THE MANUFACTURE OF STEEL PENS.

BY L. A. HAWKES.

When, in the year 79 A. D., the celebrated volcano Vesuvius belched forth fire, lava, and ashes, and destroyed, among others, the beautiful historic city of Pompeii, it at the same time preserved in the ruins of that city the first and only evidence that we have of the early use of metallic pens. In excavating the ruins of the city, specimens of metallic pens were found, which are now preserved in the British Museum and the museum of Naples. These specimens were made of bronze. Most of the early metallic pens were made of this material, although some were made of silver. The use of metallic pens was very rare, and before the introduction of steel pens, the implements most commonly used for writing were stilos, brushes, reeds, and quills, all of which are even up to this time used in some countries.

The quill pen, which was the direct predecessor of the steel pen, was so difficult to make, and its life was so short, that efforts were continually made to produce something that would last longer and supersede it. In the effort to do this various metals were used, among them steel. The forms of the first steel pens were copies of the quill pen, being both pen and penholder combined, or what is known to-day as the barrel pen. They were slit similar to the quill pen.

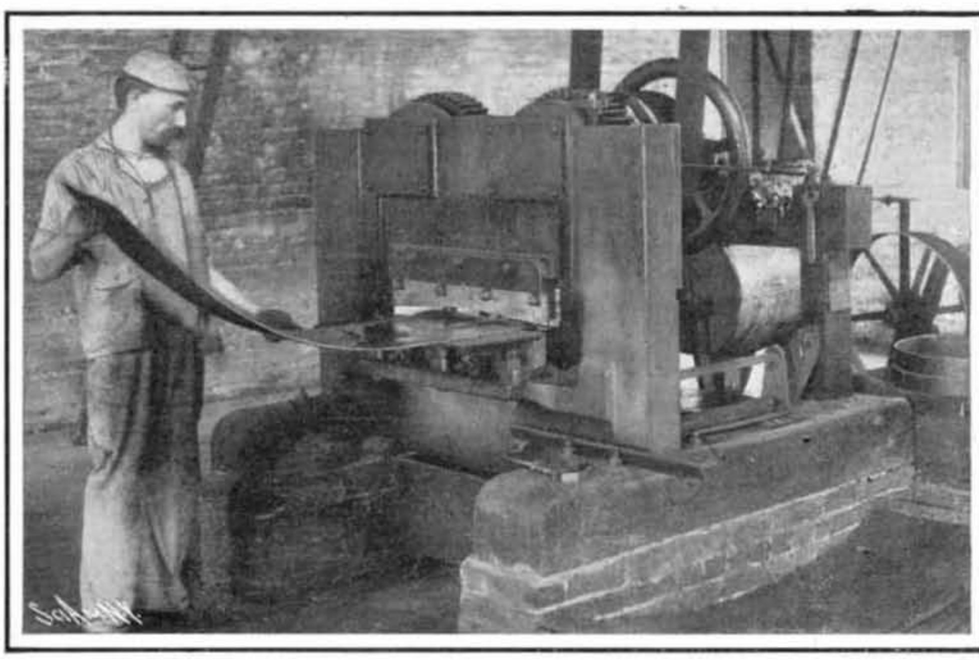

Fig. 2.—Cutting the Steel Into Strips.

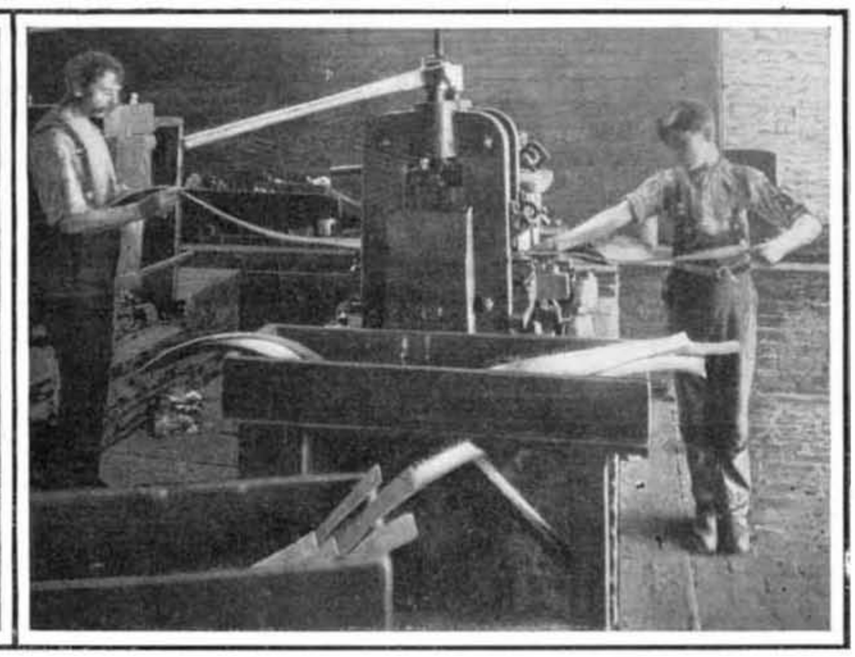

Fig. 1.—Rolling the Steel to the Proper Thickness.

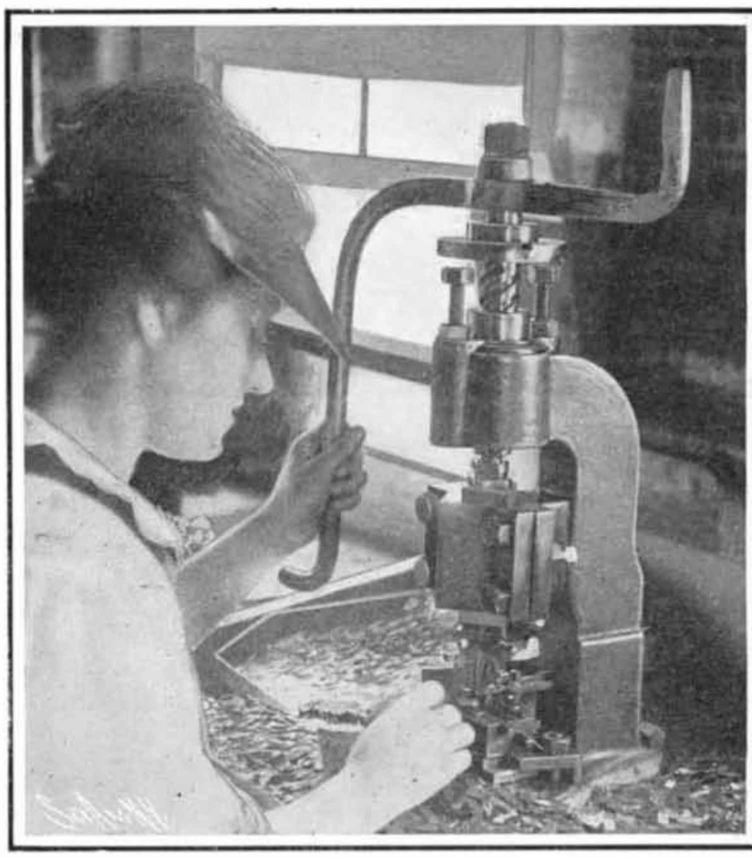

Fig. 3.—Cutting the Pens.

Fig. 4.—Marking.

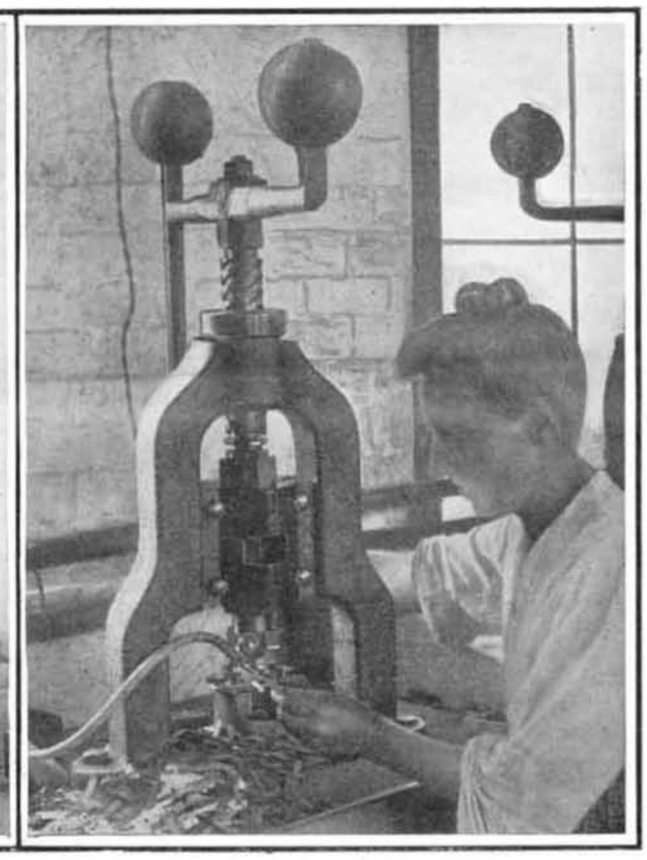

Fig. 5.- Raising the Pens.

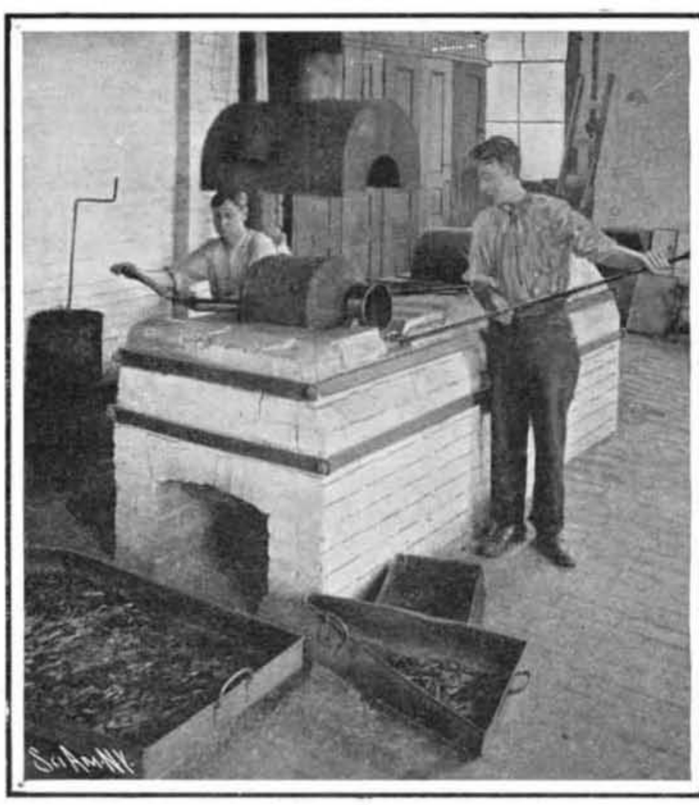

Fig. 6.—Tempering the Hardened Pens.

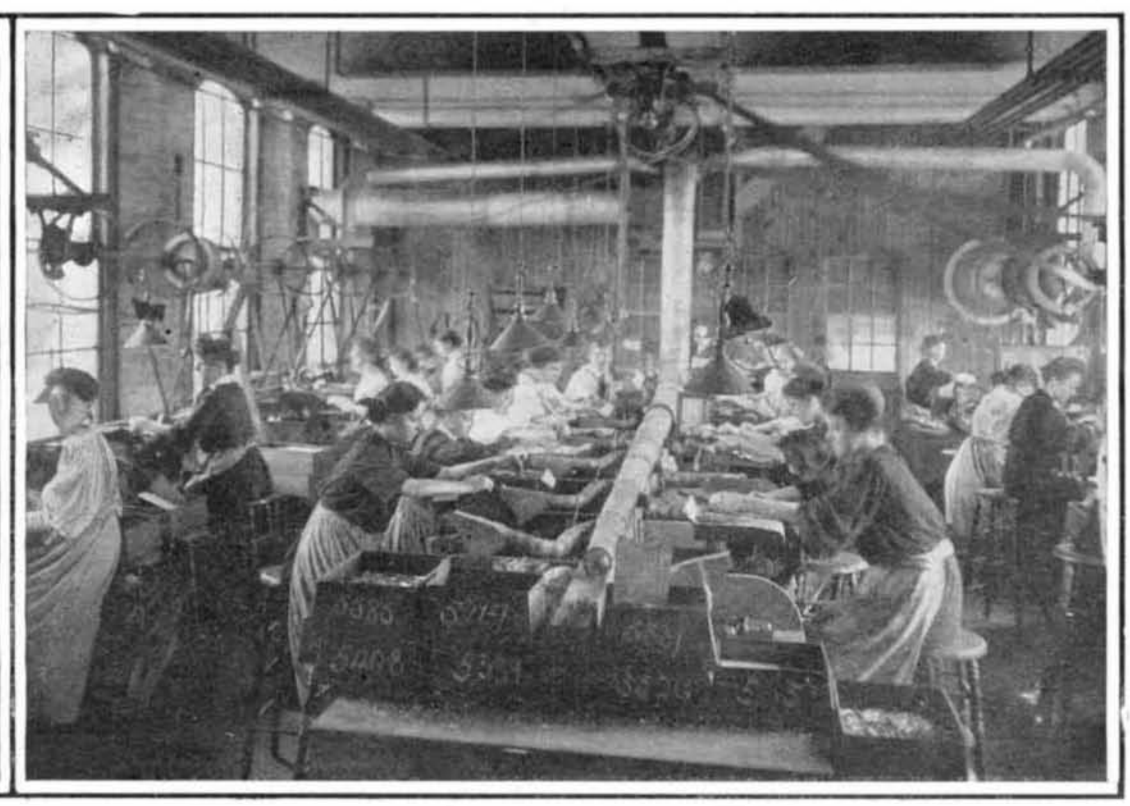

Fig. 7.—Grinding With Emery Wheels.

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This style of pen was used for a number of years, but was very expensive, because as soon as the pen was worn out, it was necessary to throw away practically both the holder and the pen, so that the nib part was made separate, and the barrel part became the tip of the penholder of to-day. This was a great economy, and soon the pen took its present form, and the penholder was made to hold it.

One of the objections to the early steel pens was their stiffness. This was overcome by the introduction of the side slits; by varying the size, shape, and position of these side slits, a pen can be given any resiliency desired.

Fig. 8.—The Slitting Machine.

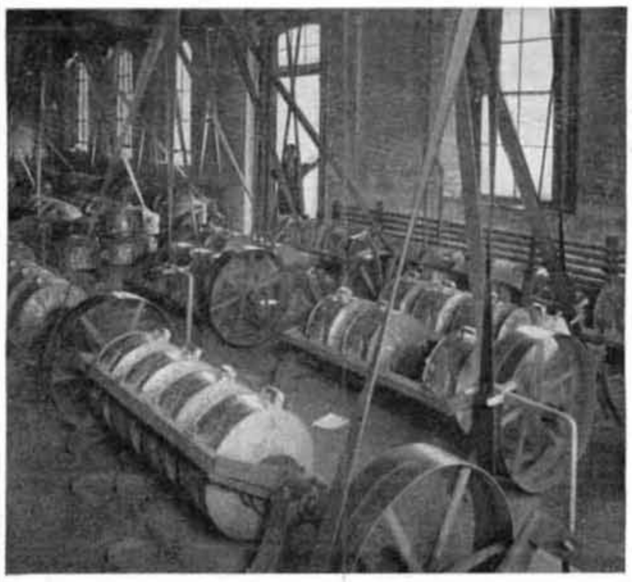

Fig. 10 Polishing and Coloring.

Fig. 9.—Examining for Defects.

The steel pen industry did not make any rapid advances until the adoption of the foot, drop, and screw presses about the year 1825; then they were manufactured in fair quantities, but their introduction was by no means rapid, for even as late as 1860 to 1865 the Quartermaster's Department furnished the United States army with the quill pens. The first steel pens sold anywhere from 25 to 50 cents each, so that one pen cost as much as will now buy from one-third to one-half a gross of the better grades. In other words, they cost from fifty to seventy-five times as much as they do now. The consumption has increased very rapidly, and at the present time the world probably produces from ten to twelve million gross annually, of which the United States produces two million five hundred thousand gross, and consumes over three million gross.

Although the pen may be mightier than the sword, its daily use by millions of people has made them insensible to its importance; and those who have given it a thought, believe that the sheet steel goes in one end of a machine and the completed pen falls from the other end. This is far from being the case, as there are from twenty to twenty-eight handlings, the number depending on the style of the pen.

The following description of the operations is of the manufacture as carried out at the works of the C. Howard Hunt Pen Company, manufacturers of round-pointed pens, Camden, N. J., and describes the most advanced methods and latest improvements.

The steel is imported from England, and consists of selected sheets, 19 inches wide, about 5 feet long, and 0.023 of an inch thick; it is of the very highest grade, American manufacturers not having attempted to make this class of steel.

The first operation is to cut the sheets into strips 19 inches long and wide enough to cut two pens with their points interlapping. These strips, which are rolled hard and are too thick to cut a pen from, are annealed by packing them in iron boxes and heating them at a low red heat for a number of hours. They are then gradually cooled under a hood to prevent drafts striking them. When cool the strips are soft and coated with a scale which is removed by a pickle of dilute sulphuric acid. They are now ready to be put through the rolling mill, and reduced to the required thickness, which averages about 0.009 of an inch. The rolling is known as "cold-rolling," the strips not being heated after the first annealing. This gives an increased toughness to the steel. The number of times necessary to put it through the rolls depends on how thin the steel is to be rolled. Each strip is tested with a micrometer gage, and should it be too thick, it is again put through the mills, and if too thin, it is laid aside for a pen for which a thinner steel can be used. The steel which started 19 inches long has been stretched to about 50 inches, and is then ready for the pens to be cut from it.

Cheap pens are cut from steel that comes in large rolls ready for use, as it is impossible to roll this uniformly. The pens that are made from it are very irregular.

Pens are cut in screw presses provided with dies of the desired shape. About two hundred styles of dies are required for regular and imprint pens.

An operative can cut from forty to forty-five thousand pens in a day of eight hours, and her hand will move about seven miles in doing it. After the pens have been cut they have the appearance pictured in Fig. 12. Fig. 13 shows the scrap that is left after the pen has been cut from the steel.

Fig. 11.—Packing the Finished Article.

The blanks are now pierced and side-cut as shown in Fig. 14. These operations, to a large extent, determine the flexibility of the pen, and vary with the style of pen, some pens requiring two and three handlings in the piercing department.

The blanks having been cut from hard rolled steel, it is now necessary to soften them by annealing. This is done by putting them in large iron pots, heating them to redness for several hours, and then cooling gradually. They are then soft and pliable and ready to receive the name, which is the next operation, called marking, as is shown in Fig. 15. Some pens have a raised letter or design on them, called embossing. This is done in a marking press.

After marking, the pen is raised, that is, brought to the form that it is to have when finished. There are on the market about two thousand styles of pens. Fig. 16 shows one of the most popular of these, the Courier, No. 700. Raising is done in a peculiarly constructed screw press, and the pens are removed by compressed air.

Each pen is now carefully examined for imperfections in the previous operations, and as they are soft, it is necessary to harden them by heating them red hot, and dropping into cold oil. The oil is removed by centrifugal force and boiling lye, and the pens are then dried in sawdust. This makes the pen very brittle, so that it has no resiliency. In order to obtain the latter quality, the pen is tempered by gradually reheating it until it has acquired the greatest toughness and elasticity possible.

The pen now has a coating of oxide, which must be removed by scouring. This is done by placing the pens and a scouring material in tumbling barrels and revolving them until they are bright. Girls then grind the pens on emery bobs lengthwise and across the nibs. Some pens have only one operation in this department, while others have two and three. Fig. 17 shows a pen which has been cross-ground, and Fig. 18 one which has been both cross and straight ground. Pens are ground to enable them to hold the ink better, and also give them more resiliency.

The pens are now ready for slitting. As it is necessary to cut through the hardened and tempered steel without damaging the point, it can be readily appreciated that the tool for doing it must be one of the most delicate. It is a miniature shearing machine with knives of extreme hardness of absolutely perfect gage to hold the pen, so that the shears will always cut through the center of the point.

After the pens have been slit, as in Fig. 19, they can be used for writing; but they would be very scratchy and would stick in the paper. In order to overcome this, the points are rounded and made perfectly smooth.

The final examination is now given each pen; expert examiners sit before slanting desks on which is a slate of black glass; the pens lie on this desk and the examiners pick up one in each hand, pressing them on the glass and looking at the cutting, piercing, marking, raising, grinding, slitting, tempering, etc. Should the pens have any imperfections in any of these operations, they are thrown into separate boxes, so that each room can be charged with the amount of its waste. This waste is then put in iron pots and heated so as to prevent their being used, when they are sold for scrap steel. There are 1,728 chances to make a bad pen in every gross; consequently its manufacture requires vigilant care and inspection.

The pens are now polished, and, if they are to be left gray, are ready for the lacquering operation; if they are to be made bronze, blue, black, or any of the various shades, they are sent to the tempering room, and gradually reheated in a revolving cylinder until the required color appears upon them, when they are chilled quickly, so as to prevent the color changing. The pen is now practically finished; but if put on the market in this form, would rust very quickly. Each one is therefore given a thorough coat of lacquer, which

Fig. 12. Cut.

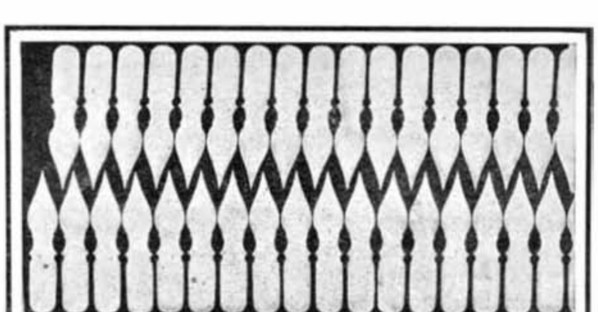

Fig. 13.

Fig. 14. Pierced.

Fig. 15. Marked.

Fig. 16. Raised.

Fig. 17. Cross ground.

Fig. 18. Cross and straight ground.

Fig. 19. Slit.

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preserves it. If the pens are to be plated with bronze, silver, or gold, these operations are performed while the pen retains its bright polish.

The pens are now ready to go to the boxing room, where they are "counted" by weight. It will be found impossible to put a gross of pens in the box intended for them unless they are laid parallel. In order to do this quickly and easily, they are put in a half-cylinder and shaken. This quickly places them in a parallel position, and by a very quick move of the operative they are dumped into the boxes, which are then ready to be labeled and packed.

There is a story widely copied by newspapers that the introduction of the typewriter had diminished the use of steel pens. This is not only untrue, but strange as it may seem, the typewriter has benefited the steel-pen business. It has done this, by increasing the volume of correspondence a hundredfold, and called forth return correspondence that would never have been sent.

Capt. Amundsen's Voyage and the Magnetic North Pole.

Capt. Amundsen's recent return from his Arctic expedition has prompted Fridtjof Nansen to publish his views on the importance of the achievement in Morgenbladet, a Norwegian daily newspaper. Because of the careful preparation of every detail, both scientific and practical, and the excellent manner in which everything has been carried out, in spite of the limited means at the disposal of the explorer, this voyage, in the opinion of Nansen, ranks among the most remarkable of polar expeditions. The most important aim of the daring Norwegian, viz., to locate the magnetic north pole, has been realized as successfully as could be hoped.

Our earth, as is well known, may be regarded as a rotating magnet, the poles of which (viz., the magnetic north and south poles) do not coincide with the geographical poles. In fact, the magnetic North Pole is situated about 30 degrees south of the geographical North Pole, toward Canada, somewhere in the neighborhood of the meridian 100 degrees west of Greenwich. The magnetic South Pole presumably lies at the antipodal point, at a similar distance from the geographical South Pole, in some unexplored Antarctic region. No expedition has thus far been able to advance to the vicinity of the magnetic South Pole. For this reason, as well as for the reason that it is nearer to ourselves, the magnetic North Pole has been more accessible.

Whether the magnetic North Pole constitutes a single point or several points, or even an extensive region, has not yet been ascertained. Amundsen's excellent observations, after having once been worked out, will however afford the most valuable material for solving this problem.

In the neighborhood of the magnetic North Pole the magnetic force, as is well known, is directed toward the interior of the earth, at right angles to the surface. The inclination is just 90 degrees, that is, a magnetic needle, suspended by a thread so as to be free to move in all directions, will adjust itself vertically with the northern end pointing downward, or else at an angle of 90 degrees to the horizontal plane.

For this reason, an ordinary compass proves quite inefficient at the magnetic North Pole or its neighborhood, the downward-working magnetic force being unable to direct the compass needle in any given horizontal direction. For the same reason, compasses will gradually become "lazier" as they approach these parts of the earth's surface. Magnetic studies carried out in the course of time under different latitudes have shown the magnetic forces and the deviation of the compass needle to be subject to highly remarkable and quite enigmatic variations, which are either of short duration (e. g., daily variations, and what are called magnetic storms) or of long duration, extending over many years. From these observations the magnetic poles themselves have been found to move in the course of time. To explain this fact, many theories have been advanced, which, however, are far from affording a solution of the problem, as with all our endeavors to arrive at a better understanding of these phenomena, we have not had trustworthy systematic observations at the neighborhood of the magnetic pole itself. This gap has now been filled by Amundsen's work, which was crowned by exceptional success, and which may be said to constitute the most valuable scientific material ever secured by any North Pole expedition, having been derived from the most interesting part of the Arctic regions, the neighborhood of the magnetic pole itself.

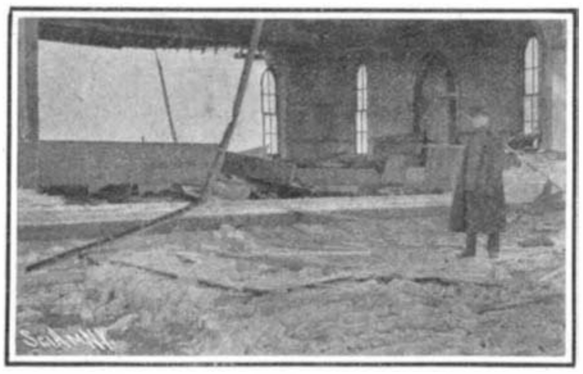
While the theory of terrestrial magnetism will thus be indebted to the voyage of the Norwegian explorer for a most valuable addition to its scope, other scientific branches as well are likely to benefit by it, because of the intimate connection existing between terrestrial magnetism and the electrical phenomena of the atmosphere, as well as the physical and other conditions of our earth.

A CHURCH BLOWN UP BY NATURAL GAS.

The town of Bunyan is located in the petroleum-producing district of western Ontario, and a number of the buildings are heated and lighted by natural gas, which is piped from wells in the vicinity. One of these buildings is the Baptist church at Bunyan. The edifice was constructed with heavy brick walls surmounted with a roof of shingles, while from the front section extends a brick tower with a shingle top. The church was heated by a large gas stove. The pipe conveying the gas became strained from the pressure, and the odor of the escaping gas caused a search to be made for the leak along the pipe which was laid under the flooring. To examine the pipe, one of the searchers lit a match, with the result that an explosion took place so violent that the side walls were almost entirely blown out, as shown in the illustration. Although as already stated they were composed of brick, all but a small portion of the rear and front walls were completely demolished, the material being scattered over the ground a distance of nearly fifty feet from the building.

Strange to say, the roof was but little damaged, the main injury being caused by settling in the center, where the supporting wall had been carried away. The front section and tower were uninjured, but a chimney in the rear was partly demolished from the shock.

The accident presents an interesting illustration of the direction of the explosive force, which appeared to



The Ruin Within the Church.

The Walls Blown Out.

A CHURCH BLOWN UP BY NATURAL GAS.

be almost entirely lateral, not even a hole being blown in the roof.

After-Burning in the Gas Engine.

According to the Engineering Times, Prof. Hopkinson, of Cambridge University, England, has used platinum resistance thermometers to investigate the explosions of homogeneous mixtures of coal gas and air at atmospheric pressure and temperature. The mixture was placed in a cylindrical vessel and fired by an electric spark at the center. The platinum wire used for the thermometer was exactly 1-1000 inch in diameter. When the flame approached the wire there was a sharp rise in its electrical resistance, and this could be easily measured, for the wire was placed in series with a battery of constant potential. When a thermometer was placed near the spark it was found that on ignition of the mixture there was a sudden rise of temperature to 1,200 deg. C. It was found that if the gas was fired in a closed vessel, whose volume did not alter, the differences of temperature in various parts of the vessel at maximum pressure after an explosion of this kind varied as much as 500 deg. C. With weak mixtures of gas and air it was found that the spread of the flame was much slower. With one volume of gas mixed with twelve volumes of air it was found that 2½ seconds elapsed before all the gas was burnt. With a mixture of one volume of gas and nine volumes of air the flame spread rapidly from the spark, and all of the gas was completely burnt within 1-40 second. The results are used to explain the phenomena of "after-burning" in the gas engine; and it is argued that the observed specific heat of the products of combustion, together with the loss of heat during the passage of the flame through the compression space, accounts for all of the peculiarities of the gas engine diagram.

Science Notes.

A realistic idea of the trade that is prosecuted in the imitation of old masters by unscrupulous dealers, especially for would-be collectors, is afforded by the recent discovery that has been made in the Art Gallery of Bath, England. Upon his death Sir William Holbourne bequeathed his extensive art collection to the civic authorities, and a building was especially erected to house the bequest. For some years this collection has been considered one of the most comprehensive and valuable extant. Recently, however, the pictures were minutely examined by an eminent expert, as doubts concerning their genuine character had been circulated, despite the fact that other experts had carefully investigated the collection and pronounced the pictures to be genuine. As a result of this last examination, however, no less than two hundred have been proved to be spurious, and worthless except as remarkably clever forgeries. The result of this discovery has aroused skepticism as to the *bona fide* nature of many of the art treasures possessed by other art museums and private collectors, not only in England but in other parts of the world as well. The majority of these imitations are the product of Continental artists, and are so cleverly and skillfully executed as to be almost impossible of detection.

In determining the difference between the longitudes of two places, the comparison of their time, as is well known, plays an important part. While this comparison has so far been carried out by use of the telegraph, telephones have recently been advantageously employed in determining the longitude of Brest as compared with that of Paris. According to the Elektrotechnische Zeitschrift, two chronometers striking half-seconds were used, of which one indicated mean time and the other astronomical time, thus allowing the coincidence process to be used. On the glass plate of each of the two chronometers was arranged a Hughes microphone inserted together with a battery in the primary circuit of a transmission coil, while the secondary winding was connected to the long-distance telephone circuit. The operators installed at Brest and Paris respectively could thus watch the stroke of the two chronometers while being in a position to communicate by telephone. A variable resistance inserted in the primary circuit of one of the two stations enabled the two chronometers to be synchronized, and the operator perceived the two strokes with the same ear and with equal intensity, thus seizing the coincidences with far greater accuracy than in the event of the stroke of the near and distant chronometers being detected with different ears. It was possible to reach results within 1/100 of a second of perfect accuracy.

A survey of the field of technical education shows, first, a group of high-grade engineering schools preparing young men for the leading positions in professional, industrial, and educational callings. These schools are increasing their laboratory facilities, year by year, and are steadily improving their instruction in mathematics, physics, and chemistry, as a basis for good engineering practice. The development in this field will be the extension of the work beyond the requirement for the bachelor's degree or the engineering degree. Just as medical schools add a year or more of post-graduate study, so engineering schools in the near future will extend their work into the realm of post-graduate work. The need of engineering education beyond the stage reached to-day in the ordinary college was apparent to such a far-sighted educator as the late President William R. Harper, of the University of Chicago. No engineering college has yet been organized in the university, but the plans contemplate a school that shall tower above all other schools of its kind as the university itself towers above the small college. A further survey of the field discloses a number of "cut, fit, and try-on" schools. These do not devote their energies to any one subject or stratum of education. They may teach art, high school studies in general, engineering, photography, stenography, cooking, dress making, library economy, or any other subject for which there is sufficient demand to form a class. These schools form an essential link between the older and the newer phases of education; they show the tendency of the age; in them the experimental educational work is done and later special schools are founded to carry on the work begun here in a small and tentative manner. As evidence of this, witness the course in library economy established by Armour Institute of Technology in 1893 and after a few years of successful life adopted by the University of Illinois; also the numerous schools of domestic economy following on the heels of the successful courses given at Armour.

The new Cincinnati waterworks are now ready to furnish about 12,000,000 gallons daily to the high service system of the city. This supply is not filtered, as it will be some time before purification works are built,