SECOND PART.

THE PITTSBURG DISPATCH.

PAGES 9 TO 12.

PITTSBURG, FRIDAY, OCTOBER 10, 1890.

SCIENCE AND SKILL

Two Great Requisites for the Success of a Metallurgist of Modern Times.

THE FIRST LOCAL SESSION

Of the Three Great Societies Whose Eminent Members Are Now

GUESTS OF PITTSBURG PEOPLE.

Interesting Papers of Messrs. Kitson, Bell, Barnaby and Others.

WARM WELCOME BY JOHN H. RICKETSON

It was a distinguished assemblage that gathered in Carnegie Hall yesterday morning at 10 o'clock for the first joint session of the British, German and American societies of engineers and men learned in metallurgy.

It was the first time that the representative societies of men—deep thinkers and practical exponents of the results to be obtained from the fusion of metals—of the world met in common to discuss the progress of science in their particular pursuit. And that Pittsburg should have had the honor of being selected for this distinction is a matter of which her citizens should feel duly proud.

The hall was well filled by the distinguished visitors, and many ladies graced the meeting by their presence when Sir James Kitson called the meeting to order. On the platform with him were Sir Lowthian Bell, Sir John Alleyne, Sir W. T. Lewis, E. Windsor Richard, G. I. Snelus, John H. Ricketson, E. V. Martin, William Whitwell and Mr. Jeans.

Sir James Kitson briefly stated the purport of the meeting, and then John H. Ricketson, Chairman of the Reception Committee, made the address of welcome.

Mr. Ricketson regretted the absence of Sir Henry Bessemer, and wished he had been successful in his efforts to build a steamship, to which sea sickness would be a stranger. He welcomed Dr. Wedding, Mr. Daelen, Mr. Thieler, and Mr. Schroenter, and regretted the absence of Abram S. Hewitt. He mentioned George Westinghouse as one of the great inventors of the age, and regretted the absence of a former fellow citizen to whose generosity the city was indebted for the magnificent building in which the meeting was assembled. Proceeding, Mr. Ricketson said:

A WORD AS TO OUR GEOGRAPHY.

The other day, in New York, one of our foreign guests (I will not say whether he came from the mother country or the "Faderland") asked me the name of the lake on the borders of which Pittsburg was built. The mistake was a very natural one—we Americans often find ourselves equally uncertain in our geography when we are abroad—no, perhaps a word as to where we are may not be out of place. We are at the foot of the Western slope of the Alleghenies, within the water shed of the Mississippi Valley, about 750 feet above the level of the sea, 444 miles west of New York, about 180 miles from the nearest port on Lake Erie, whither our ore comes by water from Lake Superior and thence reaches us by rail. The greater portion of Pittsburg lies between the Allegheny and Monongahela rivers, the former rising in New York State, and the latter in Virginia. Together they form the Ohio, whose waters washes the shores of ten States, as it winds its way for more than 2,000 miles to the Gulf of Mexico. A steamer starting from and returning to Pittsburg can sail over 2,000 miles of navigable rivers, all tributaries of the Ohio and the Mississippi, and reach on the upper Missouri, a distance from this point of 4,300 miles.

Pittsburg was laid out in 1765 on the site of the old French Fort Duquesne, so famous in colonial history, and on its capture by the British the name was changed to Fort Pitt, in honor of your great statesman William Pitt, from whom our city derives its name. Time will only permit me to add that almost within the city limits the unfortunate General Braddock laid down his life in defense of the British flag, and with him the young American civil engineer from Virginia, George Washington, received his baptism of fire and won his spurs.

Our committee have prepared for you a little souvenir of Allegheny county, and incorporated with it are some general statistics of our leading industries and many facts of historical interest to iron and steel men. I will content myself with a very few totals, in order to give you at the outset some idea of the extent and variety of our resources.

SOME INTERESTING FIGURES.

We have 21 blast furnaces which in 1889 produced 1,293,435 tons of pig iron; 33 rolling mills, 27 of which roll steel, and their production in 1889 was 1,165,573 net tons of steel and 638,450 tons of rolled iron. Our annual capacity of steel rails is at present 550,000 tons. Our product of wrought iron pipe this year will, I am informed, not fall short of 350,000 tons, while our output of structural iron and steel will be fully 165,000.

We have 49 iron founderies, representing a capital of nearly $10,000,000.

The principal electrical industry in Pittsburg is in apparatus for incandescent lighting. Of the dynamos in the United States having a capacity for the supply of current for 1,500,000 16-candle power lamps, Pittsburg alone has furnished 650,000 of this, or nearly 44 per cent. We have 15 firms or companies making window glass, 37 making flint and lime glass and 15 making green and black glass bottles.

The 15,000 coke ovens in this district consume 9,000,000 tons of coal in making their product of about 6,000,000 tons coke. In 1889, in round numbers,

We shipped to Southern markets by river	4,000,000
We shipped to Eastern markets by rail	2,500,000
We shipped by rail for reshipment by lake	1,000,000
Railroads entering Pittsburg used	1,000,000
We shipped by rail to Northeastern market	500,000
We used for home and miscellaneous trade	2,000,000

Making a grand total of 20,000,000 of tons, or sixty per cent of the output of bituminous coal in Pennsylvania.

TONNAGE OF ALLEGHENY COUNTY.

The railway tonnage of Allegheny county of business originating here, exclusive of what passes through, is 20,000,000 tons per annum, or a fraction over 3 per cent of the total railway tonnage of the United States, which amounted in 1889 to 619,137,237 tons.

One word as to natural gas, that wonderful fuel which has been distilled for us in nature's own alembic. I am officially informed that in this district 750,000,000 feet of gas are delivered to consumers each day through 1,125 miles of pipe to our mills and factories, and to upward of 80,000 private warehouses, stores, hotels and dwellings. The present annual displacement of coal by natural gas is estimated at about 8,000,000 of tons.

There are 46,000 oil wells in the United States, producing on an average 130,000 barrels per diem, and representing a capital of $120,000,000. The district including Western Pennsylvania, West Virginia and Southeastern Ohio, produces 85,000 per day, and Allegheny county 10 per cent of the latter amount.

There are 10,000 miles of pipe lines for the transportation of crude petroleum, involving a capital of $50,000,000.

The stock in tanks at present of crude petroleum is 26,500,000 barrels. The country has a refining capacity of 140,000 barrels a day for illuminating oil; 15,000 barrels a day are used for fuel purposes.

OUR PETROLEUM PRODUCTION.

Gentlemen, when, in addition to the 300,000,000 of barrels of petroleum which have flown from the soil of Pennsylvania from 1876 to 1890, we remember that she is still producing 2,500,000 barrels per month, that her total yearly output of bituminous coal is 30,000,000 of tons and of anthracite 35,400,000 of tons, and that she produced last year within a small fraction of one-half of all the pig iron and more than half of all the rolled iron and steel made in the country, you can form some conception of the immeasurable and boundless, though then hidden, resources of the princely domain of 44,985 square miles which King Charles II ceded to the Penns in satisfaction of a claim against the British Government for £16,000.

Mr. President: Naturally from the character of our industries and avocations no section of the country appreciates more fully than ours the significance, importance and far-reaching consequences of your visit to America. We, probably, more than most of our countrymen are familiar with the history, the objects and the achievements of the Iron and Steel Institute, the highest metallurgical authority in the world. Numbered among your members are not only scientific men of universal reputation and capitalists and captains of the world's industry, "Knights of Labor" in the true sense of the word, but on your roll are many who from a distinguished ancestry are by inheritance the possessors and guardians of some of the most honored names in English history. In the journals of your proceedings has been chronicled every step in the onward march of the great material forces of modern civilization for nearly a quarter of a century. Organized in 1869, your Institute this year attains its majority, and we esteem it a privilege and an honor to unite with you in celebrating the event on American soil.

LASTING BENEFITS PREDICTED.

When the manufacturers of the civilized world unite in taking counsel with each other, and freely sharing their experiences in the search for the hidden treasures of nature, and the secrets of her laboratory and workshop, lasting and ever-increasing benefit cannot fail to accrue to the welfare, comfort and happiness of mankind.

Mr. President—More than 2,000 years ago a Hebrew sage, in the spirit of prophecy, the fulfillment of which we are witnessing to-day, uttered these words, which in this presence seem like a benediction:

"Every carpenter and work master that laboreth night and day * * * * * * the smith also sitting by the anvil and considering the iron work, the vapor of the fire wasteth his flesh, and he fighteth with the heat of the furnace; the noise of the hammer and the anvil is ever in his ears, and his eyes look still upon the pattern of the thing that he maketh."

"He setteth his mind to finish his work and watcheth to polish it perfectly."

"So doth the potter, sitting at his work and turning the wheel * * * * * *

"All these trust to their hands and every one is wise in his work. * * * * * *

"Without these cannot a city be inhabited. They shall not sit on the judge's seat, nor understand the sentence of judgment, and they shall not be found where parables are spoken."

"But they will maintain the state of the world and all their desire is in the work of their craft." [Prolonged applause.]

SURPRISE OF THE GUESTS.

Sir James Kitson Replies for the City's Visitors—His Institute Not Exclusively British—A Valuable Scientific Essay Listened to With Great Interest.

Sir James Kitson replied in behalf of the visitors. He mentioned the surprise with which he and his fellow members had approached the city, with its blazing mills, its outbursts of natural gas, and the general aspect of great industral wealth. He then continued:

By the courtesy of the President and Council of the Institute of Mining Engineers of the United States, I have been invited to take the chair, and to open the proceedings of this Congress. It is a graceful compliment to those members of the Iron and Steel Institute who are your honored guests at this moment—an acknowledgment of high consideration for scientific services rendered to a great industry by the Iron and Steel Institute, and a marked distinction conferred upon the President of that Institute. I gratefully accept the position, and I now undertake the duty because, although I am fully conscious of my own deficiencies, yet I feel that the institute is worthy of the respect you show to it; and, also, I know that we have the happiness to count among our members men who merit the honors you offer, whose names are known throughout the world as metallurgists, and leaders in scientific study of the laws which govern the acquisition and production of those metals which we know as iron and steel.

Our Institute is not exclusively British: in truth, it is cosmopolitan, having enrolled on its list of members distinguished metallurgists of the United States, Germany, France, Sweden, and Russia. The birthplace and the headquarters of the Institute are in England. It will, therefore, I hope, not be considered in any way presumptuous if I ask you for one moment to consider how much the world is indebted to my native land for the vast benefits which mankind has received from its engineers and its manufacturers of iron and steel.

SOME OF THE WORK OF ENGLAND.

The inventions of Watt and Trevethick; the development of the steam engine, with all its consequential powers; the construction of the locomotive, and the creation of the railroad by Stephenson, are directly the work of England and of Englishmen. These discoveries have made that system of railway and service of ocean steamers which have brought the nations of the earth together, have made new lands accessible and of service to man, and are destined in due time to diffuse knowledge and civilization into every quarter of this globe.

The puddling furnace of Cort, and his method of rolling the puddled blooms in grooved rolls, produced wrought iron in quantities and at a cost hitherto unattainable. Through these inventions South Wales became the seat of the rail trade, and it was enabled for many years to dominate and control the rail trade of the world. The puddling furnace continued, from the latter part of the last to the middle of the present century, to be the instrument by which practically all the malleable iron in the world was made.

The hot blast process of Neilson, patented in 1828, secured a great economy of fuel and a large increase of production. It entirely changed the condition of the pig iron manufacture, and was truly ranked by Mushet as "a means of developing the national wealth, of equal value with Arkwright's invention of cotton spinning."

The economy effected in the use of coal in the various processes of the manufacture of iron and steel has been great and progressive. The margin for economy which then existed has been narrowed. But still when you know on the authority of Sir Lowthian Bell, the duty performed is by no means equivalent to the whole of the useful effect which coke is capable of affording. "Taking a ton as being able to produce 20 cwt. of pig iron from Cleveland ironstone, this, after an allowance for ash, etc., when burnt to carbon dioxide, represents 147·200 calories, whereas something like 90·000 calories has been the limit of the power obtained." This sacrifice of 40 per cent lends itself to reduction, as does the heat held in the stream of molten slag flowing from the furnace.

RAPID DEVELOPMENTS IN IRON.

Nasmyth's steam hammer gave the means of forging, which led to rapid developments and improvements in the applications of iron. The reversing rolling mill engine of Ramsbottom has been invaluable in the rolling of plates and bars of great dimensions. The forging press, too, has been designed and improved by English inventors—to whom the world owes much for other mechanical appliances devised to meet the various wants of the Bessemer process and the treatment of masses of iron and steel.

To you probably the most important invention of modern times has been that of Sir Henry Bessemer. It has given you a material in quality and quantity for your railroads which it was a physical impossibility to obtain by the ancient methods of iron making. It is no exaggeration to say that without the Bessemer process for steel rail making, the present railway system of the United States would not now exist; and the settlement of the new lands you have peopled, and the binding together of the vast territory between the Atlantic and the Pacific under one civilized power, would not yet have been effected.

Sir Henry Bessemer has been kind enough, at my request, to prepare, for communication to this meeting, an account of his discovery of the process for manufacturing what is known as Bessemer steel; and some history of his investigations, and the way in which step by step he overcame the difficulties he met with, and finally dispersed, in his developments of his remarkable invention.

The Siemens-Martin process for the manufacture of open-hearth steel met with its greatest development in England, and it has enabled us to produce a material suitable for the requirements of the shipbuilder—of which he has availed himself to a vast extent.

GREAT BRITAIN'S OUTPUT OF STEEL.

In Great Britain the production of Bessemer steel ingots in 1889 was 2,140,791 tons; of open hearth steel ingots, 1,429,169 tons. We in Great Britain and Ireland are justly proud of our mercantile marine. The supremacy of our shipbuilders and of our shipping interest is based upon the excellent quality and the abundant supply at a moderate price of steel furnished by our steelmakers.

The demands of naval architects and marine engineers have been responded to with intelligence and enterprise. Plates, frames, shafts, forgings, steel castings of forms and dimensions thought impossible but a few years ago, have been manufactured at low prices. These productions have enabled our naval architects to design, and our builders to construct, the magnificent ships which are the pride of our navy and our mercantile marine.

The strength of our position and the remarkable economy of this important industry can be best demonstrated to you by a fact within my own personal experience. I have, within the past two months, as chairman of a shipping company, entered into contracts for the purchase of several new first-class cargo steamers, to be built of steel, of the most improved design, with triple expansion engines, at the cost of £7 per ton registered tonnage. These ships, of a carrying capacity of 4,000 tons, will be built and afloat within a few months from the laying of the keel. This example will suggest to you that our methods must be economical, and that great attention is given to economy of management. For this we are much indebted to the researches of our chemists, not only in England, but also in Germany and France. An interesting example of which is the use of basic slag as a manure.

This was first applied as a manure in England in the summer of 1885 by Prof. Wrightson, of Downton, Salisbury, who was employed by the Northeastern Steel Company to make a series of experiments. The results were so satisfactory that basic slag immediately became a marketable article instead of a waste product. Now in the 12 months ending June, 1890, 103,680 tons were delivered from works in Great Britain. Owing to the very much more rapid development of the basic process in Germany, a very much larger quantity of slag has been produced; and during the past three or four years, not only has the whole make been utilized, but stocks have been used up, as well as a considerable proportion of the total quantity exported from England. The make of basic slag in Germany is estimated as about 325,000 tons for the year 1889.

SOME OF THE ALLOYS OF STEEL.

The alloys of steel with other metals continue to be the subject of research and experiment. Many of our members have devoted earnest attention to this fruitful field of inquiry. Communications by Mr. Riley, Mr. Hadfield, M. Osmond, and others, will shortly come before the members, in papers or notes, in the *Transactions* of the institute. It may be stated in general terms that, owing to the high cost of aluminium, it cannot at present come into extensive use. Mr. Hadfield and M. Osmond agree that iron with silicon and iron with aluminium have many points of resemblance. But when the addition of .15 of aluminium, the minimum amount that has been found efficacious, means an addition of from 12s. 6d. to 20s. per ton on the cost of steel ingot, its employment in competition with silicon, as "ferro silicon," or "silicon spiegel," cannot be more than experimental.

I hear, however, an American company promises the production of aluminium at a much lower cost than the cost of a year ago; and that a German chemist, now living in Chicago, promises to produce it at a cost of about 7d per pound.

The remarkable success which has rewarded the researches of inquirers and experimenters on the alloys of steel with chromium, tungsten, aluminium, and nickel, gives us good reason to stimulate our members to continue their exploration of this field. Among these alloys the most important results appear to have been obtained from the use of nickel as an alloy of steel.

It will be remembered that when Mr. James Riley's valuable communication on the subject of the alloys of nickel and steel was read before the Iron and Steel Institute meeting in May 1889, Mr. J. F. Hall, of Messrs Wm. Jessop & Sons, Sheffield, at once rose and laid claim to priority of invention, informing the institute of the innumerable experiments he had been making with alloys of nickel and steel during several years past. Since then, continuous experimental research has been made into this matter. Under the superintendence of Mr. Hall, armor plates have been manufactured from this material, and tested by English Admiralty officials, giving results which rank about 75 per cent above any similar plates ever tested in England.

GOOD RESULTS IN ALL TESTS.

During the same period Messrs. Schneider & Co., of Le Creusot, France, have furnished nickel steel armor plates which have been tested by the French, Danish and Chilian Admiralty authorities, with results almost identical with those obtained by Mr. Hall. Within the last month a nickel steel armor plate of Mr. Schneider's manufacture has been tested in the United States, and has given similar results. At the present time Mr. Hall has under course of manufacture breech-loading ordnance cannon and projectiles for the English War Office, and he has already applied it in the production of rifle and sporting gun barrels, boiler tubes for torpedo boats, telephone and telegraph wire. When it is considered that nickel steel can be made in various tempers, giving trusils strain of 107 tons per square inch, with an elongation of 3 per cent in 8 inches; 97 tons trusils, with an elongation of 7 per cent; 50 tons trusils, with an elongation of 45 per cent, it is impossible to foresee to what uses this most remarkable material may not be put; and now that the various patents and interests owned by Mr. J. F. Hall, of Sheffield, W. H. Marbeau, of Paris, William H. Schneider, of Le Creasot, and Mr. James Riley, of Glasgow, have been associated, their joint labors promise to give rapid development to this interesting alloy. Works have already been erected by this association in France for the special manufacture of ferro nickel, and will shortly be followed by others in England and in the United States of America.

CONTINUAL EXPERIMENTS MADE.

Since Mr. James Riley's valuable communications on the subject of the alloys of nickel and steel, continuous experimental research has been made into this matter. The treatment of large masses of steel by tempering, hardening and annealing, in water, oil or molten metal, has been carefully studied, but the secrets of the behavior of masses of steel in heating and cooling are yet far from being unfolded. M. Osmond, in his excellent paper delivered before the International Congress in Paris last year, points out that tempering in oil was known to the ancients—being mentioned by Pliny; and Shakespeare also knew that the Moors had the knowledge that different temperatures of water effected the results of the hardening process. *Othello* says: "I have another weapon in this chamber: it is a sword of Spain, the ice-brook's temper." One day, in conversation with Mr. Gladstone, I related this to him. He at once capped the quotation by saying: "Yes, and I remember that Homer, in the 'Odyssey,' says: 'As when the smith dips into cold water a great ax or an adze, and it hisses loudly as he is tempering it, for so it is that iron is made hard.'"—(Odyssey ix. 391 4.)

I have ventured to make a passing mention of some of the men and of some of the inventions which were conceived and brought forth in our island home. I have named some of the inquiries and experimental researches which are being conducted by our metallurgists. You will see that we have need of many precious metals which your prolific country contains, to enlarge the properties of the materials demanded by our engineer, our army and navy, our ship and bridge builders. It is fortunate that we can make known these wants to men like the mining engineers of the United States, whose knowledge of those materials and their localities is as wide as their continent. We need these metals; we need also to feed and clothe our vast industrial population. For your grains and fruits, your cattle and cotton, your remarkable mechanical devices, we have no precious metals to offer in return; but we have the products of our mines, the labor of our looms, the service of our mercantile marine. It is well that we should meet thus, eye to eye and voice to voice, to discuss the interests and the scientific aspects of the great industry which absorbs us. It is thus we learn that by persistent and intelligent labor, how much has been accomplished, how much more remains to be achieved; and that by free exchange of ideas and of productions friendly understanding is promoted, and personal acquaintance is built up. Through such orderings we are convinced that Providence has designed to wind the silken chain of commerce round the world. [Applause].

BESSEMER AND HIS PROCESS.

The Veteran Metallurgist Gives a Breezy Account of His Invention—How It Was Cradled, and How It Grew to Its Present Proportions.

At the conclusion of his address, Sir James Kitson read a long and interesting letter from the veteran metallurgist, Sir Henry Bessemer. Following is an excerpt:

It is with great pleasure that I accede to your request to furnish you with a brief outline of the circumstances which led to the invention of my steel process. At the time of the Crimean War I had invented a mode of firing elongated projectiles from a smooth-bore gun, the rotation necessary to insure their proper position during flight being obtained by utilizing a portion of the powder gas to produce rotation by reaction, after the manner of producing rotation in turbines, and not by the rifling of the gun, consequently rendering all smooth-bore guns at once suitable for firing elongated shot or shell. I of course offered this plan to our own Government, but it was discarded without a trial.

A little after this period I happened to be on a visit for a week or two with Lord James Hay at the house of his daughter in Paris. During this visit our host gave a farewell dinner to General Hamlin and several other distinguished officers in the French army, who were going out to the Crimea.

Among the guests on this occasion was Prince Napoleon, and while taking a cigar in the library after dinner, the conversation turned naturally enough on artillery, and I then mentioned my system of firing elongated projectiles from smoothbore guns. The Prince was so impressed with the importance of this idea that he said he was sure that his cousin, the Emperor, would be much pleased if I would explain my invention to him, and that he would get an appointment made with the Emperor for this purpose. This was done, and I had a long and most interesting discussion with His Majesty, whom I found most thoroughly conversant with the whole subject of artillery. His Majesty, in the kindest possible way, gave me a carte blanche to make any experiments I desired at Vincennes.

SOME EARLY EXPERIMENTS.

A great many 30-pounder elongated projectiles were made, and were fired from 4½-inch 12-pounder smooth-bore cast-iron gun at the Polygon at Vincennes. They were fired through a succession of thin wooden targets placed 100 meters apart, through all of which they cut circular holes, thus showing that they went end on; a thin coat of black japan had been purposely put on them, and when the shots were recovered from the bank in which they were lodged, the coat of japan was seen to be partially scraped off in spiral lines, caused by their passage through the wooden target; the angle of these scratches being carefully taken, showed that from 1¾ to 2¾ rotations had taken place in the length of the gun.

After many hours' practice, on a cold December day, we retired to the officers' quarters in the old fortress of Vincennes, and while standing around a blazing wood fire, sipping some hot spiced wine, Commandant Minie (the inventor of the rifle) observed "that, although the rotation of the shot was effected, unless we had something better to make our guns of, such heavy elongated projectiles could not be used with safety." This casual observation was the spark that has kindled one of the greatest industrial revolutions that the present century has to record, for during my solitary ride in a cab that night from Vincennes to Paris, I made up my mind to try what I could do to improve the quality of iron used in the manufacture of guns.

My knowledge of iron metallurgy was at this time very limited, but this was in one sense a great advantage to me, for I had very little to unlearn, and so could let my imagination have full scope. After many months of trial and much building up and pulling down of reverberatory furnaces, I cast a small model gun; the iron was very white, and, in turning it, little short curly shavings were cut off. It was wonderfully tough for cast iron, but wonderfully brittle if classed as wrought iron. The little model gun looked very beautiful when highly polished, and I took it to Paris and begged the Emperor to accept it as the first fruits of my studies of the metallurgy of iron. He expressed himself much pleased with it, and complimented me on having achieved a step in the right direction, and with his own hands placed it in a bureau, saying, "Some day it may become an interesting relic."

ON THE EVE OF DISCOVERY.

About this period I began to fully appreciate the fact that if I could improve cast iron and render it malleable, and still retain its fluid state, that, apart from its use for artillery, it would be of the greatest commercial value for all engineering purposes. I therefore pursued my experiments with greater ardor than ever, for I was convinced that I was on the eve of producing a quality of metal that would supercede wrought iron. I consulted Mr. George Rennie, the eminent civil engineer. I showed him a small upright fixed cylindrical converter, and in it we made a charge of 700 pounds of Blaenavon pig iron into an ingot of malleable iron. Mr. Rennie was in raptures with the result, and said: "You must not keep this light under a bushel for a single day longer; and, by-the-bye, there is a first-rate opportunity for you. The British Association meet at Cheltenham next Tuesday; read a paper there by all means. I am President of the Mechanical Section; it is true all the papers are arranged, but if you will write a paper I will take the responsibility of putting it first on the list." He kept his promise, and I read my paper "On the Manufacture of Malleable Iron Without Fuel."

The entire iron trade of the kingdom was startled by the facts detailed in this paper, backed as they were by two small bars of malleable iron, one of which had been piled and re-rolled; a few days later the iron masters came trooping up to London to see the new process. There are many interesting incidents connected with these visits, which I cannot trespass on your time to relate; but some idea of the excitement may be gathered from the fact that, notwithstanding the imperfect state of the process at that time, I was actually paid £27,000 for licenses granted within one month of the reading of my paper. At many iron works the managers set to work to test the invention in the rudest possible manner, with such means as they had at their disposal, all of which attempts were failures. In my experiments I had used Blaenavon pig iron, which was successful, and at that time I had no idea that other brands of iron would fail in the manner they did. No sooner were these failures known than an extraordinary revulsion of feeling was manifested, and the most perfect distrust of the invention became universal. The public press, which had spoken of it in such glowing terms, now condemned it as impracticable, and spoke of it as "a brilliant meteor that had flitted across the metallurgical horizon, dazzling a few enthusiasts, and then vanishing forever in total darkness."

THE FUTURE OF IRON.

Its Manufacture Hereafter Handled by Sir Lowthian Bell—A Discussion on the Paper Participated in by a Number of the Institute's Members.

Sir Lowthian Bell was next introduced. His paper on the "Probable Future of the Manufacture of Iron," was listened to with close attention. He said:

With the exception of air and water, it is open to question whether there is any form of matter which the human race could less easily shape than iron. Short of going the length of asserting that, without this metal for an anchor or steel for the compass, the adventurous navigator could never have crossed the wide Atlantic, we may credit the locomotive and the steamer, and hence iron, for that sequence of events which has peopled North America with the Anglo-Saxon race. The result has been to raise a vast territory to a position without a parallel in the progress of the world.

To the attractions afforded by this interesting episode from modern history may be added the unprecedented development, in the United States, of that branch of industry which most concerns this society.

Let me here remind you, although we are guests upon the present occasion, and Great Britain is the birthplace and home of the Iron and Steel Institute, its name and constitution were intentionally adopted so as to exclude geographical boundaries from being any limit to the scope of its operations. Accordingly these cosmopolitan intentions have been followed by our numbering in our ranks considerably above 200 members belonging to other countries, and of these, nearly one-half are inhabitants of the United States. This union between members of one great family is a subject of sincere congratulation to the founders of the body, and, I feel sure, is not without interest to those who have joined it from the continent of Europe.

The present assembly is, so far as my reading goes, without a precedent in the annals of industry. Manufacturers of a metal from the Old World, where, in spite of what has been said by some antiquarians to the contrary, iron probably has been made for thousands of years, have accepted a courteous invitation from those of the New, with a view to discuss questions of interest common to both. To carry out this intention, three representatives from each hemisphere have been deputed to prepare subjects for this International Congress, and I shall always consider my having been chosen by the Council of the Institute, to act on their behalf as a very high and flattering distinction.

ANCIENT HISTORY OF IRON.

Sir Lowthian then discussed the ancient history of the iron trade. He referred to the isolated barbarians found near the great African lakes, as being familiar with a mode of obtaining iron by means of a Catalan fire and a pair of bellows. He traced the progress of metallurgy through its stages, and referred to the various degrees through which the science passed down to the present day. Continuing, the speaker proceeded:

Many eminent metallurgists have regarded with favor, the principle contained in a variety of the processes known as "Direct," and it must be admitted that there is, in the idea, a simplicity as compared with the present mode of manipulation which is highly attractive. In the latter, the iron from the blast furnace has been made to unite with certain metalloids, we knowing at the same time that, in order to render the product malleable, these substances have to be removed. Among those who have labored in this field, not the least distinguished was my late friend, a former president of this Institute, Sir William Siemens. In the hope of solving a problem in which his predecessors had not been successful, he spared neither time nor money. Ritter von Tunner, a high authority in all things connected with iron, has, in our frequent correspondence on such matters, extending over many years, expressed himself at one time hopefully on the direct process. In a recent communication, however, he seems to have abandoned all expectation of its being able to compete with the combined forces of the blast furnace and the Bessemer process. On the other hand, so far as I know, Siemens died believing in its future success.

I have elsewhere endeavored to prove that reduction is not exclusively effected in the so-called reducing zone of the blast furnace; on the contrary, that oxygen, amounting to about 25 per cent of its original quantity, arrives at or near the tuyeres, combined with iron in the form of some suboxide.

THE ACTION OF CARBON.

Further, that final deoxidation of this suboxide is probably effected by a quantity of carbon, generated by a dissociation of carbonic oxide. This reaction is inferred from the result of numerous experiments in the laboratory and from repeated observation at the furnace itself, confirmed by the fact that the gases at the tuyeres contain a quantity of oxygen, about 2 cwts. per ton of metal produced, and something like 1½ cwts. of carbon; the former not being accounted for by the atmospheric air used, nor the latter by the weight of fuel burnt in the hearth. Whether it is the actual carbon precipitated from the carbonic oxide or coke itself which completes reduction or not, in a heat-producing point of view, is immaterial; what seems proved is, that it is reserved for the crucible to complete this work at or about the period when fusion takes place.

As a theoretical proposition, we have been reminded that the exact quantity of carbon required to deoxidize 20 cwts. of iron, in the form of ferric oxide, is 4.28 cwts. It is further assumed that this mixture of ore and carbon must be raised to a temperature of 800° C. for which, provided the entire carbon used is burnt, half to monoxide and half to dioxide, 1.27 cwts. ought to suffice. It is suggested not that the work can be done for these 5.65 cwts., but that they are the limits toward which we may work.

So far as my observations, experimental and otherwise, have enabled me to judge, the maximum quantity of oxygen representing the second equivalent in carbon dioxide in the gases, is that corresponding with the equivalent contained in the ferric oxide of the ore. From this it might be inferred that reduction is completed in what has been generally known as the reducing zone, i. e., the uppermost and cooler portions of the furnace. We know, however, that the deposition of carbon, accompanied by the generation of some carbon dioxide, as already mentioned, is also most abundant at moderate temperatures.

A CONDITION DETERMINED.

These facts might reasonably lead us to expect a quantity of carbon dioxide in excess of that due to the reduction of ferric oxide by carbon monoxide. It will, however, be shown immediately that a condition of equilibrium in the gases is determined, not alone by the relative quantities of the two carbon oxides, but also by the amount of oxygen still remaining in combination with iron. Now, having regard to the quantity of carbon required to be burnt at the tuyeres, in order to fuse the slag and iron, added to that rendered necessary to reduce the metalloids found in the pig, is such that at the various temperatures through which the ore descends, a position of equilibrium is reached, when the gases contain at the outside about six hundred weight of carbon per ton of iron, in the form of dioxide, and when the metal still retains about one-fourth of its original quantity of oxygen.

This observation refers to ores of the type of Cleveland, but with those of a different character the composition of the gases may be materially modified. Thus, in certain Swedish furnaces, the fuel consumed does not greatly exceed two-thirds of the quantity necessary for smelting the Cleveland ironstone. The volume of carbon monoxide for every ton of iron is correspondingly diminished, the result being that, instead of having two volumes of this substance in the escaping gases for each volume of carbon dioxide the two gases are found in almost equal volumes. In one respect, however, all furnaces agree, viz, in there being an increase of carbon and oxygen in the gases at the tuyeres, as compared with that found a short distance above this level.

Thus it will be seen that at no time during the descent of the ore in a properly constituted blast furnace is it, with one exception, ever exposed to a high temperature, in an atmosphere of gases, capable of oxidizing iron. The exception is when carbon monoxide is split up into carbon and carbon dioxide; and then the precipitated carbon serves, as has already been observed, to remove the oxygen, taken up by the iron during the act of dissociation, when the ore arrives at the tuyeres.

SOME REVERSE CONDITIONS.

Now it is not too much to say the conditions of every reverberatory furnace are the very reverse of those just laid down. If coal is the fuel burnt, which generally is the case, we have vapor of water, carbon dioxide, and very often a good deal of free atmospheric air, heated probably at least to 1500° C., passing over the materials. (Of course, it would be quite possible to maintain an excess of the reducing gas—carbon monoxide—in the furnace, but this merely means a great waste of fuel.) Thus exposed, spongy iron, when formed by direct reduction, as proposed, could not fail to be very readily oxidized. But the circumstances under which it is now expected to produce spongy iron, consist in burning half the carbon to dioxide and the other half to monoxide. From the information contained in the table just given, we learn that while carbon monoxide is a reducing agent, the product of reduction—carbon dioxide—is of an opposite character, and, in consequence, is able to reoxidize the metallic iron by the production of which it was generated. The cause which determines this reflex action is difference of temperature, and, as might be expected, when both gases are present there is brought about a position of equilibrium determined, as has been said, not by temperature alone, but also by the extent of the oxygen still remaining united with the iron.

Thus, if a mixture of two volumes of carbon monoxide and one volume of carbon doxide is passed over calcined Cleveland ore at about 417° C., one-third only of the oxygen can be removed, i. e., the ferric is reduced to ferrous oxide.

If, on the other hand, the gas consists in equal volumes of the oxidizing and reducing gases, the same effect is produced, provided the temperature is raised to a bright red; and spongy iron similarly exposed is oxidized, and becomes also ferrous oxide.

At a white heat the attraction of the metal for oxygen is so intensified that further action ceases when 12 per cent of the combined oxygen is removed from the ore. At the same time ten volumes of carbon dioxide are able to keep in check the reducing power of 90 volumes of carbon monoxide.

I see no reason, however, why a close approximation to complete reduction, in the direct process, should not be effected by using a sufficient quantity of carbon mixed with the ore, in the manner already described. The difficulty to be apprehended is the reoxidation of the spongy iron when, by the revolution of the furnace, a fresh surface is exposed to the flame which is serving to heat the materials under treatment. Certain it is that Siemens failed to reduce the loss of metal to within reasonable limits.

UNABLE TO CHANGE RESULTS.

Forty-five years ago I labored for some time with Mr. William Neale Clay, who was very sanguine of being able to dispense, wholly or partially, with the blast furnace. The results, in our case, were the same as those obtained by others who have followed us in the same path since that time. As regards the carbon, required as a source of heat, for raising the temperature of the mixture of ore and carbon, I see no prospect of reducing this with any approach to the quantity previously named, i. e., 1.27 cwts per ton of iron. Not only theoretically, but practically, in the Bessemer converter, the combustion of the metalloids and a portion of iron suffices to raise the bath of melted cast iron to a proper temperature, for keeping malleable iron in a state of fusion. Attempt the same thing in a puddling furnace, rotating or otherwise, and the oxidation of the same metalloids and iron, producing the same quantity of heat as in the converter, requires to be supplemented by the heat afforded by 15 cwts of coal, in each case commencing with iron in a fluid state. In both there is a great loss of heat at the chimney, but this we will neglect, and regard the remainder in each as due to radiation, convection, etc., inseparable from the larger size of the furnace and the small amount of work turned out as compared with Bessemer's apparatus.

Sir Lowthian, proceeding, discussed the question of the capabilities of a reverberatory furnace, as compared with the united action of a blast furnace and a Bessemer converter, and the amount of labor required by the two systems.

AN INTERESTING DISCUSSION.

A discussion on Sir Lowthian Bell's paper followed, participated in by Professor Howe, of Boston, G. W. Maynard and Mr. Snelus. Mr. Snelus referred to the first attempts made in the direction of manufacturing iron direct from the ore. He said that the element of cost was one that stood in the way of successful results, but that developments would no doubt be brought about, which would attach to the direct process more attention than was at present attached to it. He agreed with Sir Lowthian Bell that the blast furnace will still continue to produce the bulk of the iron, and even that required in steel making. Mr. Snelus could not agree with some of the deductions of Sir Lowthian Bell. The ex-President, in replying at a later period, handled Mr. Snelus without gloves, and as if he did not like any doubt raised against the stability of any of his arguments.

MANY USES OF ARMOR.

Sir Nathaniel Barnaby's Paper on the Protection of Iron and Steel Ships From Foundering—His Defense of Side Armor—Talk on the Essay.

Next came Sir Nathaniel Barnaby's paper on "The Protection of Iron and Steel Ships Against Foundering From Injury to Their Shells; Including the Use of Armor." Sir Nathaniel in opening said that one-fiftieth of the value of the vessels in the mercantile marine is required annually to make good losses and repairs entailed by collisions alone. He said that the security of an iron or steel ship against fatal injury depended upon two things only—size and subdivision. On the question of armor the speaker said:

Now, in 1890, you have a perfectly regular material, stronger and more ductile than any of this iron, with no trouble as to surface blistering and lamination. You can get Siemens plates of 20 cwt., almost without extras for any increased size, delivered at the ship's side at less than £8 per ton. It has, unfortunately, been as low as £6 5s. This change from iron to steel was not made without a vast amount of anxiety on the part of responsible engineers who led the way.

The result may not be altogether pleasant to the iron and steel makers. To the shipbuilder and engineer it calls for ungrudging acknowledgment of indebtedness to two eminent British subjects, Bessemer and Siemens, and for the grateful recognition of the enterprise and skill of French, German and British makers. We all owe Germany a lasting debt of gratitude for the birth and training of that true prince—William Siemens. In modern ships of war the main use of armor in the formation of shot-proof decks adjacent to the load water line, and of more or less complete belts of side armor combined with such decks, is to protect the machinery and magazines from shot and shell.

There has been a wide abandonment of side armor, founded upon the recognition of several facts:

WHY SIDE ARMOR WAS ABANDONED.

First—The increasing penetrating power of the gun. The 12-inch gun is now more than a match, at close quarters, for the best 18-inch steel plates. It requires the best 9-inch armor to keep out steel projectiles from the 6-inch gun at short range.

Second—The great volume and accuracy of shell-fire makes the original arrangement of broadside ports in armored side inadmissible. The crowding of men in the rear of an open or unarmored port can no longer be accepted.

Third—The propelling machinery and the magazines are of more consequence than the whole battery of guns, because the ship has become, by virtue of her ram and torpedoes, a powerful fighting machine apart from her guns.

Fourth—The large use of side armor, by reason of its weight and cost, limits the number of ships obtainable with a given sum of money.

But while side armor has been largely suppressed and superseded for these reasons, it still possesses one great advantage. It prevents the entrance of water into the zone between wind and water through holes made by light projectiles not capable of perforating armor, but capable of damaging seriously an unarmored side.

Those who have appreciated most keenly the value of side armor at the water line, for preserving the floating power of the ship against light guns, have sometimes failed to see that my apparent unreadiness to concur with them has arisen from real sympathy.

My contention has been that all armed fighting ships present equal claims to be kept afloat against the attack of the guns which they have to face. I consider that in all such ships the first duty of the designer is to enable the crew to inflict damage on the enemy. Arms and mobility, therefore, come first; endurance under gun fire next. There must be degrees, varying with the size of the ship, in the strength of the arms and in the amount of the mobility. But all the fighting men, except those in forlorn hopes, are equally entitled to a chance of existence under the artillery fire which they must receive and endure. I have been unable to understand the exclusive claim for protection by means of side armor in a particular class of ships in a large navy, such ships not being distinguished by exceptionally large crews, nor as being centers of operation for a fleet, nor as being required to attack fortresses. And the question as to the use of belt armor in classes of ships not distinguished as above is perplexed by the following considerations:

QUESTIONS OF EXPEDIENCY.

First, and generally, whether in strengthening the water-zone by side armor against feeble projectiles, we do not expose it more to the very serious attack of larger ones than it would be if formed with an armored deck near the water. Secondly, whether with a ship of given size and cost we are not sacrificing active offensive qualities for the sake of a passive defensive quality. Speed of ship, power of armament, or stored-up capital (expended in the ship) may be made to pay too dearly for a passive defense against the invasion of water at the water-zone, seeing that the invasion of water beneath that zone becomes a more imminent and more serious peril to the State in proportion to the reduced speed and the increased cost.

So we arrive at an alternative arrangement, a solid raft body at the water zone in place of side belt armor.

It appears that such a raft body can be made which, when undamaged, weighs with its casings not more than one-third the weight of water, and which, when saturated, does not exceed the weight of an equal bulk of dry fir.

Such a system of water line defense may prove suitable for all fighting ships, large and small, by reason of its lightness and small cost. As I understand the position, it is proposed to give a trial to this system in the navy of the United States.

I think the time is coming, if it is not already come, when there will be a demand, not only for the recognition of the equal claims of all the fighting-ships to be kept afloat against the attack of the guns which they will have to face, but also that their crews between decks should be equally protected against the overwhelming effects of the bursting of high explosives there.

For belt and battery armor it is still a matter of debate whether the process of manufacture first introduced, and since most successfully developed, by M. Schneider, or that subsequently devised and manufactured in Sheffield, is the better.

SHEFFIELD'S GREAT EXPERIENCE.

After this paper has left my hands, and before it will be read, there will probably be an interesting series of trials of armor on both plans in the United States; what I say may therefore be very brief. Both systems have been in open competition from the beginning, and gun trials have been made by all the maritime powers. The experience of the Sheffield compound armor-plate makers as to their own manufacture and that of their rivals has been very great. The amount of steel-faced armor which has been manufactured by them, or by their licensee, during the last 12 years, together with that which is in process of manufacture, equals 112,000 tons.

They urge several considerations in favor of steel-faced armor. They say that steel armor cracks through under blows which are not sufficiently powerful to perforate the plate. They consider that the manufacture of steel armor is less uniform and certain, because it is of very great importance to oil-harden and anneal such armor; and these processes are not required for steel-faced armor. They point out that this treatment can only be applied commercially to large and awkward plates, with great risk, expense and difficulty, and that under these circumstances a good test plate offers no security as to the quality of the plates it represents. It is conceded that hard-faced armor endures better under oblique blows. They say that a cubic foot of steel armor weighs 492 pounds, whereas a cubic foot of compound armor weighs only 480 pounds—a difference of 2¼ per cent in favor of the latter.

An experiment has recently been made in England to ascertain whether it can be confidently stated that oil-hardening and annealing, or some equivalent finishing process, is necessary for steel plates. Messrs. Brown and Messrs. Cammell, the two great Sheffield firms, makers of compound armor, are satisfied as to this necessity.

A nine-inch plate of steel was manufactured and cut into two plates each four feet square. One piece was left untreated, and the other was oil-hardened and annealed. They were fired at by the six-inch gun with Firth steel projectiles weighing 100 pounds.

The striking energy of the blow upon the untreated plate was 2,389 foot-tons, and the energy of the blow upon that which had been treated was 2,378.5 foot-tons. In the latter case the projectile made an indent of 10.5 inches, so that light was just visible through the center of the bulge at the back of the plate. The projectile rebounded, broken into three pieces. The plate was cracked through, but was whole, and no material was splintered out at the front or back of the plate.

In the case of the untreated plate, the shot passed through, and the splintering of the steel round the hole in the front of the plate spread over a space 15 inches across. The splintering round the hole at the back of the plate covered a space 33 inches across. The plate did not remain whole, but went into six separate pieces.

NOT A LOVER OF ARMOR.

I am myself no lover of armor. As a member of a great and peaceful trading community, I dislike everything which, by differentiation, tends to lower the comparative fighting value of armed mercantile ships. I dislike also that which reduces the available number, by increasing the individual cost, of ships of war.

There is, I think, no such necessary and vital distinction between the man-of-war and the properly armed and protected State auxiliary of high speed as would justify the neglect of such auxiliaries for maritime warfare. One must admit that at present there are very great differences between them in fighting value, ship for ship, due partly to the very superior subdivision, and partly to the use of armor of high quality in the regular ship of war.

The man-of-war proper will probably never abandon the use of armor. We may rather expect that steel and steel-faced armor of the highest quality, instead of being confined to a few ships, called battle-ships, will be employed universally for the defense of the absolutely vital parts of every ship built expressly for war service.

Commander Barber, of the United States navy, was called upon by the President to offer any remarks on the paper. He referred to the importance of nickel in connection with the hardening of armor, and said that the time would come when the armor would resist and break the best projectile.

The third paper was by A. E. Seaton, on the "Development of the Marine Engine," and the meeting adjourned till 10 o'clock this morning to a selection on the organ by Mr. Leonard Wales.

CAPTURED AT LAST.

Murderer Willett, of California, Arrested After Many Years of Immunity.

LOS ANGELES, October 9.—After enjoying the fruits of his crime for 17 years and living an honest life, Nathan Willett was arrested yesterday at his ranch near here and taken back to Texas to answer the charge of murder. Willett was plowing in the field when the sheriff and his deputy drove up, jumped the fence and showed him the warrant. He hesitated a moment, eyed the two officers keenly and at last said: "All right; I'll go," and climbed into the wagon. His wife and children did not know he had gone.

Willett was arrested for having killed H. B. Woodward, on December 2, 1872, in Anderson county, Tex., in cold blood and for pay. The story told by Willett is that years ago he killed a man in Western Texas and fled to Anderson county. While there he became acquainted with Woodward and also with another man who loved the same woman Woodward loved, and was jealous of him. This man offered Willett a large sum of money to kill Woodward. Willett had no friends, wanted to get away, and was fearful of being arrested for the other murder, and accepted the proposition. He carried it out and made his escape and came to Southern California, where he has lived since. Sheriff Bixby got his pointer from Willett's brother-in-law. He says there are living witnesses to the murder. Willett's ranch is worth $30,000.

BAD ERROR IN M'KINLEY'S BILL.

Tobacco Manufacturers May Have to Pay Too Much Tax.

CHICAGO, October 9.—An afternoon paper says the internal revenue department here has received information of a clerical error in the McKinley bill, recently passed, that may mean a difference of several hundred thousand dollars to the tobacco manufacturers and dealers of this district alone. The old tax on tobacco was 8 cents a pound, and the new bill provides for its reduction to 6 cents. The bill as presented to Congress and passed by that body provided that on all manufactured tobacco on hand at the time of its passage the reduction would be allowed, giving a rebate of 2 cents on the pound. It is reported, however, that the clerk who prepared the bill for sending to the President, omitted the clause providing for the rebate and that the measure was engrossed and recorded without the error being noticed.

"In this district," said Deputor Collector Landergren this morning, "there are at least from 10,000,000 to 15,000,000 pounds of manufactured tobacco on hand at the time of the bill's passage. If the error removes the rebate, from $200,000 to $300,000 more money can be collected from the manufacturers of this district."

AN ADVANCE IN SHOES.

Local Dealers Receive Notice of an Increase in the Manufacturers' Price.

The local shoe dealers have received notice from the manufacturers of an advance in the price of shoes. The increase ranges from 7½ cents, on cheaper grades, to 25 cents per pair. This will not greatly effect Pittsburg for the present, as the dealers mostly have large stocks on hand, and will not be compelled to purchase until spring.

The cause of the advance in price is the fact that leather has become scarce and that has raised its cost. Other shoe findings have advanced also, and this adds its little mite to the increase. Another reason given is the fact that shoemakers are thoroughly organized and advance the scale of prices almost every season.

ON HER FIRST TRIP.

The New Cruiser Newark Starts Out to Sea for a Test.

PHILADELPHIA, October 9.—The new cruiser Newark left her dock at Cramp's ship yard this morning and started down the Delaware river on her initial trip. The specifications call for 8,000 horse-power, but for every horse-power over that amount the builders will receive a premium of $100 above the contract price.

To-night the Newark will anchor at the Delaware breakwater and early to-morrow morning she will steam out to sea, where the trial will be made. The test is expected to consume about two days.

THEY MUST HAVE LICENSES.

Plumbers to Have an Examination to Undergo Hereafter.

Plumbing Inspector Layton says a bill will be introduced at the next session of the Legislature, making it necessary for plumbers to take out licenses. They will have to undergo an examination before the proper authorities before they can do business.

Mr. Layton says this will do away with faulty sanitation in overcrowded buildings, and it meets with the approval of the master plumbers.

Deaths of a Week.

The mortuary report for the week ending October 4 shows a total number of 88 deaths in the city during the week. During the week ending September 27 there were 103 deaths. During the corresponding week of last year there were 84 deaths. In the Old City there were 24 deaths; East End, 39; Southside, 16, and institutions, 9. Fifteen of the deaths were from diphtheria, 8 from typhoid fever and 11 from scarlet fever.

Got Tired of Being Clubbed.

Samuel Adams, aged 41 years, and a resident of the Twenty-third ward, near Brown's station, was sent to Dixmont, yesterday, by the Department of Charities. Adams become insane over religion, and would chase any person around the neighborhood where he lived with a club if they did not accord with his views. He has a wife and four children.

THE STORY OF THE BOOKSELLER.

A Strange Tale of the City of Mexico in Our Day.

I have a great liking for bookstores, and I am not ashamed to confess to a feeling akin to affection for a bookseller, even if he be merely the proprietor of a little stall where second-hand books are vended.

A bookseller is never a commonplace mortal—he rubs up against knowledge and becomes learned by absorption. It is the most respectable of vocations.

I would feel more complimented by being addressed in a fraternal way by a bookseller than by receiving a nod from a duke. Confessing thus these weaknesses, it is not to be wondered at that one of my haunts in the ancient city of Mexico is a certain bookstore with a quaint old name over the door. It is a queer, dusky place, and, when you go inside, the contrast with the glare of the sun in the street is startling. You feel that you may be, perchance, in a tomb of literature, a catacomb of books.

The two windows which allow some light to flow into the shop are filled with books temptingly displayed. I like to stand close, very close, to those windows, and look over the titles of the books, most of them paper-bound. They rage over many fields of information. There are treatiss on the noble art of bull fighting, really quite a respectable art, with a whole literature, embracing treatiss on the technique of the subject, biographies of noted espadas, etc. Then, too, you will see in the windows of this transient seat of learning books on science, the lives of saints, the latest Spanish novels fresh from the Madrid and Barcelona presses, translations from the French and gaudily fronted works, more gay than edifying, such is the Latin frankness.

After you have peeped in the windows, you will pass inside the shop and make the acquaintance of my old and venerated friend Don Carlos Baltasar, a famous bookseller, who has seen the book shops of Mexico grow and multiply during his nearly 60 years in the trade. He is a rosy-cheeked old gentleman, and after dinner he often will be found napping behind his counter, comfortably seated in a chair. Close at hand on the counter is a large black cat, who knows full well that her life is passed among authors and book buyers. She is as erudite as Minerva's owl.

Up to three months ago Don Carlos Baltasar lived a most tranquil, even-flowing life. He came to the shop at 9 in the morning, talked with his customers, smoked innumerable fragrant cigarettes, went home to dine at 1, returned to the shop at 3, and went home again to supper, to a game of chess and an early bed. His only excitement was the incoming of the Madrid and Barcelona packets of books and papers, a frequent event.

His assistants in the shop long ago took the burden of the work off the old man's shoulders. You would fancy that when a man had attained the age of 78 the rest of his life would flow on to the grave as quietly as the most sluggish of streams.

But fate ordained that there should happen to this serene old bookseller one of the most extraordinary adventures recorded in the annals of human kind.

It is all as fantastic as if it had transpired in Bagdad in the times of the good Caliph.

Since my venerable friend told me what I have ventured to call "The Story of the Bookseller," I have not walked "these streets of God," as the Spaniards say, without a feeling that the most marvelous and incredible things might occur to me.

It is now late in September. The adventures of Don Carlos took place in early July of this year, 1890. I will tell the tale in the third person, for my friend has not yet succeeded in getting all the facts in his oral narrative into consecutive order.

On the morning of the 6th of July, the hour close to 10 o'clock, an old woman, wizened of feature, black-eyed and a vender of snuff, entered the book store and saluted her faithful customer, Don Carlos. He bought his customary peseta's worth, gave her his usual "go you with God, my friend," and resumed his perusal of the morning paper. The snuff he tried, to ascertain if the standard was still maintained, and he found, to his surprise, that it was finer than any he had ever purchased. "Go and call back the old woman," said Don Carlos to a lad in the shop, "for I wish to buy an extra lot of this excellent snuff." The lad went out, but the old woman had disappeared.

Pinch after pinch the old bookseller took; it was most tempting stuff. He felt incredibly young. He hummed a tune he had forgotten since he was a boy at home in Spain. He even whistled, at which the clerks looked up in wonder, and then significantly nodded to one another. While in this pleasant frame of mind, his thoughts away in other years, far remote from the quiet shop, Don Carlos saw again the old woman enter. This was most extraordinary for her to do. She had never before come twice in one day. And she had come of her own will, for the shop boy had not found her. She looked oddly at the old bookseller, and said to him in a low voice: "Come with me, my friend; one who knows you is dying, and you are wanted to witness the will."

Why Don Carlos obeyed without a question he says he will never be able to explain to himself. He said he felt that he must go, and he had in his blood that day the energy of his youthtime.

The old woman led the way through the streets, across the great sunny, busy plaza, the Cathedral clock sounding the noon hour, on and on through ancient streets behind the great church to No. —— Calle de Montealegre. The house was old, very old. It had been built in viceregal times. It had a dark red front, oddly shaped windows, and projecting waterspouts, queerly carved. Don Carlos recognized the house as the home and office of a patron of his shop, a wealthy lawyer, famous in the city for his learning and his skill.

The old woman lifted the knocker of the door, which, strangely enough, was closed at high noon, and the door was at once opened from behind by some person out of sight.

Don Carlos was astonished, and well he might be. The courtyard was in the ancient style. Many quaintly-dressed servants stood around. A great coach of the fashion of the early part of the last century stood near the fountain, servants were harnessing to it a pair of mules of undeniable Spanish breed. But he had no time in which to vent his feeling of surprise in words; his guide hurried him upstairs, and, passing from the corridor into a huge chamber hung with dark tapestry, he found himself among many people. A great bed stood in the middle of the rearward wall. On it lay an aged man, pallid, emaciated, the eyes lusterless. There were at the bedside a lawyer and a notary, dressed in a fashion which was in nothing like the garmenture of the year 1890. Young men in the costumes of gallants of the viceregal court of 1700, were there, all weeping, as were also several young women and the white-haired dame, whom Don Carlos soon found to be the wife of the dying man.

"We have sent for you, sir, to be a witness to the will of this gentleman," said the lawyer to Don Carlos, and continued: "Two witnesses are needed to such a document, and therefore I have sent for another, who has arrived. Let me present to you Don Ricardo Orozco."

After the formalities, usual on presentations, the lawyer remarked: "We have summoned you two gentlemen because of your youth and strength, and, believing for these reasons that you may both long survive our