

Women in Advertising

Women have been successful in the advertising business from the start. The achievements of the pioneers in this branch of work have encouraged others, and the number of women now in the advertising field is large and is constantly augmenting. The work of women in this line is capable of variation. It may touch upon literature, art, and business. She may know how to write catchy advertisements, or "ads," as they are often called, she may be able to illustrate them with artistic drawings in pleasing taste, or she may have the knack of getting contracts. Some women have all these three talents, and their success is assured. Sometimes a woman who can write will associate herself with one who can draw, and thus the way is made easier for both of them. Many of the salaried advertisement writers employed by big retail stores are women. In drygoods houses they are very valuable, being capable and faithful. Other lines of business are also represented by women in this work. The entire advertising business of a well-known publishing house is conducted by a woman.

Generally speaking, the merchant finds that he can employ much better talent for the money, if the employs a woman in the advertising department. The work is well suited to women, as it does not require much physical strength, and is not a great tax on the nerves. Women who are connected with the advertising departments of special trade publications are themselves specialists in some line of goods, gloves, or laces, or corsets. One woman connected with a special trade paper of this sort acts, in addition, as the advertising agent of a corset manufacturer, frequently handling as much as $25,000 a year of its advertising, writing the advertisements and placing them where she sees fit. She earns about $6,000 a year. Another woman on the staff of the same paper earns the same amount as an advertising solicitor, and has put her oldest children through college.

A large silk and dress goods house, very prominent in the trade, has placed its advertising department entirely in charge of a woman, who has the writing and placing of thousands of dollars worth of advertisements every year. In Syracuse a woman has charge of the advertising of a large department store.

To gain prominence in this branch of work a woman must have certain qualifications. Accuracy and discretion are requisite. A sense of form and proportion is desirable. Care must be taken in the wording and arrangement of an advertisement. One should study to make headlines striking and attractive. A knowledge of three or four kinds of type is needed, but the range need not be very large. Too much variety in types is a drawback rather than a help. Most of the school advertising in the magazines was for years handled by a woman.

CHAPTER X

TRAVELLING SALESMEN, CANVASSERS, AND REAL ESTATE AGENTS

Commercial Travellers—Qualifications of a Travelling Man—The Travelling Man on the Road—General Conditions Relating to Travelling Salesmen—American Salesmen and Buyers in Foreign Countries—Agents, Canvassers and Solicitors—Commission Merchants—Book Agents—Real Estate Agents—Real Estate Brokers—Women as Real Estate Agents—Real Estate Board of Brokers—Managing Office Buildings and Apartment Houses—Managing Private Estates

Commercial Travellers

THERE are in the United States 100,000 manufacturers, jobbers, importers and manufacturers' agents who employ 300,000 commercial travellers in the aggregate; and to this number could be added travellers for business, the buyers of farm products, insurance agents and adjusters, special auditors and general buyers. An estimate placing the total number of travelling men at 350,000 is therefore conservative and safe. Many houses employ not less than fifty salesmen; some employ more than 200; a large number twenty-five, and several thousand having between six and twenty. These figures, furnished by representatives of commercial travellers' organizations, do not agree with the figures in the Census reports, which place the total number of travellers at less than 100,000.

Travelling men are not drones. Their life is most active, and filled with many sacrifices of ease and comfort. Weaklings can not stand the strain incident to the avocation, and it is generally observed that travelling men are robust and stalwart. They really get very little rest. Their days and nights are taken up with talking, walking and travel. Their beds are often the berths of the sleeping-car, and sometimes all the sleep they secure is on an ordinary railway coach, which they may perhaps board late and leave early. In some cases they can see their families every Sunday, but this is only when the route is close by home. Frequently travelling men are away from home for several months at a time. They are paid for their work in three ways. They receive a salary alone, or a salary plus a commission, or a commission only. Those working on commission only, earn a good deal, and pay their own expenses. They have, in many instances, previously been in business for themselves, and have a large personal acquaintance. Many valuable men will work on no other basis, as they are thus much more their own masters, and free as to time. The profits of some of these travellers are sometimes so large that they are offered a share in the business, or what many would deem enormous salaries. They take their trade with them when they enter the service of a new firm. One thing that may be said in favor of the position of a travelling man is that he certainly is sure to get the best attention at the hotels, and the best horses at the livery stables. His custom, being regular, is highly valued.

Qualifications of a Travelling Man

The qualifications of a good travelling salesman are so complex, yet so simple, that it is difficult to define the exact make-up required for success in this field. It is plainly patent that the simple requisites are common honesty, aptitude for the work, a thorough understanding of the business, indefatigableness coupled with a certain amount of persistency, a good constitution to stand the wear and tear of the life he will lead, and a certain amount of the geniality of an optimist. He must be, to some extent, enthusiastic, but this enthusiasm must be genuine, based upon his belief that he has attractive goods to sell and that he is charging the right prices. A simulation of enthusiasm will not do; it does not carry weight as does the genuine feeling.

A commercial traveller must be well dressed. And that means he must be able to withstand the critical scrutiny of well-dressed, well-to-do business men. He must wear immaculate linen, have a good ten-cent polish on his shoes, and wear an up-to-date hat. It it astonishing how much influence a well-dressed man has over a buyer.

Back of all this he must be a gentleman. Twenty-five years ago, if a man was considered a good man, lapses like a drunken spree lasting for a week were forgiven. Not so to-day. The travelling salesman is a marked man. Hosts of employés of his customers know him by name. He has to be circumspect in everything he does, else anything but that which is proper is heralded abroad. His employers quickly hear of it, his competitors are more than likely to make capital of his weaknesses, and the first thing he knows he has lost his position. He must be over prudent in his daily life. He can not afford to spend his time in saloons, nor to gamble, nor to visit other questionable places. Such indiscretions, be he ever so cunning, are sure to be found out, and his name will be batted about by gossip. He must be a business man, pure and simple, attending to his work, as some great worker has said, "eight days in the week and thirteen months in the year." For such labor as this a good physique is essential. There is such a thing, of course, as overwork, even among commercial travellers.

One of the most important requisites for success as a travelling salesman is tact. A born salesman is also a born diplomat. He must be able to accept disappointment with a smile and to acknowledge defeat gracefully. Who among the veterans on the road does not know the buyer who glibly promises an order "sure, next trip"; and who, when the salesman puts in an appearance, fails to fulfil the promise? The traveller who, under such circumstances, controls his feelings, possesses a capital that can not be estimated in figures. He is wise who puts no more faith in the buyer who is lavish of promises than in the prince who passes his word which is not as good as his bond. It pays better never to remind a buyer that he has failed to keep his promise.

Character, of course, according to its strength or weakness, hinders or advances the career of the man on the road. This element, called character, which lies behind ability, and which is built up day by day, is recognized by the drummer's customers, and, according as it is good or bad, will influence his dealings with them. Perhaps personality plays an even more important part in the traveller's success or failure. The alert man on the road soon discovers that while his personality is congenial to some it is disagreeable to others. And his manner is forward or retiring, accordingly. Even then he frequently finds that it is absolutely impossible, because of his personality, if for no other reason, to sell every buyer in his line on his route. There is an old saying that there is no friendship in business; but, after twenty or thirty years of active travelling life, all drummers testify to the contrary. There certainly is a distinct advantage when your customer is also your friend. That is to say, all other things being equal, your friendship will give you the preference.

The Travelling Man on the Road

To "cover" a certain route with a specified time, and make more sales than his rival in the same line, is the ambition of every salesman. None know better the value of time, or that "time is money," than the road representatives of a great wholesale house. Hence, the buyer who gives you his prompt attention, who keeps his appointment to the minute, has your profound respect and gratitude.

A "route" may be anything from a single county to the whole of the United Statese. It may include a group of towns and villages within a radius of one hundred miles, or it may extend to and include Seattle, San Francisco, New Orleans and the principal cities within that imaginary circle, New York being the starting point. At eleven o'clock at night the traveller may find himself at a junction; if he possesses the wisdom of a soldier on the march, he will throw himself down on the floor of the station with his grip as a pillow and his overcoat as a blanket, and thus, while waiting for the connecting train, snatch a little sleep. At one o'clock the train comes along, and he tumbles into his berth. At 4.30 the porter calls him; he leaves the train and hurries to the nearest hotel to get, perhaps, another two hours' sleep. Thus the travelling salesman has often to sleep in three different beds, in three different places, in a single night. After such a night, this man must spend the whole of the day calling on a number of buyers, each one of whom is wide-awake and keen of mind. To meet his customers on equal ground, therefore, the traveller must, by sheer force of will, eliminate all signs of the fatigue resulting from his broken rest during the previous night.

On the other hand, he may spend four or five consecutive nights in sleeping-cars, thus securing unbroken rest. Starting from New York, he may make Cleveland, Cincinnati, St. Louis, Kansas City, Omaha and Chicago;

then Detroit, Pittsburg, Buffalo, home. He may be required to include in his itinerary many other cities besides those mentioned, prolonging his journey thirty or forty days. Now if he takes this trip regularly, year after year, he naturally makes many friends and ultimately commands a valuable trade and a high salary. Nine-tenths of his customers have never met any member of the firm he represents. So it is of the utmost importance to such a firm that their representative be a man of good address. For the customers "size up" the firm through its road representative.

General Conditions Relating to Travelling Salesmen

The young man starting out on his first trip on the road will meet with obstacles which will quickly discourage him unless he is of the never-say-die sort. Like the competitor in the obstacle race, he must remember that he must surmount each barrier as it presents itself, and must perform such feats in less time than the other men in the race.

There is this peculiarity about the work of travelling men—they lose their local identity. A local man, living in a comparatively small town, covering a limited territory, coming back Saturday night to his family, going out again Monday morning, does not see one-twentieth of his acquaintances while he is at home. His acquaintances are here and there all over his territory. After he has travelled many years, he comes home to find himself a comparative stranger in his own town. This is true in a greater degree of men who cover a large territory, like one travelling from New York through the Southern States, or through the West, where trips are very much longer and the stay at home shorter. Men often travel eleven and a half months out of every twelve, staying away five or six months at a time, coming home for a week, then leaving again for another half year. As for earnings, the minimum, as applied to men travelling over a territory of 100 or 150 miles for local houses in lines that do not pay a large profit is about $900 per year, plus expense, of course. The maximum is between $4,000 or $5,000 a year.

Travelling salesmen are sometimes allowed a standing commission on all goods bought by firms whom they first secured. In such case their incomes are very large. Three hundred million tons of goods are shipped through drummers every year.

Commercial Travellers' National Associations

Commercial travellers have their national associations, among which are the Travelling Men's Protective Association. The objects of this Association are to bring about a better acquaintance of persons engaged as commercial travellers; for the abolishment of all local, State and county licenses exacted from commercial travellers; to secure reduction of passenger rates to commercial travellers on all lines of transportation; to obtain a fair and equitable allowance of baggage; to secure hotel accommodations commensurate with the prices paid; to elevate the social and moral character of commercial travellers as a profession; and to provide a benefit fund for members of the Association in case of accident or death, and to take interest in all such matters as pertain to the welfare of commercial travellers of America. Another society of the kind is the Commercial Travellers' Mutual Accident Association of America, with headquarters in Utica, N. Y. This Association admits to membership commercial travellers exclusively, and has more than 20,000 members. The officers of this organization have calculated that one out of every fifteen of the commercial travellers of the United States are members of their Association. Another important organization of travelling men is the Commercial Travellers' Home Association of America. A fourth society of this class is the Commercial Travellers' National League. The membership fee is two dollars. The dues are $10 a year. The dues are divided between the national expense fund, the national benefit fund, the State division, and the local post. The society has an indemnity fund amounting to about $50,000. It pays $25 a week in case of total disability for not to exceed fifty-two weeks, and $1,000 for the loss of an arm or leg, $2,000 for the loss of both hands or both feet or both arms or both legs, and so on—about the same as any accident insurance company. The League has paid out since its organization something over half a million dollars in insurance. It pays $5,000 death benefit, when death results from accidents.

American Salesmen and Buyers in Foreign Countries

The importance of a knowledge of foreign language to commercial travellers, and to buyers in particular, is argued as follows, in the report of the United States Bureau of Education:

> The conditions of many industries and trades have become international. The raw materials of an industry or commerce may come from various parts of the globe in different qualities; and he is the best buyer who gets his material at the exact spot where it is best produced, and who can speak the language of the country in which he is obliged to buy. The cotton for a given fabric must be either bought in the one district where it is raised, or the cotton plants of this district must be spread throughout other cotton-growing countries. If China has a better tea plant than Ceylon, tea must be bought in China, or the better tea plant must be transferred to Ceylon. A chocolate industry established in Boston must seek its cocoa wherever cocoa best grows, and must be always inquiring in what other parts of the world cocoa can be well produced. This means that good buyers for great industries must often be polyglot men.
>
> As for "drummers" who solicit business in foreign countries, it is obvious that they need to speak the tongue of those with whom they would trade and among whom they must study on the spot the existing commercial conditions. The managers of great international industries need to be able to study foreign trade conditions in foreign newspapers and books, to understand the commercial intelligence in a foreign paper, besides knowing all the complications of local currencies, weights and measures.
>
> If an American merchant wishes to introduce his goods into a foreign country, he is not wise if he sends out his price lists in English and in dollars and cents; he must employ men to translate.
>
> Year by year, as ocean carriage becomes securer and quicker, and as business is done all over the world by telegraph and telephone, the individual merchant's need of overcoming the obstruction to commerce caused by the variety of languages spoken and written in the business world becomes more and more pressing. The man who can speak foreign languages stands the best chance, in the wholesale house, of promotion to the position of buyer. And the more tongues he can speak, the larger his salary.

Agents, Canvassers and Solicitors

Thousands of manufacturers and business houses advertise daily for agents, canvassers, solicitors, and travelling salesmen. A study of these advertisements leads to the conclusion that the four occupations just mentioned may be classed under the general head of "agents," the four terms being interchangeable and synonymous. If any distinction can be made it is somewhat as follows:

An agent is one who sells anything anywhere, from automatic washers to space in a periodical or directory, on a salary or commission; a canvasser is one who makes a systematic tour of a town or a city district, going from house to house in an attempt either to sell something or to get an order for something; a solicitor is one who "drums up business," soliciting trade among manufacturers and wholesalers, usually on a commission basis; a salesman is one who travels about the country selling a certain line of goods for a certain house. Commercial travellers are an organized body, but among agents, canvassers and solicitors there is no organization, each agent selling anything he can, the best way he can, at any time and place and for any salary or commission that offers.

Whether the men in this field are called agents or canvassers or solicitors, they are always "representatives." Among these are a number of high-class agents, each of whom represents a manufacturer or a wholesale house in a certain territory. These high-class agents sometimes maintain an office and employ a corps of assistants. They represent piano and organ manufacturers, or the advertising or subscription departments of periodicals; they act as agents for machinery manufacturers, and for manufacturers in many other fields. These agents are usually paid a salary as managers of branch offices, and a commission on all goods sold. There are a number of representatives of carriage and wagon manufacturers, and of manufacturers of carpets, furniture, machinery, jewelry, etc., who make from $5,000 to $10,000 a year. Advertising and insurance agents are members of distinct professions, the duties, earnings, and standing of whom are told in detail in the chapters on the advertising and the insurance buisness.

To come to the ordinary agents, those who usually regard their calling as a temporary one, and who therefore never attain any great success, are those who answer advertisements like the following:

Wanted.—Agents and canvassers throughout the United States for indispensable article to the retailer, buyer, manufacturers, large or small; sells at sight; agents making $50 to $70 weekly.

Agents.—Selling goods by mail, the new business that can be started at home in spare hours; immensely profitable if properly conducted; we furnish goods, illustrated circulars, advertise you in a big list of papers free of charge; original operating plan that produces results in one week; particulars free.

Agents, attention! A patented article, used by every man; retails for 25 cents; quick seller, good profits; will mail you circulars.

Agents.—Big money selling my fountain pen; exact duplicate $2.50 pen; fitted with 14 carat gold plate pen; samples to agents 25 cents; write for catalogue.

Agents.—We guarantee $2 to $5 a day; introducing our genuine super-asbestos wicks; just out; light equal to incandescent electricity; last about eight years.

Agents.—For best stocking supporter for men; nickel plated; easy to adjust; not preventing blood circulation; a splendid seller.

Agents.—American leather suspenders sell themselves; $25 to $50 weekly easy; exclusive territory to hustlers; introduced by agents only.

Agents.—For contract work on commission; can make $25 weekly; to visit strictly business people; hustlers only; steady selling after few weeks.

Hundreds of advertisements of this kind appear in a single issue of a New York daily. It is estimated that there are at least 125,000 agents of this class in the United States. The personnel of this body of men is constantly changing, as the recruits come principally from the ranks of the unemployed, and the great majority abandon their work as agents as soon as permanent employment can be secured. The minority, however, are professional agents—those who sell suspenders this week, soap next week, patent medicines the folowing week, and whiskey next month. Such men can hardly be called "Jack of all trades" because they are always agents, but as they sell many different things in the course of the year the only business they ever learn thoroughly is the business of selling, which in itself does not constitute a specialty. The agent who boasts that he can "sell anything" seldom rises to a high place in any industry.

For the industrious, businesslike agent, however, who brings a good head, a whole heart and indefatigable hands and feet into his trade, there are excellent opportunities for advancement and for earning large amounts. The present head of the proprietary medicine department of one of the large wholesale drug companies started as an agent in a small but exclusive territory. At the beginning he had several offers of a higher salary and more liberal commissions if he would sell other merchandise in the same territory, but he stuck to patent medicine, eventually working up a larger trade than that of any other agent in the employ of the company. One day he was asked to come to New York and call at the home office. The result was that he was given charge of all the agents in the State of Massachusetts. Later he organized the agency system for that house throughout the New England and the Middle States. In a year or two he had so thoroughly organized the agency system throughout the whole country that he was made general manager of the entire proprietary medicine department, with a salary of $9,000 a year.

Commission Merchants

Commission merchants also may be classified as agents. The amount of business done by commission merchants is very large. Not only are foreign houses thus presented to our public, but home factories and neighboring farmers dispose of their products in this manner. The process is simple. One has only to hire an office and space for storage in a warehouse, and send circulars to dealers in grain or stock, if that is his line. Of course his storage bills depend on the quickness of his sales, but if he is ordinarily fortunate he has every chance of making money.

Agents for supplies should be included here. A supply agent or company does not keep goods in stock, but is an agency through which one can order any goods he wishes, from specimens or samples. Here is another business demanding very little capital. Rent and clerk-hire are cut down, and there is no risk.

Book Agents

Among the most successful agents are a great number of well educated men, who, by application, integrity and industry, have found that such work offers a permanent career and very satisfactory rewards. Among these may be included especially those agents who "work up" a given territory for book publishing houses or for weekly or monthly periodicals of national circulation. The subscription agents are men of more than average intelligence, who, in taking their calling seriously, give it dignity. They are usually men of family and of good standing in their respective communities. They earn from $3,000 to $6,000 a year. This class also embraces many book agents and canvassers, men who, in carrying the best literature into the homes of the people, thus supplying the dominant demand for instruction, are directly instrumental in the spread of education in the United States.

The profits of some book agents are really astonishing. Religious books always sell well. A man selling a Bible commentary has often made as much as $25 a day. Encyclopædia agents have made $3,000 a year, working only half the time. Agents for a popular memoir have earned from $10 to $20 a day, very easily. A gross daily return of from $3 to $5 a day is generally considered satisfactory.

Real Estate Agents

Billions of dollars worth of real estate—nearly four billions in New York alone, a billion more in Boston—nearly another billion each in eight other great cities, not to speak of two hundred millions each in cities like Washington, D. C. Who's to care for all this property? The owners? Not always. There are houses and factories and stables and ground to lease and to sell; rents to be collected; taxes to be paid; legal papers to draw; documents to be filed; repairs and alterations to be made. This work is done by tens of thousands of real estate agents. Some handle only certain high class properties, and in tremendous "blocks," making $100,000 in a single deal. Others collect rents from dwellers in tenements—$2 per week per room—the agent himself, for all his trouble, receiving 5 per cent, or perhaps a trifle more, of the amount collected for rents. Two per cent is the average commission charged for buying and selling.

Some agents make large incomes; others simply plod. But in this respect the occupation of real estate agent differs not from other callings. In New York and in all the larger cities, the agent's commission is smaller, because of the greater volume of business. Five per cent, however, is the minimum rate for collecting, and two per cent for sales and purchases. In smaller cities, the agents demand as high as five per cent, sometimes more.

Real Estate Brokers

Dealers in real estate sometimes make vast fortunes. A real estate dealer must look, first of all, to the title, or he many find that he has purchased a share in an expensive litigation. The property bought should also be in the line of march of the city's growth and expansion. The immediate neighborhood ought to be very carefully considered. The buyer ought to have an accurate knowledge of market values. He ought, also, to take cognizance of taxes and probable assessments. A tract of ground not so enormous in extent, in New York, is worth more than one hundred millions, without the buildings. The tide runs northward, and to secure a cheap or low-priced property one must buy in the Bronx or some such quarter. Real estate is, and always will continue to be, the safest and most secure of all investments. Property in an attractive suburb likewise is sure to advance.

A dealer who is fortunate enough to buy land in a pleasure resort while it is in the state of development is almost certain to make a fortune. Cities must have pleasure resorts, and the growth in value of property at Coney Island, Bergen Beach and Asbury Park has made large fortunes for the owners. The enterprise of one man alone made Asbury Park a beautiful "City by the Sea."

Investors who are able to prognosticate correctly as to the location of new towns always reap a large reward. Western lands should always be personally inspected. If along the line of a railroad they are desirable.

The development of the apartment house idea in various cities is remarkable. This is deemed a very highly profitable form of real estate investment. In some of the more luxuriously fitted apartment houses rents amount to large sums. Some tenants in a choice neighborhood pay as much as $100,000 for a ten years' lease, and quite an ordinary apartment rents for $1,000 a year.

Women as Real Estate Agents

There is no reason why women should not be successful in the real estate business. This much might have been said years ago. At present, however, woman's qualifications for this business have been amply demonstrated. There are numerous instances throughout the country in which they have proved their capacity in this direction quite satisfactorily to themselves and to their many clients. A young woman entering the business of handling real estate must take herself and her calling seriously. In New York there is a woman who is a member of the Real Estate Exchange. She has studied law, and her real estate business is so large that she employs fifteen clerks. In Malden, Mass., there is another very successful woman real estate broker. She has most excellent judgment in the selection of tenants, and has a knack of renting houses quickly. A Boston woman, from managing her own property, after her husband's death, took the step of going into the real estate business herself. She opened an office, began to advertise, and soon built up a good business.

There are many attractions to women in the real estate brokerage business. It is pleasant and profitable. In that it keeps one a good deal out of doors, it is healthful. A woman, to follow it advantageously, should be tactful, and should possess some business ability. She must be posted on matters of sanitation, drainage and ventilation. She must remember that a small transaction often leads to a big one. Women are surely as adaptable as men are, and there is every reason why they may become very successful real estate brokers.

Real Estate Board of Brokers

Other businesses may differ somewhat with the locality, but none is so local as the real estate business. Neighboring towns may differ entirely in customs and methods as applied to real estate. A few minutes' ride from New York, for instance, brings one to a town in which real estate auctions are held at eight o'clock at night, and the plots are sold by the front foot. Lease-hold property, again, is harder to sell in New York than in Chicago, where it is esteemed equally with a "fee." Different cities also vary in their standard of lots, in some the lot being 20 x 80, and in others 50 x 200. In New York the real estate business has been elevated to the level of a profession. The Real Estate Board of Brokers has done much to bring this about. Its "weekly call" is a very great advantage both to brokers and clients. This meeting of the brokers is held every Tuesday afternoon at the rooms of the association. Here the business consists in the announcements of the wants of their clients, a comparison of the wants and negotiations for the sale or rental of the properties presented. Of course, all this is advantageous to the owner. In former days property was placed for sale either in the hands of many brokers or with one broker exclusively. But neither of these plans worked well, each being adapted to make the brokers disinclined to special activity. Right here steps in the Board of Brokers. Its membership consists of a number of the leading firms in the city. Members announcing a property at a "weekly call" thus lay it before all the members at once, and a purchaser is soon found. Many of the members are specialists in property situated in certain sections of the city, and their knowledge becomes available to a broker not well acquainted with that section, exchanges being thus greatly facilitated. In addition to the matter of bargains and sales, the object of the Real Estate Board of Brokers is to improve the status of the business, and to eliminate, as far as possible, the unworthy men who hang upon its utskirts, and bring it, sometimes, into disrepute.

Managing Office Buildings and Apartment Houses

A new field was offered to real estate agents by the building of great office sky-scrapers and apartment houses. These vast structures hold more tenants, almost any one of them, than many blocks of dwellings. The work of leasing and collecting for a single one of these buildings yields sufficient revenue in commissions for even the most avaricious real estate agent. In many instances, the agent gives his entire time to looking after one building. He is called the manager, and is a person of great importance—to the tenants. If he is really expert in his business, his work begins even before the ground for the building is broken. He is supposed to know the particular needs of the neighborhood in which the building is to be erected. Therefore it is he who advises the capitalist as to the floor plan of the street floor, whether to arrange it for a store, or a bank, or an express office, or a restaurant. It is he who dictates the plans of the upper floors, specifying the number and size of the offices or rooms, according to his knowledge of the needs of the locality, and of the class of tenants who are to occupy the building. Then, having divided his great cage into compartments, the manager must proceed to catch his birds. If it is an office building he finds out what old buildings are to be torn down and approaches the tenants of the same with alluring offers of light and heat and elevator service, and a mail chute—all to be had in his new building. He approaches tenants whose leases are about to expire, with the story that while the building they occupy at present has every modern business *necessity*, his new building is provided, in addition, with every business *luxury*. Hence for weeks prior to May 1—commonly known as "moving day"—and for weeks prior to October 1, another moving day, the manager works, as it were, with his coat off and his sleeves rolled up. Tenants he must have, or the capitalist, his employer, will demand the reason why.

As to rates, it has been decided, perhaps, that to make the building a paying investment, rentals upon the whole structure must average a certain amount, say $4 a square foot. So he begins by charging at least $8 a square foot for the ground floor and the extreme upper floors, these being the most desirable, the one because of its accessibility, the others because of light and quietness. The several middle floors may go for the average, or even less.

In New York, so many sky-piercing office buildings have been erected, and with such rapidity that managers are obliged to resort to all kinds of tricks—honest tricks—in the effort to get tenants. Some of these tricks suggest the theatrical manager. Others suggest the ways of the hotel manager. For instance, one manager of a new office building determined to make a bright and shining start. He resolved to secure his "star" first; after that, the securing of the "company" would be a simple matter. So he went to a famous old firm of lawyers. The very name of this great firm—in the prospectus and in advertisements—as the tenant of the best floor in the new building, would pack the remaining floors even to the roof. So the enterprising manager offered his best suite to the famous firm at a lower rate than they were paying in the dark, ramshackle building where their shingle had been hanging for years. He fitted his suite up to suit the firm, without charge. Then he moved the firm—free of all cost—in a day and a night, books, documents, desks, fixtures, safes, and all, setting each particular piece of furniture down in the new building, in the same relative position it occupied in the old. The famous firm was delighted—and so was the manager. For by his enterprise, the manager gave the building a character of the kind that lured hundreds of tenants of the best class.

Managing Private Estates

Sometimes the owners of great estates manage their properties independently of agents. Hundreds of estates, in fact, are managed this way. The estate has its headquarters, an office centrally located, where all the work usually performed by real estate agents is executed by a trained and salaried corps. The tenants of one estate, thus managed, number not less than five thousand. Counting only four persons to each family, fully twenty thousand persons live in the houses belonging to the estate, paying $1,000,000 a month in rents. The 5,000 tenants occupy five hundred dwelling houses, apartment houses and flats in the heart of New York City, eight or ten huge office buildings downtown, hundreds of cottages in the annexed districts and the suburbs, and many farms and minor estates in the country. These figures do not include the hundreds of people sheltered by the great hotels owned by the estate. The scattered buildings owned by this particular estate, in New York City alone, if brought together in one "parcel," would cover twenty-five acres, or perhaps twelve or fifteen full city blocks. The estate really owns a city within a city. At the office of the estate a whole floor is given up to the Repair Department. In this department there is a number of managers and clerks who have the ordering of a small-sized army of painters, plumbers, plasterers, carpenters, gas-fitters, masons and decorators. There are also several men known as "doctors." These doctors have their "patients," namely, houses in need of repair. Each doctor is assigned to a particular district, and is responsible for all "patients" in that district. He has his office hours and his hurry calls, the same as a doctor of medicine. Whether the repairs will be made or not, depends upon his diagnosis of the case he is called upon to treat. At a glance, he can detect the cause that has made repairs necessary, whether accident or wanton destruction, or neglect on the part of the tenant. There is not a penny of insurance on any of the ordinary dwelling houses belonging to the estate, the fact being that when so much insurance would be needed, it is cheaper to let one or two houses burn up than to pay for insurance on all. The average loss by fire each year amounts to much less than the sum that would have to be paid to insurance companies in premiums.

CHAPTER XI

STENOGRAPHERS, TYPEWRITERS AND BOOK-KEEPERS

Stenographers and Typewriters—Day's Work of a Typewriter Operator—National Association of Women Stenographers—Law Stenographers—Bookkeepers—Women as Bookkeepers—Expert and Public Accountants—The Credit Man

Stenographers and Typewriters

IN THE business world to-day the stenographer is everywhere. He is the mouthpiece of the management. He is needed in the fields of law, journalism, literature, and in all the professions. For a young man there is no more attractive branch of industry. The stenographer has a most intimate knowledge of a firm's operations. He knows the patrons and customers, he learns the methods prevailing in the office, he absorbs a knowledge of commodities, prices and discounts. In no other position can one so quickly learn the "ins and outs" of a business. Many a stenographer, by his attention and tact, has been able to step in and fill a vacancy occurring in the staff. Shorthand offers to a young man a most promising career. Its possibilities are endless.

And for young women, stenography certainly is by far the most attractive field of business work. In fact, the number of women stenographers is very large, and is constantly increasing. Women, by their intelligence and their faithfulness, have established their place in business, and they are going to keep it. In all the towns and cities thousands of women are earning good wages, and no business employment open to them is more suited to their nature and temperament than shorthand and typewriting. In this, too, they can earn good salaries. Of the great stenographic and typewriting offices in New York and other cities, ninety per cent are managed and run by women, with thousands of women assistants. Women also largely control the stenographic service of hotels, and frequently fill the place of court reporter. Private secretaries are very often women, and women stenographers outnumber the men in the various trades.

The earnings of stenographers vary according to their ability and the nature of the work. The mere automatic recording machine, who transcribes evident errors, in a wholly mechanical way, gets about eight or ten dollars a week. If, however, he can save his employer work to some extent, his wages are greater. The employer can not afford to spend his time in correcting stenographers' mistakes. Valuable is the stenographer who can work from suggestions. Many stenographers earn twenty-five or thirty dollars a week, just because they have knowledge and tact enough to write a proper reply to a letter, merely upon being instructed to answer it affirmatively or negatively. A competent stenographer need not be long out of employment.

A young woman to become a good amanuensis must be an expert shorthand writer and operator on the typewriter, a good penman, and must be a good English scholar. She must dress becomingly, and yet appropriately to her business. Neatness, of course, is taken for granted. Little tricks, such as gum-chewing, must be avoided. The girl amanuensis should be helpful, but not aggressive, nor over-anxious and fidgety. A sensible girl can soon make herself necessary. To do this she must be alert and ready to help in any little way, such as finding missing papers or giving information about any letter sent or received. She must not be reluctant to do things outside of her strict duties. A girl owes it to herself, as well as to her employer, always to do her best. She must make her services valuable and then demand good wages for them.

Day's Work of the Typewriter Operator

Promptly at nine A.M. the "typewriter girl" arrives at her office. Her chief may be in bad humor or he may be all smiles, but his mood does not matter. She understands all her chief's whims and vagaries. She may have left at home a relative very ill, perhaps dying; she may be tormented in some way in heart, body or mind; she may have been beside a sick bed all through the night; but no matter how troubled, or how worried, or how faint for want of sleep she may be, her duties and the routine of the week must be taken up with every outward semblance of good health and spirits. She must instantly answer her employer's thousand and one questions: "Miss So-and-so, how much was my gas bill last month?" "How much does Smith owe me for services?" "Have you told the newsdealer to leave the morning papers here?" "How do you spell xylophone?" "What was the date of my last trip to Washington?" "What did I write to Jones about that dinner party?" "Has my club bill come in yet?" "What did Dr. Robinson say when he called?" "What are my engagements for the day?" "At what hour next week can I give the photographer a sitting?" And so on, all through the day, the typewriter girl must patiently answer the interminable string of questions. With equal patience she must assent to all sorts of assignments, commands and commissions. But this one thing every typewriter learns, sooner or later: That the maxim, "Obey orders if you break owners," does not hold good in her case. Her employer often gives a command the execution of which would be contrary to his best interests, or an order which differs from some agreement he has made, or instructions which may conflict with his previously laid plans. The typewriter makes it her business to remember every detail, every trifle, of her employer's affairs, and when she receives an order which if obeyed would cause trouble for her chief, she disregards her instructions, sets him right, openly receives a growl by way of thanks—and a great deal of secret appreciation for her value.

When the typewriter girl also acts as private secretary she must open all the mail, answer all letters on subjects familiar to her, and submit the remaining letters to her employer with any notes or data pertaining to each that may be useful in the dictation of the answer. The mail disposed of, the secretary then begins the special work or set work to be done that day. She must clip from papers or periodicals any references to her employer or his business, she must see all callers, diplomatically admitting to the "Presence" only those whom it is wise to admit.

The preference is given to the women typewriters in business offices because they are more orderly than men, because they are the steadier workers, and because, all the usual attributes of their sex notwithstanding, they do the work with considerably less fuss than their brothers. She must possess a little more than the average amount of education and a great deal more than a moderate amount of intelligence. She must be well-balanced, healthful of mind and body, and must have what is called a "good character," out of her employer's sight as well as in it. She must be flirtation-proof and flattery-proof. If all the female typewriters could be summoned together in convention, we would behold one of the most contented bodies of women this country can produce, notwithstanding an occasional individual complaint here and there.

National Association of Women Stenographers

An improvement in the standard of knowledge and ability among women stenographers was recognized as desirable. The National Association of Women Typewriters was established to further this purpose, and is exerting great influence in many cities. Stenographic work is now of a much higher grade than was formerly the case. Too many young women were inclined to go into it without the necessary qualifications. Incompetent girls were willing to work for small salaries. It was difficult at first to get girls to join the Association, and it was met, at the outset, with indifference by business men. In the United States there are about one hundred and twenty thousand women stenographers, earning $70,000,000. In New York City alone there are more than twenty thousand, and in Chicago about twelve thousand. The salaries which they receive range from five dollars to fifty dollars a week, the average salary being about ten dollars. The salary of court stenographers is sometimes as high as one hundred dollars a week, although they do not get more than fifty or sixty dollars as a rule. In railroad offices women stenographers earn about seventy-five dollars a month.

In Chicago the Association has established an employment department, which is meeting with great success. By it the girls are rescued from the thriving "general employment agencies." The only charge is ten per cent of the first month's salary. Girls who are incompetent to qualify as stenographers are helped to get situations in other branches of work, and find employment as governesses, companions, nurses, etc. The Association is also trying to elevate the standard of shorthand schools.

Law Stenographers

Law work is fascinating for stenographers, not only because, as a rule, it pays better than other work, but because they become interested in it from the nature of the business. If, indeed, they do not feel their work to be as important as that of any other person in the office, they have mistaken their calling. The law stenographer must be filled with enthusiasm, and be willing to work after regular office hours if duty requires. While intelligence is indispensable, he or she is not expected to "improve" upon the lawyer's diction, but to take down his words without the slightest change. A slight "improvement" in phraseology might take the vitality out of a contract or a stipulation. Time is of great importance in many legal documents, and each must be done in its turn, without delay. Implicit obedience is absolutely requisite. If orders are followed with exact precision, responsibility ends there. The stenographer should always remember that he or she is a link in the chain, and that much often depends on the appearance of the papers drawn in the office.

Bookkeepers

Many stenographers and typewriters employed in business houses to-day are also trained bookkeepers. But it is only in very small offices that the typewriter girl is called upon to keep books. In bookkeeping, specialization has been highly developed by the great insurance companies, publishing houses, banks and department stores. In smaller offices one bookkeeper may keep an entire set of books. In the large offices, however, the work is so subdivided that to each bookkeeper is allotted one special task, making entries concerning perhaps only a part of one branch of the business. Bookkeepers are paid sometimes even less than stenographers or typewriters—so overcrowded has the field become. Hundreds of young men and women leave the business colleges and finish the correspondence school courses every year, as trained bookkeepers, regardless of the demand for service of this kind. The best paid bookkeepers of to-day seldom earn more than $25 a week. The number engaged in this field to-day in the United States is twice the number of stenographers and typewriters.

Women as Bookkeepers

A fact significant of woman's progress in business, is that of the total of 260,000 bookkeepers and accountants, 75,000 are women. More and more women are employed in this work every year, first, because men find they can earn more in other fields, second, because women are generally neater and more careful than men—an important qualification in bookkeeping; and, third, because women will do more work for less money than men.

The result is that young girls are not slighting mathematics in their studies. The old notion that this branch of learning was of no use to women is exploded. There is not a town or city in the country but has hundreds of women bookkeepers and cashiers. The opportunities for advancement may not be so good in this as in other work, yet the field is a good one, and it has as many women earning a good salary as any other line of employment. In the executive departments of the government at Washington about one-fourth of the employés are women. In clerical work they are said to maintain a higher standard of efficiency than men. In the redemption division of the Treasury worn out money is exchanged for new. From the division of issue all the bank bills and greenbacks are sent forth to the commercial world. A woman who handles money in these divisions is called a "countess." These women become exceedingly skilful, accurate, and acute. They excel as detectors of counterfeits, and they are almost universally honest. The women workers are also very efficient as clerks and correspondents. Two or three women clerks in Washington get as much as $1,800 per year, although generally women are not paid as much as men for the same services. The "civil service examination" system, now in vogue, has been a great help to women desiring to become government clerks. They generally pass the competitive examinations with a very high average. There are numerous business colleges which give a very good course of training for bookkeepers and cashiers and other business workers. A six months' course is enough for some pupils, others require a longer one. The rates of tuition vary from about $40 a quarter of ten weeks to $120 a year. Women bookkeepers who are competent earn from $15 to $25 a week. Those less proficient can not earn so much. Cashiers get less pay than bookkeepers as a rule. Women who have a special talent are perfectly able to take charge of the books of any business, and to earn a salary of from $1,500 to $1,800 a year.

Expert and Public Accountants

Modern business methods and the demand for expert work in the field of accountancy have created the specialists known as certified public accountants. The notice of business men has been called to the necessity of employing the safeguards which modern business experience has shown are required in the regulation and systematizing of business interests. A wrong system of accounting, if persistently pursued, leads to disaster. Even a right system, if in charge of careless and dishonest bookkeepers, is equally disastrous. The mistakes of inexperience and ignorance have accounted for the failure of many an apparently healthy business. These conditions, as before inferred, have made necessary the existence and usefulness of the certified public accountant. "Our services," says a member of a firm of accountants, "are available to non-subscribers, that is, firms who do not enter into yearly contracts with us, and the work done will be charged for separately and on the merits for each transaction; for instance, our fee to a non-subscriber for consultations of ordinary length by correspondence or in person is $5. For more lengthy and intricate matters requiring also difficult mathematical solutions and adjustments, our charges are based somewhat on the amount involved and the importance of the transaction as well as the time expended in accomplishing the work."

The Credit Man

Few positions require so much business experience and knowledge of human nature as that of the credit man in a mercantile house. By proper methods he may save his firm hundreds of dollars. Not only must he know the rating of customers, but he must be able to run to earth any dishonest schemers who may have taken an unworthy advantage of the firm's generosity. An instance in which a credit man displayed his faithfulness and cleverness occurred in the business of a large hardware house. A customer in the West, of good standing, ordered a large bill of goods, as it appeared. Nothing was heard from him, and a young credit man was put in charge of the case. He ascertained that a man purporting to come from his own firm had gone to the freight-house and informed the agent of the railroad that the consignment must be sent to a different city. Following the trail, the credit man found that, at this destination, the goods had again been reshipped to still another town, where the consignment had been split into two parts and each of these had been sent to separate cities on different railroads. The goods were finally traced to a warehouse and recovered by summary process of law. The thieves were balked, and the credit man had done good service for his house and earned promotion. Sometimes the credit man, by a little firmness and judgment, may save the firm much money. For example, in some cases of assignment a credit man may refuse to accept a small settlement and force the customer to pay the firm's just claim in full, so that he may secure a discharge of his whole indebtedness and start afresh. In helping a customer over a tight place, the credit man must take into consideration his general worthiness, his business ability, and his prospects. A customer to be helped must show soundness both in material and in moral worth. Honesty alone, without some trace of business ability, and the possession of some elements of business success, will not suffice for the extension of credit. Men who barely eke out an existence are not good subjects for the leniency of the credit man. Looked at in a large way, such men are virtual failures, even though they may be solvent.

CHAPTER XII

HOTEL, BOARDING HOUSE AND RESTAURANT BUSINESS

Hotel Statistics—Travellers' Hotels in the United States—Hotel Management—The Hotel Proprietor—The Conduct of a Great Hotel—Hotel Employés at the "Front"—The Hotel Steward—The Hotel Housekeeper—Skilled Labor and Promotion for Hotel Employés—The Tipping System—Resort Hotels—Boarding and Lodging Houses—The Restaurant Business and Waiters—Quick Lunch, Supper and Tea Rooms

Hotel Statistics

ACCURATE statistics of the hotel business of the United States can not be given, either as to capital invested, number of employés or profits. The hotel guides place the number of hostelries at 18,000, but the number of hotel keepers given by the last Census is 54,900, of whom 8,500 are women. The publisher of the Hotel Red Book says: "We leave out nearly all towns of less than five hundred inhabitants. I should think you could safely add 25 per cent to the number—18,000—described in our guide. Nor do we take any account of so-called family hotels, of which there are a vast number."

In New York City alone, in addition to the great new hotels, plans for still another $40,000,000 worth of hotel structures were filed in 1902. This means that employment will be offered in 1903-4 to 4,000 additional hotel hands, for the percentage is about one hundred employés for each million dollars invested.

In New York State there are probably three thousand hotels of all classes. In New York City there are one hundred of the better class.

The number of employés in the hotels of the whole country ranges from fifteen hundred or more in one of the great hotels in the cities, to five or six in a country hotel. The average number of employés may easily be placed at thirty, making for say 20,000 hotels a total of at least 600,000 persons in the supposed minimum number of hotels. In some of the greater hotels, there is an average of one employé for each guest, though this is above the average, which is probably one employé for each two guests.

The capital invested in the 20,000 hotels reaches its highest point with $15,000,000 in a New York hotel, before referred to. The lowest consistent average would be $10,000 for each hotel, or $200,000,000 for the hotels of the country.

All these figures are probably too low, and all of them are intended only to convey a suggestion of the extent of the hotel business in America.

Travellers' Hotels in the United States

In the United States people travel principally for business. In Europe, for pleasure. Why? "Because," say both Americans and foreigners, "excepting in the great centres of population or at the summer, winter and health resorts, hotel accommodations in the States are wretched, while in England and on the Continent one is almost certain to find a comfortable bed and a well-cooked meal every few miles." Practical hotel men admit there is ample room for the investment of capital, and splendid promise of returns, in the building of better hotels in the towns and small cities. Travelling salesmen complain not so much of lack of hotels, as of the "badness" of those now inviting patronage. This is especially true in the New England States. In one manufacturing city in Massachusetts—by no means a small place—a traveller arrived at the largest hotel and asked for a room with bath. "There's no such thing in any hotel in the city," said the clerk. A once prominent actor, now retired and a chronic dyspeptic, says: "What ruined my health? The cooks in the kitchens of the hotels in the smaller cities of this country." There are towns in every State which need better, cleaner, more comfortable hotels. The man with even a small capital who can pick out one such town, and open a good hotel, will earn the gratitude and the dollars of travellers. A railroad guide-book says: "At every station there is a hotel, or what passes as such." The trouble lies with those which "pass as such."

Proprietors of the older houses are having a rather hard time in these first years of the new century, principally because of the number of new hotels everywhere rising skyward, with a bath, or running hot and cold water, steam heat, and telephone in every room. The hotel man, with the old house on his hands, complains that the supply of first-class houses exceeds the demand, but his outcry is only a demonstration of the first law of nature, self-preservation. The newer hotels, with "every improvement" charge no more for accommodations than the old-fashioned houses. Nor can the proprietor of the old-time hotel afford to reduce his rates. And there the matter stands. But the hotel that still burns gas, is not fireproof, lacks private bathrooms, and makes the guest eat his dinner at a table with strangers, must give way as did the stage-coach to the railroad, as did the horse-car to the trolley.

Hotel Management

Success in the hotel business is not so much a matter of volume as of management. A large hotel, badly managed, may yield a lower profit for each guest than a small house well managed. There are large hotels so wofully mismanaged that they would long ago have seen sold under the hammer were it not for a transient patronage of a class which prefers show to comfort. These hotels have no permanent guests. On the other hand many small, modest hotels, making no great display without, are nevertheless homes within. They are so managed that their names, the country over, are synonyms for comfort. These hostelries are nearly always filled with permanent guests. Organization amounts to practically the same thing in either the large or the small hotel—the difference lying wholly in the extent of the business thus organized.

The secret of tranquillity, of smoothness, in running a large hotel, is organization as thorough as that which characterizes an army. This organization begins with the proprietor, as represented by the room clerk, who welcomes the coming guest; and ends with the proprietor, as represented by the porter, who closes the carriage door for the guest at his departure. As is the proprietor, so is the establishment from roof garden to wine cellar. Though the proprietor is seldom in evidence, though few of the guests know who he is when they pass him in the corridors, yet like the captain of a transatlantic liner he must be ever on the watch. Not for one minute in twenty-four hours can he be said to be off duty. He is personally responsible for the safety and comfort of his guests. He must be guide, friend and philosopher to all within his gates, from the man in the single room on the top floor to the distinguished foreigner in a Royal suite, such as that rented for the purpose in a great hotel in New York. He acts as witness at weddings, and is bondsman in legal matters; attends christenings; is master of ceremonies at social events; soothes the lone traveller on his death-bed. Upon demand he is banker, postmaster, and fiscal agent for any of his patrons.

The Hotel Proprietor

During the last fifteen years many changes have taken place in the matter of managing first-class American hotels, but none has been more noticeable or more radical than the effacement of the proprietor. In former days, much of the success of the house depended on the attitude of the proprietor toward the guests. Though his manner had, of course, lost all the servility—the rubbing of hands, the bowing and scraping, and the backing from the guest's presence—of the boniface or host of the inn of last century, yet up to fifteen years ago the American hotel proprietor personally welcomed the coming guest and speeded the parting, meanwhile attending diligently to the duty of having his daily drink with the man of the family, and making his daily inquiries as to the health of the wife and seeing that the children were occasionally supplied with candy. All this has changed, and, as has been said, the proprietor has dropped into the background. The general management, the perfection of detail, and courtesy on the part of every employé of the house are now the elements that count most in hotel management.

The Conduct of a Great Hotel

Some idea of the immensity of modern hotel enterprises can be gained by the following statement, made by a representative of one of the largest hotels in New York:

I cannot state the salaries of our different employés, but might add that it amounts to about $50,000 monthly. I do not know anything whatever about what tips may be handed to them by the guests. I presume in the case of waiters and such employés it is a considerable amount. Our house will average about 1,400 guests per day for nine months in the year, and about eight or nine hundred for the other three; no season of the year excepting summer affects this, there being no dull period during this time excepting Christmas holidays. The capital invested, taking into consideration value of ground, buildings, etc., is $15,000.000.

The number of our employés averages 1,500; there are periods during the year, such as Horse Show week, for instance, when they will run up to 2,000 and over. Regarding the length of their service, some remain for a considerable period, many of them having been in the house since it was opened; as a rule, however, a certain class of employés, specially waiters, are of a roving disposition, and it is not uncommon for them to work their way around the world, remaining very often for only a short time in each city; this means that they obtain a practical knowledge of their business in different countries and return again to their own country, where in many instances they become hotel keepers themselves.

There are in the hotel above referred to over 1,000 bedrooms and 750 bath rooms, all opening to the outer air. This has been accomplished by a series of inner courts. The height of the hotel from the sidewalk to the observatory roof is 250 feet: there are three great ball rooms and several concert halls; and private dining-rooms which will accommodate from 10 to 1,000 persons.

Some idea of the magnitude of this great hotel may be conceived when it is said that the Charity Ball, which is the largest public ball in New York, and at which 3,500 guests are present, can be given, completely isolated and separate from the hotel proper, so that the hotel guests do not know a great function of this kind is going on. Mention of the quantities of supplies consumed may be interesting. For the year 1902 the bills for various items of food were as follows:

Meat	$200,000.00
Poultry	113,000.00
Vegetables	80,000.00
Fruit	42,000.00
Eggs	12,000.00
Butter	57,000.00
Flowers used in decoration	30,000.00

Hotel Employes at the "Front"

The staff of a great hotel includes the manager, cashier, chief clerk, steward, chef, headwaiter, housekeeper, chief of detectives, chief electrician and chief engineer, the musical director, head porter and head bell-man. Each of these is the head of a branch of the service, and the employés under each head form the rank and file of the hotel army corps. Each branch is conducted independently of the other, so far as expenditures and receipts are concerned, so that the proprietor, in half an hour, can at any time know the exact financial condition of the business. The heads of the important branches make daily reports in writing.

The manager is the direct personal representative of the proprietor. He is to the business organization what the adjutant-general is to the army. He receives the highest salary—next to the chef. The chefs of two or three of the greater hotels are paid $10,000 a year, while the chef of one particular hotel in New York draws even more.

Next in importance, as representatives of the proprietor, come the clerks in the office, the room clerk or "front" clerk, the cashier and the key clerk. What are the qualifications of a good hotel clerk? He must be not only what is known as affable and courteous and of presentable appearance, but he must also be well informed on the topics of the day; he must keep posted on local events, but above all he must be quick to understand the man or woman with whom he has to deal. He must be well balanced mentally, and must possess the patience of Job. Other necessary qualifications for the room clerks are a perennial smile, a flawless attire, a superhuman knowledge of superficial things, and an automatic memory for faces and names. He must be able on the instant, and a hundred times a day, to associate face, name and room-number accurately. These hard-working young men receive from $50 to $60 a month in small hotels, to $400 a month in the great hotels, and a room under the skylight.

The cashier is practically the executive officer of a bank. He conducts financial operations on no small scale. He must know which checks to cash or to decline, must know to whom money may be advanced safely, how "long" or "short" a credit to give each guest, and help audit all accounts. His pay, as a rule, is a trifle less than that of a room clerk, and in the larger hotels he must sometimes give bonds.

The Hotel Steward

The chief steward is the hotel commissary-general. He is the purveyor in chief. He supplies everything to eat and to drink, and to make merry with. He has his office somewhere in the subterranean part of the plant. He must know where and when to buy the best of foods, the rarest of delicacies, the oldest of wines. He goes abroad every summer at the hotel's expense to buy, buy, buy. The chief steward of one large New York hotel is responsible for three-quarters of a millon dollars' worth of cigars and wines in the store rooms, and for a quarter of a million in silverware. His pay is about the same as that of his prototype in the army, the commissary-general, which is $5,500.

The chef, like the foreman of a department wherein skilled labor is employed, seldom works with his own hands. He thinks for the sub-chefs, and directs their hands. In the busy hours, when hundreds, even thousands, of meals are being served above he takes his place in the centre of the kitchen, shouts his orders like a marshal of France, and always wins the battle. He has a separate chef in charge of each of the departments of soups, entrées, vegetables, meats and desserts, and as each sub-chef has many ordinary chefs under him, there are about one hundred in all. Yet there is never a case of "too many cooks spoiling the broth."

The Hotel Housekeeper

Among other important departments in hotel management is that in charge of the housekeeper. The kind of housekeeper employed by a hotel is revealed in the kind of chambermaids and other female help, just as the efficiency of the head bellman is indicated by the efficiency of the boys under him. A good housekeeper is often difficult to secure. If the housekeeper is easy-going and careless, or is blind to certain defects in the work of her subordinates, the girls soon discover the weaknesses of the woman who employs them. Like the waiter in the restaurant, who on the first day of his employment in the hotel knows the kind of service he must give to qualify as a permanent employé under the head waiter, so the chambermaids recognize at once just how complete or just how half-hearted their work may be, in order to hold their positions under the housekeeper.

As to the qualities necessary for a good housekeeper, the woman who has made the best housewife will also make the best hotel housekeeper. It is the duty of the woman holding this position to make a round of the rooms regularly on a tour of inspection. Some housekeepers go into a room, look around and, by their silence, pronounce it in perfect condition. Whereas a housekeeper with a keener eye to cleanliness would have noticed that there was dust on the top of the curtain pole; that the surface of the mirror was dimmed by dust or that some of the catches on the hangings had slipped their rings. It is the housekeeper with the eye for small defects that is of the greatest value to a hotel, as the great defects can be seen with an ordinary eye. The housekeeper has charge, too, of a great number of furniture men, laundresses, and other servants. Also of a great stock of property, such as chairs, tables, rugs, sheets, towels and blankets. All mending, too, comes under her superintendence, and the cleaning of windows, the polishing of brass and scrubbing of floors.

Skilled Labor and Promotion for Hotel Employes

Almost all the large hotels are self-sufficient in the matter of skilled labor. Each has its own cabinet-makers, silversmiths, tinsmiths, plumbers, paperhangers and decorators, steamfitters, brassworkers, electricians and printers. One or two of the greater hotels have their own looms in Belfast kept busy the year round for replenishing the linen, an item of \$25,000 to \$50,000 a year. Some have, too, their own tobacco plantations in Cuba, for their special supply of cigars. Many hotels spend from \$30,000 to \$40,000 annually in improvements, in keeping the equipment up to the standard. Every large hotel has its own police force, including private detectives, the secret service men of the hotel army corps.

In such institutions it is obvious that there is just as much chance for advancement as in any of the great business enterprises of the day. The room clerk at one of the best-known hotels was a "bell hopper" ten years ago. He is now the manager. Graduates, as it were, of the larger hotels are constantly in line for higher positions in smaller first-class houses. Opportunities for advancement for young men and women in the hotel business, indeed, are more numerous and more constant than in some other lines of work. In the lumber business, for instance, promotion to a position beyond the most ordinary is not obtained until after many years of hard work, nor until a man has become thoroughly familiar with all branches of the industry from the study of the trees in the primeval forest to the most intricate machinery in the process of manufacturing. Among the vast number of hotel men in this country it would be hard to find half a dozen proprietors of first-class houses who are not constantly on the lookout for talent in their employés. The hotel proprietor is elated when he discovers ability of a high order in any one of his people. He is only too glad to reward efficiency, thoroughness, punctuality or originality with promotion. Does he see the mere promise of ability he will go out of his way to encourage its development. He knows that the more promotions he can make, the better will be the service of his hotel. Moreover, hotel help is much better paid than are workers in other fields of industry. Female workers, besides their pay, are housed and fed, while the male helpers are given their meals in addition to their pay. With wages and tips the average hotel waiter makes about $75 per month. The earnings of other employés depend upon the class of work they do, and upon the class of guests. One peculiarity of the hotel business and one which distinguishes it from all other kinds of business is that in the dull season it is not possible to materially reduce the number of employés. In a shop, for instance, when trade falls off in the summer, the proprietor may dismiss a number of hands, retaining only just enough for the actual conduct of the business. In a hotel, however, this is not possible.

The Tipping System

Travellers and people who live in hotels often wonder if there is not some way by which hotel proprietors can do away with the tipping system. But no method of obviating this great American custom has been found. Were the proprietor to put up a notice that employés would not be allowed to receive tips his force of help would immediately be depleted, thus crippling the running gear of the house, as it were, so seriously that guests would flee in dismay.

The majority of waiters in the highest grade hotels are Swiss, the best waiters in the world. The number of waiters in one great hotel is 750, but this number is increased at times to 1,000. These waiters make from $30 to $100 a week—principally in tips. Many of them are more independent, financially, than the patrons to whom their hands are ever extended for a *pour-boire* of at least ten per cent of the bill. All waiters in all hotels dislike to wait on the proprietor or his family, for in this direction lie no tips. Again, the smaller, quieter hotels of the first class are obliged to pay first-class waiters higher wages, because here again a small patronage makes a small aggregate in tips. In the matter of tips, it is notorious that the best waiters are to be found in the restaurants that yield them the largest perquisites. Where so-called tips are not forthcoming, waiters either abandon their posts entirely or perform their duties in such a perfunctory way as to be a discredit to the house, and a bane to the guests.

Resort Hotels

One of the most important branches of the hotel business is the conduct of resort hotels. Some of these, like the houses at Lakewood, Atlantic City, Old Point Comfort and the Hot Springs of Arkansas, are open all the year. But the greater number are short season houses—the summer months in the North, the winter months in the South. Many of the Jersey, Long Island and Florida coast hotels are open only two or three months in twelve. Mammoth houses like those at Long Beach, St. Augustine, Palm Beach, Saratoga and Tampa, must be filled during the season or a fortune is lost. Many proprietors of short season houses run two hotels, one at a summer resort, and the other at a winter resort in one of the large cities. So great is the number of resort hotels on the Atlantic Coast, that it might be possible for persons cruising on a yacht from Bar Harbor to Key West, to put in-shore at random every night, and sleep at a great inn. In the mountains and in the mineral spring regions of the interior, too, are scores of hotels with accommodations for health and pleasure seekers—through Virginia, through the Land of the Sky, then west through Colorado, ending with superb hostelries on the Pacific Coast, at Coronado Beach and Monterey. Where the proprietor owns two resort hotels, he usually transfers his employés in a body, from one to the other, for their respective seasons. Most of the resort hotels are run on the American plan, and, in good seasons, the profits are large.

Boarding and Lodging Houses

All that has been said in the foregoing pages regarding the management of hotels applies also to boarding and lodging houses, the assumption being that any establishment that rents room accommodations or furnishes meals is a hotel. The cost of board and lodging is, of course, much less in boarding and lodging houses than in regular hotels. The service, accommodations and cuisine are on a correspondingly lower scale. But, as every one knows, there are many different classes of boarding and lodging houses, just as there are many different classes of hotels. In any large city it is possible to obtain quarters in lodging houses at almost any rate a day between ten cents and four or five dollars; similarly, board, including lodging, may be had at any price a day, from fifty cents to ten dollars.

The vast majority of boarding and lodging house keepers are women—the statistics of this business for the United States showing that out of a total of 72,000 proprietors of houses of the kind, 60,000 are women. In every large city there are hundreds of boarding and lodging houses. In certain neighborhoods in New York, Boston, Philadelphia and the other great cities it is not unusual to find that rooms and board may be had in every dwelling on each block for several continuous blocks and on both sides of the street. In many mountain and lake regions, in summer, boarders are taken at every farmhouse for miles around.

Many women believe that "taking boarders" is a good way in which to add to their incomes. Some of them, however, claim that it is a thankless and profitless task. The latter fail because they are unwilling to learn the business, for, as before averred, it is a business just as much as is running a hotel.

The Restaurant Business and Waiters

A department of utmost importance in the management of a first class hotel is the restaurant. The restaurant is the index of the character of the house. It is an indication of the character of the management above and below. Some hotel managers may say that the greater part of the proprietor's attention should be given to the cuisine; if a good chef is employed, paid well, and given to understand that he is personally responsible for his department, things in the regions below stairs will be conducted in a manner that will give satisfaction upstairs.

Hotel guests recognize good service, and are repelled by a poor and negligent service; but, as a rule, they are not aware of the source that influences good or poor service. They know when an individual waiter is attentive or neglectful, but they do not realize that as is their individual waiter so is the entire restaurant corps. The character of the service in a hotel restaurant is the direct influence of the head-waiter. If the monarch of the dining-room is a disciplinarian, if he possesses all the qualities that make a first-class head-waiter, all those under him will testify to his excellence or betray his carelessness in the way they do their work. Head-waiters are hard to find; that is, waiters of the right kind. Money will not buy them, but most hotel proprietors would willingly double the amount paid to the head man in the dining-room for the sake of having the right man in the right place.

The most popular class of restaurants comprises those which are conducted simply as "eating houses," without connection with hotels. The number of such restaurants in the United States (the number includes only the larger establishments) is 34,000, of which 5,000 are owned by women.

It is a peculiar fact that all the first class restaurants serve a greater number of dinners than of any other meal, while in restaurants not included as first class, the greatest business of the day is done during the luncheon hour.

Quick Lunch, Supper and Tea Rooms

The "Rotunda" of a famous old New York hostelry led the way to the development of the modern "quick-lunch" restaurant. In the business district the clerk is allowed an hour for luncheon, or sometimes only half an hour. The employer takes a few minutes off, or foregoes his luncheon entirely. The quick-lunch counters have eliminated the custom formerly obtaining among clerks of carrying their luncheons with them in a basket to the office. The counters of a quick-lunch establishment offer for consumption a heterogeneous collection of edibles. Pie leads as a prime favorite. Remaining items on the ménu are hard-boiled eggs, ham sandwiches, coffee, cocoa, prunes, cakes, etc. The floors, and often the walls, are of porcelain tiles. In some of them there are rows of chairs with one broad, flat arm to serve as a table, often with a small socket to receive a coffee cup. The customers, put upon their honor, serve themselves with food from the vast commissariat of the counters, or take it from the waiters. While there is apparently no check on the dishonesty of patrons, it has been remarked that the fraudulent customer is very soon detected, and is assisted to the door with extraordinary celerity, being cordially invited *not* to come again.

A modern development is the host of downtown luncheon clubs in various cities maintained by lawyers, hardware men, woollen merchants, underwriters and the transportation interests. Some of these luncheon clubs are luxuriously fitted up, and are rather expensive.

There are two luncheon clubs for women in New York. There are also very expensive and luxurious restaurants in the downtown business district.

There is a downtown restaurant in New York with a vast clientile, catering to produce dealers, farmers, butchers, and clerks. This excellent establishment feeds an army every day, not having locked its doors, day or night, in thirty years.

Some large business institutions provide gratuitous luncheons for their employés, granting them half an hour for eating. This custom, however, is never popular with the clerks, who prefer their independence.

In the shopping district of all cities there are luncheon places crowded almost exclusively by women. In the great department stores there are very good restaurants, with reasonable prices, which are very well patronized. There are also in this section cheap table d'hote luncheons, crowded with shop women.

In the theatre district of every city there are high-priced restaurants, which cater to the midnight crowds. Here there is glare and bustle, and the prices charged for special dishes are not at all modest. These restaurants, as before inferred, are well nigh deserted at noon.

To a woman who is thrown on her own resources, and wishes to earn a living, a very practicable and available method is to open a tea room. This is within the capacity of any woman. Restaurants exist by the hundred, but a tea room is a different thing. It should not be too far from the shopping district, and daintiness, in surroundings, service and viands, should be its aim. There are three or four successful tea rooms in New York, generally on a side street, near one of the great main thoroughfares. The bill of fare, though not very long, is made up of dainty dishes.

CHAPTER XIII

MISCELLANEOUS MANUFACTURING AND BUSINESS PURSUITS

The Match Industry—Match Factory Employés—The Manufacture of Bags and Boxes—Button Manufacture—The Pearl Button Industry—The Manufacture of Pens—The Manufacture of Lead Pencils—Toy Making—The Manufacture of Pins—The Manufacture of Needles—The Turpentine and Resin Industry—Glue Manufacture—Manufacture of Dyestuffs—Manufacture of Electric Motors for Automobiles—Manufacture of Electric Motors for Street Railways—The Tin Can Industry—Flax, Hemp and Jute Products—The Cordage and Twine Industries—Roads and Pavements—Artificial Stone—Manufacture of Fertilizers—The Mail Order Business—The Safe Deposit Business

The Match Industry

IN the twenty factories in the United States in which matches are made, two thousand persons are employed. They are paid nearly one million dollars annually in wages. As many more are employed by practically the same companies in supplying the materials from which matches are made. It is estimated that each man, woman and child in the United States uses five matches a day. For eighty million persons this would make a total daily consumption of four hundred million matches, or a hundred and fifty billion in a year. One of the Diamond Match Company's plants, at Barberton, Ohio, probably the largest plant of the kind in the country, has facilities for turning out one hundred million matches per day. Another way to convey an idea of the number of matches used is to state that the consumers annually burn matches to the value of $6,000,000.

At least ten million dollars are invested in the match industry throughout the country, one-half of the total investment being in match factories proper, and the remainder in lumbering and manufacturing enterprises which form part of the match plants and which supply the raw material, if such may be called the splinters of wood from which matches are made. It is related that one winter the largest of the match companies fitted out a lumbering expedition, consisting of six thousand men and twelve hundred horses. One hundred and eighty-five million feet of lumber, in logs, represented the total amount cut, and it cost two-thirds of a million dollars. All that lumber was converted into matches.

In the making of all these matches the factories use annually over forty million square feet of one-inch pine lumber; three and one-half million pounds of brimstone and paraffine in saturating the ends of the sticks; six million pounds of chemicals in making the match head; and finally sixteen million pounds of strawboards and paper in boxing and wrapping, or about two million boxes a day. All American matches of to-day are made by automatic machinery. With every revolution of a certain wheel in one machine forty-four matches are cut from a block and set. On an endless chain the sticks of wood pass through another machine, which dips their ends in paraffine, then on to a third machine, where the head is put on, then to a fourth machine, where the matches are boxed. The boxes, too, are made by machines most wonderful in their operation. All the chlorate of potash and the greater part of the other chemicals used in making match heads are imported. The material could be made here just as well, but the lower wages paid for labor abroad accounts for this item in the lists of imports. As in all industries, manufacturers are ever on the lookout for new inventions and improvements in machinery. For this purpose one company maintains a staff of inventors and expert mechanics at an annual cost of fifty thousand dollars.

The Diamond Match Company, the principal, if not the only, combination in the match industry, is a regularly incorporated and yet a co-operative concern, in which every important employé in the business, from time to time, is aided in becoming an owner of stock. The policy of the management in this respect has gained for the business a corps of able young men in every branch of the company's several factories and stores. The company controls nine plants and has a capital of fifteen million dollars.

Safety matches, of both the imported and domestic varieties, are rapidly taking the place of the old-fashioned parlor match. A municipal law was passed making illegal the sale of parlor matches in New York City after March 1, 1903.

Match Factory Employes

The constant inhalation of phosphorus results in a terrible and deadly disease known as necrosis of the jaw, which means the death of the jaw bone. A warning is usually mercifully given to match makers by toothache—the first symptom of the disease. Match makers often inhale so much phosphorus that their very breath shows phosphorescence in the dark, and as the evil results begin in the mouth, only persons with absolutely sound teeth are employed. The slightest defect in the teeth presents an opportunity for the dread disease to begin its deadly work. Much of the evil effect of phosphorus is avoided by compelling the operatives to wear small tin boxes, containing turpentine, suspended at their necks. Operatives in match factories who wish to commit suicide scorn the rope, the pistol, the dagger or the river; they simply swallow a number of match heads, knowing that, in so doing, self-destruction is assured.

One young girl had been working in the match factory for four years. Her wages averaged $1.50 a day. She was of delicate constitution, but when the whistle sounded at seven o'clock in the morning she never failed to be in her place at the machine at which she toiled side by side with other girl match makers. But this morning the niche which was hers in the match world was vacant. Presently the superintendent received word from her home that she had—it. "It" was the awful, and the expected. "It" is to the match industry what the plague is to the people of India. When least expected the body is smitten, and not often does the victim survive the attack. So she had "it" (necrosis of the bone). If the bone had only been that of her lower jaw there might have been some hope, but the attack was upon her upper jaw bone, and that is fatal. She died.

Such is the danger to which match makers are subject. The danger has been reduced to the minimum, by the use of machinery, and by the fact that match magnates have constructed factories architecturally adapted to the business of match making—well ventilated, well lighted, and having every safeguard. But persons of delicate or scrofulous constitution, despite the efforts of science, should avoid inhaling the fumes of phosphorus, and should therefore avoid employment in match factories. The girl match maker who died of the hideous disease had been in contact with phosphorus for four years, and, as she was of frail physique, it was a wonder she so long escaped paying the penalty. Strong persons in modern match factories are as safe as they would be in any factory where chemicals are used, but the weak, the scrofulous—these had better fly from phosphorus as from the plague.

The Manufacture of Bags and Boxes

The manufacture of bags and boxes as a business ranks with that of cooperage. It is a separate industry, however, the amount of business done depending on many of the greater industries, such as flour mills, salt manufacturers, coffee grinders, cotton growers, etc. Seven or eight large bag manufacturers in New York turn out about four hundred thousand bags of all kinds in a day. The number of imported bags is only twelve thousand a day.

Bag and box manufactures may be divided into five classes, namely: paper bags, burlap and all bags other than paper; cigar boxes, fancy and paper boxes, and wooden packing boxes. In the two branches of bag manufacture the invested capital amounts to $15,000,000 and the employés number 7,000. In the three branches of box manufacture the invested capital amounts to $40,000,000 and the employés number nearly 60,000. The average annual value of the product of paper bags is $7,000,000; of burlap and bags of similar material $20,000,000; of cigar boxes $6,000,000; of fancy and paper boxes $27,000,000; of wooden packing boxes $38,000,000.

There are companies who make a business of loaning bags. Manufacturers or shippers pay a certain sum for their use for a certain time, just as one would rent a piano, or pay for the use of library books. When the bags are emptied they are returned to the firms who loaned them.

Button Manufacture

Eight million dollars a year for buttons is the amount spent in the United States. Two hundred and thirty button factories, with a capital of four million dollars, supply our wants. Brass button manufacture is the most interesting feature of the industry. One firm alone makes as many as five thousand varieties for uniforms for officials of all kinds, from army and navy officers and men, railroad employés, policemen, postmen, and others who wear a uniform or livery, down to "buttons" who opens the door of the shop in which buttons are to be bought.

Ivory buttons are made from vegetable ivory nuts, grown in South America and gathered by the natives and shipped north. These nuts constitute to-day the principal article from which ivory buttons, sometimes called bone or horn, are made. They are cleaned, sawed into slabs or pieces for the various sizes of buttons, and then turned into any size desired by special tools made for the purpose. The buttons are finally dyed the desired color, and this is one of the principal features of button manufacturing in the finer grades of goods. The product goes largely to the wholesale clothing manufacturers and merchant tailors.

There are three kinds of buttons, "shank," "hole," and "covered." Waterbury, Conn., is the centre of the metal button industry. Metal buttons, oval or flat, are made from rolled brass plate. In the manufacture of covered buttons nearly all the "lastings" and other parts of the machinery for covering are made in this country. New machines have constantly been introduced, until most of the process is now automatic. The raw material of the horn button is generally the hoofs of cattle. The hoofs are boiled, which process softens them, and are cut by machines into pieces, which other machines form into buttons. Patterns are stamped upon them by a hydraulic press. Holes are bored and polishing is done by still different machines. For the vegetable ivory button the raw material is the seed of the fruit of the Phytelephas Macrocarpa, a low growing palm of South America. Most of this material is shipped from Colon, Colombia, and is commonly called the "ivory nut." It is about the size of a hen's egg, resembling the finest ivory in texture and color, and is highly susceptible to the reception of dyes. The home factories now rival the European product.

Composition buttons, now a successful manufacture, are made of a plastic material which becomes hard when cold, the ingredients being certain fossil and vegetable gums, combined with finely comminuted carbonate of lime, feldspar, mica, and other similar minerals. After amalgamation with the gums, the product is run off in sheets and allowed to cool. These sheets are softened by being placed on hot platens, and are then ready to be cut into strips for the dies.

Progress in this department has been so great that, with the new automatic button machines and mixers, two of the factories in the United States producing composition buttons are among the largest in the world. These are in Pennsylvania and New York.

Buttons are made from celluloid, especially the campaign and society button. There are also photograph buttons. Buttons are likewise made from casein, blood, and seaweed.

The United States Patent Office has granted, up to the year 1900, 348 patents for button machines, and 1,355 for the making of buttons.

The Pearl Button Industry

Of all the branches of the button industry in this country the most important is the manufacture of pearl buttons, which are made from mother-of-pearl and from the shells of the "Unios," abundant in the Mississippi River. In value, these buttons have recently formed 48.4 per cent of the entire product of the button industry. The buttons made of mother-of-pearl are technically called "ocean pearl," and those made of the "Unio" are named "fresh-water-pearl." The higher grades are still made from the ocean shell. In 1900, the making of fresh-water-pearl buttons constituted the second most important branch of the button industry.

The majority of the factories of the West do not finish the buttons, but send the blanks to Eastern factories which have the improved machinery for finishing. Such is the depredation of the shell deposits that there is some fear that, unless something is done to protect the mussels, the raw material for this industry will soon be exhausted.

The manufacture of buttons from the native fresh water shells began in the United States in 1891, impetus being given to the business by the high tariff on imported buttons imposed by the tariff bill of 1890. A remarkable development was witnessed in 1898, no less than thirty-six factories being established during the first six months of that year. The United States Fish Commission reports that pearl button making is one of the principal businesses along the Mississippi between Iowa and Illinois. It gives employment to large numbers of people, at good wages for such labor. Besides the workers directly connected with the business, many others in more than a score of towns are benefited, including merchants, machinists, boatmen, draymen, and transportation companies. At Muscatine, Iowa, there were eight or nine button-making establishments in operation in 1897, six of which began work in that year. In 1902, there were forty factories in operation. At other places in the same region there were five factories in 1897, and twenty in 1902. Besides men, who have the more arduous and important duties, many boys and girls, who would otherwise be idle, are given employment. In 1897, the employés in the button factories of the region numbered eight hundred. The number at present is nearly fifteen hundred. The best wages are received by the cutters. In the larger factories they are paid from five to ten cents a gross for "rough blanks," according to size. Skilled men can cut from one hundred and fifty to two hundred gross of blanks per week, and can earn $15, but the average is from $8 to $10.

The Manufacture of Pens

More than four million dollars worth of pens and pencils are consumed annually in the United States. A capital of nearly $4,000,000 is invested in more than fifty establishments in this industry.

The material used in the manufacture of pens is cast steel, of the best quality, imported from England or Sweden. The best variety is made from Swedish iron. The steel is received in sheets, which are cut by the manufacturer into strips of convenient width, and are packed in an oblong iron box, and this is put into another iron box, the interstices being filled with a composition to exclude the air. The boxes are then gradually heated in a furnace until red hot, and then gradually cooled. To remove the scaly roughness, the strips are immersed in diluted sulphuric acid, and are then placed in wooden barrels containing water and broken pebbles. The barrels are revolved, and the strips are polished, becoming a silver-gray in color. They are then rolled to the required gauge, the more common thickness being the one hundred and sixtieth part of an inch. So far the work has been done by men and boys, but the "forming" and "shaping" processes are carried on by women and girls. The cutting of the blanks is performed by a die and a punch. The next process is the "marking," which is done with a stamp, operated by foot power. A skilful workwoman can stamp 200 to 250 gross of pens per day. Next comes the "piercing," which produces the desired elasticity and causes the ink to adhere to the pen. The blanks are put through a process called "annealing," to soften them, so that they can be properly shaped. Then comes the "raising," giving the pens the various shapes required. The blanks then go through a "hardening" process. The pans containing the blanks are then immersed in oil, which is afterward drained off. The pens are now greasy and brittle. The grease is removed by submersion in boiling soda water.

The pens are then tempered to the desired degree of softness, indicated by the color of the metal. After "scouring" in diluted sulphuric acid, the pens are placed in iron barrels, with a quantity of water and a material composed of "annealing pots" broken and ground fine, and the barrels are kept in motion from five to eight hours. The pens are then placed in barrels of "drypot" for the same length of time, and then into other barrels, together with a quantity of dry sawdust. Then they are ground between the centre piece and the point by a "bob" or "glazer," this being done by girls. Last, and most important, is the "slitting," performed by tools known as "cutters." Again the pens are smoothed by revolving in iron barrels with "pounded pot," and afterward are polished in sawdust. They are colored by being placed in a copper or iron cylinder which revolves over a coke fire until the desired tint is secured. When the pens are to be lacquered they are placed in a solution of shellac dissolved in alcohol, which is drained off, and the pens are then dried in revolving iron cylinders, and heated in ovens until the lacquer is equally diffused over the surface. After a careful inspection they are now ready for the market.

The perfected gold pen is the result of the efforts of the American manufacturer. The gold used in the construction of this article is obtained from the United States Assay Office; is melted and alloyed to about 16 carats fine and rolled into a long narrow ribbon. From this pen blanks, or flat plates in the shape of a pen, but thicker, are cut by a lever press or a die and punch. The blunt nib is notched to receive the iridium forming the hard point. When the iridium is secured by "sweating," the blank is passed between rollers. After this the nib of every pen is stiffened by hammering, giving it the required elasticity. The convexity is obtained by means of a screw press. The iridium is cut into two points and the nib is slit. After grinding, the pen is polished upon buff wheels and carefully inspected. The growth of this industry is gradual but satisfactory. There are many varieties of fountain pens manufactured in this country. The stylographic pen is a variant of the fountain pen. In this, a blunt needle, incased in a sheath at the end of the holder, releases the ink when the point is pressed on the paper.

The Manufacture of Lead Pencils

In the manufacture of lead pencils the Conte system is used, and it would appear that the product has almost reached perfection. The raw material, graphite, used in most American lead pencils, is mined at Ticonderoga, N. Y.

The graphite is pulverized, and "floated," or separated, by being mixed with water and carried through a series of tubs. The graphite is now ready for the clay, which has been separated by a similar process. For a medium grade the proportions are about seven parts of clay to ten of graphite, the more clay used the harder being the pencil. The mass, mixed with water, is ground many times, to avoid grit and secure uniformity, and, the water then being forced out, it is sent to the forming press. The lead is forced through a small aperture and coiled on a board placed beneath, the coils are broken off in sections sufficient for three leads and baked in a kiln.

The material is now put in the wooden cases, pine or cedar, prepared for its reception. This is done by three operatives. The first places the lead in the grooves and passes it to a second, who receives another strip, with the grooves and surface coated with glue, from a third operative, and puts them together. The united pairs are pressed together and left to dry. The strips are smoothed and each is cut into six rough pencil forms, rounded on one side. Another cutter rounds them on the other side and the pencil is finished. Pencils are varnished by a machine at the rate of one hundred per minute. Certain styles are sharpened on a wheel. The work is cleanly and healthful. Except for the lead makers, most of the work is done by women.

Toy Making

Toys and games are made in nearly two hundred establishments in the United States. An enormous quantity of toys and games are imported, especially from Germany, and yet more than $3,000,000 is invested in the industry in this country, 4,000 hands are employed, and the annual output is valued at $4,000,000.

Santa Claus is sometimes a dragon. Not in this country, but in many places in Europe, where dealers in toys thrive on sweat-shops and child labor. In spite of European competition, where dealers are not above taking advantage of this child labor and the inconsiderable wages, the toy trade of the United States has greatly developed of late. Several important factories have been established, and are very successfully conducted. In the Eastern States there are three of four factories with a large output of wooden toys, doll-houses, doll-furniture, building-blocks, tubs, scrubbing-boards and hobby-horses. A floor in every factory is given over to painting the toys. Some of the factories are devoted to specialties. In Massachusetts, for example, there is one which turns out principally toy drums, tin soldiers and warships. Toys have a fashion, as well as everything else. The changing styles of battleships and of soldiers' uniforms must be indicated, or Young America is not pleased. New York City has some factories. In one of these, tin toys are constructed on four floors and sold on the first. In the manufacture much of the work is done by heavy machinery. There are several departments devoted to special stages of the process. On one floor is the cutting department, on another the soldering-room, on still another the painting section. Only in recent years was the first American doll factory established in this country, in what is now the Borough of Brooklyn, New York City. These dolls were so made as to be unbreakable. The process of manufacture is somewhat complicated. First come the molding of face and limbs from a patented composition, to produce the unbreakable variety. The ingredients are simple and harmless. The molds are filled with this composition. When the substance is sufficiently dried, the face and limbs are taken out and finished. They are first carefully polished, and eyes are inserted. Care for the complexion comes next, and the eyebrows and cheeks are properly painted. Little wigs, of various types, are now adjusted, and the doll's head is complete. The bodies and the limbs are made and attached in another department. The finished doll is dressed in a captivating costume, and is ready for her childish possessor. The popularity of American-made dolls is now firmly established, and they find a ready sale and a large market.

The principal toy manufacturers of the United States, in the early part of 1903, formed a combination, or "toy trust."

The Manufacture of Pins

In the manufacture of pins and needles in the United States, forty-three establishments are engaged, and 2,500 persons employed. The invested capital and the value of the product are each $2,500,000. Connecticut, the State renowned as containing within its borders factories for the making of more different articles than any other State in the Union, leads in the production of pins and needles, as in other articles generally classified as notions. The principal materials used—purchased usually in manufactured form—are steel wire for needles, brass wire for pins, and iron wire, aluminium, aluminium bronze, bar steel, burr steel, sheet metal, all these being used in certain varieties of pins and needles. An interesting feature of the industry is the number of pins and needles produced; the figures are ten billion pins and one hundred and fifty million needles.

In former days each pin passed through from fourteen to eighteen hands. The modern pin is turned out in enormous quantities by the Atwood or Fowler machines. The process is interesting. Wire is automatically drawn from a reel by a pair of pincers between fixed studs, and thus straightened. A pin length is seized by lateral jaws, and a snap head die advances and partially shapes the head. By a repetition of the squeezing the head is completed. About one-eighth of an inch of wire is required to make a pin head. These headed blanks then arrange themselves in the line of a slot formed by two inclined, bevel-edged bars, suspended by their heads, and pass along in front of a cylindrical cutter that points the pins. If of brass, the pins are now cleaned by being boiled in weak, sour beer, and coated with tin. They are brightened by being shaken in a revolving barrel of bran or sawdust. Lastly comes the process of papering by an automatic papering machine. The pins are placed in a hopper in connection with which a steel plate is used. This plate has longitudinal slits, corresponding to the number of pins which form a row in the paper. A comblike tool stirs up the pins in the hopper. The shanks drop through the slits in the plate, and the pins are thus suspended by their heads. The operator now feeds sheets of paper to the machine which crimp them in two raised folds. The row of pins collected in the slit steel plate is then pressed through the two crimped folds, the operation being repeated until each paper has the desired number of rows of pins.

The Manufacture of Needles

Needle manufacture has been upon a prominent basis in the United States since 1852, when the kind of needles used in machinery was introduced. With the sewing machine came the needle constructed by Elias Howe, 8 per cent of all the operative labor in making the sewing machine being devoted to making the needle. The manufacture of needles for knitting machines followed.

The needles for sewing machines are made in endless varieties, straight or curved, long, short, round-pointed, chisel-pointed, etc. The most prominent is the needle used in the ordinary household sewing machine. This needle has the eye at the pointed end, a long groove on one side and a short groove on the opposite side, and is used in connection with a shuttle for carrying a second thread, passing through a loop of the thread in the needle and forming the "double lock stitch." There are also needles for sewing leather, in many varieties. Some have a hook instead of an eye, the material being perforated with an awl and the thread being then pulled through by the hook. But generally the needle does both the perforating and the pulling. In sewing cloth, only the round-point needle is used. But for sewing leather there are several kinds known as "twist," "reverse twist," "wedge," "cross," "chisel," "reverse chisel," and "diamond." The steel spring and latch needles used in making hosiery are extensively manufactured in this country.

The following is one method of manufacturing needles: Needles are made from the best quality of crucible steel wire. This is straightened, and cut off in blanks, which are "roughed," "dressed," and "smoothed" with emery wheels and an emery belt. Next the blank is taper-pointed, and grooves on the sides of the needle are made by circular saws. A punching machine then punches the eye. The needles are heated to a red color, then immersed in whale oil, and then tempered. After being cleaned on an emery cloth the needles are polished by a scratch-brush of brass wire revolving 8,000 times per minute. A bristle brush finishes the polishing of the grooves. The eye is polished by cotton thread covered with oil and emery, and the needles again cleaned by a revolving hairbrush. After passing inspection the good ones go to the hand-straightener. The final operations are finish-pointing on an emery wheel and finish-polishing by a revolving hairbrush with crocus and alcohol. The transfer of the blank from one operation to the other is done automatically, without hand labor.

The Turpentine and Resin Industry

In the turpentine and resin industry more than 40,000 persons make a livelihood. The number of establishments exceeds 1,500, a capital of $12,000,000 is invested, and the average annual value of the products is $20,000,000.

The turpentine industry has extended to all regions in which the long-leaf pine is found in large quantities. Resin is the crude material from which spirits of turpentine are made by distillation, tar being produced by the destructive distillation of the wood itself. There are other products, such as oil of resin, oil of tar, common pitch, and brewers' pitch obtained by a re-distillation or combination. In the consideration of this industry one must include the forests owned or leased, the gathering of the resin, cooperage and fuel. Before the Revolution crude resin was shipped to European and northern ports for distillation. Distilleries were operated at an early date in Wilmington and the North Carolina forests. The clumsy iron retorts gave way to the copper still, which led to a largely increased yield of volatile oil; the methods of distillation showing little change. The purpose of the owner of the plant is to obtain the largest possible quantity of spirits of turpentine from a given quantity of resin.

The character of the crude turpentine and the skill of the distiller are the factors in the quantity of spirits obtained. The crude turpentine is composed of "dip," or the gum in a liquid state, and of "scrape," or the solidified resin scraped from the tree. The first year that a tree is "worked" it gives the best quality. This is called "virgin dip" or soft white gum, being almost colorless, and containing the largest quantity of volatile oil. The next year the tree yields a gum of a deeper, yellowish color, which is known as "yellow dip." With each succeeding year the color of the gum becomes darker, and it is more viscid and poorer in volatile oil. The process of distillation is simple, but requires experience in order to avoid loss in spirits of turpentine, and to obtain the largest quantities of resin of higher grades. Care must also be taken to prevent overheating. After the still has reached a temperature a little beyond the melting point of crude turpentine, a very small stream of tepid water from the top of the condensing tub is conducted into the still and allowed to run till the process is completed, which is indicated by a peculiar noise of the boiling contents of the still and a diminution in the quantity of volatile oil in the distillate. Careful regulation is here necessary. When all the spirits of turpentine have distilled over, the fire is removed, and the contents of the still are drawn off. The molten resin is first allowed to run through a wire cloth, and is immediately strained again through a coarse cotton cloth, into a large trough, from which it is ladled into barrels. The legal standard weight of the commercial package is 280 pounds gross, no tare being allowed. Resin is largely used, in its finest grades, in the manufacture of paper for the purpose of "sizing," and in the making of soaps and fine varnishes. The medium qualities go to the manufacturer of yellow soap, sealing-wax and for pharmaceutical uses. The lower qualities are employed for pitch in shipbuilding and boatbuilding, for brewers' pitch, and for the distillation of resin oil for lubricants. The yield per tree in crude turpentine is about 60 pounds in four years.

Lands, according to figures furnished by an operator, with the privilege of boxing the timber for the term of four years, are rented at the rate of $50 per crop of 10,000 boxes (about 200 acres with 4,000 to 5,000 trees). The establishment of plant for the working of 20 crops requires an investment of about $5,000, including the still, houses, sheds, tools, wagons, and working animals, mostly mules.

Glue Manufacture

A business of six million dollars is literally glued together in the United States every year. There are sixty large glue factories, with an invested capital exceeding six million dollars. Peter Cooper, father of the glue industry, used to say, "If you would succeed, stick." Glue is still made to-day in the factory which he established in Brooklyn; it still "sticks," and the product is used by wood workers, clothing manufacturers, straw hat makers, coopers, paper makers, and thousands of other workers in many industries. The principal combination in this industry is the American Glue Company, controlling six plants and having an invested capital of nearly $2,000,000.

Manufacture of Dyestuffs

Dyestuffs are of organic or inorganic origin; and, although the art of dyeing dealt originally with materials of the former order, later inventions have brought mineral and artificial dyes increasingly to the front. Notable among materials of the latter class are artificial indigo, anilin, alizarin and other coal tar colors. At the same time, the use of various vegetable colors and products still continues an important item in dyestuff manufacture. The average annual importations of important foreign woods is as follows: Of logwood, over 48,000 tons; of logwood extracts, etc., nearly 3,500,000 pounds; of cudbear, 61,000 pounds; of crude indigo, about 2,750,000 pounds; of indigo carmine, pastes and preparations, nearly 280,000 pounds; of madder, over 120,000 pounds. The manufacture of dyestuffs and extracts in the United States is conducted at seventy-seven establishments in fifteen States, employing nearly 2,100 wage-earners, and producing an output valued at over $7,000,000. At seventy-two establishments making a specialty of this line a total of over 61,200,000 pounds of all kinds of product are produced, including artificial and natural dyes, mordants, iron liquor and red liquor. Nearly 52,000 tons of logwood are consumed annually, in addition to over 2,000,000 pounds of logwood extracts, 3,000 tons of fustic, nearly 800,000 pounds of cutch, over 100,000 pounds of indigo, almost 5,000 tons of yellow oak bark, and over 3,000,000 pounds of coal-tar colors. For the manufacture of iron liquor, or pyrolignite of iron, obtained by treating iron scrap with pyroligneous acid, nearly 3,000 cords of wood are consumed. Varying quantities of other substances, such as nic wood, quassia, gambier, nutgalls, sumac, etc., are also used.

Manufacture of Electric Motors for Automobiles

In using electric motors for the propulsion of road carriage and wagons the conditions are somewhat different from those found in either stationary power plants or street railway cars; the principal difference being that such vehicles cannot derive current from a trolley line, which involves that either primary cells or storage batteries must be used. The use of primary cells for this purpose has been attempted in several instances, with the invariable result that the consumption of zinc or other substance represented a cost far in excess of coal, involving also constant renewal of the cells. At the present time, therefore, the rule is to use separately charged storage batteries, although at least one American manufacturer of large wagons and omnibuses has a dynamo propelled by a gasoline engine to supply current direct to the motors, using a secondary battery to "store up" surplus energy and equalize the load on rough roads and in hill-climbing.

Although the electrically-propelled automobile is by no means the prevailing type, on account of the comparatively short working radius—between twenty-five and forty miles on the average—on one charge of battery, and the present difficulty of recharging outside of cities, it represents a very convenient type for short runs and for urban cab service. Some enthusiastic advocates predict a great future for it, with the rapidly developing facilities in the use of electricity, particularly on account of the ease and safety in handling.

During 1903 nearly 2,000 electric vehicles of all sizes and powers were built, while the total for automobiles of all classes was about 5,200. This output represented a total value of more than $4,000,000. Most of the motors used were manufactured by regular electrical concerns, although some carriage builders made them for themselves. Outside of the use of heavy vans and drays by commercial houses, nearly the principal use of electric vehicles is for cab service in cities. The company formed for this end in New York in 1897 began with an equipment of twelve hansoms and one surrey, but has increased its business to about three hundred vehicles of various types, which represent a total average of five thousand miles per day. In other cities there are electric stage lines between points of interest, which represent a constantly increasing patronage.

Manufacture of Electric Motors for Street Railways

The best known, and in some ways the most important, application of the electric motor is to the propulsion of street railway cars. This is a branch of electrical industry that has grown immensely within the two decades since its practical introduction. According to published statistics for 1890, the number of electric railways in the United States was 144, out of a total of 789 street lines; the number of cars being about 3,000, out of a total of 32,500, and the track mileage nearly 1,300, out of a total of over 8,000. The prevailing motive power was then the horse, with a rapid advance in the underground cable system. Nine years later the number of cable cars had fallen from over 5,000 to a little over 4,000, and the number of horse cars, from nearly 22,500 to about 1,500, while the electric cars had increased to over 50,600 and the mileage of electric railways to nearly 18,000. At the present time the cable railway has practically disappeared from the streets of all cities in the country, while horses are used only on the shortest lines, and there also are rapidly yielding to electrical traction. Furthermore, within the decade, 1892-1902, the combined capital and funded liabilities represented in the street railway industry had risen from about $363,000,000 to something over $1,800,000,000, an increase of 500 per cent. In the same period also over 1,000,000 horsepower of dynamos had been installed by the electric railways of the country, in order to provide current for over 2,000,000 horsepower of street-car motors, while the motors themselves had been, in many cases, increased from two to four for each car, with an average of power output of forty horsepower, over fifteen horsepower in 1890. In spite of all the vast expenditures and improvements, the income of the industry throughout the country continues to represent an average of from four to five per cent on the capitalization. Even with the use of the slot, or underground, trolley system, the most expensive both to install and maintain, the average expense per car per mile is only 13.16 cents, as against 17.76 cents per car for a cable car mile and 18.98 cents for the horse car mile. All these figures show indubitably that electric traction will be the rule in practically all street lines at the end of the next decade.

The Tin Can Industry

Tin cans form a subject of common interest, because of their close association with canned fruits and vegetables, so familiar to every one to-day.

The tin can is the most popular package for hermetically sealed goods. It brightens the shelves of every grocery in the land. In 1901 the largest company in the tin can field was formed with a capital stock of $88,000,000, to manufacture cans and tin receptacles of all kinds. This company practically controls the output of the country, and since the industry is an immense one, experts figure that if one-half of a cent can be saved in manufacture on each can, the additional profits will reach at least $5,000,000.

Not more than ten per cent of the tin cans in use are made by the canning establishments. The manufacture of these "packages" is, in fact, a distinct industry. For fifteen years the use of machinery in this field has been growing, until at present all the parts of a can are made and put together by this means. The process of making is simple. The cans are made from Bessemer steel plates cut into sheets 14 by 20 inches and about a pound in weight. After acid has removed all scales and impurities the cans are coated with pure tin by the acid process, or, better still, by the palm-oil process, which is safer and more efficacious.

Expert chemists, employed by the Government, after extensive investigations in the tin can field, report that objections to their use in preserving food products are groundless, so long as good tin is used.

Flax, Hemp and Jute Products

The industries which use the three classes of vegetable fibres—flax, hemp and jute—are so closely allied as the result of the use of more than one of the materials in each establishment, that it becomes necessary to classify these industries according to goods produced rather than according to materials used. These heads are: cordage and twine, jute and jute goods, and linen goods and linen thread. The total value of all flax, hemp and jute products is very nearly $50,000,000, four-fifths of this sum being represented by cordage and twine, while the remaining fifth is divided about equally between jute goods and linen goods. The whole number of persons employed is 21,000, and the total capital $42,000,000. Cordage and twine employs the greater number of wage-earners and more than half the total capital. Jute and jute goods are made in less than twenty establishments, the number of persons employed is less than 5,000 and the capital invested $7,000,000.

The Cordage and Twine Industries

The cordage industry is one in which it has so far been impossible to establish a successful combination on a permanent basis. There is an association for the betterment of the industry, but no trust controls it. The National Cordage Company made an effort to bring the cordage concerns of the country together, but in 1893 the company surrendered to receivers. The United States Cordage Company two years later met the same fate as the National. So the hundred thousand tons and more of rope and binder-twine made annually in this country are produced by independent concerns. Over ten thousand spindles are busy turning out "cord." Four thousand of these are sufficient to supply the wants of every ship flying the Stars and Stripes, to bind the harvests of the country, to furnish rope fire-escapes for the twenty thousand hotels in the Union, to tie up mountains of bundles, and to equip every back-yard in America with a clothes-line. In the olden days the length of a rope could not be greater than the length of the building or yard in which the work was done. In the factory of to-day, on a rapidly rotating machine, a single rope can be spun as long as a Pacific cable. The annual value of the product of cordage and twine in the United States is nearly $40,000,000. Manila and sisal are the principal fibres used, the proportion of the total output of the finished product being slightly in favor of sisal.

In the twine industry, the principal department is that in which binder twine is made for agricultural uses. The great wheat farms of the West use tens of thousands of miles of this twine every season. In the great twine mill at Chicago, the largest plant of the kind in the world, the output for a day would tie a band around the globe, with several thousand miles to spare. The product for a single week would reach to the moon. The annual production would fill a train twenty miles long, or make a hammock containing nearly four hundred strands that would encircle the earth at the equator. Made into a mat two feet wide, this binder twine would reach across the American continent from ocean to ocean.

Roads and Pavements

The enormous increase in the demand for better pavements has given a special impetus in the last few years to the mining of asphalt. It has brought the paving and paving material industry to a position of great prominence. The census of 1890 gives seven hundred firms as the total of those engaged in paving and in manufacturing paving materials. The number of men then employed was only twenty-three thousand, and the output was valued at $30,000,000. All these figures will probably be doubled in the census reports for 1900. The agitation and investigation of the road question by the United States Department of Agriculture during the past ten years has brought out the fact that the people of this country are needlessly losing over $600,000,000 each year because of bad roads, making this the most important economical question before this country at the present time. The advent of the bicycle, followed by the automobile and the free delivery mails, has greatly stimulated the agitation of this question.

The Public Roads Office of the United States employs scores of scientific experts, and it is certain that their work must continue to prove of greater and greater value to the country. We are just entering upon a great road-improvement era, in which we may excel all other countries and past epochs. The government has recognized the importance of this movement, and it has put trained road-builders and experts in the field to co-operate with the local bodies interested in the work. The science of road-building is the science of the mechanical engineer, and only those who have made a study of the questions at issue can produce the highest results. The collecting of data concerning road-building in other countries is also a part of the business of the employés of this office.

The poor character of American country roads is attributed to the early development of railroads in many parts of the country, which has made the need of country roads less imperative, and also to the scarcity of good road materials in many regions. The average cost of transportation on wagon roads has been estimated at about twenty-five cents a ton for every mile, and on the best improved roads in this country between ten and fifteen cents, as compared with eight cents on some European roads, one-half of one cent by railroad, and one mill by steamship on the Great Lakes. It is thought that four-fifths of the present cost could be saved, which would still leave the cost of transportation on roads ten times as great as on steam cars.

The importance of road improvement was emphasized by several witnesses before the Industrial Commission, who pointed out that the largest populations and the greatest wealth are found where roads are fine. Good roads virtually bring the farmer nearer to market and save the necessity of disposing of products immediately or storing them in elevators, making it feasible to store grain in farm graneries, where the cost of insurance is less than in city elevators.

On the other hand, the building of roads in some cases entails more expense than the adjoining property is worth, and in view of the fact that in many agricultural sections the roads are in any case good during a large part of the year, the importance of road improvement may be over-emphasized; but for farmers adjacent to large cities, especially dairymen, who go to town every day, good roads are undoubtedly very important.

Artificial Stone

Artificial stone is largely used for pavement in the West. Chicago furnishes many beautiful examples of this class of sidewalk. According to a United States Consular report, artificial stone, such as is used for paving purposes, is made as follows:

> Quartzose sand is first dried by being heated. It is then thoroughly mixed with hydraulic lime in the proportion of about twelve per cent of the latter to eighty-eight per cent of the latter. This mixture, still in dry condition, is packed into very strong molds of any desired shape, the filled molds being subsequently built up in a steel frame or box. The latter is conveyed by tramway to an immense steel cylinder, inside of which it is placed. The cylinder is then closed and the door strongly bolted. Water near the boiling point is admitted until the cylinder is full, and an indicated pressure of from sixty to seventy pounds is maintained. The water is kept in a highly heated condition by steam coils running along the length of the cylinder inside. On the admission of the boiling water, the hydraulic lime in the molds commences to slack, and the pressure maintained assists in forcing the water into the sand and lime mixture so as to bring about complete slaking throughout the mass. The mixture being confined in strong molds, it follows that the expansion of the material consequent on slacking is not allowed free play. An immense

pressure is consequently set up within the material itself, which tends to render it much more compact than might otherwise be the case. When the lime is thoroughly slaked, the pressure and temperature are gradually lessened and the material is allowed to cool slowly. When the cylinder is opened, the mixture is found to be converted into solid stone. The latter is in a wet condition and becomes harder in the course of twenty-four hours. The whole operation, from the packing of the cylinder to the withdrawal of the molds, occupies about fifty hours. The manufactured stone and bricks may be molded into any form, are of a handsome gray color, and make a fine, smooth pavement.

There is a fortune awaiting the man who shall discover a calcareous deposit capable of making a "good, silicious, or argillaceous, hydraulic lime" for cement. A new concrete thus made would be invaluable.

Artificial marble can be manufactured by causing water to percolate through chalk. The Verde antique effect is procured by the use of an oxide of copper. The slabs of marble are hardened in a bath. American manufacturers might imitate the Italians and make black marble from white sandstone, which may be done in connection with gas works.

Manufacture of Fertilizers

The manufacture of fertilizing materials is, strangely enough, a distinctively modern industry. Although agriculture has been a fundamental occupation in human society for untold ages, it is only within the last fifty years that it has been placed upon a scientific basis by the discovery of the true nature and theory of fertilizing agents. Previous to Liebig's discovery in 1840 that the true food of vegetable life is composed of inorganic mineral substances, the prevailing theory was that the "humus" of the soil, decayed organic matter and moisture, was of the first importance in this respect. Subsequent experiments along this line demonstrated the fact that all traces of organic matter may be eliminated from earth and the vegetation supported by watering with solutions of the needed inorganic salts. This is true because of the fact that the real value of any organic fertilizer lies in the liberation of certain chemicals, principally nitrates and phosphates. The fertilizer industry is one of the largest in the United States, both in point of the number of establishments engaged and of the total products handled. There are nearly five hundred establishments in thirty-four States producing fertilizer material of all descriptions to the amount of nearly 2,900,000 tons. In addition to this, the refuse material of slaughter houses and other manufactories yield an additional 200,000 tons, making a grand total of about 3,100,000 tons for the entire output of the country. Among the producers of fertilizer may be included those establishments that make the business a specialty, of which there are more than four hundred; chemical industries yielding fertilizer as a by-product, of which there are ten; other industries, not chemical, yielding fertilizer as a by-product, of which there are twenty-eight establishments.

One of the earliest, and, for many years, one of the most extensive, sources of fertilizer material was the fish-oil industry. Certain fish, most notably the menhaden, are rich in oil useful for various purposes. This is extracted by pressing the fish in presses. The scrap left over is very excellent for fertilizer, although the oil would be detrimental. There are twenty-five establishments in this line in the United States, employing five hundred wage-earners, and yielding nearly 29,000 tons of fish scrap and over 1,000,000 gallons of oil. The scrap is shipped in bags, with ground phosphate to prevent decomposition, and is worked over into various compounds. In the cotton-seed industry, after the expression of the oil, the hulls and linters are similarly treated and shipped, making excellent ingredient for various kinds of fertilizer.

In slaughtering establishments, fertilizers are usually made from waste produced in manufacturing lard and other animal products, such substances being rich in the required ammonia and nitrates. After being cooked in specially prepared tanks—these are disposed either on the top floor of the factory, or else in a sequestered building, on account of the disagreeable odors produced—the fertilizer material is pressed, under hydraulic or screw pressure, which reduces the contained water and extracts all grease, and is then dried. The drying is effected in any one of several varieties of machine, constructed to keep the material in rapid movement and thus prevent burning at the required temperature, generally over 260° F. This done, the material is ready to be manufactured into ground fertilizer compound.

The industry of garbage-reduction yields about 18,000 tons. Valuable fertilizer material is also obtained from the spent "bone-black" from sugar refineries, although this product forms at present a small part of the total of fertilizers. Another substance, formerly used very extensively, is guano, or the accumulated excrements of sea birds, mined principally on oceanic islands off Peru and Mexico. Its present comparative insignificance is due to the virtual exhaustion of the supply. In connection with guano, a valuable importation was found in the limestone rocks underlying the deposit, which, from leaching out of certain soluble salts, was converted into tricalcic phosphate, or "bone phosphate of lime." The value of this mineral as a fertilizer ingredient led to the present extensive utilization of the phosphate rocks found in some of the Southern States, particularly Florida and South Carolina. This phosphate rock is treated, like bones, with sulphuric acid, thus forming the calcium superphosphate, which is nearly the most important product of the chemical fertilizer-producing industry. The superphosphate is mixed with ammoniates and with potash to form completed fertilizers of various grades. Out of 422 establishments making fertilizer exclusively, 76 make their own sulphuric acid, while the remainder purchase it from various sources or purchase the superphosphate, to mix with the other ingredients.

The Mail Order Business

The growth of the mail order business within the last few years has been astounding. Beginning in a small way, there are firms which now do a business of millions a year. In Chicago there is one firm which occupies the whole of an enormous building and employs hundreds of clerks. These mail order houses, as a rule, pride themselves on never selling to a customer except through the mail. A personal call would not be welcome. A man in Connecticut, in five years, has built up such a mail order business that he now employs eighty people. The present Governor (1902) of one of the New England States is worth over two million dollars, made in the mail order business. A Boston woman runs a monthly publication paying her $12,000 annually, who earned enough to start by advertising and selling an article through the mails. That is the whole secret. Advertising and the use of the mails. It is an attractive field, requiring little capital at first. Every great mail order house began in a small way.

The Safe Deposit Business

The renting of individual safes in great variety of sizes has become an important adjunct of banking, and requires most watchful care. The motto of the safe deposit business is: "Secrecy, Scrutiny, and Security." The safe deposit vaults of a bank may contain only a gold watch, or they may hold millions of dollars. The officials never know what is in the compartments, and in one such vault on Broadway there are 15,000 such compartments. All the bank knows is that each lessee puts something in a strong-box, but the nature of that something is not known.

These boxes or safes are arranged in tiers against the walls of the vaults, each opened by its own peculiar key or combination, so as to be absolutely secure from interference by any one but the owner himself. They range in size all the way from small "pigeon holes," sufficiently large to contain a small package of bonds or stocks, to receptacles as large as an office safe of ordinary dimensions, the annual rental varying according to size. The entrance to these safe deposit vaults is by a huge steel door, having a lock and numerous large bolts of wonderful complexity, which are opened only with a difficult combination, or by a twin key, one half of which is always carried by the President or Cashier. In order to secure perfect immunity against burglars who might attempt to destroy this massive structure, a portion of the floor directly in front of the door is arranged to rise up by hydraulic power, thus effectually preventing the opening of the door, while a pipe capable of belching boiling water on any intruder, should a certain electrical combination be touched, is arranged over the door; also electrical alarm circuits leading to police stations or other distant places, are arranged so as to be closed, should a drill come into contact with a particular connection. Many modern vaults are further protected by a device for exhausting the air within, thus adding atmospheric pressure against a vacuum to the other provisions for the safety of contained valuables.

END OF VOLUME ONE.