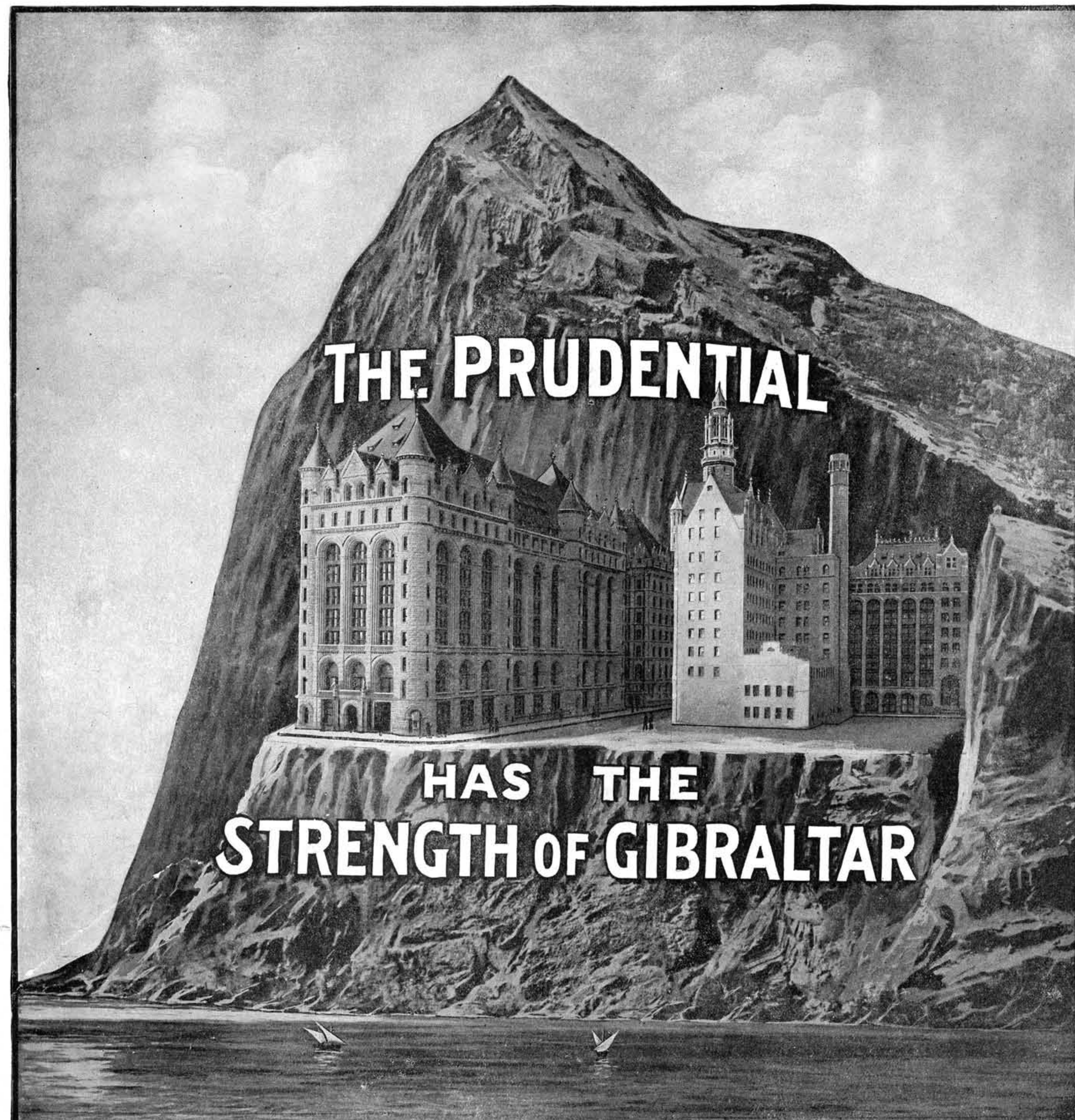
ARMOR WITH AIR GENERATING EQUIPMENT FOR DEEP SEA DIVING.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SCIENTIFIC AMERICAN

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Vol. XCV.—No. 23. ESTABLISHED 1845. | NEW YORK, DECEMBER 8, 1906. | 10 CENTS A COPY $3.00 A YEAR.

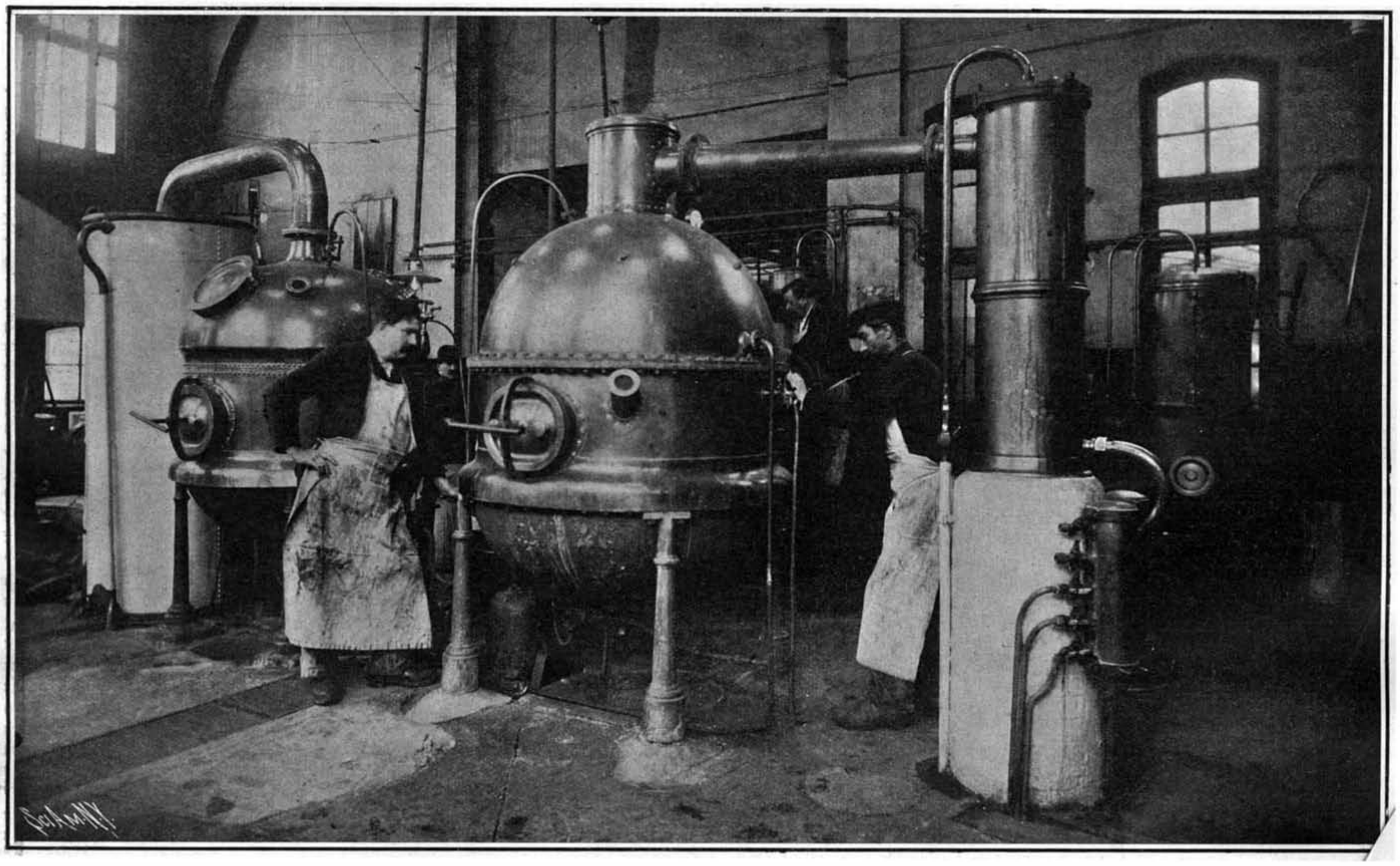

Fig. 1.—Extraction of Peruvian Bark Alkaloids by Hot Petroleum in Vacuo.

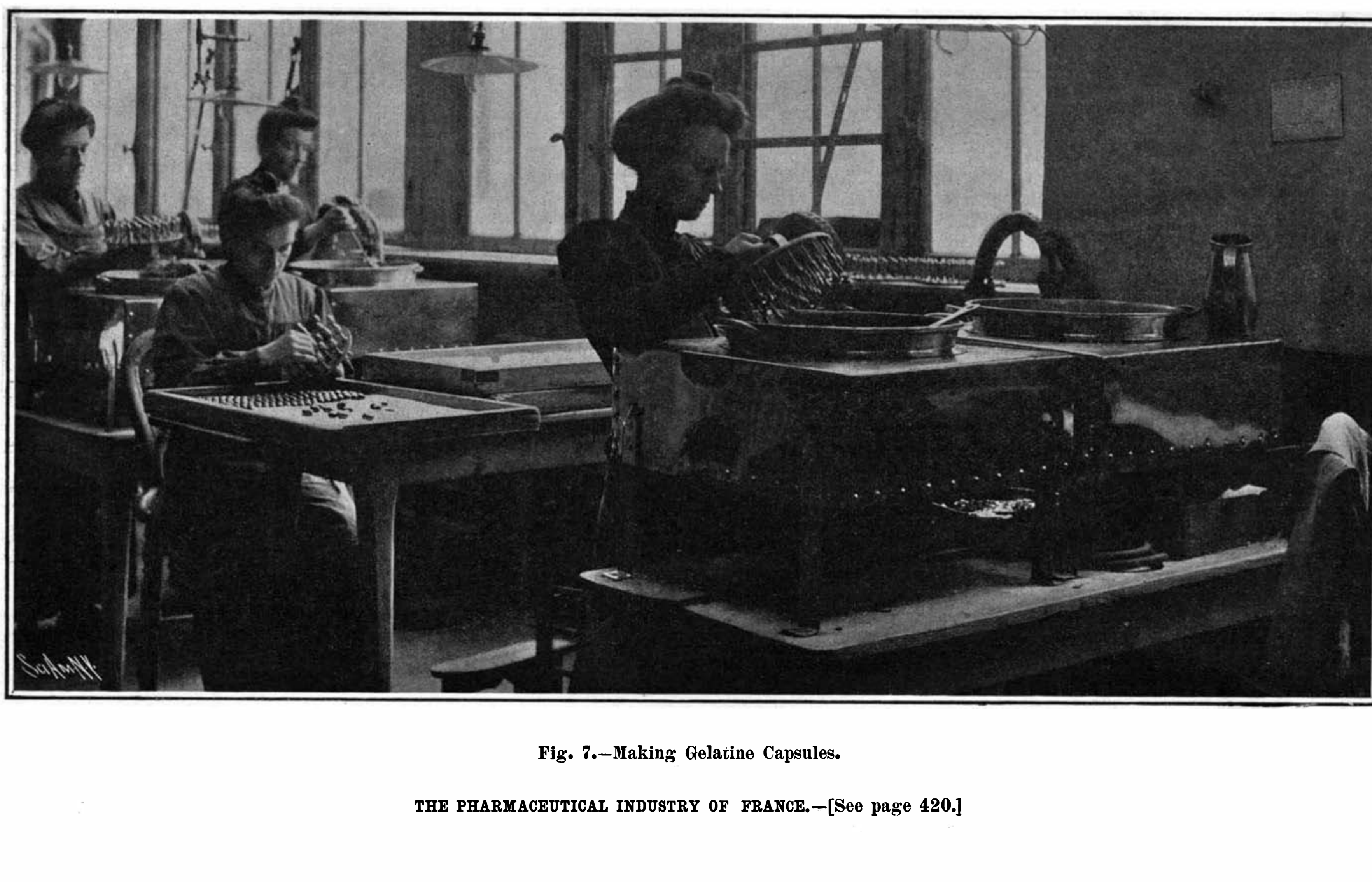

Fig. 7.—Making Gelatine Capsules.

THE PHARMACEUTICAL INDUSTRY OF FRANCE.—[See page 420.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO. - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, DECEMBER 8, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

BRIDGING THE HUDSON RIVER.

Since the failure of the Pennsylvania Railroad and other companies, that have their terminals in Jersey City, to build the great Hudson River bridge, of which so much was heard and written in the early nineties, the subject of bridging this river has dropped entirely out of sight. During the past year, however, the question of building a highway bridge across the Hudson has been the subject of consideration by a joint commission of the States of New York and New Jersey. This committee has recently completed its investigations, and will shortly present its report.

The original proposition for bridging the Hudson contemplated the construction of a colossal railroad bridge with a capacity for fourteen railroad tracks on two decks; and had this structure been built as originally planned, and at the original date proposed, it would have solved at a single stroke the problem of direct railroad communication between Manhattan Island and the West, and it would have done so for about one-fourth of what it will now cost to construct the same number of tracks in separate tunnels beneath the Hudson River.

It has never been generally understood how near this great enterprise came to being actually put through. Had it not been for the parsimony shown by the lesser railroads when it came to the final question of distribution of cost, the bridge would have been built. It was the endeavor of these roads to force the Pennsylvania Company to carry the burden of construction practically alone, that led the president to abandon at the last minute the scheme for the construction of a bridge and order the construction of tunnels exclusively for the use of the company. At that time real estate did not command the high prices which it does to-day; there was not so great a demand for structural steel; nor was labor so scarce or so highly paid. The combined railroads would have secured fourteen tracks into New York city for a cost, including terminals, which was estimated at $60,000,000, and certainly would not have exceeded $100,000,000. Two years from to-day, the Pennsylvania Railroad, after spending $100,000,000, will find itself limited to two tracks for communication with Manhattan and Long Island; and the other railroads will have no connecting tracks whatever.

Because of the great increase in the value of real estate, and in view of the very proper prejudice of the citizens of New York against the construction of viaducts and elevated railways within the city, it would be impossible either to secure the necessary permission for such a bridge, or interest the enormous capital that would be required for its construction. The city has wisely made up its mind to place all future railways and terminal stations as far as possible below ground, at least in the lower and business sections of Manhattan. On the other hand, if the site for a railroad bridge were found at the upper end of the island, where real estate would be cheaper and the objections to a great terminal station would not be so many, the station would be too far removed from the business centers to serve as a satisfactory city terminal.

The objections against a bridge over the Hudson designed for railway purposes disappear when the structure is designed simply as a connecting link between the highway systems of New York and New Jersey. The objections on the score of the excessive cost of the structure itself; of the enormous outlay for downtown real estate; and of the disfigurement of the city by the construction of elevated railways and terminal buildings, are no longer formidable. If the bridge were built primarily as a link between the public roads systems of the two States, there would be no necessity to locate it in the downtown district; and its Manhattan approach could very conveniently be made at street grade from the high level of the Washington Heights district. Here the bridge could be made to serve as a part of the fine system of boulevards and driveways which extends from Riverside Park into the Bronx and Westchester County; while on the New Jersey side connection would be easily made with that splendid system of roads for which New Jersey is justly famous.

The chairman of the joint commission of New York and New Jersey announced that they will not attempt definitely to fix any particular site for a bridge; but will merely suggest that it be built somewhere between 14th and 72d Streets. We are of the opinion that if the site of the first bridge is selected in the vicinity of 72d Street, its convenience and popularity would be such that there would be an early demand for a second bridge to accommodate the general vehicular traffic in the lower business section of the city.

SAFEGUARDS FOR THE PANAMA CANAL LOCKS.

The engineers of the Isthmian Canal Commission have recognized that the absolute safeguarding of the locks of the Panama Canal against destruction by steamship collision is one of the most vital problems in the whole of the canal enterprise. When the Commission announced its decision in favor of constructing a lock canal, in which the summit level was to consist of an inland sea held at an elevation of 85 feet and entered by three stupendous locks in flight, a storm of criticism was aroused against the plans on the ground that an accident might result in the carrying away of the locks, the emptying of the large high-level lake, and the wrecking of the whole enterprise. The most weighty criticism came from Mr. Hunter, the Chief Engineer of the Manchester Ship Canal, and a member of the consulting board, who drew attention to the fact that there had been several accidents on his own canal by collisions of steamships with lock gates which, for the time being, had tied up traffic on the whole canal.

During the past six months, or since the plans for a high-level lock canal were adopted, the Isthmian Canal Engineers have been giving very careful study to the question of safeguarding the locks, both against collision and against the disastrous effects which would ordinarily follow if one or more of the lock gates were carried away. Among the devices for preventing collision, which have been made the subject of study, the most promising is that calling for the provision in front of each pair of lock gates, and about 50 feet therefrom, of a pair of safety gates, which a vessel, entering the lock too quickly, would have to carry away before she could collide with the lock gates proper. The protection afforded by these gates would be twofold. In the first place, a vessel would exercise as great care to avoid hitting them, as if they were the actual gates that held the water in the lock, since collision with them would in any case result in serious damage to the ship itself. In the second place, these gates, because of their enormous structural strength and the great resistance which they would offer to an end-on blow, would suffice, even though they were carried away, to absorb the remaining momentum of the ship.

In addition to the gates, a system of control by means of powerful warping and snubbing devices is being developed, these latter being installed upon the massive concrete masonry which forms the side walls both of the entrances and the locks themselves. One method under consideration contemplates the use of powerful friction drums, working on the same principle as the friction drums used to ease the strain in towing during heavy weather at sea. Cables led from these drums, which would be securely held in the masonry, would be made fast to the ship, and as they unwound, each cable would exert a retarding pull on the ship of from five to ten tons. This control would be positive, and sufficient cables could be made fast aboard to give absolute control of the largest vessel.

The carrying away of a lock gate would be a calamity, not because of the value of the gate itself, but because its destruction would cause a rush of water that might sweep out the whole flight of locks and result in the loss of the whole 37 miles of summit level. Consequently, in addition to making provision, in the way of safety gates and elaborate braking devices, to prevent collisions with the gates, the Commission engineers are making a careful study of various devices by which, should the gates be broken down, a barrier could be interposed back of the gates at the entrance to the locks, which would close the entrance and hold back the water. There are three principal methods under consideration. First, the use of huge caisson cylinders, which could be floated across the lock entrance and close it in much the same way as the caisson gate closes a drydock; second, the use of an emergency swing bridge carrying vertical gates; and third, the use of a special type of hinged swinging gates.

If cylindrical caissons were used, they would be placed either horizontally or vertically. In the horizontal system a cylinder 46 feet in diameter, which is the depth of the water in the lock entrance, and slightly longer through its axis than the width of the entrance, would normally lie in a transverse sunken pocket, built transversely to the axis of the lock, and sufficiently deep to allow the cylinder to lie submerged below the 45-foot level. Should a lock gate be carried away, this cylinder would be rolled up out of its pocket on an inclined plane, until it rested upon the bottom, with its ends bearing against suitable shoulders built for this purpose in the side walls of the entrance. As the cylinder would be built with a diameter slightly greater than the depth of water in the entrance, it would serve to effectually close the channel and hold up the lake level until repairs had been effected. The rolling of the cylinder, which would be water-ballasted sufficiently to give it a slight margin of submergence weight, would be done by means of heavy cables passed around the ends of the drum and operated by powerful winches suitably placed on the shore. Another plan under consideration contemplates the use of two vertical cylinders which normally would stand in vertical pockets formed in the side walls of the entrance. Each cylinder would be slightly smaller in diameter than the width of the entrance so as to secure a slight resultant horizontal pressure when they close, and provision is made for swinging them out of their pockets until they meet at the center of the entrance channel, where they would form a barrier to the flow of water.

Another method contemplates the use of two vertical sectors of cylinders, hung on heavy pintles at the side walls of the entrance and normally swung back into pockets out of the way of the traffic. Should a vessel collide with a gate and be sunk in the channel, these gates would be swung shut until they met or closed against the sides of the sunken vessel. The advantage of this type of gate is that, as the resulting thrust is normal to the curved upstream faces of the gates there would be no destructive impact as they swung together in the face of the rush of water.

Another most effective method of holding back the lake would be the provision of a swinging bridge, mounted on a turntable, and corresponding, in its construction and operation, to the ordinary swing bridge over a navigable waterway. In case of accident, one arm of the bridge would be swung across the 100-foot opening of the entrance, until it brought up against an abutment formed in the opposite side wall. From the bottom of the arm, which would be a steel truss of great strength and rigidity, would project a series of vertical steel guide pockets, reaching down the full 45-foot depth of the entrance, and bearing on a bottom sill. In case of accident this arm would be swung across the entrance, and a series of steel curtains would be lowered until the flow of water was entirely shut off.

It will be seen from this outline of the studies which have been made of this problem, that the destruction of the lock gates would not necessarily involve the washing away of the whole flight of locks and the emptying of the summit level lake. The devices which we have above described are, it is true, of gigantic size, and would involve some careful planning both as to their construction and subsequent operation; but with the modern materials and appliances which the engineer has at his disposal, there is no inherent difficulty in these plans to prevent the satisfactory realization of one or other of them in practice.

AIRSHIPS IN THE FRENCH ARMY.

The French army seems to have taken the lead in the way of practical use of airships for military work, and will soon have two airships in actual service. It will be remembered that the first one of these, the "Lebaudy 1905," which made such a fine run from Moisson to Chalons, and a set of maneuvers at Toul, was turned over to the government by Messrs. Lebaudy, and the Minister of War had it stationed first at the Toul fortress and afterward at the Meudon establishment near Paris. It is proposed to use it especially in order to train the aerostatic personnel, and it will remain there for the instruction of the officers and men who are to form the first crews of the airships. Commandant Bouttieaux and Capts. Voyer and Bois, who followed last year's tests, are charged with the instruction of the men. The personnel will thus be well trained by the time the second airship "Lebaudy 1906" is delivered to the army. The new airship presents a great interest. M. Etienne, the Minister of War, having seen the value of the former airship during last year's maneuvers, decided to have a new balloon of the same kind built by Messrs. Lebaudy, and the new "Lebaudy 1906" is the development of the principles already applied with success by Engineer Julliot. Modifications over the type we have already described are made in some of the details. The envelope, still of rubber-treated canvas, measures nearly 200 feet long with a large diameter of 35 feet as before, and a volume of 4,000 cubic yards. A Panhard-Levassor 70-horse-power petrol motor is used now, and it gives much better results than the 20-horse-power form used on the first airship. All the mechanical parts are calculated accordingly, and a higher speed is looked for. Some changes have been made in the planes and the steering apparatus. As it is somewhat longer and thus has a greater volume, and the arrangements for ballast are improved, with a higher power, it should give even a better performance than the first, with a greater range of action. Most of the maneuvers are worked by automobile steering wheels placed near the pilot. The floor of the nacelle is of steel plate. While building at Moisson the construction has been kept secret for the most part. The most recent reports state that the new airship is now entirely finished, and it is filled up with gas by a corps of military aeronauts commanded by an officer. Then the first trials will be made on all the different parts so as to show what modifications may be needed. After these are made the final tests will take place, probably near the first of December. Then the Minister of War will take possession of the airship, as has been agreed upon, when it will have been put in perfect shape by Messrs. Lebaudy. It is to be known as the "Patrie," while the other will keep the name of "Lebaudy," and will be allotted to the fortified post of Verdun. Here will be established a well-fitted airship park which will be much more complete than the temporary one first set up at the Toul fortress. A third airship will no doubt be built, and will be called the "Republique."

NATIONAL ACADEMY OF SCIENCES.

BOSTON MEETING.

BY WILLIAM H. HALE.

The meeting of the National Academy of Sciences at Boston, November 20 to 22, was notable in several respects. A majority of all the members of the Academy were present; forty-three papers were presented, so that both in attendance and number of papers all previous records were broken; and also a new and interesting feature was added in the conversazione, which means, as they use the word here, not merely a social gathering, such as the conversazione to which the British Association for the Advancement of Science has long been accustomed, but a collection of most interesting and instructive exhibits showing the latest phases of scientific research in many departments. Boston may well claim to be the best place in the world to hold a scientific meeting, and the sessions were held in the most delightful environment possible—the new group of marble palaces just opened for the Harvard Medical College.

With so much of interest to describe and report, no exhaustive account is practicable. The topics presented cover a wide range, from the evolution of the universe to the measurement of waves of electrical energy of the wireless telegraph, of but one or two millionths of a second duration. A very curious and novel theory as to the extent and nature of the stellar system was advanced by Prof. George C. Comstock, to the effect that there is something which quenches light coming from the regions outside the milky way than from the milky way itself; hence, that the bright stars in the latter may not really be larger than the faint ones outside; the small apparent motion of these stars is due to the fact that they are drifting in the same general direction as our sun; and there is reason to believe that the universe is infinite.

Dr. George E. Hale exhibited photographs of the sun taken at the Carnegie Institution in California, and discussed solar spectra and their bearing on stellar evolution. Photographs taken by the incandescent calcium vapor at different heights surrounding sun spots show that the atmosphere is hotter in its lower and cooler in its higher strata. It is also found that the temperature of sun spots is so much cooler than that of the surrounding atmosphere as to allow elements elsewhere dissociated to combine, notably oxygen and titanium, as the spectrum shows the presence of oxide of titanium in the sun spots. A similar evolution has taken place in the stars.

Prof. William H. Pickering demonstrated by a gyroscope the solution of a problem which has long perplexed astronomers—why the tenth satellite of Saturn has a retrograde revolution. This is really the original direction of revolution, but the other satellites and all but one of the planets of the solar system have been caused to change the original direction by the friction of the annual tide which in the course of ages has caused the axis of our earth, as well as of the other planets and satellites to turn clear around, causing the rotation to be opposite to its original direction. By imitating this tidal friction—producing an artificial tide on the gyroscope—Prof. Pickering caused a similar inversion of the gyroscope.

Prof. Bailey Willis discussed heterogeneous elements of the North American continent, indicating that this continent has had five elevations and four submergences.

Prof. Henry F. Osborn spoke of the American tertiaries, pointing out seven different successive changes of fauna due to the making or severing connections with different continents, so that North America has in turn been stocked from South America, Africa, again South America, and finally Europe, giving us from the last the types now prevalent.

Prof. Charles S. Van Hise gave an explanation of the origin of the ores of the cobalt-silver district of Ontario—the Nipissing mine, etc. This is the first discovery of cobalt of any extent in America; the only other important cobalt mines are in Saxony. The wonderful richness of the Ontario mines of cobalt and silver is attributed to the fact that the veins were filled as a result of two and in some cases of three successive concentrations.

It was well worth a journey to Boston to hear Dr. Charles S. Minot discourse on the nature and causes of old age. He began by saying that a German philosopher who told a visitor in the course of a short visit all the system of philosophy which it had taken him a lifetime to work out was angry that his guest could not master in so short a time what it had taken him a lifetime to acquire. Dr. Minot expressed much the same feeling at being expected to explain in a few minutes what it had taken him as many years to discover. Senescence, as he explained it, begins even before birth. The percentage of growth of an infant in comparison with its whole body rapidly diminishes. Guinea pigs as soon as they recover from the shock of being born, grow at the rate of 5 per cent a day, but at the end of the first month this rate has fallen to 1 per cent a day. Rabbits are born in a less fully developed condition, and they grow 17 per cent for the male and 16 per cent for the female at birth, which decreases to 5 per cent after one month and to 1 per cent after two months. But the rate in growth is many fold greater before birth. On the ninth day, immediately after the segmentation of the ovum is complete, the fœtus increases in weight 1,000 per cent, but this rate rapidly decreases. On the eighteenth day, the cells have differentiated in the different organs, and they are seen to have a thin coating of protoplasm. The differentiation of the cells continues to progress and the amount of enveloping protoplasm to increase. These two kinds of change are all that Dr. Minot has been able to discover; in other words, they are all that we know as to the changes which accompany increasing age. It is these changes in cell structure, then, that continue to progress as age increases and which constitute growing old or senescence, so far as we know anything about it. The only period of rejuvenation is the brief time occupied by the segmentation of the ovum immediately after impregnation. Senescence, therefore, begins long before birth.

The Alpha and Omega of the programme was Alexander Graham Bell on aerodromics, his name occupying both the first and the last place. He read only one of the papers, however, in which he gave an historical account of the development of aerial navigation, and described the form of apparatus on which he is now experimenting in Nova Scotia. He said that the problem was really solved by Langley in 1896, when he constructed a machine which actually did fly, for Bell saw it. Langley's later and more elaborate machine was unduly discredited because it never was actually launched, and so it never had a fair chance.

The discouraging factor of aerodromics is the well-known mathematical formula that the sustaining surface of a machine increases only as the square of its dimension, whereas its weight increases as the cube. If, then, you build your large machine in the same form as a small and successful model, it soon becomes too heavy to rise at all. To meet this difficulty, Dr. Bell decided to fasten together many small supporting surfaces. By this means he could increase the supporting surface at just the same rate as the weight. The best units are tetrahedra, with two faces covered and one face and the base open. These are made about double the size of samples which he passed around; probably about eight inches long on each edge. His first thought was to connect a set of these by their corners and to alternate this construction with open spaces; but he found that it was practicable to build up large masses of these units compactly, giving a great supporting power, combined with strength and lightness. The edges are of aluminium. The structure constitutes a sort of kite, using that word as a suitably descriptive one, but of course not at all in the nature of the old-fashioned simple flying toy.

In order to avoid needless risk of life, he uses his structures on water or at slight elevations, and kept captive. He finds it practicable to go at as low a rate as ten miles an hour, instead of the kilometer a minute, nearly thirty-seven miles an hour, at which the Wright brothers operated their machine in Dayton, Ohio. Apparently this high rate of speed was necessary to keep the machine in the air. He found also very recently that he could move his machine against a rather brisk breeze for the reason that it is heavier than the air, and momentum is the combined product of weight and velocity.

On archeology, Prof. Charles P. Bowditch gave an extremely interesting account of the temples of the cross, of the foliated cross and of the sun at Palenque, Mexico, which showed a high degree of accuracy of knowledge as to periods of revolution of the earth and the planets Mars and Venus.

Ellsworth Huntington, who has recently returned from a tour of three thousand miles in Central Asia, presented evidence to prove that the climate of Chinese Turkestan has greatly increased in aridity in recent times. He showed photographs of villages inhabited from fifteen hundred to two thousand years ago, and necessarily requiring abundant supply of water, which were now in ruins, and very remote from water, in some cases as far as sixty miles.

Prof. Joseph Barrell showed how a comparison of sedimentary rocks over a continental area may enable us to discover what were climatic conditions in geologic ages. Periods of great rainfall were characterized by large areas of fresh-water sedimentation, and those of small rainfall by a greater proportion of marine deposits. The inclosed fossils indicate whether they were organisms of marine or of fresh-water life. He stated also that about one-tenth of the earth's present land surface is desert.

Dr. R. S. Woodward exhibited and explained a double suspension pendulum, devised especially in order to determine the rate of acceleration of the speed of a falling body. He avoids defects of previous pendulums, especially the knife-edge. His invention vibrates more steadily than the pendulums of the best astronomical clocks.

POINTS ABOUT NEEDLES.

BY H. R. CHRISTY.

One needle is a pretty small item, but the daily consumption of something like 3,000,000 needles all over the world makes a pretty big total. Every year the women of the United States break, lose, and use about 300,000,000 of these little instruments.

Our needles are the finished products of American ingenuity, skill and workmanship, and yet how many people, threading a needle or taking a stitch, have ever given a thought to the various processes through which the wire must pass ere it comes out a needle? The manufacture of a single needle includes some twenty-one or twenty-two different processes, as follows: Cutting the wire into lengths; straightening, by rubbing while heated; pointing the ends on grindstones; stamping impression for the eyes; grooving; eying, the eye being pierced by screw presses; splitting, threading the double needle by the eyes on short lengths of fine wire; filing, removing the "cheek" left on each side of the eye by stamping; breaking, separating the two needles on the one length of wire; heading, heads filed and smoothed to remove the burr left by stamping and breaking; hardening in oil, the needle is thus made brittle; tempering; picking, separating those crooked in hardening; straightening the crooked ones; scouring and polishing; bluing, softening the eyes by heat; drilling or cleaning out the sides of the eye; head-grinding; point-setting, or the final sharpening; final polishing; then papering, and finally, labeling. For wrapping, purple paper is used, because it prevents rusting.

There are many sorts and kinds of needles: First, there is the surgeon's grewsome outfit—the probing needle, made for tracking bullets or hidden cavities of pus; the hairlip needle, the long pins for pinning open wounds, the post-mortem needle of curious pattern. Some of these little instruments are thin, some are thick; others are long and straight; others, again, curve once, twice or three times. The veterinary surgeon has his special outfit also. The cook's needles are wonderfully, fearfully made. His larding needle is used to sew large pieces of meat together. The trussing needle is made on purpose to insert melted butter or sauce right into the vitals of a Christmas turkey. It is hollow, and has a large opening into which the sauce is poured. Nor less interesting are the needles which the upholsterer uses. Some are half curved, and some have round points. He has needles with curious eyes—long, round, egg, and counter-sunk eyes; the same kinds of needles are used by collar-makers. Then there are the delicate needles used by wig makers, glove makers, and weavers; these are often as fine as a hair. The glove needles are splendid specimens of skillful workmanship; the finest of them have three-cornered points. The great sail needle, which has to be pushed with a steel palm, would puzzle most people; so, too, the broom-maker's needle, which must also be pushed with a steel palm. The curious knitting-machine needle, with its latchet; the arrasene and crewel needles, and the needle for shirring machines; the weaver's pin for picking up broken threads, with an open eye in the hook. The long instrument used by milliners, the needle of the rag-baler, the knife-point ham needle used in the stock yards, the astrakhan needle—these and other varieties do not call for special notice.

The needle, as we see it to-day, is the evolved product of centuries of invention. In its primitive form it was made of bone, ivory, or wood. The making of Spanish needles was introduced into England during the reign of Queen Elizabeth. Point by point the manufacture has improved, until the little instrument is one of the highly-finished products of nineteenth century machinery and skill.

THE PHARMACEUTICAL INDUSTRY OF FRANCE.

BY JACQUES BOYER.

The pharmaceutical industry of France is now monopolized by a few large firms, which supply all the retail dealers. The accompanying photographs illustrate the operations of the largest of these establishments, in whose works, at Paris and at St. Denis, quinine and other medicines which are given in minute doses are made by hundred-weights and tons. The modest apparatus of the old-fashioned apothecary would appear quite insignificant beside the gigantic vats in which sulphite of magnesia is crystallized, enormous retorts in which quinine and cocaine are purified, and the heavy pestles which are always grinding benzoate of soda in great mortars. For the raw materials which nature supplies to the pharmacist are seldom available for immediate use in medicine. They must be subjected to various manipulations in order to facilitate their administration—or, in other words, to gild the pill. Let us, then, examine the principal modern methods of preparing various *classes* of pharmaceutical products such as *espèces*, or simple mixtures of dried parts of plants, solutions, distillates, extracts, sweetened pastes, pills, granules, and *cachets*, pomades, ointments, plasters, and other remedies intended for external use.

The manufacture of *espèces* requires only mechanical operations without the addition of any reagent. In the large herbarium where woods, barks, etc., are stored, the freshly-gathered plants are spread out or hung up to dry and after complete desiccation are tied in bundles and labeled. When wanted for use they are comminuted in various ways—by shaving with planes (quassia, sandalwood); by triturating (Peruvian bark); by passing through fanning and grinding mills (flaxseed); by pulverizing in mortars with machine-driven pestles, arranged usually in batteries of four, eight, or ten; by grinding under millstones; and, finally, by sifting in order to give the powders the fineness prescribed by the "Codex."

The mortars are of cast iron and are mounted on stone bases and covered with leather hoods in order to prevent the powder from scattering. The millstones are of granite. "Medicated waters" and "spirits" are obtained by distillation. In the former water, in the latter alcohol is the vehicle of the medicinal principle. Both are made, in most cases, from vegetable substances, either fresh or dried, which are allowed to macerate for a period of from one to several days and are then put into a retort and distilled over a water bath. Sometimes the distillation is effected in a vacuum in order to lower the temperature of ebullition and prevent the decomposition of the essential oils.

As a typical example we may take the preparation of quinine, the invaluable febrifuge discovered by Pelletier and Caventou in 1820. Peruvian bark, the source of this alkaloid, is first broken up, pulverized, and sifted by machines and then, mixed with a certain proportion of lime, is heated with heavy petroleum oils *in vacuo* (Fig. 1). Usually, the oil required is pumped daily from a great tank, through underground pipes, to the apparatus, in order to avoid the accumulation of a large quantity of the inflammable hydrocarbons in the factory. Peruvian bark contains, besides quinine, another alkaloid, cinchonine. Both are dissolved and extracted by the hot petroleum which deposits them on cooling. They are separated by converting them into sulphates and crystallizing the mixed solutions in immense vats (Fig. 2). The sulphate of quinine crystallizes out, while the more soluble sulphate of cinchonine remains in solution in the mother liquor. The former is purified by successive crystallizations, after each of which it passes through a centrifugal machine which rapidly removes the adhering mother liquor. Finally, the pure sulphate of quinine is spread on trays covered with absorbent paper which are taken to the drying ovens. When completely desiccated it is packed in boxes or in bottles.

Solid extracts, dry or moist, are made by evaporating vegetable and animal infusions, more or less completely, in order to obtain the active principles of the drugs in comparatively small bulk. Although the discovery of alkaloids, acids, glucosides, and other definite chemical compounds in medicinal plants has diminished the importance of extracts, pans holding from 250 to 500 liters (70 to 140 gallons) each, and retorts, one of which has a capacity of 1,500 liters (413 gallons), are in constant use for the preparation of aqueous extracts of coca, kola, digitalis, and opium, alcoholic extracts of colchicum and hyoscyamus, and essential extracts of cantharides and male fern. The extracts

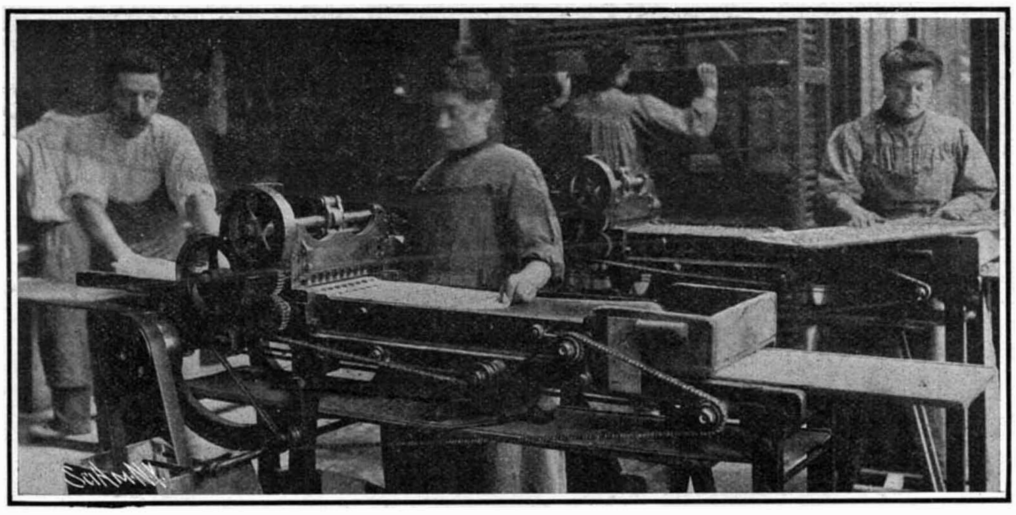


Fig. 8.—Cutting Out Pastilles by Machine.

Fig. 9.—Casting Marshmallows in Molds of Starch.

Fig. 10.—A Pill-Making Machine.

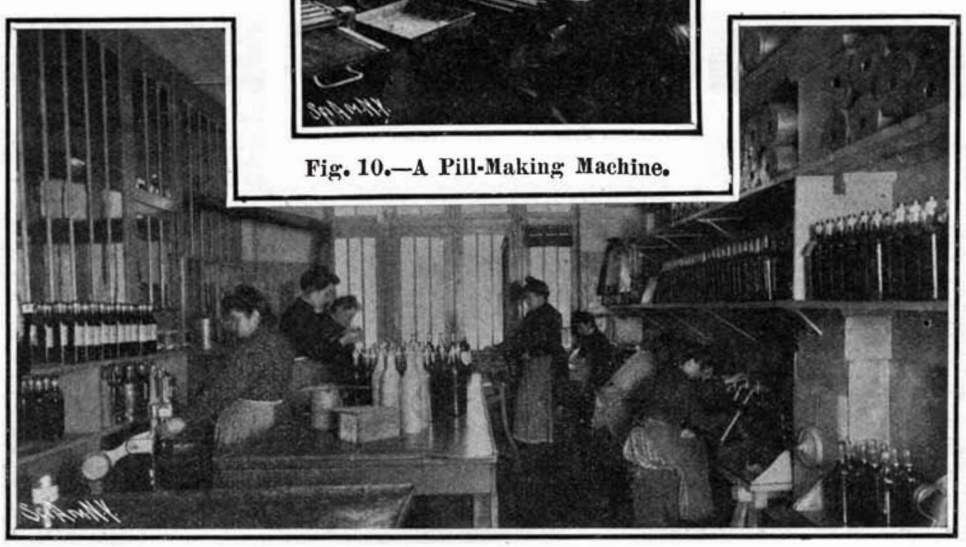


Fig. 11.—Bottling Cod-Liver Oil.

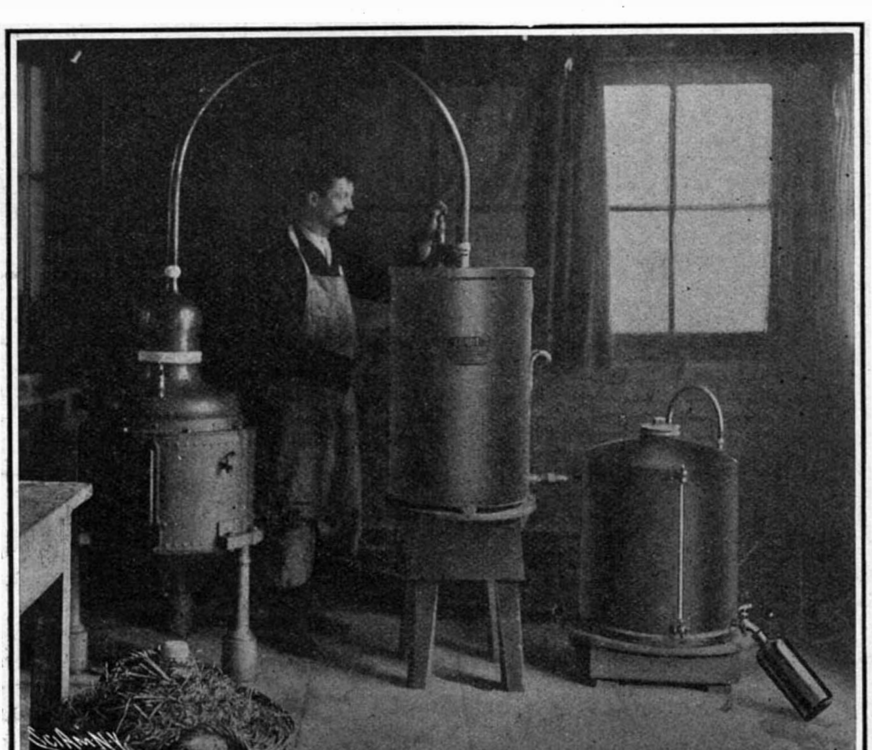


Fig. 5.—Distilling Chloroform.

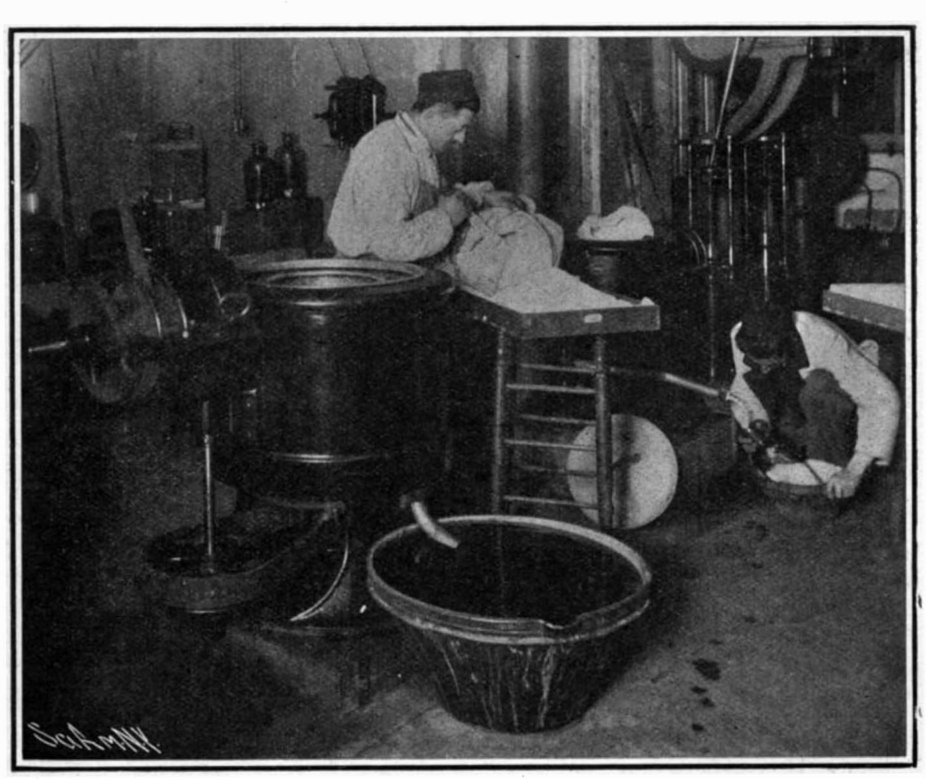


Fig. 6.—A Centrifugal Drying Machine for Cocaine.

THE PHARMACEUTICAL INDUSTRY OF FRANCE.

which are known as "robs" are obtained by the direct evaporation of the natural juices of certain plants, including lettuce, aconite, belladonna, and hemlock.

Some idea of the quantities in which certain medicines of mineral origin are produced may be gained by visiting the room devoted to the manufacture of kermes mineral (Fig. 3). Here we find twenty-five sheet-iron kettles, each of the capacity of 1,200 liters (330 gallons), which are connected by large pipes provided with stopcocks so that any kettle can be shut off from the rest at will. The kettles contain a mixture of sulphide of antimony, carbonate of soda, and water, which is boiled for an hour and then drawn off into evaporating pans of 5,000 liters (1,375 gallons) capacity. The liquid is filtered while hot. On cooling it deposits a light, velvety brown powder which, after being dried on wooden trays covered with paper, constitutes kermes, an expectorant which is given in doses of from 5 to 20 centigrammes (about 1 to 3 grains).

Near the kermes pavilion stands a kiln in which 5,000 or 6,000 kilogrammes (5 or 6 tons) of magnesia are calcined annually—enough to purge half a million persons. Twenty vats of 2,000 liters (550 gallons) capacity are used in washing the carbonate of magnesia which, formed into loaves, is dried on shelves in an immense oven or hot room (Fig. 4).

The solution of sulphate of magnesia is concentrated in steam-heated kettles of equally great size. Thence, the liquid flows, through wooden gutters, to the crystallizing pans, from which workmen shovel the beautiful white crystals. Eighty thousand kilos (80 tons) of sulphate of magnesia (Epsom salt) are produced annually at the St. Denis works.

Chloroform occupies a special building, the windows of which are darkened by black curtains (Fig. 5). It is made by mixing, in a large retort, 10 kilos (22 pounds) of chloride of lime with 3 kilos (6.6 pounds) of lime slaked in 80 liters (22 gallons) water, adding 2 kilos (4.4 pounds) of alcohol and passing a current of steam through the mixture, which should occupy not more than one-third of the capacity of the retort. At about 80 deg. C. (176 deg. F.) the mass swells and disengages almost pure oxygen. At this moment the fire is extinguished and the distillation begins. As soon as the swelling has subsided an additional quantity of the same mixture is introduced and this process is repeated until the retort is full. The heating is then resumed, and a mixture of chloroform, water, and alcohol condenses in the worm, whence it flows into a metallic receiver. The chloroform, being heavier than the other liquids, is easily separated from them. It is then washed by shaking with water and carbonate of potash, again separated, and dried over calcium chloride. As the finished product must be very pure, to avoid the possibility of accidents in the course of surgical operations, the chloroform is rectified by shaking with sulphuric acid, washed with a solution of soda, thoroughly mixed with pure poppy oil and redistilled, the first and last portions of the distillate being rejected.

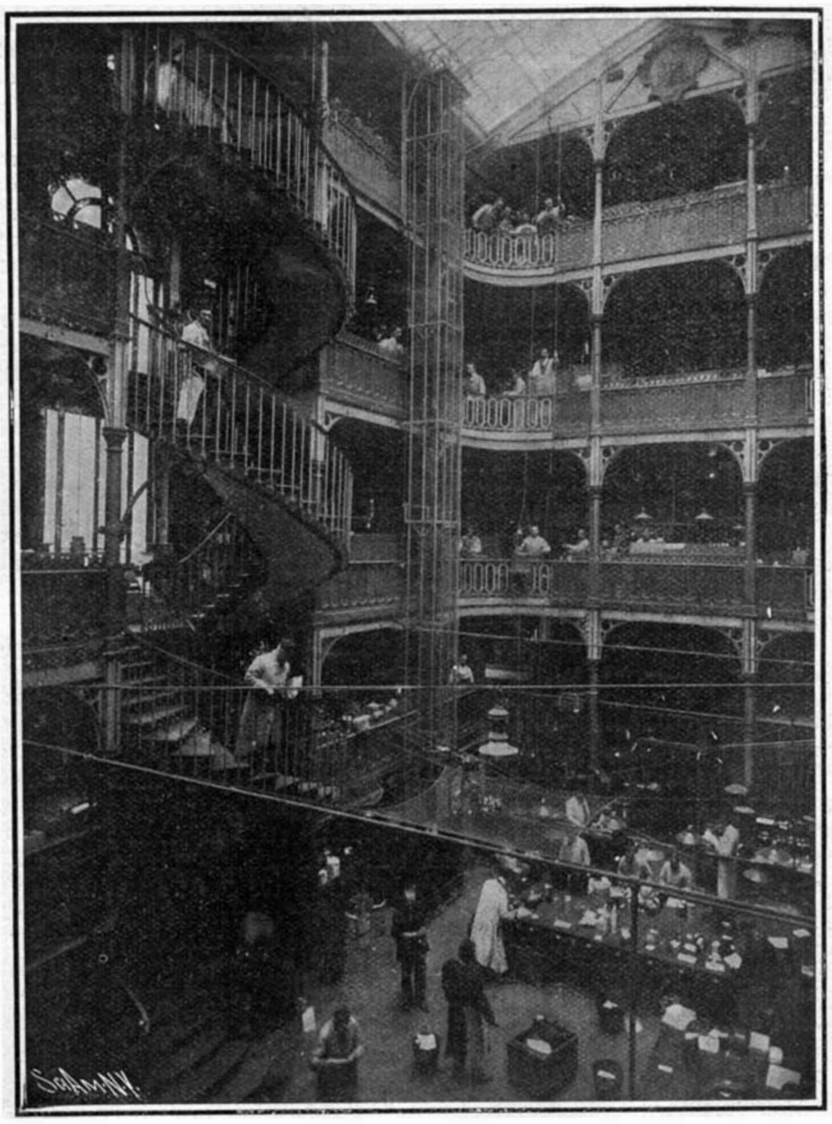


Fig. 12.—Sales Department of a Large French Drug House.

Modern surgeons use cocaine so much that, before leaving the anæsthetics, we will glance at the apparatus employed in the extraction of cocaine from the leaves of the coca plant. The infusion is filtered and precipitated by adding acetate of lead. The precipitate, after the excess of acetate of lead has been removed by sulphate of soda, is shaken with ether, which dissolves the cocaine. The alkaloid is then converted into a hydrochlorate which is recovered in a pure state by means of a centrifugal separator. In one of the illustrations (Fig. 6) a workman is shown removing the linen bag of precious crystalline flakes and spreading them on sheets of filter paper laid on wooden trays which will next go to the drying oven.

Now let us examine the various forms in which medicines of disagreeable taste and odor are conveniently administered. Long ago, bitter powders were disguised in unleavened bread, suitably moistened. About 1872 Limousin, a pharmacist of Paris, conceived the idea of inclosing powders in envelopes made of unleavened bread. These *cachets* are now made in a mold resembling a waffle iron and consisting of two iron plates marked with little depressions. Starch paste is introduced between the plates, which are heated by a gas furnace.

A similar purpose is served by gelatine capsules which, though not attacked by the medicine, dissolve in the digestive fluids. Into a solution of gelatine and gum, kept hot by a water bath, a girl dips a number of little olive-shaped iron forms, polished and oiled, which are attached by their stems to holes in a plate, which the operative turns to and fro in order to secure a uniform coating of the viscous fluid (Fig. 7). The mold is then removed from the bath and, as soon as the coating of gelatine has cooled and "set," it is taken to a drying room

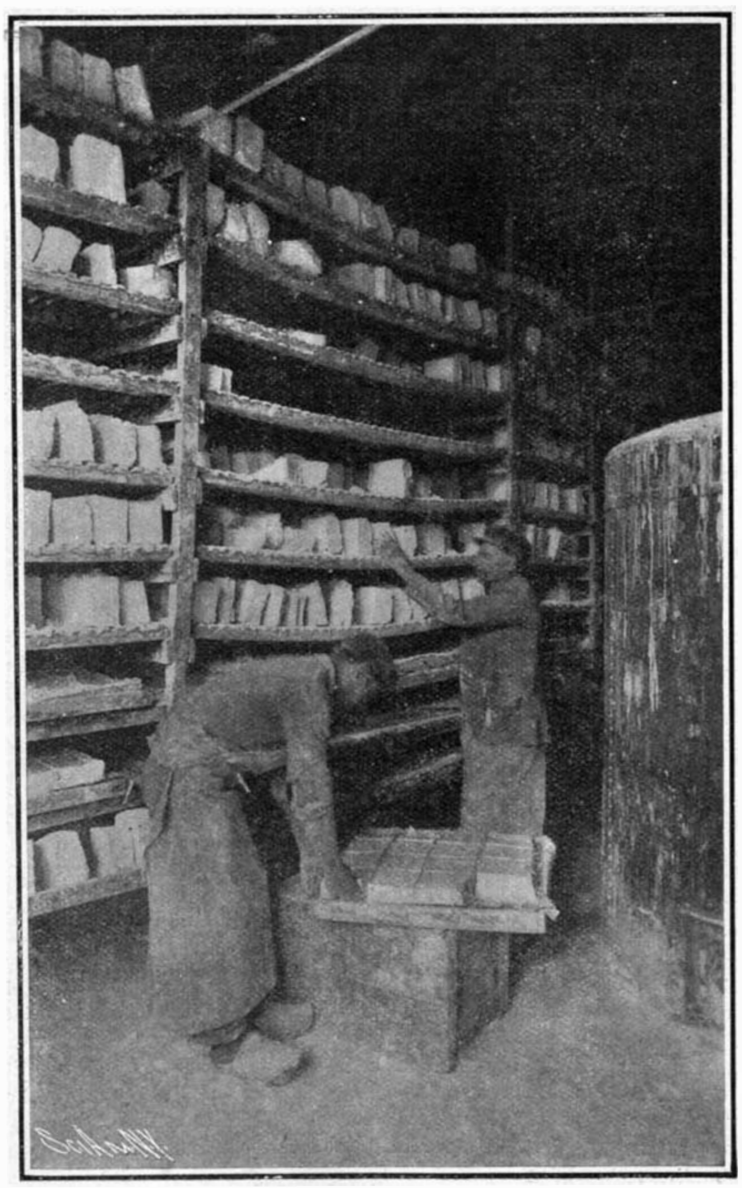


Fig. 4.—The Magnesia Drying Room.

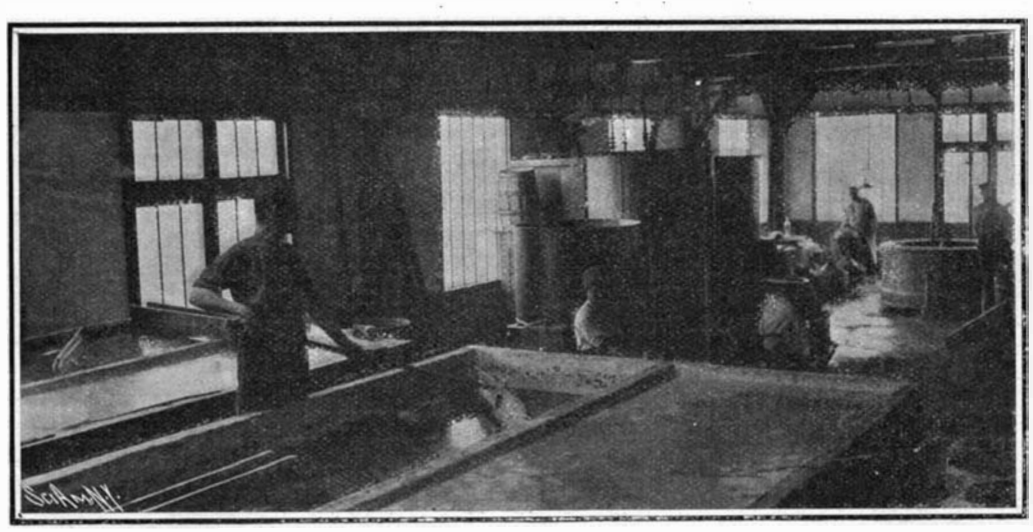


Fig. 2.—Crystallizing Salts of Quinine.

Fig. 3.—The Kermes Room.

THE PHARMACEUTICAL INDUSTRY OF FRANCE.

which is very gently heated. When the capsules are partly dry, but still elastic, they are removed from the forms and set, mouth upward, in little hemispherical depressions in wooden boards, each of which accommodates one hundred capsules.

Women now fill the capsules with liquid medicines by means of pointed pipettes or very fine tubes attached to reservoirs, opening and shutting the stopcock for each capsule. This operation appears very simple, but considerable dexterity is required to perform it without spilling the liquid. The filled capsules are then closed by brushing the orifices repeatedly with the hot solution of gelatine.

Another method, much used for ether, oil of turpentine and other very volatile substances, was invented by M. Thérenot. The liquid is poured between two sheets of gelatine which are then pressed together between two plates of metal marked by small and opposite indentations. The sheets of gelatine being welded together around the indentations, the result is a sheet of flattened beads, or pearls, filled with liquid, which are connected by their edges when they come from the mold, but are easily separated with the fingers.

Pastilles, troches, or lozenges are made by the ingenious apparatus which is shown in operation in Fig. 9. A paste, formed by mixing the medicine, in powder or solution, with sugar and gum tragacanth, is kneaded and rolled into a layer of the desired width and thickness. This is carried, by a moving apron, to and between the opposing punches of the pastille machine (Fig. 8). As the pastilles are cut out they are arranged in wooden trays which are placed on racks to allow the pastilles to dry. The scraps of paste are kneaded over and again passed through the machine. In this way are made the Vichy pastilles used in dyspepsia and the pastilles of kermes, sulphur and chlorate of potash, which are prescribed in bronchial affections.

Iceland moss and marshmallow pastes are made by adding the medicinal substance to melted sugar and slowly dropping the liquid mixture, from a dipper furnished with a spout, into peculiar molds (Fig. 9) in which they remain during their stay in the drying room. The molds are made by filling wooden boxes with fine dry starch and putting them under a press containing metal plungers, or forms, which make in the starch the cavities or molds into which the liquid paste is poured.

Pills are now made by machinery. The active ingredients are ground and mixed together in mortars by pestles formed of great wooden beams heavily shod with iron, which are moved by cams on a revolving shaft. Then, if the contents of the mortar, after being thoroughly ground and mixed, are pulverulent, glycerine, honey, syrup, a vegetable extract, or some other agglutinant is added to give the necessary consistence. If, on the contrary, the mass is liquid or very soft and wet, it is thickened by stirring in an inert powder such as licorice or marshmallow, which is called an excipient.

A stiff paste having been produced by either of these methods, it is rolled out into thin rods called "magdaleons." The pill-making machine (Fig. 10) consists essentially of two grooved plates, one of which, sliding over the other, divides the "magdaleons," which lie at right angles to the grooves, into approximately spherical pills.

The pills are perfected and tested by rolling them between a wooden disk and a metal plate and the perfect ones are kept in lycopodium powder to prevent them from adhering to each other.

Medicinal dragees are made by the process used by confectioners in making sugared almonds, the almond being replaced by a lump of stiff paste containing iron, mercury, anise, digitaline, atropine, or other medicine. The little medicated balls are put in a basin called a "shaker," which is heated and caused to vibrate. A thick solution of gum is added and then, slowly, a scented syrup. The dragees, polished smooth by mutual friction, become covered with a coating of sugar. They are whitened by sprinkling starch over them in the "shaker" and then go to the drying oven.

Leaving the confectionery department, let us visit the cellars in which oils, pomades, balsams, and ointments are prepared. Our attention is first attracted by fourteen round tanks of galvanized iron, each containing 1,200 liters (330 gallons) of cod liver oil which is poured into the tanks through holes in the floor of the building above. After remaining in these tanks for a time the oil is drawn off into great cemented cisterns, two of which have a capacity of 6,000 liters (1,650 gallons). From the cisterns it is pumped, as required, to the ground floor, where it passes through filters into a row of vats lined with zinc. From these it flows, through pipes that traverse the partition, to the adjacent bottling room shown in Fig. 11. Here the oil, which flows clear and limpid from a row of faucets over a zinc-covered table, is bottled, corked, capped, and labeled by girls. This rather unpleasant and repulsive work is done at St. Denis with the most scrupulous cleanliness, although the annual output of the establishment averages 150,000 kilogrammes (150 tons) of cod liver oil.

In other cellars ointments and pomades are made, by simple mixture, by solution, or by heating the active medicament with the fatty vehicle. The mixture is usually contained in a copper basin, which has a machine-driven stirrer and may or may not be heated over a water bath. The vehicle most commonly used is vaseline, which possesses the great merit of not becoming rancid.

Of other external remedies the most important are plasters, or cloths covered with an adhesive composition. The foundation generally used is unbleached muslin, which has a downy surface that adheres well to the plaster, but silk is also employed. The material is cut into strips 5 meters (5½ yards) long and 20 centimeters (8 inches) wide. On these the melted plaster is poured and distributed uniformly by passing the strips between two beveled scrapers, with their edges separated by a space equal to the desired thickness of the finished plaster. The coated strips, after drying in the air, are rolled up and packed in boxes.

A glance at the lavatory will complete our review of these pharmaceutical workshops. This is a large room with walls and floor of cement. The center of the room is occupied by cast-iron basins of a capacity of 600 liters (165 gallons), heated by steam. The waste pipes are stopped with plugs of copper. Machine-driven brushes of various forms, including bottle brushes, complete the equipment of the lavatory.

A word should be added about the sales department of the house with which this article deals. The department occupies the great hall of the Paris establishment (Fig. 12). The three galleries are connected with each other and the floor of the hall by electric elevators which stop automatically at each story. In addition, there is a powerful freight elevator which runs from the cellar to the roof.

To facilitate the rapid execution of orders, the establishment is divided into twenty departments, each of which has charge of a different class of goods and has its own separate organization, stores, and personnel, under the charge of a responsible chief. The departments of exotic drugs and rare products are located on the ground floor. In the first gallery are the chemical products and essential oils. The poison department occupies a room to which only persons engaged in that department are admitted. On the same floor is the department of galenic pharmacy. Plasters, health foods, antiseptics, medicinal confectionery, and various specialties occupy the second story, while the third contains the department of powders and the herbarium. The center of the ground floor is occupied by numerous clerks engaged in checking and transmitting orders. Here a very animated scene is presented during certain hours of the day. The lifts and elevators are continually bringing down parcels which, however, are not allowed to accumulate, but go as quickly as they come. It is a commercial hive of intense activity.

In order to eliminate every source of error in the quarter of a million orders that are filled annually—from 500 to 600 are received daily—every order, as it arrives, is copied on a sheet of paper the color of which indicates the method of forwarding (mail, freight, express, or export) and marked with a serial number which thenceforth serves to identify it. After being registered, the sheets go to the city clerk, who copies off the articles that are to be purchased from other houses. (These are brought to the hall and entered in the shipping register.) The colored order sheets then receive their shipping numbers and go to the ticket office, where clerks assigned to each of the twenty departments transcribe with manifolding pens the items that belong to that department. The stub of the ticket remains in the office. The other part goes to the proper department, from which it presently returns, attached by a drop of mucilage to the article ordered. The orders are now made up on tables divided into compartments which bear corresponding serial numbers. The checking clerk, as he inspects each article, detaches the ticket and places it in an envelope marked with the number of the order. The envelope then goes with the order to the packer, who again verifies each item at the moment of packing that particular article. This ingenious triple system of checks reduces the chances of error to a minimum and enables orders to be filled with accuracy and dispatch.

Motions in the Sidereal Structure.

BY PROF. EDGAR L. LARKIN.

All corpuscles—electrons—atoms, molecules, particles of interstellar dust, nebulæ, meteorites, uranoliths, comets, asteroids, moons, planets, and suns, move perpetually. In this note the motions of suns, vast masses, only will be considered. Suns are known to be moving in every possible direction, with varying but enormous velocities, for massive motion. In the present state of astronomy the ablest observers and mathematicians cannot detect any cause but gravitation. Many suns are coming toward the earth; while others are receding. These motions are those in the line of sight and can be detected in the telespectroscope only. Velocities of approach and recession are determined by computations based on wave-lengths of light. Other suns traverse paths that make angles with straight lines drawn from the earth to them. The angular displacement of these can be measured with telescope and micrometer, without the aid of the spectroscope. In cases where suns have a parallax large enough to be measured, these angular velocities may be translated into linear—to miles. The proper motions of suns are in every direction. Bees in a flying swarm move in all directions. The insects obey their wills. Suns obey universal gravitation.

Suppose all matter in existence to be condensed into one solid globe—then the words *rest* and *motion* might as well be taken out of the dictionary. Imagine all the atoms to be as close to each other as possible; then the mass would be "dead," unless, indeed, corpuscles revolved around their central suns—atoms. Now, let the sphere be divided into two equal masses, separated by an enormous distance. Gravitation would act and set up motion causing them to draw nearer to each other. Both would approach a point between them—their center of gravity—with ever-increasing speed. Given original distance apart great enough, then the cessation of motion at instant of collision would, by the law of conservation of energy, evolve heat sufficient to dissipate the entire mass back to the primordial cosmical state—the corpuscular. These would expand through an inconceivably wide space. If the tenuity of the expanded mass of corpuscles should equal that resulting from the resolution of the matter now in the solar system, so that a sphere having a radius equal to half the distance to our sun's nearest neighbor would be filled with the electrons—then enough of them to be in mass equal to one grain, would occupy 290,000 cubic miles! If the corpuscles in a little aluminium weight used by pharmacists should be expanded to fill an ordinary room in a house, the rarity of the mass would already be beyond all imagination. Then what will be said of the state of the same quantity of matter diffused throughout 290,000 cubic miles? Our two bodies will strike together; but let a third body appear. All will move toward their common center of gravity, but will not collide. They will form a regular revolving system, and become a "triple star." Suppose that in the case where only two bodies were in existence, some unknowable force had acted at any time in their career, to deflect one away from a straight line joining their centers of gravity; then no collision could take place, they would fall into orbits around their gravitational center and become a fine "double star." A third body acts as the unknown force. If the third mass is so far away that time is had for the two bodies to form a double star before it arrives near enough to produce a pronounced effect, the result will be a double sun revolving around a single. For, let cosmical masses in free space be deflected from a straight line joining their centers of gravity, then impact is impossible. Regular circuits will be made, in stable equilibrium, of necessity. This is owing to centrifugal tendency, one of the most potent agencies in nature. The complex curves traversed by three bodies before they become locked on regular orbits, have not been completely elaborated by mathematicians. The only possible case where an absolutely straight line could be traced by any cosmical body would be where only two were in existence. Hence, with many billions of cosmical bodies, suns and worlds, curves only are moved over. And the curvature of these is continually changing. Thus, our sun is attracted this way and that, by ever-shifting suns, to the right and left, and its pathway is sinuous and wavy. Every sun in existence attracts all others, modifying their motions slightly. Binary and triple suns traverse regular orbits, but solitary suns, like our own, are not in revolution around any stable or permanent gravitating mass. The idea of a vast central mass, whether hot or cold, light or dark, so enormously massive as to be able to dominate the entire universe, has long been exploded. We live on an atom of a world revolving around a lonesome sun, somewhere in the vicinity of the center of the Galactic Ring. A ship in mid-Pacific is not more isolated or lonely. Our sun's nearest neighbor is twenty-five trillion miles away. And on an express train with an incessant speed of one mile per minute, the time to go there would be 48,630,000 years! From our infinitesimal home, we look into the most appalling solitudes and deeps of space, and behold myriads of suns. Many of them, after long-continued and laborious research, are found to be shifting their positions. This displacement has been assigned by the ablest astronomers, for two and one-half centuries, to universal gravitation. Yet, letters have been received at this observatory, disputing this cardinal fact, saying that gravity is not the cause of the motion of suns.

Lowe Observatory, Echo Mountain, Cal.

Aluminium absorbs nitrogen when melted. A lot of aluminium skimmings will give off ammonia when wet. This shows that nitrogen has been absorbed.

The Care and Use of Spark Coils.

BY E. Q. WILLIAMS.

One of the most important considerations with any coil is to keep it dry. Although we hear a great deal about waterproof coils, it is a good plan with any kind to keep them in a dry place, not where they will get hot, but where they do not get damp, as the pressure of the jump spark is so high that it will run along a little streak of moisture almost as well as on a wire, and though it tends to dry up this moisture in so doing it sometimes carbonizes the wood* and makes another path for itself. Too much care cannot be taken, especially on launches, to have a good place for the coil and battery. And here let us sound a note of warning: Do not put on over six cells of dry battery or three cells of storage; if your coil doesn't work with this amount of battery in *good condition*, look for trouble in it; increasing the voltage will only burn out the contact points without helping the secondary spark materially.

Another thing to be guarded against is the tendency to set the vibrator spring too tight, "so as to get a good, big spark." This is tested in the air, and when a big, flaming spark is secured, the operator thinks "that will fire anything," while as a matter of fact it will skip and bother on a quick-moving engine. What is wanted for successful running is a "quick spark," that will get there just when it is needed and every time. Such a spark is usually a small one. The adjustment to secure it is the following: The vibrator screw is drawn back until it does not touch the spring. Then set the spring so that the iron head is from 1/16 inch to 1/8 inch from the core. Now bring the screw up until it touches the spring lightly, and start your engine; if it skips any, try adjusting the screw a little tighter, but leave the spring just *as weak as you can* and not have the engine skip. In this way the engine will run at its highest speed, and the battery will last very much longer. The battery consumption can be frequently increased to three or four times the amount a coil should take, by merely setting the spring stiff and getting a "big spark." On the other hand, there is a danger of setting it too weak, so that when the engine stops the vibrator spring does not touch the contact screw, and the engine will not start.

Another puzzling trouble to find is a wire that is broken inside the insulation. This sometimes happens in the most unlooked-for places, but usually where the wires are moved or bent most, as at the commutator or where there is a great deal of vibration. It can usually be located by bending and pulling, as the wire will be very much weaker and more limber in the broken spot. The writer frequently uses another piece of wire, and "jumps" the suspected wire; this tells the story quickly and surely, when the defective wire is replaced or repaired.

Spark coils when in use almost always have one secondary terminal connected to the primary, or "grounded," as it is called. This is to reduce the number of wires to the engine, and to enable the spark to complete its circuit.

In the dashboard or multiple types this connection is made inside the coil box, but in the ordinary single and some multiple coils, both secondary terminals are brought to the outside, and the ground connection is put on outside. Sometimes when a coil ceases to spark or breaks down, by changing this ground to the other secondary terminal and putting the plug wire on the terminal that was grounded, the coil will work as well as ever and run for a long time.

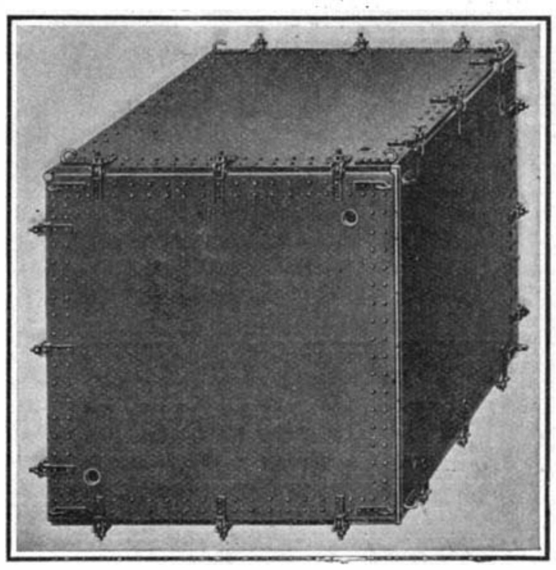
A secondary or plug wire lying over a hot pipe or cylinder is pretty sure to give trouble sooner or later. Block it up with a piece of wood or fiber, or if possible, move it away entirely; also keep oil away from your wiring, as oil rots rubber, and the wires are, or should be, insulated with rubber to guard against dampness. Do not draw the spark out in the air to see how long it is; this strains a coil, and if there is any weakness it will be sure to increase the trouble, even if it does not break down then.

Watch your spark plugs, too, as well as the spark points, as many a coil is blamed on account of the plugs; the outside gets greasy and dirty, then the spark occasionally jumps there and the engine skips, or if the plugs are foul, the spark cannot ignite. If you want solid enjoyment from your ignition system, keep everything clean and dry.

* A peculiar characteristic of wood is that when wet it is a conductor, when dry it is a non-conductor; when blackened by heat or carbonized it becomes a conductor, and when burned to ashes it is again a non-conductor.

THE DE PLUVY DIVING DRESS.

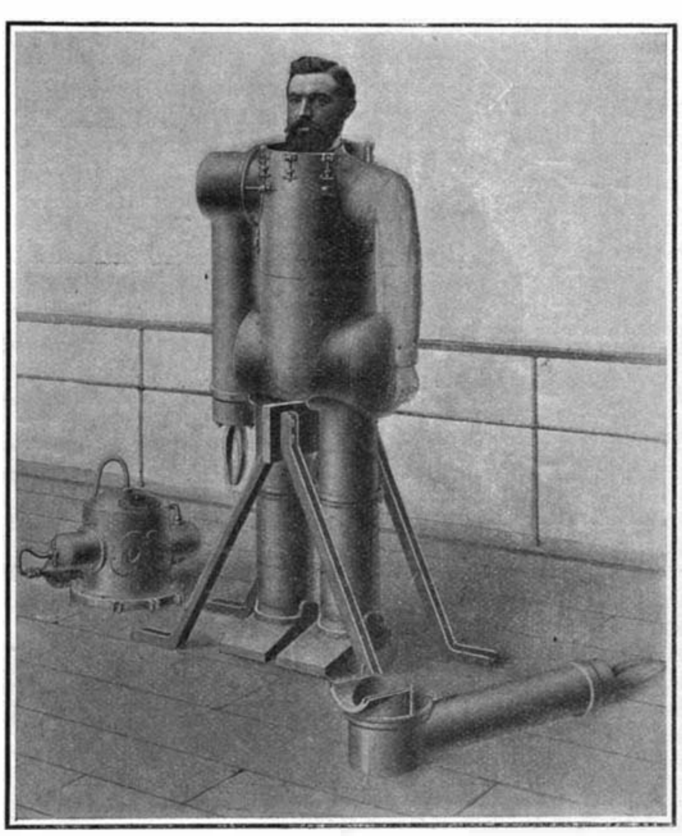
A novelty in the way of diving apparatus is the invention of M. de Pluvy, a prominent hydrographic engineer of Paris. This invention forms the subject of our cover illustration and is one which promises to be



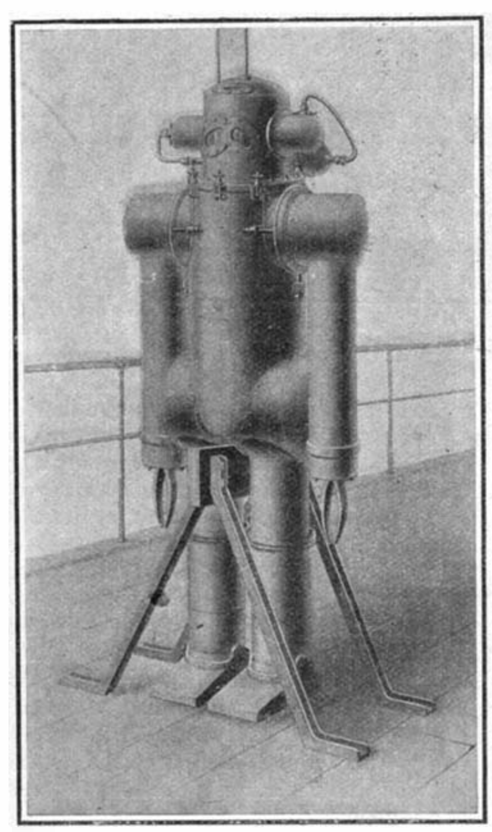
The Collapsible Caisson.

of great value in salvage operations. As De Pluvy has had many years' experience in diving operations, there is no doubt that the apparatus is of practical value. He uses a metallic diving suit which is made somewhat on the plan of the ancient coat-of-arms, being built of light and strong sheet metal having a thickness varying from 0.2 to 0.3 inch according to the position of the pieces. The joints and coupling points are made of pressed leather and rubber, and a special form of hydraulic joint is employed. On the top of the armor is fixed the helmet, which is the principal feature of the apparatus. The air is not brought to the diver from the outside, as usual, but the air he breathes is sent by a tube into a special regenerating chamber containing certain chemical products which renew the supply of oxygen and the air is then sent to the interior of the helmet by another tube. The air-renewing apparatus is contained in a pair of cylindrical chambers attached to each side of the helmet. Regulating valves keep the air pressure within the helmet at the right amount and always constant, no matter what the depth may be below the surface. Mounting and descending are effected by a drum and cable worked by an electric motor. At the same time the cable serves to carry the current which is needed for the respiratory apparatus. The diver communicates with the surface by a telephone, and a number of wires run from the armor up to a set of colored lamps, showing how the different parts are working. There are many advantages to be secured from the new apparatus, and we expect to give a more complete and illustrated description of this interesting device. M. de Pluvy has personally been able to go down to a great depth, and during the 115 descents which he has already made with the new diving suit he reached depths varying from 150 to 300 feet. This far exceeds the depth to which an ordinary diver can go.

Besides the new diving dress, M. De Pluvy is also the inventor of a collapsible caisson which may be used in connection with the diving suit.



The Helmet and One Arm Piece Removed.



Ready for the Descent.

THE DE PLUVY DIVING DRESS AND CAISSON.

Pure Alloys of Tungsten and Manganese and Their Properties.

A method of obtaining tungsten, or alloys of this metal, is presented by a French chemist, G. Arrivaut. By reacting with aluminium upon a mixture of oxides of these metals, it is possible to obtain alloys of tungsten and manganese which are rich in tungsten, but it is difficult to have a complete separation from the slag, and to do this it is necessary to operate on a large scale. But the author is able to obtain good results with reacting masses which are relatively small, by using tungstic anhydride and bioxide of manganese added to the right amount of lower oxides. The heat of the reaction is thus increased by the excess of oxygen in the mass. Alloys which are low in tungsten can be also obtained by the Schloesing furnace by using a current of hydrogen in which are heated the metals in powder mixed and compressed, but the value of 25 per cent in tungsten can hardly be exceeded. The author succeeds in forming alloys ranging from tungsten = 12; manganese = 87.34, up to the value tungsten = 60.05; manganese 39.20, making seven alloys in all.

The properties of the alloys are as follows: These bodies appear in the form of hard and brittle masses with a granular section and a steel-gray color. They are not magnetic. Air acts upon them slowly, forming brown spots of manganese oxide. Sulphuric acid, concentrated and boiling, or better still, bisulphates in fusion, will dissolve them entirely. Dilute acids, acetic, hydrochloric, etc., attack them energetically, even in the cold, but the action is always incomplete, and there remains a residue which contains all the tungsten. The latter finally contains no manganese. Preparation of tungsten by the alumino-thermic process is hard to carry out owing to the relative infusibility of this metal, but it is easier to form the alloys of it with manganese and the former can be then separated as above. Mixing oxide of manganese 360 parts, tungstic anhydride 100, bioxide of manganese 40, oxide of tungsten 100, and powdered aluminium 150, he obtained a mass which is well melted and homogeneous, free from slag and weighing half a pound. It contained about 45 per cent tungsten. When broken up and treated with hydrochloric acid it set free about one-half the weight in tungsten which was very nearly pure (99.55 per cent). This is seen as a steel-gray metallic powder, very heavy and presenting the usual properties of tungsten. Its density at 0 degrees C. is 15.28 compared with Moissan's value for cast tungsten of 18.7.

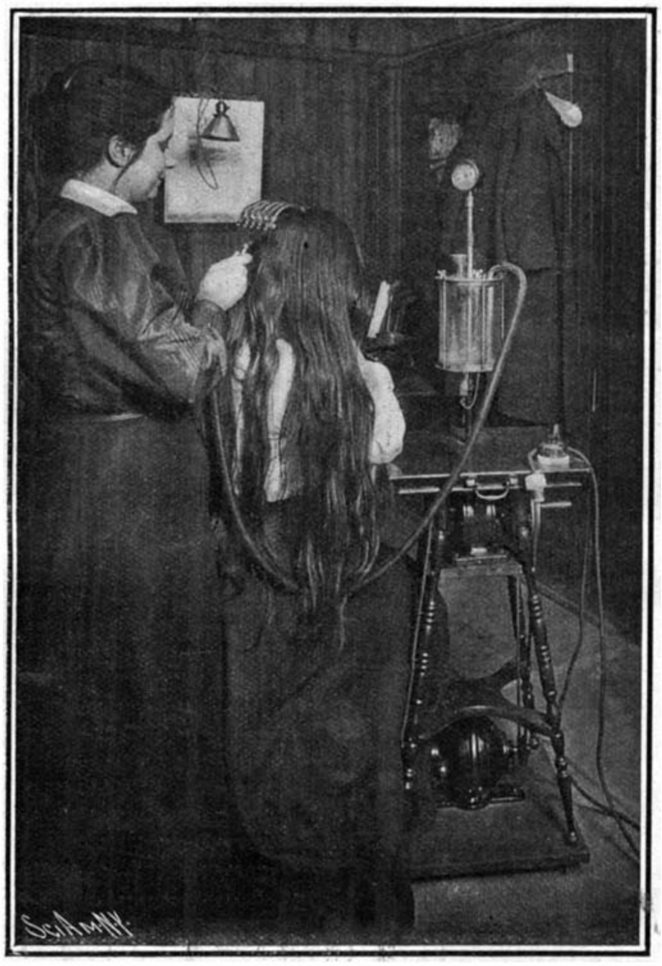
Flake graphite lubrication has been tested by Prof. Goss at Purdue University in comparison with neat kerosene lubrication. For this purpose one part by weight of flake graphite was mixed with two parts of kerosene. The immediate effect of adding the graphite was to permit an increase of load from 50 pounds to 110 pounds per square inch, and to reduce the coefficient of friction from 0.00547 to 0.00296. Another result was the excellent running of the bearing with kerosene alone after the rubbing surfaces had been cleaned; this was due probably to the enduring effect of the graphite in the microscopic pores of the metal.

A brass solution should be run slightly warm, but not smoking hot. The results are then not as good. A temperature of about 120 degrees is excellent. A solution that is hotter drives off the ammonia rapidly, evaporates the water, and does not give any better results than when a lower temperature is used.

SOME NOVEL ELECTRIC LABOR-SAVING DEVICES.

The wonderful adaptability of electricity for most varied purposes is constantly being made evident in new forms of light, new heating appliances, and new uses of the electric motor. The accompanying engravings illustrate a few novel labor-saving devices, which are dependent for success on the convenience of the electric motor as a power source.

The dandruff-removing apparatus, which we show, is the invention of a resident of New York city. Many of our readers are doubtless aware of the difficulty with which the cuticle of the scalp is thoroughly freed from dandruff scales, and how inadequate the conventional means are for this purpose. The device in question utilizes a partial vacuum, by means of which air is drawn through the teeth of a hollow comb with which the scalp is massaged, thus drawing the loosened scales through the teeth of the comb into a receiver. As the illustration shows, a small electric motor is provided in the base of the device. This motor may be connected by convenient flexible wires to the ordinary lighting circuit. Above the motor is located a small rotary air pump, which is connected by means of a belt to the motor. The air pump communicates through a metal tube with the interior of a glass cylinder supported above the top of the apparatus. The tube enters the cylinder, and extends to a point near the top of the same. A flexible tube communicates

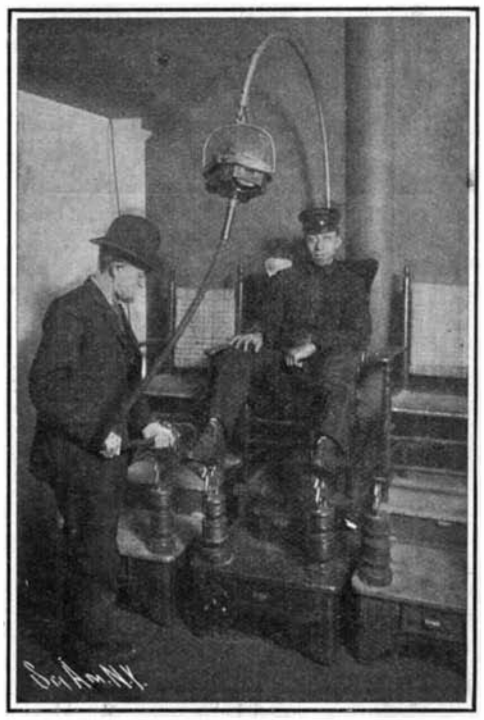


Removing Dandruff by Vacuum.

with the interior of the cylinder, and has at its free end a specially-constructed comb, which has hollow resiliently-mounted teeth covered with rubber or similar material, so that they will not injure the head when in use. The cylinder, which is provided with removable heads, also has a safety valve, an adjustable air inlet, a vacuum gage, and a pressure gage. When the motor is started, the air is soon exhausted from the cylinder by means of the pump, and a strong current of air is thus drawn through the teeth of the comb into the cylinder, bringing with it the loosened dandruff scales. The cylinder is partially filled with water which catches the dandruff, thereby preventing the entrance of the same through the pump into the room.

By throwing a switch the motor may be reversed, causing the air pump to force a strong current of air through the cylinder and out through the teeth of the comb. This or a special nozzle may be used for drying the hair, or an atomizer may be connected directly to the tube. The machine is furthermore equipped with a massage appliance, by means of which the vacuum or suctional massage so generally used may be applied.

A device which resembles the above in purpose, though it is very different in operation, is the electrically-driven horse groomer. Not only does grooming improve the appearance of a horse, but it materially assists in keeping him free from skin diseases of various sorts. To properly groom a horse takes time, time which can be ill afforded in large stables, such as those of an express company, a department store, or the like. As a consequence, the hard-worked, dust-coated animals must often be content with a hasty or careless brushing, and sometimes they are entirely



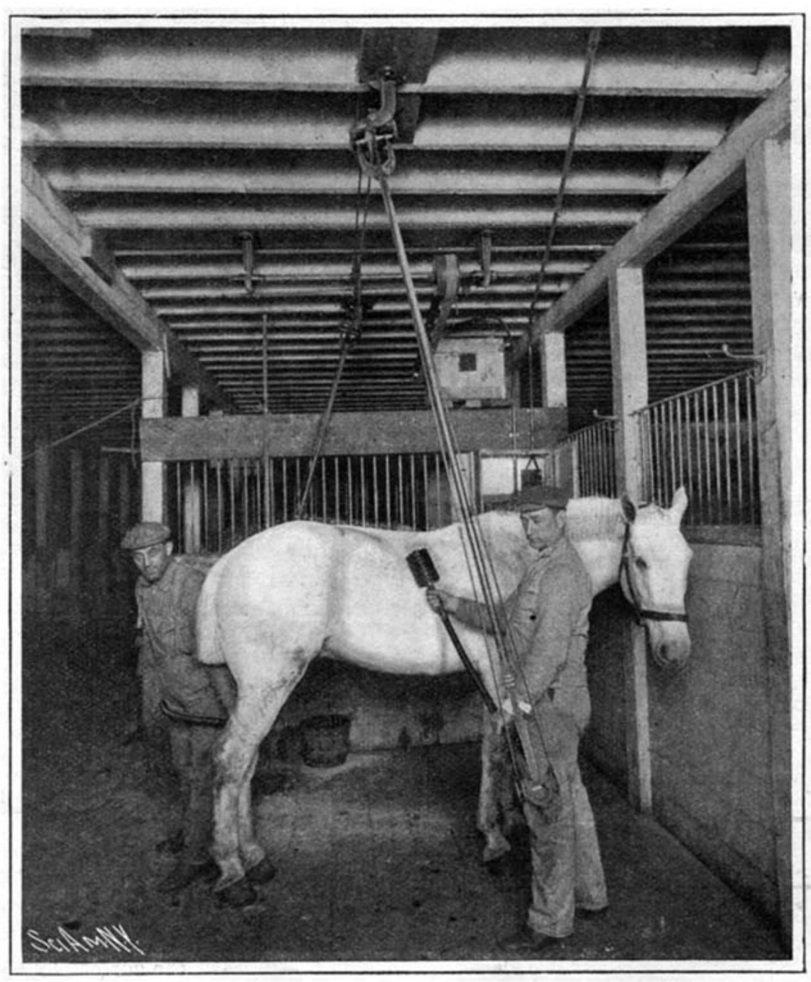
Electric Shoe-blacking Machine.

neglected. Recently many progressive concerns have been using the mechanical groomer which we illustrate, thereby affecting a great saving in time, and securing better results than could be obtained with handwork. The machine consists of a pair of flexible shafts, each connected by a universal joint to a swinging arm, which in turn is connected by a universal joint to a bracket secured to the ceiling. The device is operated by a two-horse-power electric motor, inclosed in a box, which may be seen at the rear near the ceiling. The power furnished by the motor is transmitted by means of belting down to a pulley on the flexible shaft, thereby causing the latter to rotate. The free end of each flexible shaft is provided with a spindle, on which a cylindrical brush of any desired type may be secured. The brush is very rapidly rotated by the flexible shaft, and in use is passed with a gentle pressure over the animal's coat. The shaft is very flexible, being formed of spirally-coiled wire, and is provided with handles which permit the operator to seize it and freely bend it to any desired angle while following the contour of the horse.

The work done by this machine is very thorough. The amount of dust and dandruff that it will loosen and remove from a horse which has been well groomed by hand is surprising, and well illustrates the superiority of machine grooming over hand grooming. When one of these machines is introduced into the stable, it must first remove from the horse's coat the dirt which has been accumulating for years. It may be a week or two before this is thoroughly effected, but when once the skin is clean, it takes less than two minutes of grooming twice a day to keep it clean. Thirty horses per hour is the average work per machine done in many stables. Furthermore, the animals thoroughly enjoy the massage, for this is virtually what the operation is, and when released from their stalls will often run over to the machine of their own accord. The look of perfect peace and contentment depicted on the face of the animal shown in our engraving is an excellent testimonial in behalf of the grooming machine.

The shoe-blacking machine which we illustrate might almost be called a modification of the horse groomer, so similar is it in operation. In this case, however, the flexible shaft is directly connected to the motor, which is suspended from a crane over the customer's chair. The crane is swiveled on the back of the center chair of a three-chair stand, but can be swung to overhang either of the other two chairs. The motor is mounted on a double set of trunnions, so that it may tilt in any direction. Brushes suitable for the various classes of work may readily be secured to the spindle at the end of the flexible shaft, and used in obvious manner. The ordinary lighting circuit supplies sufficient current to operate the motor.

Many an inventor casting about for some field of usefulness has lit upon shoe-blacking as a promising subject, and quite a number of boot-blacking machines have accordingly been invented. The difficulty with most of these machines is that they are too mechanical, the boot-black being almost entirely eliminated. With this type the present invention forms a marked contrast; for it is only the muscle-tiring, back-breaking work that is taken over by the motor, while the application and the manipulation of the brush is still left to the intelligent control of the experienced boot-black.



Grooming a Horse by Electricity.

SOME NOVEL ELECTRIC LABOR-SAVING DEVICES.

Imitation Precious Stones.

Consul Albert Halstead, of Birmingham, reports as follows in regard to successful methods of imitating certain precious stones:

Birmingham is the center of jewelry manufacture in the United Kingdom. Here are trained jewelers of the most skillful kind. Jewelry workmen have emigrated from Birmingham to the United States in such large numbers that a few years ago in one of the largest silverware manufactories in America there were employed 600 men who had learned their trade in the Birmingham district. Not a little jewelry was formerly exported from this district to the United States, but the development of the art in all classes of jewelry in America has materially reduced Birmingham's exports. Still the trade here is reported to be better than for some time, although manufacturers complain that things are not as they were. The keen competition of German cheap and imitation jewelry has so seriously interfered with Birmingham manufacturers that they now make comparatively little imitation jewelry. Much 9-carat gold jewelry is still made here, but the finer type of jewelry is Birmingham's staple.

The Birmingham Daily Mail shows how adept fakirs have become in recent years, now that the prices of genuine precious stones of the highest quality have greatly increased. The diamond seems to be the only stone that resists successful imitation. The ruby, sapphire, emerald, and pearl are skillfully imitated. Even experts find it hard to detect the fraudulent gems. Defective white pearls can be converted into brown or even black ones. A converted black pearl has been so well colored that it sold at a fabulous price.

Imitation pearls are plentiful and look so like the real thing that they deceive experts. They are made by means of a transparent glass shell, a little glue, and some essence of the Orient, a silvery, pearly substance, composed of fine scales rubbed from a small fish called the "bleak" or the "ablete," 17,000 of which require rubbing to get a pound. Even turquoises are not above suspicion.

The copper output for the United States for 1905 was 397,909 tons, 100,000 tons greater than the average for the last five years.

A POCKET-KNIFE ARTIST.

BY DAY ALLEN WILLEY.

When we speak about whittling we generally think of one who sits on the barrel or cracker box and kills time by cutting shavings off a stick or putting a point on it—the crossroads store whittler we see in the play. There is a Philadelphia man who is a different sort of pocket-knife artist, for with the sharp blade of a simple jack-knife he turns out various things from imitations of tools to wooden jewelry. Ben Clay, as his neighbors call him, is a sort of neighborhood Santa Claus, besides being a wizard with the jack-knife. He calls the work whittling, but instead of turning wood into shavings he makes chains, pincers, and other objects which are highly prized by his friends, for the reason that he gives away a great many of them for Christmas and birthday presents. Consequently his friends and neighbors are well aware of his talent in this respect. In looking at some of the chains which Mr. Clay has fashioned, it seems impossible that they could have been made out of a single piece of wood, but such is the fact. One can examine the links with a magnifying glass and see that they are all cut from the solid wood. There is not a crack or crevice or a place where the ends of the links have been glued together, yet the chains are as flexible as if finished by the goldsmith or the silversmith. This veteran whittler calls it an easy task to fashion a chain of single links. This anyone would think was made of parts first finished, then linked to each other, but not a link has ever been separated from its fellow. The knife blade shaped each from the block, after which it was smoothed down with sandpaper. Even the swivel at the end is from the same stick and was cut out while attached to the links without severing it from the link into which it fits. After Mr. Clay found he could make a watch chain of this pattern he tried his hand—or rather his knife blade—at what he calls a double-link chain—one in which two links arranged parallel to each other loop through two other parallel links, and so on. This was much more difficult, but he finished it without breaking a link. Then he attempted a quadruple chain—four parallel links looped through four others. In this case it was necessary to make some nice calculations to tell just how much wood would be needed for each set of four links, how much extra wood to leave where the ends of the links were to be cut out, for here the ends of one set of links would lap over the ends of the set into which they looped. It took a good many evenings before the "four linker" was finished, but it was finally completed without a break. This chain is Mr. Clay's most skillful whittled piece of work, although he has cut out several "anchor chains" besides. Each section, instead of being merely an oblong ring, is hollowed out in the center and pierced through with four slits running lengthwise. The four parallel links thus formed are looped into the four adjoining links, and each link is as movable as if it formed part of a single-link chain. The anchor chains are likewise worked out of one piece, and not a pin, bit of wire, or other connection is used.

The chains vary from a foot to sometimes three feet in length. They are usually cut from sticks of black walnut. When Mr. Clay begins operations he first takes a stick of a suitable length. He shapes down the outside to the proper proportions with a plane so as to give a smooth surface. This, however, is the only tool used except the knife, and it really has nothing to do with fashioning the chain. He measures off the surface of the stick with a rule, marking the sizes of the links upon it. Then his knife blade goes into action, and the wood is formed into these intricate chains, into this curious jewelry, which as stated above, are as flexible as any chains made of metal, since each link is loose and plays into the one with which it is connected. After the rough work with the knife has been completed, Mr. Clay takes the sand-paper to remove the sharp edges which may remain.

As may be imagined, a straight eye and steady nerve are needed when the block is cut down to a point where the link ends are to be shaped, for a cut a quarter of an inch too deep or too much on one side may sever the chain. As a single-link chain requires some 75 hours to complete, an accident means the loss of considerable time. But seldom does the knife blade slip, and the pieces which are spoiled through such a mishap are few indeed considering the intricate designs.

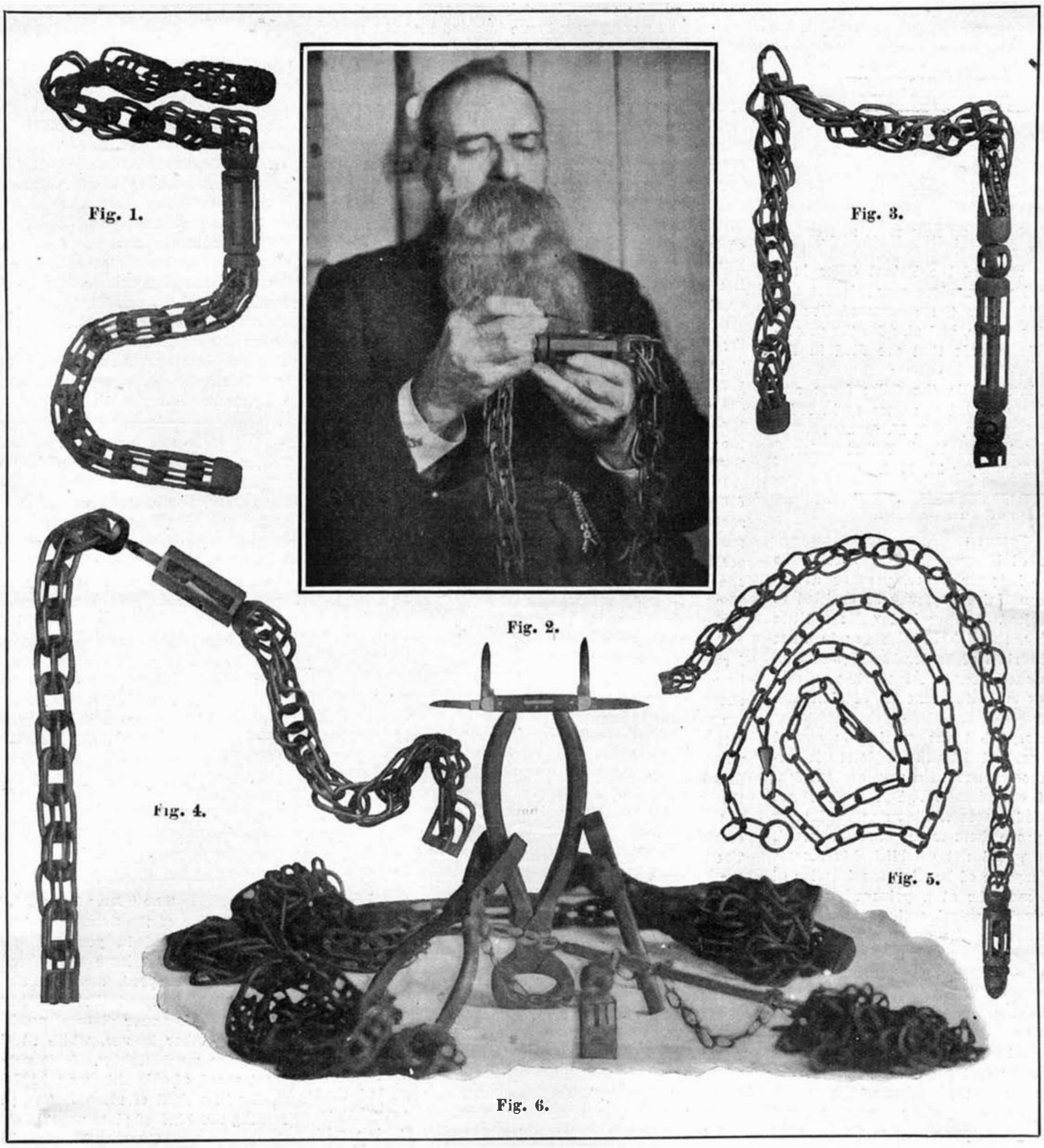


Fig. 1.—The section on the left is composed of links divided into six parts; the section on the right is made up of links of four parts. Fig. 2.—The whittler at work. Fig. 3.—Double link chain cut out of one piece. Fig. 4.—Chain made from one piece of wood. Fig. 5.—A single link and a double link chain. Fig. 6.—The jack-knife and its work.

A POCKET-KNIFE ARTIST AND HIS WORK.

New Photographic Shutter.

In the exposure of a sensitive plate in the camera, under ordinary circumstances, it is impossible to get a correct timing for all the different parts of the plate, for the reason that such parts of the view which are more generously illuminated will be greatly over-exposed when the right timing has been given to the shadows. This is particularly true of landscapes, where it is desired to have the cloud effects as well as the proper definition of the various features of the composition. In order to overcome this disparity, it has been necessary to resort to the use of a ray filter, which was undesirable because it greatly prolonged the exposure, or to make use of a process known as "double printing." In the latter method the photographer makes two plates from the same viewpoint, one timed for the sky and the other for the foreground. Each is put through the various operations of development, and when it comes to making the print, the sensitized paper is exposed for the sky under one plate and for the foreground under the other plate. This work must be very neatly done, or the imposition will be detected.

After a long period of experimenting, a camera shutter has been devised by a well-known optical firm, by which it is possible to illuminate the plate properly, no matter what the conditions of light may be. As on the plate in the camera, the sky is reversed, and so at the bottom, the rays of light from the sky must enter at the top of the front lens and cross the rays of light from the foreground at the diaphragm point. It is a fact, therefore, that a shutter working before the lens which admits more light from the bottom than from the top will necessarily equalize the exposure. This is what is done by the new shutter. It has but one leaf or blade, which rises from the bottom, the speed being regulated by an indicating device. No matter what the time of exposure may be, the sky will be given a very much shorter period than the foreground. Thus it is possible to give one part of the plate a second, while the other part will receive but one-eighth. This shutter is placed before the lens, and is supplied with an automatic clamping device, which makes it readily attached and detached. An ingenious regulating feature makes it available for all kinds of work, as well as for the purpose for which it was designed.

It is reported that the new swift steamer to be put into the New York service of the Compagnie Générale Transatlantique will be of 11,600 tons, and a speed of 23 knots, and will only carry two categories of passengers—first and third; she will be named the Chicago, and it is not yet decided whether or not she shall have turbine engines.

Correspondence.

Improvement in Patent Office Conditions.—A Letter from the Chief Clerk of the Patent Office.

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to correct several statements which appear in an editorial of the SCIENTIFIC AMERICAN for November 24, 1906:

"There is no sign of improvement in the serious congestion that hampers the work of the Patent Office. . . . At the present writing there are about 21,000 cases on file which have not yet been examined. . . . The office is falling behind at the rate of 300 to 350 cases a week."

As a matter of fact, all of the examining divisions of the Office have been making substantial progress with the work for some time past. A summary of the condition of the work in the various examining divisions made yesterday shows that the average position of all the divisions is now *within sixty days* on both new and old work. Half the divisions are close to one month on both the dates, while but two are four months in arrears, and two five months on their new work. None of the divisions are over two months in arrears on the amended work, averaging thirty-six days.

Since the return of the examiners from their summer leaves of absence, and the training in of the twenty-nine new men who began work here on July 1, the work has gone steadily forward, with large reductions of the delays in taking up new cases and in the number of cases on hand.

The most pressing need of the Patent Office is a new building, equipped with modern conveniences and of fireproof construction for the accommodation of the Office force and the public, and also for the preservation of the valuable records that are filed in the present building.

A regular annual increase in the Office force and larger salaries are also regarded as necessary in order to accomplish the best results, C. M. IRELAN,

Chief Clerk U. S. Patent Office.

Washington, D. C., November 28, 1906.

The Causes of Gun Erosion.

To the Editor of the SCIENTIFIC AMERICAN:

While the subject of big-gun erosion is being so thoroughly discussed in your paper, perhaps a student of Ohio Wesleyan University may be entitled to be heard on the subject. I have had quite a little experience in gunnery, and I hold with you in what you said in your editorials of September 15 and September 29, with the exception that I think you, and Mr. Cardullo also, overrate the amount of abnormal erosion.

Mr. Cardullo's theory that the erosion is caused directly by the heat generated by the explosion is certainly new, and if erosion needed a new explanation, might be worthy of consideration. But it does not appear that the eroded places exhibit any distinctive features that would prove them to be "burns"; though even if they did, it would not establish his theory, for if the gases are capable of burning the interior of a gun anywhere, it must be at a point where they rush at an inconceivable velocity through a small opening. That "burning" of the gun-wall under such conditions may be a possible, nay, probable, cause of abnormal erosion, I do not deny. Ironworkers tell me that in a "scrap" furnace, which is constructed so that the flame and gases of combustion must pass through a very small neck between the furnace and the chimney, the fire brick at the narrowest place is slowly eaten away by the volume of flame which roars past them. It might be adduced that in a gun the projectile is moving, and that consequently a new and cool surface is being constantly presented against the play of gas; but it must be remembered that we only seek to account for erosion in that part of the gun's length where the projectile is moving slowly. That the abnormal erosion could be caused in so short a time, merely by the free circulation of even the hottest gases, is not to be taken for granted without stronger support than the fact that the erosion progressively increases from muzzle to breech.

In any operation we can conceive of by which so heavy a projectile as the 12-inch shell could be accelerated through a 45-foot tube to a speed of 2,900 feet per second, there must be enormous friction, and consequently, great wear, on the inner wall of the tube. This necessary erosion is what I describe as "normal." In rifled guns I have always been inclined to take as a unit of normal ercsion an amount slightly less than the amount actually produced one or two feet below the muzzle, and if this unit could be accurately expressed in figures for any given caliber of gun, ordnance theories would be robbed of much of their complexity; for, given this unit, it would be only necessary to refer to a table showing the varying amounts of acceleration the shell received from the breech to the muzzle, to be able to find what the normal erosion for any point of the gun's length was. In the absence of any such data, however, we can only affirm that the amount of normal erosion should progressively increase from the muzzle to the breech.

This is only the natural working out of the law which governs a projectile, when it is being accelerated and at the same time made to hold itself to certain uniformly twisted grooves. When the charge is exploded the projectile begins to move. As it begins to move forward, it also begins to turn. The strain of making it move forward is borne by the gun, and is called the elastic strain; the strain of making it turn is borne by the rifles, and is called the rifling strain. It is the rifling strain that causes normal erosion. If the projectile is light and accelerated to only a moderate velocity in a comparatively long space of time, the rifling strain and its accompanying erosion will be slight; but if the projectile is heavy and accelerated to an enormous velocity in a very short space of time, the rifling strain and its accompanying erosion will be proportionately greater.

It must be constantly borne in mind that the rotary acceleration is the primary cause of normal erosion, and that, in a gun with uniformly-twisted rifles, the rotary acceleration throughout the gun's length varies directly with the forward acceleration. As the projectile receives a larger part of its forward acceleration at the breech, and consequently a larger part of its rotary acceleration, than in any other equal portion of the gun's length, it is evident that both the elastic strain and the rifling strain must be greatest at the breech. The greater elastic strain is taken care of by the breech jacketing, or the gun would burst. But the greater rifling strain is left to take care of itself, and the result is excessive, but still normal, erosion.

Of course there would still be erosion in a gun if the rifling was perfectly straight, or even if there were no rifles; but it would be inconsiderable. To appreciate the amount of erosion caused by the twist in the rifling, suppose the projectile started at full speed—if the bearing rings on the projectile were of the proper material to "stand up" the rifles of the gun would be stripped for half their length.

If one looked only at the 12-inch gun, it might be difficult for him to prove that there was present any such a thing as abnormal erosion; though there would remain even then the strong probability of it, for there are present elements in the firing of a big gun which one would naturally suppose would cause erosion. The most important of these is the imperfect fit of the shell to the bore of the gun.

But when we compare the 12-inch gun with other forms of firearms, the probability of abnormal erosion becomes a certainty. For instance, a 30-30 rifle of about ninety calibers in length will fire from four to ten thousand rounds without seriously deteriorating from its original accuracy, and here there is probably no abnormal erosion whatever. A 6-inch cannon, forty-five calibers in length, will fire from one to two thousand rounds without serious erosion; here there is the probability of there being considerable abnormal erosion, but we still consider all the erosion normal. Then comparing the weights, calibers, and erosion of the two guns, we must calculate the life of a gun of the size of the 12-inch as from 300 to 400 rounds. But we find our calculations greatly in error, and so we have no choice but to conclude that there is an erosion outside of what we have fixed upon as normal, which increases progressively as we increase the caliber of the gun. Turning now to the probable cause of abnormal erosion that we spoke of before, the imperfect fit of the shell, we find that a 30-30 bullet can be made to fit the rifle almost perfectly, that the 6-inch shell fits imperfectly indeed, but is light and is able to readily set itself to the rifling grooves, but that the 12-inch shell fits very imperfectly, is very heavy, and is intractable about taking the rifles. This would seem, at least on its face, to connect abnormal erosion with an imperfect fit of the shell.

There is another element which may play a part in producing abnormal erosion, and its testimony is in the same direction. The inertia of a 12-inch shell is greater than that of a 6-inch shell in the ratio of 8 2-5 to 1, while the base of the 12-inch shell is greater than that of the 6-inch shell only in the ratio of 4 to 1. It will be readily seen that the 6-inch would start under a much lower pressure than the 12-inch; consequently the gases, if they do produce the abnormal erosion by flowing past the shell, would have a longer time to work before the shell started, and would work under a higher pressure both before and immediately after the shell had begun to move. Certainly, if the hot gases succeeded in getting past the projectile before it had begun to move, there would be little need to look further for the cause of abnormal erosion. What reason is there for supposing that they do not do this very thing? There must be a considerable pressure behind the shell before it begins to move, and as soon as the pressure reached any figure at all the gases generated would certainly begin to flow through any apertures that might have been left between the wall of the gun and the shell, both eroding the bore and heating the rifles.

It would appear, then, that we have got at the cause of abnormal erosion, in the imperfect fit of the shell, but as in spite of the most carefully constructed theory there still remains a possibility, if not probability, of error, the question can only be settled absolutely by experiment. A few trials of firing, from an ordinary nickel-steel barrel, patched bullets somewhat smaller in size than the caliber of the barrel would probably be decisive one way or the other.

If it were found to be true that the cause of abnormal erosion is what our theory states, there can be no difference of opinion on what would constitute a remedy, however difficult it may be to produce a device that will successfully carry it into execution. Mr. Cardullo's high-speed steel would probably help, but I look for the remedy to appear in some form of your obturating pad. If this should fail, I have in mind a remedy of a different sort that might be tried as a last resort; but I think with you that our ordnance engineers have not as yet done enough to entitle them to declare the task an impossible one.

An idea has occurred to me since I began writing, which, though it would probably prove impracticable, may nevertheless be of interest. I would prescribe for abnormal erosion a small depression to extend around the projectile at the base of the first bearing-ring. This depression-ring should be in cross-section a clear-cut segment of a circle, with its chord absolutely flush with the surface of the iron. It should be of a depth subject to experiment—say ⅛ of an inch—and should extend under the base of the bearing-ring a distance also subject to experiment. The white-hot gases rushing into this depression, something like steam into a whistle, might possibly be checked sufficiently to swedge the base of the bearing-ring into the rifles before the projectile started, thus sealing the rifling ahead of the ring against any further flow of the gases into them. EUGENE VAN BREMMER.

Delaware, Ohio, October 5, 1906.

To Prevent Railroad Collisions.

To the Editor of the SCIENTIFIC AMERICAN:

Will you permit me to call your attention to the suggestion of an old railroad man, which is the result of mature judgment, and seems to me to appeal to reason and common sense? It is that all collisions with standing trains, especially rear-end collisions, often so terribly destructive to life and limb because no buffer intervenes, may be entirely prevented by the immediate isolation of every passenger train as soon as it stops. Thus by the turning of switches before and behind it, cutting it off from the main line, it is safe from other trains, whether running wild or from any reason out of control. The moving train will pass to one side, to regain the line beyond, and harmlessly expend its momentum. Thus such terrible disasters as the one at Revere, Mass., at Jackson, Mich., and lately at Lansingburg, N. Y., and in the suburbs of Boston, could not occur. May not this be, in the future not so very far, as much a requirement of the law as the safety brake and the interlocking switch?

Waterville, Me., October 21, 1906. G. S. PAINE.

The "Dreadnought."

To the Editor of the SCIENTIFIC AMERICAN:

I am interested in your editorial concerning the "Dreadnought." I have seen frequent press notices concerning its speed, etc., but no comments on its armor. I understand that this new war machine is equipped with armor plate of much greater resistance than any other in use, while at the same time the plates are much lighter. Is it not probable that the great speed of this ship may be due in part to great saving in weight of armor? Can you inform me concerning the kind of plate used?

CHARLES MANUEL, M. Am. Soc. C. E.

The Engineers' Club, 374 Fifth Avenue, New York.

[The "Dreadnought's" armor is Krupp face-hardened. Her speed is due to the 28,000 horse-power (maximum) of her turbines, coupled with her fine lines due to her great length.—ED.]

The Current Supplement.

The current SUPPLEMENT, No. 1614, opens with a splendid illustration of the President at Panama, showing him operating one of the giant steam shovels. An excellent article is that on metallic filaments for electric lamps. Dr. Wittelshofer writes of an alcohol illumination. An automatic carbonic-acid gas starter for automobiles is described and illustrated. Mr. James Alexander Smith's paper on air in relation to the surface condensation of low-pressure steam is concluded. Mr. Craig S. Thoms continues his instructive observations on how seeds are carried. In this installment he explains how seeds are carried by animals and birds. Camille Flammarion gives his views on earthquakes. Sir John Eliot writes on world weather. Steam traps are very exhaustively discussed by W. H. Wakeman in an article elaborately illustrated.

OCEANOGRAPHIC MUSEUM OF MONACO.

The museum occupies the eastern extremity of the gardens of St. Martin, on the rocky plateau of Monaco, covering the site which was formerly occupied by the powder factory and a small museum. It is established upon a steep declivity of the rock by means of solid foundations which descend as far as the sea, and covers ground which could not be used hitherto. In this way the Prince of Monaco succeeded in keeping the museum from infringing too much upon the magnificent gardens which surround it. The present building, erected on the plans of the architect Delefortrie, is entirely of stone taken from the Turbie, this being a secondary limestone which is very resistant and whose grain comes very near that of lithographic stone. A few pieces only, such as the monolith columns of the façade, have been brought from Brescia, but this stone is of the same kind. The museum is a long building, running about northeast-southwest. It measures 325 feet in length. The central part, measuring 65 feet long and 65 feet wide, is continued on each side by a wing 130 feet long by 50 feet wide. The arrangement and dimensions are the same for the whole of the building, except that the width is different for the basements. On the Avenue St. Martin is the entrance, and it gives access to a vestibule which is situated in the front portion, the latter being a projecting part in front of the middle portion of the museum. It contains the staircases which lead up to the upper or second story. From the vestibule, into which opens the entrance to the museum, we pass into the large central hall of the ground floor, which forms the reception hall. At each side of the latter is a hall for the exhibition of collections. The ground floor, which lies at 172 feet above the water level, is 23 feet in height. The second story, which is 37 feet high, carries an intermediate gallery between the ceiling and floor, and runs around the different rooms, which are laid out on the same plan as on the lower floor. These two stories are designed to be used to show the collections and instruments. On each floor the three rooms can be opened into a single large hall by means of sliding doors, thus making a hall of some 320 feet length which can be used for congress meetings or like purposes.

The lower two or basement stories face directly upon the sea, and therefore are well lighted. In Fig. 2 is shown the eastern end of the museum, and we observe the four stories of the building and also the arrangement of the roof, which is in the form of a vast terrace some 1,800 square yards in area, overlooking the sea. In Fig. 4 will be seen the interior of the lower basement floor, which is 11 feet high and is designed to be used for some of the rougher work, especially for the mounting of the large specimens, such as the large fish, cetaceæ, seals, etc. The same view shows in the foreground a series of vertebræ of a species of whale found in the Mediterranean, and farther back skeletons of fish about 20 feet long, which were captured by the Prince in the neighborhood of Monaco. The laboratory is equipped with a gas engine which drives the different machine tools used in mounting the pieces. Below is situated a well-aired annex room which contains the macerating basins, and these are large enough to receive the skeleton of an entire whale.

The other wing of the lower basement forms a large hall which is used to receive the aquariums. The latter are of different sizes, and we have first a range of nine basins measuring from 3 to 16 feet long and 3 feet high. Fig. 1 shows the contents of these aquariums, consisting of congers, lampreys, eels, and similar specimens, and the view was taken by magnesium light. At the end of this range of basins we find a large tank some 20 feet long which is to contain the fish of great size. Beside it is another large tank in which are to be seen two sea tortoises (*Thalassochelys caretta*). These specimens were brought from the Azores in 1896 by the Prince of Monaco, and since that time one of them has grown from 7 to 88 pounds weight. A large table built in armed cement supported on an iron frame and measuring 70 feet long by 3 feet wide, runs parallel to the first range of aquariums. It forms a shallow trough which is designed to carry a number of movable aquariums, and the overflow from these can run out directly upon the table. These aquariums will be used for research and will be well lighted, as they lie next the windows. Many physiological and biological researches will be carried out here. Near by is a series of tanks in armed cement 6 by 3 by 2 feet. The sea-water is brought to a height of 110 feet by two pumps placed in a special chamber underneath, operated by electric motors from the tramway circuit, and is received in a tank reservoir. Thence the water passes to the aquariums with a fall of ten feet or more, which allows automatic aeration of the basins by an injecting atomizer system.

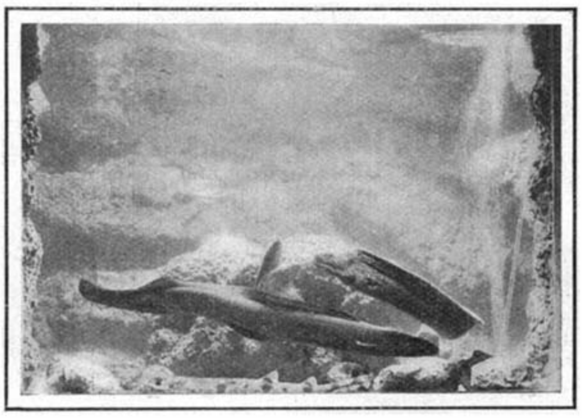


Fig. 1.—Congers in One of the Aquariums.

At present the aquariums contain a great number of specimens resulting from the captures at sea during the different expeditions. Above this floor is the upper basement story, which is 12 feet high and like the former is some 320 feet in length. It contains the rooms used for the preparation of the specimens and for their storage, also different laboratories among which is to be noted the chemical laboratory shown in Fig. 3. Several private work rooms are set apart for the use of persons who come to consult the collections or who wish to make oceanographic researches. A special library occupies the central hall of the floor, and near by is a large photographic laboratory. The basement floors are now entirely installed, but the two upper floors which are designed for public use will not be fitted out before the building is quite finished. In this portion will be exposed the objects relating to oceanographic work, including the apparatus, the results of researches, etc. Under this head we find different types of floats and apparatus used for studying surface or deep-sea currents, sea-sounding apparatus of many kinds, and sounds which contain specimens brought up from the bottom, such as mud, sand, gravel, and even pieces of pipe inhabited by sea animals; also water flasks designed to take samples of water at a given depth at the same time as their temperature, besides thermometers, densimeters, etc., affording the observation of densities and chemical composition of different layers of water, also instruments for studying the penetration of light into deep water, etc. We also find apparatus which are designed for use in capturing living specimens, several of which have been designed or modified by the Prince or his aids. Among these are ordinary sea nets, Hensen nets, vertical nets with large opening, surface nets, and finer ones for collecting the plankton during the movement of the vessel, and many like apparatus. These will be shown either in actual or reduced size.

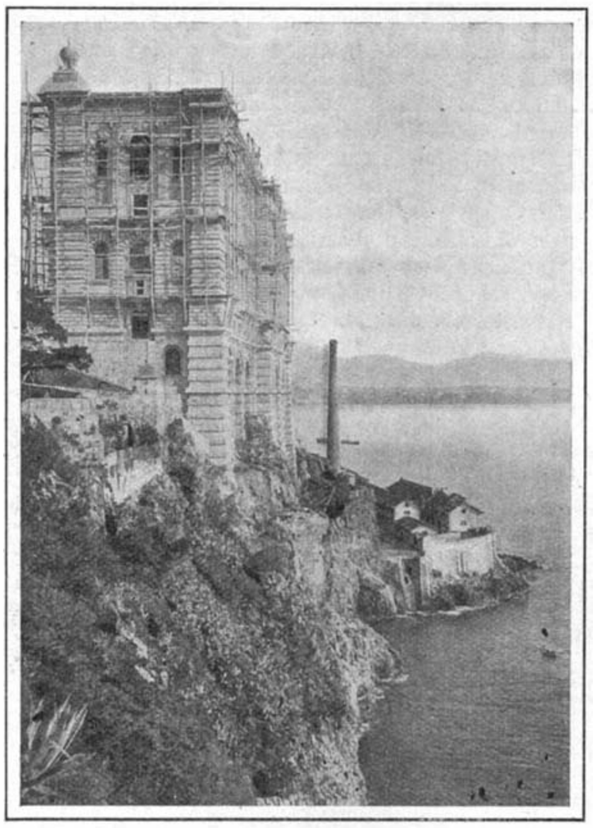


Fig. 2.—Eastern End of the Museum.

But the largest part of the exhibits will comprise the zoological collections taken from the sea-bottom, from the surface or from mid-water during the scientific campaigns of the Prince, especially the deep-sea specimens, for the latter have now been taken at depths of several thousand feet. Besides, the museum will not only contain the specimens collected since 1885 by the exploring vessels "Hirondelle" and "Princess Alice," but a large number of others which have been obtained by exchange or otherwise and come from all points of the globe. A large collection of maps, graphic plans, photographs, etc., will complete the series of oceanographic documents, besides a series of water-color views made from the living animals.

Referring to the general view of the building, under the main cornice of the roof will be inscribed the names of famous oceanographic exploring vessels, among others the American vessel "Albatross," celebrated in oceanographic work, besides others from different nations, such as the "Talisman," "Challenger," "Valdivia," etc. On the façade will figure the "Hirondelle" and the "Princess Alice," above each of the allegorical groups executed by the sculptor Dussart. These groups, which are 26 feet in height, represent Truth unveiling the world's forces to Science, and Progress coming to the aid of Humanity. From its bold construction and its purpose, the Oceanographic Museum of Monaco constitutes a monument, for whose erection Prince Albert I. deserves praise.—Translated for the Scientific American from La Nature.

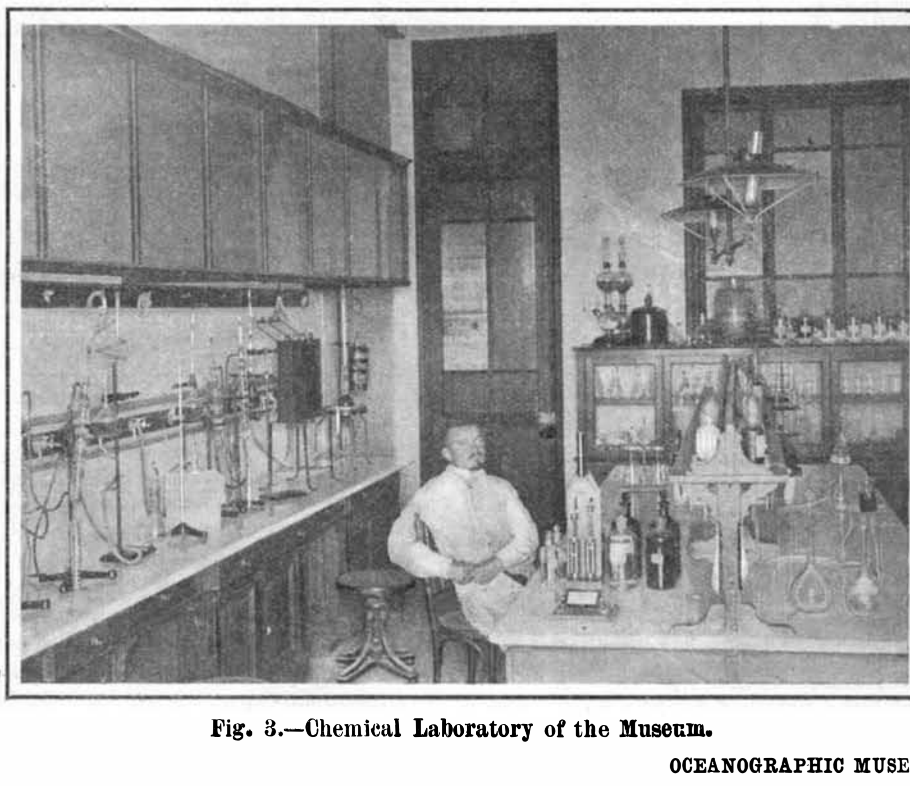


Fig. 3.—Chemical Laboratory of the Museum.

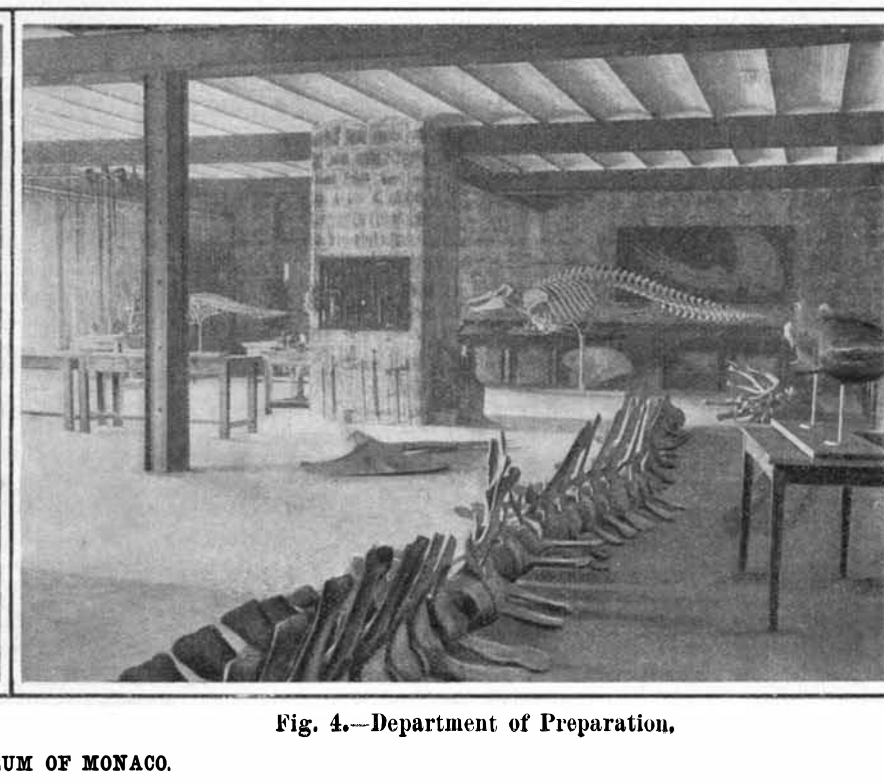


Fig. 4.—Department of Preparation.

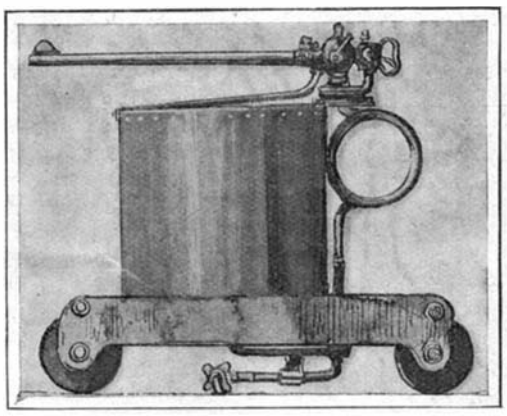
OCEANOGRAPHIC MUSEUM OF MONACO.

WEAPONS WEIRD AND WONDERFUL.

BY LIEUT.-COL. C. FIELD.

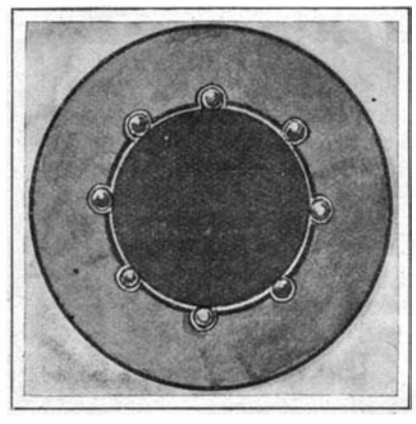
"And he made in Jerusalem engines, invented by cunning men, to be on the towers and upon the bulwarks, to shoot arrows and great stones withal."

This text, in the Second Book of Chronicles, is perhaps the first mention of the invention of warlike instruments. It was evidently a notable event, for the writer goes on to say of Uzziah, King of Judah, who is referred to by the pronoun "he," that "his name spread far abroad." Since those days the ingenuity of man has been taxed to the utmost to contrive new and more deadly means of killing and wounding his fellow men, and science has now brought our modern weapons to such perfection that it seems almost impossible to imagine any advance in their effectiveness. If we except the cold steel—which still has its uses, if we are to judge by the recent war in the East—there are but three classes of offensive weapons—the gun and its projectiles, the rifle, and the mine or torpedo. In the process of their evolution from the stone and club of our prehistoric ancestors and the "engines" of King Uzziah, an enormous number of contrivances have been invented by the fertile brains of soldiers, mechanics, and scientists. Some of these, such as the "hand gonne," Edward III.'s "crakeys of war"—the cannon he took against the Scots—and the engineer Giannibelli's "devil-ships of Antwerp," may be regarded as being the direct ancestors of the rifle, gun, and torpedo of to-day. But there have been hosts of others, which have either become entirely obsolete after a very short reign, have never "caught on," or, in very many cases, have never had any actual existence outside the plans and ideas of their sanguine inventors.

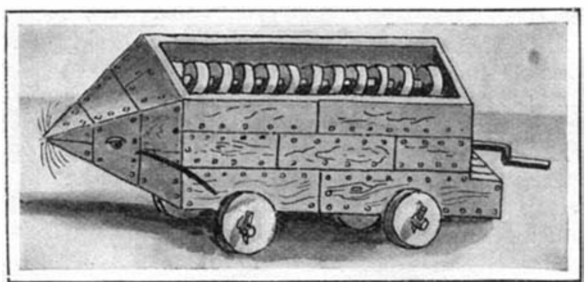


Sturgeon's Compressed-Air Gun (1888).

The Reservoir Helmet.



Cross Section of Ball-Bearing Gun. The Central Disk is the Shot.



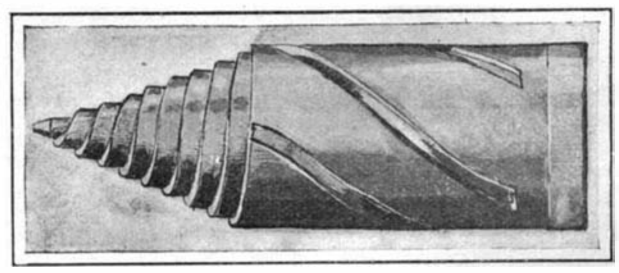
The Musculus.

Many of these warlike appliances, especially those belonging to the middle ages, are of the most grotesque description. As at no distant date the making of hideous grimaces to strike terror into the heart of an enemy was cultivated as a branch of the military art by the troops of the Celestial Empire, so in medieval times the grotesque seems to have been considered at least as much a desideratum as the practical by the inventors of offensive and defensive weapons. So we have such extraordinary contrivances as the "machine to break the ranks of an enemy" and the other dragon-like edifice here illustrated. How the former—which appears to be a kind of medieval motor car—got over the ground, and how it brought its formidable array of spikes to bear upon those who had the hardihood to oppose its progress, must be left to the imagination. The other machine is merely a grotesque edition of the movable towers that played such an important part in the sieges of ancient and medieval cities. The one touch of progress is the cannon projecting from the wicker monster's mouth. Ancient warriors had a great penchant for naming their various warlike engines and machines after animals, real or imaginary. Thus we have the Roman "musculus," or "little mouse," a machine for undermining the walls of a besieged city, the battering ram, the sow, the scorpion for discharging big arrows from a powerful bow, the onager for hurling stones. The onager, according to tradition, was an animal that had a pleasant trick of kicking stones with great violence at its pursuers. Again, the Roman warships were equipped with a spiked gangway known as a "corvus," or "crow," which on being let fall upon an enemy's ship, grappled her and formed a bridge for boarders.

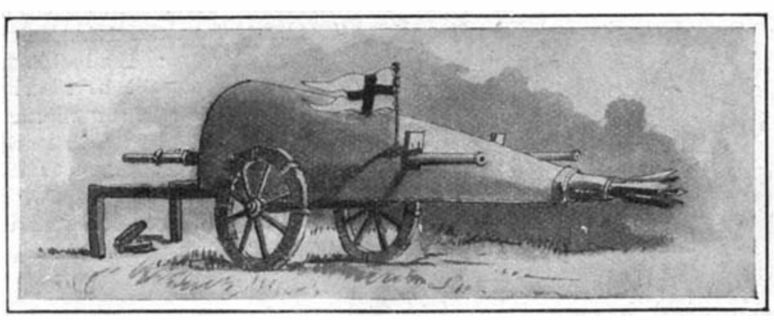
Medieval soldiers made frequent use of the "wolf" in the defense of castles and towns. This was a species of huge harrow, made of balks of timber with wooden spikes at the intersections, which set up outside the walls could be thrown down and forward to crush the besiegers as they crowded to the assault. When cannon were invented, their names became legion. A ship or a train of artillery contained a perfect zoological garden of birds, beasts, and fabulous animals. There were basilisks, drakes, dragons volant, falcons, serpents, and pelicans, not to mention "double dogs" and partridge mortars. Nowadays our bluejackets, at any rate, prefer to call their pieces "Joe Chamberlains" and "Bloody Marys."

We have of late years seen a good deal in the newspapers about the training of dogs for military purposes, such as scouting, giving notice of the approach of an enemy, and searching for the wounded. In former days this intelligent animal was also employed in warfare, not only as a watch dog. One method of "letting slip the dogs of war" was to equip them with a pot of blazing resin, a collar of spikes, and a jacket of leather scales to protect their backs from the fire, and send them among cavalry, much to the fright and confusion of the horses. An Arab writer describes some wonderful war dogs which belonged to the Grand Seignior, which he says were as big as donkeys, were clad in rich cloth, silver collars and neck rings, and a circle of iron points around the neck. Some were even clad in armor. They were equal to tackling wolves, dragons in the fire, eagles in the air, and crocodiles in the water, to say nothing of being able to bring down a man from horseback, "however stout a fellow he may be." Dogs equipped in much the same manner were also used for incendiary purposes to set villages and houses on fire, as were also cats and pigeons. Even torches for this purpose were sometimes made in the form of dragons, as will be seen by the annexed illustration, taken from an old manuscript, of a date earlier than the Conquest. This mythical beast, being supposed to breathe fire and brimstone, was of course a very appropriate animal to choose as a model.

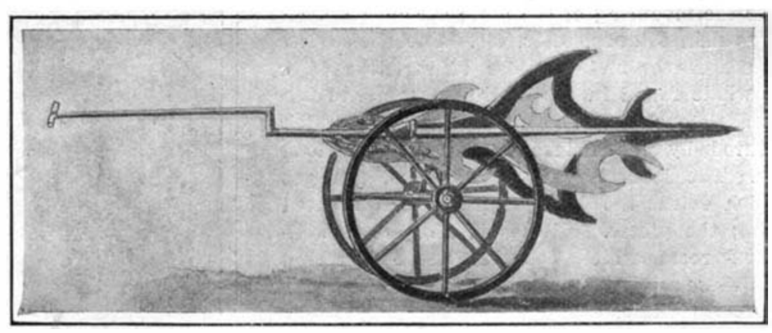
With the advent of artillery and firearms, all kinds of queer weapons were from time to time invented. Many of them distinctly foreshadowed our modern repeating and rifled weapons. Not a few revolvers, repeaters, and rifled muskets were made in the sixteenth and seventeenth centuries, but as the whole affair had to be made by hand, their cost precluded any general adoption of these ingenious devices. The earliest cannon were breech-loaders, and like our modern guns were built up rather than cast. But even after the invention of cast iron and brass cannon, the smaller pieces were generally made to load at the breech. Here are a couple of such weapons mounted in a kind of cart. These were used by Henry VIII. against the Scots, and would appear to have been quite practical little affairs. They evidently could be wheeled like hand-barrows; the sloping shield would afford excellent protection to the gunners, and probably contained a receptacle for ammunition. The flag and bundle of spearheads strike us as being somewhat superfluous. War carts or chariots were not unusual at this time, especially in Germany. They generally took the form of a rude machine gun, several musket barrels being placed together in the center, and a great array of curly, murderous-looking spears and halberds arranged on either side. The Lyoners is a later type without musket barrels and intended for blocking a narrow passage. Sometimes a whole sheaf of musket barrels were fixed upon a stand or carriage. These contrivances were called orgues, from their resemblance to the pipes of an organ, or sometimes thunder carriages.



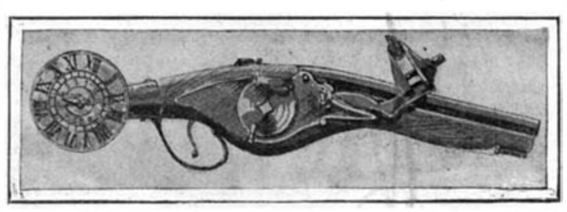
Armor-Piercing Projectile (1888).



War Cart (16th Century.)



The "Lyoners" for Blocking a Lane.

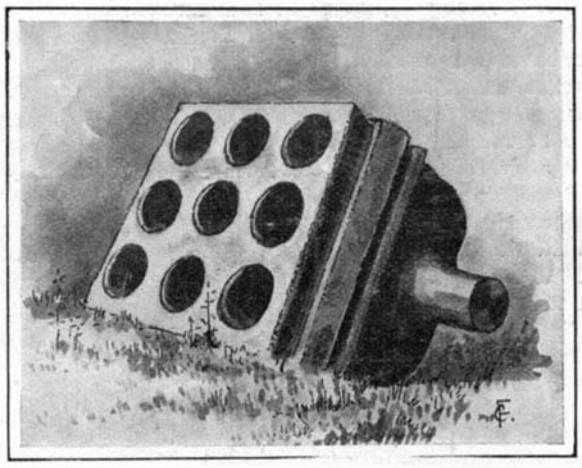


Pistolet à Reveil.

Japanese Wooden Mortar (1905).

WEAPONS WEIRD AND WONDERFUL.

Monster cannon were an early form of extravaganza in military weapons. There are several accounts of such pieces of ordnance. A traveler in 1743 stated that he had seen at Brunswick a gun or rather mortar cast in 1411. It was made of brass, was 10 feet 6 inches long and no less than 9 feet 2 inches in diameter, and was said to be capable of throwing a 1,000-pound shell. India boasted several of these monstrosities. One still to be seen at Kubberpore is said to be no less than 21 feet 3 inches long and 5 feet 6 inches round the muzzle. It is called "Jaun Kushall," or destroyer of life, by the natives, and was probably cast somewhere in Persia. Another Indian piece, cast by Chuleby Koomy, Kahn of Ahmednuggeer, about the year 1500, has such a tremendous bore that the interior is now fitted up as a kind of summer house. A cannon made at Bruges in 1346 had a square bore and fired cubical shot. Guns were made of all kinds of materials, though all such may be regarded as freaks or experiments. The leather guns invented by an officer in the army of Gustavus Adolphus had a certain vogue on account of their lightness. Some were effectively used against us by the Scots under Gen. Leslie at the battle of Newburn Ford in 1640. They were made by wrapping rope and twine round copper cylinders strengthened by iron rings. They were then coated with plaster, and finally covered with leather. They were very portable, but unreliable and short-lived. Guns have been made of wood hooped with iron, not only in ancient times, but quite recently in the Philippines, where they were used against the American troops. The Chinese had a gun made of bamboo in 1259, but only the other day the Japanese were making effective use of wooden mortars bound round with bamboo for throwing explosives into the Russian works at the siege of Port Arthur. Guns have been made of glass, and even of ice. Some of the latter, made for saluting purposes at the marriage of the Russian Prince Gallitzi in 1739, are stated to have been "fired more than once without bursting." Guns have even been made of the precious metals. In 1663 there was in the arsenal of Verona "a great gun found in Candia, all of gold and silver." A golden cannon was captured at Peking in 1860, and King Thebaw of Burma was the possessor of another, which was also incrusted with precious stones. This is the kind of weapon one would like to have a hand in capturing. The early caliver was little inferior to a cannon in clumsiness, as it took three men to carry it and a fourth to fire it. When firearms became somewhat more portable, and especially when pistols were introduced, we find them mounted in the most extraordinary fashions. Shields or targets not infrequently had a pistol fixed in the center with a small grating for aiming through, but there is an account of a shield at Genoa which had no less than 120 pistols connected with it. Rather a heavy affair to handle, one would imagine. The Emperor Charles V. had a curious shield, which he carried when walking about at night; "a spear came out of the side of it, besides that in the middle; if any thrust was made at the shield, the sword's point was catched in it and broken." A target "made in Germany" had an extension reaching to the elbow, and a dark lantern affixed to the outside, a somewhat similar idea to that patented by an American two or three years ago. This is a revolver having a tube underneath the barrel, containing a small electric light. On beginning to press the trigger the light is switched on, dazzling the "enterprising burglar," and enabling the householder



Curious Mortar Now in the Tower of London.

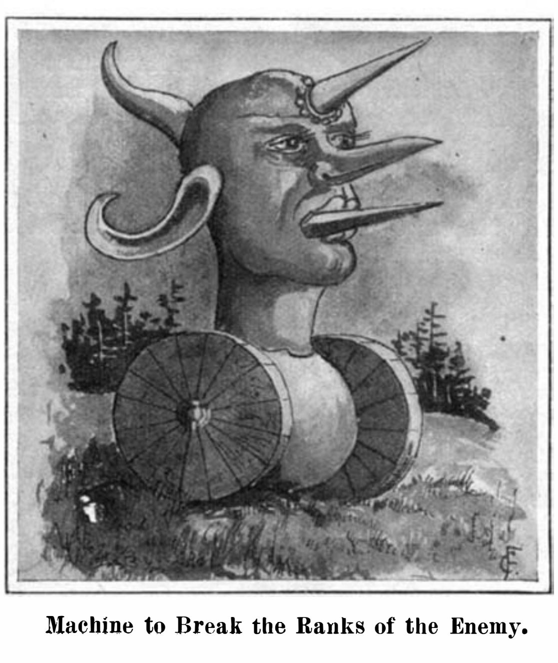
to select a point to aim at. Another surprising mediæval contrivance was an iron hat or helmet, which is described as having "two crowns, each with four pistols." A volley of eight shots from an opponent's headpiece must have been very disconcerting—probably to all parties concerned. A curious mortar in the Tower of London is square in front and has no less than nine separate bores. The eighteenth century was distinctly the epoch of sieges. The attack and defense of carefully-fortified places was carried out in the most methodical and patient manner. Who does not remember the prolonged discussions between Uncle Toby and Corporal Trim about the siege of Namur? Do they not remind us of a discussion between whist players? Everything was done by rule. Naturally, there were many inventions at that time specially applicable to the attack and defense of fortified towns. The petard was much used. It consisted of a bell-shaped iron receptacle filled with powder, and clamped down to a block of hard wood. It was intended to be fixed to doors and gates for the purpose of blowing them in. The accompanying reproduction of an old print shows the way in which this was done. The figure in the foreground looks as if he might very shortly be "the engineer hoist by his own petard," immortalized by Shakespeare. Another device was the "pot-à-feu," or fire pot, which was a kind of ball or globular jar filled with old tarred rope, which was thrown upon the enemy's works, to light them up at night and enable fire to be directed upon them. Loaded pistol barrels were attached to these, to prevent anyone from picking them up and extinguishing them. The "pistol à reveille" could be set to explode a mine at a given hour. But all said and done, we need not dive into the past to find extraordinary ideas and weird warlike appliances. Our modern inventors are quite capable of keeping up the supply. Leaving aside the steam guns, which were intended to spurt out streams of bullets after the fashion of a Maxim gun, which were invented by Perkins in 1824, by Winans in the sixties, and the very similar compressed-air gun patented by one Sturgeon in 1887, none of which realized its inventor's expectations, we can find plenty of extraordinary contrivances. The wire bullet-proof screen, behind which the soldier advancing to the attack defies any projectile smaller than a three-pounder, is as far-fetched an idea as anything produced in the middle ages. The reservoir helmet, a French scheme, is about as quaint as anything we have noticed. The lower part of this eccentric headpiece forms a species of tank or reservoir, into which the water (and pipe clay?) drains from the upper surface of the helmet. The soldier's head is therefore kept cool in the tropics—though the weight may perhaps be rather trying—and when a-thirst all he has to do is to remove his helmet and fill his cup from the tap at the back. This has not hitherto "caught on." It is just possible, though not probable, that the Russians might have found the revolving shield illustrated an efficient defense against the bullets of the Japanese. It is not easy to see how it would compare favorably either in weight or portability with an ordinary steel bullet-proof shield. This egregious apparatus consists of a pillar or standard, on which is mounted a set of fans or sails, which are revolved at a terrific speed by a small motor actuated by a portable battery. After switching this on, all bullets which might have otherwise found a billet in the soldier crouching behind this catherine wheel, are struck and deflected elsewhere by the rapidly-revolving blades or fans.

One of the most important qualifications of a good soldier is to be able to march well, but it is doubtful

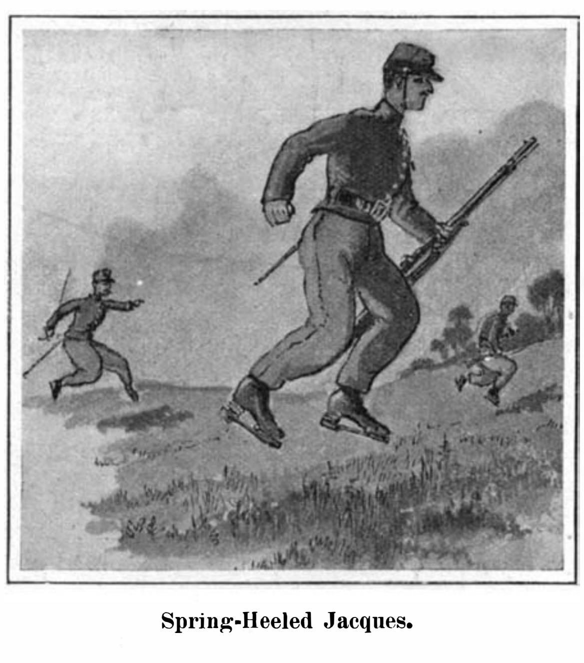
Dragon Incendiary Torch (9th Century).

Wire Netting, Bullet-Proof Shield.

The Electric Fan Shield (1903).



Machine to Break the Ranks of the Enemy.



Spring-Heeled Jacques.

A Dragon for Attacking Towns.

WEAPONS WEIRD AND WONDERFUL.

whether the wearing of a pair of spring-soled boots, such as a recent inventor has suggested, would add many miles to the day's march. These "seven league boots" have an outer sole, which is pivoted to the one made on the boot just below the ball of the foot. A strong spiral spring is fitted between the two at the heel. To see a whole regiment charging a position wearing these boots, and bounding over the ground like kangaroos or wallabys, would indeed be a remarkable sight. The boring projectile here illustrated appears a somewhat more plausible creation, but the inventor can have very little realized the immense force and velocity with which modern projectiles strike their objective. Imagine a shot weighing over 800 pounds traveling over 2,000 feet a second, and striking with an energy of thousands of tons to the square foot, pausing in its career to carry out the comparatively slow process of boring through an armor plate like a gimlet! The Cullen ball-bearing gun is another extraordinary attempt to improve modern artillery. The sketch of its cross section will enable the reader to understand the idea, which, put shortly, is to substitute for the ordinary grooves of a rifled gun, through which the soft metal of the diving band has to cut its way and so give a rotatory motion to the projectile, a series of spiral rows of steel balls. These lie in grooves of a circular section cut in the sides of the bore of the gun, into which about one-twentieth of their diameter projects, so that while a spiral motion is given to the projectile, its progress is not retarded by friction, but rather accelerated. How the inventor is going to prevent the waste products of the combustion of the propelling charge from being driven into the interstices between the steel balls and jamming them all together, so that they revolve with difficulty, does not appear. The absurdity of the scheme was exposed by the SCIENTIFIC AMERICAN several years ago. Another remarkable invention, which like the preceding one, by the way, hails from America, is a cannon that takes completely to pieces. It consists of a series of strong steel disks which fit over the inner tube, which is, of course, rifled internally. Externally it tapers slightly, so that it is bigger and thicker at the breech end. The disks slide down on this tube in their proper order, the central ones having projections to form the trunnions of the piece, and are screwed tight up by means of four rods and nuts fitting into a massive framework at either end of the gun. The rear one of these carries the breech-closing mechanism. Invisibility has been pretty well secured by the invention of smokeless powder, and now inventors are trying to do away with the noise of the explosion into the bargain. This was effected in ancient days, according to an Arab writer, by the "powder which explodes without sound," made at El Meidaün, the ashes of human bones taking the place of charcoal. The making of this propellent is now, at any rate, a lost art, but the same object is, to a certain extent, attained in other ways. Col. Humbert, of the French army, has invented a species of tube which, affixed to the muzzle of a field piece, prevents either flash or sound, while a rifle invented in America has a big cartridge containing water, which interposes between the bullet and the powder charge in its base. This is supposed to regulate the escape of the powder gas, and so minimize the report without diminishing the force and velocity with which the projectile leaves the barrel. The great addition which this system would make to the weight of the ammunition is quite enough to put the weapon out of court for military purposes.

With this quite recent triumph of impracticable invention we must bring our short review of extraordinary military contrivances to a close. Myriads of other warlike "freaks" might be cited, but we have quoted enough to make it obvious that, as far as they are concerned, the process of "beating our swords into plowshares" might begin without in any way bringing in the epoch of universal peace. The practical weapons that would remain are amply sufficient to provide "battle, murder, and sudden death" for many centuries to come.

Beans are at present cleaned by hand work, which is not only slow, but unsatisfactory. The beans are scattered on a belt which passes before a row of girls, and stones, dirt, and other objectionable particles are picked out. In this way the cleaning capacity of each girl is between three and five bushels per hour. A machine for this purpose has been recently invented by Robert A. Little, of Lockport, N. Y., which performs the operation in a much superior and more economical manner. In this process the beans fall from a height into a shaking hopper, and here the chaff and lighter material are removed, after which the mass is transferred to a belt, where the foreign particles are carried one way and the whole and perfect beans are diverted to a compartment, where they are subjected to the action of an air blast. This not only removes all trace of dust and dirt, but gives the beans a high polish, which improves their selling qualities.

THE MICROPHOTOSCOPE—AN APPARATUS FOR EXAMINING MINUTE MAPS.

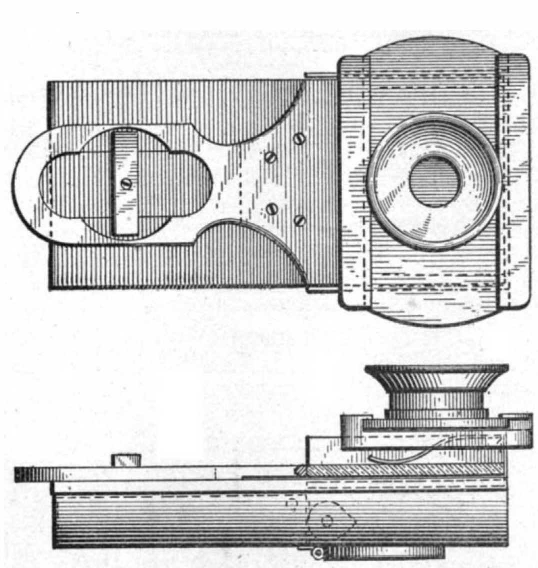
BY DR. ALFRED GRADENWITZ.

The importance of an efficient intelligence service in time of war will be readily appreciated by anybody. The most important element in similar service is a suitable stock of reliable maps, but even in case first-class maps are available, many drawbacks will be experienced, especially at night and during storms and rain, in using ordinary maps of the Etat Major; and the same may be said of maps intended for the use of tourists and sportsmen. The folding of large maps is moreover extremely inconvenient, and results in a rapid wear and tear of the same.

A very suitable device to obviate the above inconveniences has been invented by Dr. Otto H. F. Vollbehr, of Halensee-Berlin, in the shape of the microphotoscope. Though not doing away entirely with the necessity of ordinary maps, this device will afford a most welcome complement to them. With this aid microscopic transparencies 4 x 5 centimeters (1.574x1.968 inches) in size are used in place of large maps. These represent a map of the Etat Major drawn to the scale of 1-100,000. They are inserted between two glass binding plates, so as to form a lantern slide. In front of the transparency there is a lens capable of being adjusted for any eye by turning it either to the left or right. No other eyeglass should be used in connection with the lens. The latter is fitted in a small frame susceptible of a vertical and horizontal displacement, so as to enable any point of the transparent map to be brought immediately in front of the eye, 175 square kilometers (67.56 square miles) being inspected with each position of the lens. The minute map is divided into squares at distances of 2.5 kilometers (1.55 miles) each, the squares being numbered horizontally at the top of the map and marked with letters in a vertical direction, thus enabling any given point to be traced readily. The slides fit loosely in the holder and they can be exchanged at a moment's notice whenever another map is to be examined.

THE LENS AND SLIDE HOLDER OF THE MICROPHOTOSCOPE.

If the lens is used in the daytime, it should be held with the handle in front of the eye, when an intensely illuminated image of the map will be obtained, so that even the smallest lines and most minute marks will be readily distinguished. For use at night an especially designed illumination box is added, including small electric light similar to the familiar "ever-ready" lamps. This box can be attached to the back of the apparatus, where it is held in place by small clips. By pressing a button a small glow lamp is lighted. This lamp illuminates the transparent map about as intensely as does daylight, and thus the lamp can be used in dim weather if more light is needed.



TOP AND SIDE VIEWS OF THE LENS MOUNTING.

The latest type of apparatus has been arranged for keeping the button pressed down permanently, thus avoiding a continual pressure on the same. A reserve battery is provided for supplying the amount of light required for twelve hours' uninterrupted service of the glow lamp, this battery being worn like the cover of a field glass. The transparencies have recently been improved by marking any waterways in a blue color.

A Novel Photometer.

The numerous attempts so far made to utilize the luminous sensitiveness of selenium for the construction of a suitable photometer have now for the first time been crowned with success, in connection with a novel selenium photometer brought out by a Mayence constructor, which is quite independent of the inertia of the selenium, the temperature of the air, and the load on the selenium cell, as well as of all other factors disturbing the sensitiveness of the selenium. The slow alteration undergone by the selenium cell in course of time is doubtless without any influence on the tests. The accuracy insured in using this apparatus greatly exceeds the accuracy afforded by any similar photometrical process, while the tests are carried out more rapidly and without any difficulty.

The novel principle used in constructing this photometer consists in throwing a selenium cell in a rapid alternation from the range of a standard lamp into the range of the lamp to be measured, the resulting current oscillations being ascertained by suitable instruments. As soon as the oscillations of an index are discontinued, the illumination produced on the cell by both of the illuminants is found to be equivalent.

The apparatus includes two mirrors lighted by the two illuminants respectively, while a selenium cell rapidly oscillating between two given positions is lighted alternately by either. The index of an ammeter oscillates in accordance with the fluctuations in illumination thus produced, and the instrument should be displaced until these oscillations are found to cease, thus showing the equivalence of the illuminations due to either lamp, when their respective distances from the photometer will, according to a well-known rule, give the luminous intensity of the lamp to be tested in terms of the standard lamp.

This photometer is intended in the first place for the comparison of illuminants of the same class. One good point of the apparatus is the rapidity with which measurements are carried out. Moreover, the eye is put to far less strain than in any other method of testing. The instrument will be found useful in connection with scientific investigation into the hitherto unknown mechanism of the sensitiveness shown by selenium in regard to light. Our present knowledge does not go far beyond the fact that two of the allotropic modifications of selenium, and especially the light-gray brittle variety, show a decrease in electrical resistance as soon as they are exposed to an illumination, this decrease being dependent on the luminous intensity of the latter.

As regards the influence of considerable differences in color between the two illuminants, selenium seems to behave very well with the luminous sensitiveness of the eye in regard to the same color. It thus seems likely that no errors worth mentioning will be made in practical tests, and it is surmised that the retina of our eye perceives in the same way as selenium, while such differences as have been found from time to time are attributable to the absorption of rays by the liquid and other membranes of the eye. A suitable compensation could thus be obtained by inserting in front of the selenium cell an optical medium equivalent to the substances lying in front of the retina.

Free Winter Course in Dairy Farming.

The Massachusetts Agricultural College offers without charge for tuition a general course of instruction in the management of a dairy farm and in dairy operations. This course begins January 2 and continues ten weeks. It is open to all citizens of the United States above sixteen years of age.

Students taking this course enjoy the great advantage of a systematic, thorough, and short course of training under recognized experts. The subjects taken up are soils, manures, fertilizers, and crops, the breeds and breeding of dairy stock, the feeding of dairy animals, stable construction and sanitation, prevention and treatment of the common diseases of stock, dairy products, their general characteristics and the laws of milk production, pasteurization, elementary botany and entomology, and general horticulture. Students receive careful training and extensive practice in the use of separators, making the Babcock test, and in butter making.

All wide-awake communities are demanding better dairy products. Students taking this course learn how to make the necessary improvements in methods of production. The demand for farm superintendents is great, but only up-to-date superintendents are wanted. Those taking this course are able to learn the latest methods. Any one desiring information concerning the course should address Prof. William P. Brooks, Amherst, Mass.

The largest marine gasoline engine in the world has been shipped from Baltimore to Russia. It is of 1,600 horse-power, and is one of four ordered by the Czar's government, at a cost of $100,000, to go into Lake submarine torpedo boats.

BIRDS OF AN OCEAN ISLAND.

BY B. S. BOWDISH.

It is a significant commentary on the relations that man has established with the birds, that the almost universal experience of naturalists exploring uninhabited and seldom visited islands, shows that where for generations bird life has existed in ignorance of man, the birds exhibit little or no fear of him. So accustomed have we become to the display of fear of man and keen efforts at self-preservation on the part of our little feathered brothers of the thickly-settled portions of the world, that it seems unnatural to find birds displaying no such caution. Yet we have abundant evidence that fear of fellow creatures is born only of bitter experience, either in the present or a past generation. In Porto Rico the grackle (*Quiscalus brachypterus*) clambers fearlessly on the legs and tails of cattle, seeking the pestiferous flies and vermin, while the animals, apparently realizing the benefaction that the birds are performing, stand quite still. This habit has also been ascribed to our own cowbird, from which the bird has derived its name. A small species of old-world plover enters the mouth of the crocodile quite unconcernedly, to relieve the reptile of vermin infesting it. As surely as this fearlessness of fellow creatures is born of confidence in their peaceable intentions, so surely is universal fear of man where he is known born of all too well-founded suspicions of his intentions.

To the nature lover there are few, if any, experiences that can compare with those of a visit to one of those wild islands where man's influence on nature has never made itself felt. Walter K. Fisher has given a very interesting account of a visit to the Windward group of the Hawaiian Islands, on the Fish Commission's steamer "Albatross," engaged in deep-sea explorations. As is usually the case at such islands, the birds were found remarkably fearless as compared with our own birds, and Mr. Fisher secured a series of pleasing and interesting photographs. These represent birds in their home life that are unfamiliar to most people. As might be expected in such a situation, sea birds were much more numerous in species and individuals than were their fellows of the land. One of the most abundant, conspicuous, and interesting of the feathered inhabitants of these islands was the Laysan albatross. Besides being found in great numbers, the bird is large and of striking appearance and exceedingly interesting in habits. At the time of Mr. Fisher's visit these birds had young about two-thirds grown, and nearly every tussock of the grass that abounds on Laysan Island afforded shelter from the heat of the sun to a young albatross, which sat awkwardly on its heels dreaming until some one passed too near, when it snapped its bill fiercely. In most cases this demonstration was found to be largely "bluff," and the naturalist succeeded in stroking them while they mildly objected. If, in rushing about, the young birds stumbled into the burrows of the petrels, they tumbled forward heavily, which usually resulted in their disgorging their food, much to their chagrin.

It was found that the old birds had no apparent objection to the presence of man, and one could walk among them without disturbing them in the least. They objected, however, to such undue familiarity as handling, and were apparently greatly astounded when, in backing away from the intruder, they collided with a tussock of grass. They exhibited curiosity over the strangers, however, and one was particularly interested in the bright aluminium head of the tripod, which he examined and tested with his beak.

The old birds lived in absolute harmony, but the young had some small squabbles, and the parents often seemed to have a strong aversion for another bird's chick. The birds have a "game," which seems to be explained only by a desire for recreation. "Two albatrosses approach each other, bowing profoundly, and stepping rather heavily. They circle around each other, nodding solemnly all the time. Next they fence a little, crossing bills and whetting them together, pecking meanwhile, and dropping stiff little bows. Suddenly one lifts its closed wing and nibbles at the feathers underneath, or rarely, if in a hurry, merely turns its head and tucks it under its wing. The other bird during this short performance assumes a statuesque pose, and either looks mechanically from side to side or snaps its bill loudly a few times. Then the first bird bows once and, pointing its head and beak straight upward, rises on its toes, puffs out its breast,

Black-Crowned Night Heron.

and utters a prolonged nasal groan, the other bird snapping its bill loudly and rapidly at the same time.

"Sometimes both birds raise their heads in air, and either one or both utter the indescribable and ridiculous bovine groan. When they have finished they begin bowing at each other again, almost always rapidly and alternately, and presently repeat the performance, the birds reversing their role in the game or not. There is no hard and fast order to these antics, which the seamen of the 'Albatross' rather aptly called a 'cake walk.' . . . Occasionally one will lightly pick up a twig or grass straw and offer it to the other. This one does not accept the gift, however, but thereupon returns the compliment, when straws are promptly dropped, and all hands begin bowing and walking about as if their very lives depended upon it." Mr. Fisher adds that when he approached a pair of birds engaged in this game, they would cease their play and walk away in a deprecating manner some little distance, to resume the game. It is said that if a person enters a group of birds that have been engaged in this diversion and bows, they will sometimes walk around him bowing in return.

The young birds are fed by regurgitation, inserting their bills crosswise in the bill of the parent. Each bird hatches and raises only a single young one. Like many of the large seabirds, and particularly members of this family, this bird roams over vast areas when not engaged in breeding.

The terns of the Hawaiian Islands come closer home to most of us, for while not the same species as the terns of our coast, they are nearly related. All species are beautiful, graceful birds, and it is a sad thing that a desire on the part of gentle woman to herself wear their plumes, and a love of "sport" on the part of man, have almost stripped our coasts of these dainty creatures.

The carelessness of the tern in the matter of nest building reaches its extreme in the white tern of these islands. In several instances the egg was found laid on a bare limb; otherwise it might be laid on the phosphate rocks, but nowhere with any pretense of nest building.

Besides the white terns there were also found noddies and Hawaiian terns. The writer remembers many pleasant experiences while making the acquaintance of the noddies on wild little Decicheo Island thirty miles from Porto Rico. Here birds were almost undisturbed by man, and many of the noddies, a few bridled terns, large numbers of common boobies, and a few laughing gulls made their homes. The terns here built no nests, although there were plenty of bushes, but nested in most cases on the bare ledges of rock. It is an indescribable experience to be among the homes of these birds, to see them almost at arm's length, performing their various household duties, and a spectacle never to be forgotten. One who has once enjoyed it will never feel like sanctioning the destruction of the tern colonies on our coasts.

In the Hawaiian Islands Mr. Fisher found the noddies building nests in the bushes, which, I believe, is the rule with the birds in most places where they breed.

Two of the birds that inhabit these islands are the shearwaters and petrels. These birds belong to the order known as tubinares or tube-nose birds, from the tubular form of the nostrils. Both excavate burrows, in which the single egg is laid and the young reared. The wedge-tailed shearwater makes only a pretense of a burrow, in many cases not sufficient to hide the sitting bird, while those of the white-breasted petrel are six feet and more in length. The burrows of the petrels were found close together, and the birds occupied all available space in the nesting territory. Both petrels and shearwaters are most active at night, and often remain at or near their burrows during the daylight hours.

The writer yet recalls how through a powerful glass, from Aguadilla, P. R., he watched the movements of a cloud of birds hovering about Decicheo Island, thirty miles distant. They were not, of course, identifiable at that distance, but when later an opportunity afforded to visit the island, the birds that had been watched so eagerly proved to be boobies, and it was one of these which was the first bird to welcome the boat, when, just as daylight was dawning, he came sailing out, looking like a gigantic duck as he took a turn over the boat and bent his neck to inspect its contents. On Decicheo the common boobies vied with the noddies as the birds of greatest numbers. The blue-faced and red-footed boobies, though sought for, were not found. While the birds are rather clumsy in appearance on land, they are far from being so on the wing. Lacking the dash and arrow-like grace of the man-o'-war bird, they are easy and untiring on the wing, nevertheless, and when skimming the waves in pursuit of their prey, they fly into and out of the water with an ease that puts to shame the labored movements of the pelicans. In the Hawaiian Islands Mr. Fisher found the blue-faced and red-footed boobies far more abundant than the common booby. In speaking of the blue-faced booby, he says: "The boobies appear to exhibit affection for their young. I have seen them gazing at the fuzzy-white ball with evident pride in their otherwise stolid countenances, and on one occasion saw an old bird carefully lay dry sedge over the exposed and not too heavily feathered hind parts of the young."

It was noted that although two eggs were laid, in very few cases did more than one hatch, and in these cases only one young survived. In this species the eggs were laid on the sand, with little or no pretense of a nest, while the red-footed booby constructed a

Red-Footed Booby (Sula Piscator) on Nest.

Sooty Tern About to Leave the Nest After Laying an Egg.

Miller Bird and Nest.

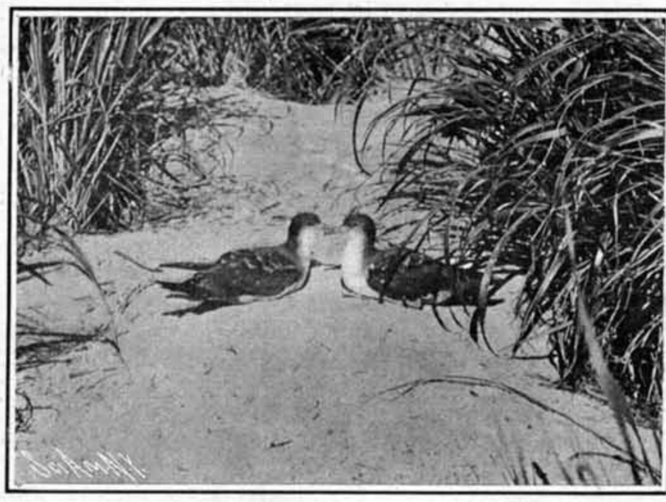
BIRDS OF AN OCEAN ISLAND.

rude platform of twigs in the bushes. The latter birds take turn in incubating, and Mr. Fisher says "are rather loath to leave their egg, when disturbed ruffling their feathers and uttering a hoarse cry, making use of their bills if occasion offers. They are singularly beautiful despite their vicious yellow eyes, as their white plumage is set off by bright blue skin about the bill and by the coral-red feet."

Of the few species of land birds found on these islands, two represent two large families, the one a finch and the other a warbler. The Laysan finch like the other birds found there was fearless and unsuspicious. They were found everywhere, singly and in small flocks, searching for food both among the bushes and in open places, and ignored the presence of man as long as they were undisturbed. They were observed to eat "soft parts of grass stems, tender shoots of bushes, seeds, and especially eggs." A pair were observed to attack a tern's egg as soon as the owner left, which they opened and started to eat, while a camera was being adjusted close by, being presently driven away by a rail, which in turn appropriated the egg. While Mr. Fisher was preparing specimens, one of these finches lit on his table and explored his implements. These birds were found to be very good songsters. Their nests were usually built in tussocks of grass.

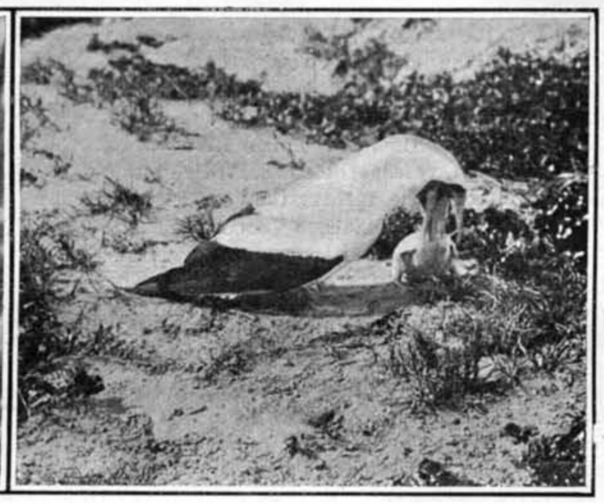
The warbler, known locally as miller bird on account of its fondness for these small moths, was one of the most abundant of the land birds on Laysan Island. As is the case with most birds, it was found to be most active during the cool morning and late afternoon hours, and at such times was quite musical. Like the other feathered inhabitants of the island, these birds were fearless, and photographs were secured without camera or operator being concealed. The bird seemed always busy in the search for millers, which it caught in the grass with great dexterity, and it hunted about, and even in, the house. It also secured caterpillars and other insects. The nests were built in the middle of a clump of grass, and the white feathers of the albatross were used for a lining.

It would seem that the success with which observations of the birds are conducted, in places where they have not learned to distrust man, and the pleasure to be derived from such familiar intercourse with them, would suggest the establishing of very different relations between man and bird than now exist in the settled portions of the world.



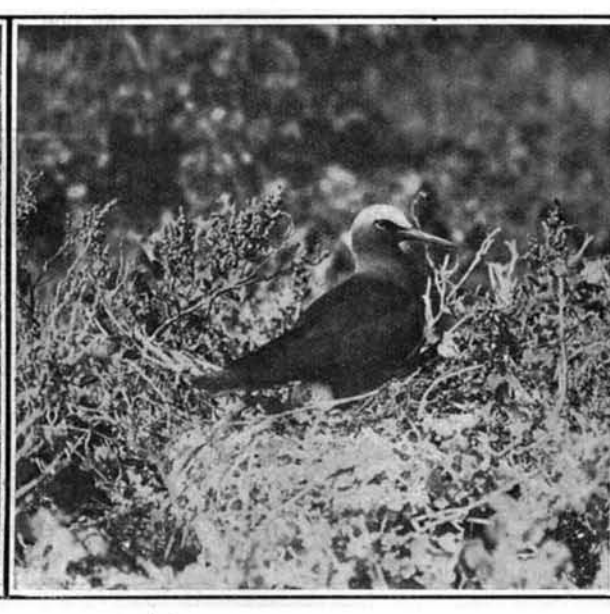
Wedge-Tailed Shearwater in Close Converse.

Laysan Finch and Nest.

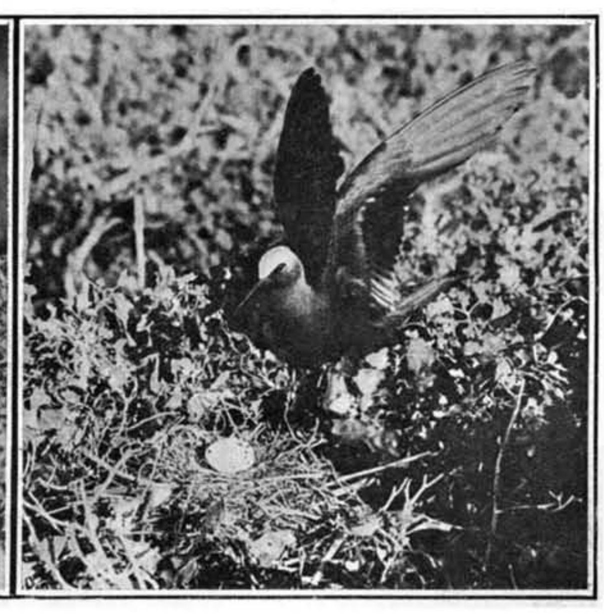


Blue-Faced Booby Feeding Young.

Red-Footed Booby in Nest.



Hawaiian Noddy in Its Nest.



Hawaiian Tern Alighting on Its Nest.

BIRDS OF AN OCEAN ISLAND

A Projected Observatory and Nautical Museum for New York.

Prof. Charles Lane Poor announces that Frederick G. Bourne, Cornelius Vanderbilt, and several other well-known men of New York have agreed to found the New York Observatory and Nautical Museum, to provide an endowment for the proposed institution, and also to purchase all the instruments and apparatus that will be required to make the New York institution one of the best equipped in existence.

"In accordance with the customs prevailing, the New York Observatory and Nautical Museum will establish various degrees of membership by which the citizens of New York who may be interested in the general work of the museum or in some particular line of investigation may become allied with it and contribute toward the support and maintenance of its scientific reputation. Special arrangements will be made whereby officers of the United States Navy, the United States Marine Corps, the Revenue Service, and the Merchant Marine may become affiliated with and entitled to the privileges of the institution during their active service.

"The principal aim of the institution," in the words of Dr. Poor, "will be to investigate all problems arising in transportation by water, especially in the careful study of all matters which tend to increase the usefulness and importance of New York city as a maritime port. Some of these problems, such as the study of the tides and currents, and the development of harbor facilities, are a part of the functions of the national government, but with so many thousands of miles of ocean, lake, and river coast to chart, buoy, and light, the federal government cannot always adequately examine and study the local conditions that affect the efficiency of any one port.

"The safety of ships at sea depends upon the accuracy of their navigating instruments, upon the adjustment of their compasses, the reliability of their sextants, and the rating of their chronometers. The master of an English ship can by the payment of a small fee have his instruments tested under government supervision, his chronometers rated at Greenwich, and his sextants standardized at Kew, but in this country there is no place where the navigating instruments of an American vessel can be scientifically investigated and adjusted. The vessels of the navy have the Naval Observatory at Washington, but the vessels of the merchant marine have to depend upon the honesty and skill of the instrument maker.

"The observatory to be established would aim to have a bureau for the standardization of instruments, where, upon the payment of a reasonable fee, the navigating instruments of any vessel in the port of New York would be investigated and adjusted, and a reliable 'certificate of inspection' furnished.

"Methods of rating chronometers and standardizing instruments depend on astronomical observations and calculations, hence the institution must be equipped with a complete astronomical observatory. New York alone of all the great cities of the world is without an observatory of any kind or description worthy of the name. Boston has the Harvard Observatory, Chicago the Yerkes, San Francisco the Lick, Philadelphia the Flower, Washington the Naval, Paris the Paris, London the Greenwich, and Berlin the Potsdam.

"There are in existence to-day fifty-three telescopic lenses of fifteen or more inches in diameter, and of these fourteen are in the various observatories of the United States. An astronomical observatory, irrespective of its necessity as an adjunct to the nautical museum, must and would be of great interest and benefit to the New York public generally.

"The New York observatory, when completed, will contain a fairly large equatorial lens for public use and instruction. It is planned that this telescope shall be open to the public two or three evenings each week. The other instruments, those for purely scientific work in connection with the work of the institution, will be located in small buildings separated from the main observatory. The plans for the various buildings of the institution have been made, the main building of the group being that of the museum, which is to be 320 feet long, 48 feet wide, and three stories in height.

"In the museum will be collected and exhibited models of all types of vessels, safety and signal devices, nautical instruments, and methods of determining positions, charts, historic instruments, and relics. The museum will be open to the public and so arranged that properly qualified persons can avail themselves of the facilities offered there for investigation and research."

Isolating Radio-Thorium.

A method of isolating radio-thorium from thorium salts is described by Messrs. G. A. Blanc and O. Angelucci in the Atti dei Lincei. When sulphuric acid is added to a solution of thorium nitrate containing barium chloride no precipitate is formed in the cold solution, but on warming, part of the barium is precipitated as sulphate, the precipitate carrying down some of the radio-thorium. The sulphate is converted into carbonate by fusion with sodium carbonate, and the product, after thorough washing, is dissolved in acid; on adding ammonia a slight precipitate of radio-thorium is obtained, which has an activity about 5,000 times as great as thorium hydroxide in a state of radioactive equilibrium.

In his address to the Chemical Section of the British Association Prof. Wyndham Dunstan remarked that the production of rubber by chemical means had been virtually accomplished by its formation from isoprene.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

TROUSERS-SUPPORT.—R. F. PARRIS, Bath, Maine. One purpose of this invention is to provide a supporting device for trousers which may remain an integral portion of the waist-band-section of the trousers and which may be hygienic, supporting the weight of the trousers from the hips solely and not from the waist, which is customary when the belt is employed. Suspenders are dispensed with.

GARTER.—D. BROADBELT, New York, N. Y. In Mr. Broadbelt's patent the invention relates to garters and the like, his more particular object being to produce a type of garter in which there is a laterally-resilient portion which may be extended or contracted at will, and provided with a longitudinally-resilient elastic portion which may be extended and of itself returns to its original shape.

Electrical Devices.

MAIN-LINE SOUNDER.—J. H. KIDNY, Lisle, Mo. The more particular object in this improvement is to produce a type of sounder adapted for use directly upon the main line and taking the place of both relay and local circuit. To this end the invention relates to improvements in construction whereby comparatively delicate currents upon the main line may cause the instrument to produce comparatively loud sounds.

Of Interest to Farmers.

FOLDING DRAFT-TREE.—G. W. WALKER, Bushnell, Ill. A folding draft-tree is provided for sectional harrows so constructed that when in use it will be as strong as the ordinary single-piece draft-tree and so that in a short time and but with little trouble the end sections may be folded up above the central section and in direction of each other, reducing the longer tree to such simple dimensions and compactness that it can be taken through an ordinary farm-gate.

FERTILIZER-DISTRIBUTER.—J. K. GOURDIN, Pineville, S. C. This distributer is adapted for discharging the fertilizer broadcast and in varying quantities. The invention is embodied in an improved construction and combination of a grooved and ribbed drum which revolves with the axle and adjustable feed-regulating slides which coact with the drum.

Of General Interest.

AUXILIARY RUDDER.—W. M. TAYLOR, Mecklenburg County, Va. Means are provided by this inventor that bring the vane in parallelism with the direction of movement of the water, so that there is no resistance thereon, and the vane may be swung inwardly into its recess, retaining it in parallelism with the side of the hull and with the direction of the force of the water. Means incline the vane so that the force of the water acts upon the outer side thereof, thus assisting in the closing of the same.

BOTTLE.—E. M. SMITH, JR., Canton, Miss. In this invention the object is to provide a bottle with means adapted to prevent it being refilled. Under this construction when a bottle has been once opened, it cannot be again refilled and placed upon the market without bearing evidence of the fact that it has been so refilled and offered for sale a second time.

METHOD OF EXTRACTING GUTTA-PERCHA.—E. C. LARSEN, Singapore, Straits Settlements, India. The invention refers to a system or process of extracting gutta-percha contained in the raw state in leaves and buds of the isonondra tree and other varieties, vines, and creepers capable of yielding gum. This system treats the substances named in order to extract gutta-percha by a mechanical method without the use or without the extensive use of oil, salt, or other chemicals.

FIRE-ESCAPE.—R. LYTLE, Afton, Ohio. It is the principal object of this improvement to provide for efficiently and rapidly elevating a mast and to provide connections with the mast in such a manner that a cage can be readily elevated and let down, so that several persons can be quickly removed from the building and, furthermore, with hose quickly elevated into a position to fight a fire.

COMB-CLEANER.—A. B. HUGHES and A. ROSE, Cedarville, Cal. The cleaner is made up either in the form of a razor-strop or comb-case provided with a series of wires strung in a novel manner, which when the comb is intermeshed with them and drawn back and forth yieldingly press on the teeth at each side, thereby completely sawing out and dispelling accumulated dirt and dandruff.

DISK-RECORD HOLDER.—X. CUKIER, New York, N. Y. This invention pertains to a device the purpose of which is to hold a plurality of disk-records, such as used on phonographs, the object being to produce a device of this class which will hold the records together in a body and in such a way that any record may be readily selected and removed from the holder.

COLUMN.—E. W. CHAMBERS, Toledo, Ohio. The invention is an improvement in columns of that class provided with an inner core of wood coated with plaster or plastic material. The column will not be affected by the swelling and shrinking of the wooden core within it. Generally stated, the column consists of a series of wooden staves so arranged as to form an annular body, said staves being secured at their ends and spirally wound with a binding material, all of which is covered with a plaster or plastic coating. The staves of the column are interiorly supported at suitable points of their length and at each end where they are connected to an ornamental base and cap-piece of any desired contour.

GAS-GENERATOR.—C. L. GERRARD, Columbus, Neb. The present application is a division of a former application filed by Mr. Gerrard. The invention has reference to certain peculiar features of construction and arrangement of parts concerned with an apparatus for generating nitric oxid or other gas. It is especially for use in connection with the treatment of wheat or flour wherein the nitric oxid or other gas is mixed with air and the mixture brought into intimate association with many. The aim is to lighten the work of the nascent condition.

Machines and Mechanical Devices.

CIGARETTE-MACHINE.—J. M. MARTINEZ, Guanajay, Cuba. The underlying object of the present invention is to construct an organized cigarette-making machine by means of which the fibered tobacco may, in a continuous operation, be fed uniformly, molded into a stick or cigarette form, enveloped and sealed in paper or other wrapper, cut into the requisite lengths, and discharged finished from the machine.

GEAR-CUTTER.—J. VOSS, Woodburn, Ore. In operation the gear-wheel is secured in place upon a pin and the pin inserted in the chuck. The pin of a plate-spring is inserted in a perforation of the series corresponding in spacing to the distance desired between the teeth of the wheel. The cutter being put in rotation, it is moved longitudinally on the bed until it engages the wheel. Upon the retraction of the cutter the pin is disengaged from its perforation and inserted in the next of the series, after which the operation is repeated.

RAZOR-STROPPING MACHINE.—E. G. KAUFMAN, Yonkers, N. Y. The object of the inventor is to provide a new and improved razor-stropping machine which is simple and durable in construction, composed of comparatively few parts, and arranged to permit an easy movement of the strop to hold the cutting edge of the razor-blade in proper contact with the runs of the strop.

CANDY-MACHINE.—T. ALLATT, Portland, Ore. Time and labor are saved in the use of this machine, since long exposure of the candy is not necessary to cool it nor is it necessary to size the strips. Every portion of the candy is utilized, there being no waste. The strips are also of uniform size throughout, and since they are cut at regular intervals the completed product is in the most convenient form for wrapping by the automatic wrapping-machine.

Prime Movers and Their Accessories.

VALVE-OPERATING MECHANISM FOR STEAM-ENGINES.—H. LENTZ, Berlin, Germany. The aim is to lighten the work of the valve-motion of reversible engines, and to secure their management by employing a wheel instead of one or more connecting-rods. This wheel, being caused to rock by the driving mechanism, will move his directly as possible the cylinder valves by its rim. This invention also renders possible the reversing by hand, obviating the need of special reversing-engine. The rocking wheel moves directly all the inlet and outlet valves of the cylinder by means of its curved cams.

ENGINE-STARTER.—G. F. BRANDHUBER, Pierre, S. D. The invention relates to a device intended particularly for starting internal-combustion engines; and the object is to provide an easier and safer means for starting the engine than the ordinary starting-crank and to enable the starting-gear to be placed in reach of a person seated in an automobile, so as to avoid the necessity of the automobile-driver alighting each time the machine is started.

Railways and Their Accessories.

STATION-INDICATOR.—I. C. BANDMAN, New York, N. Y. Means are provided whereby when the gate or door is opened or closed a movement is given to certain parts of the device so as to change the sign displayed, also to provide for announcing the stations in regular order, forward or backward, according to direction or motion of train, and means for shifting the operating mechanism in such a way as to change the direction of motion of the sheet bearing the names of the stations.

STAKE AND STRAP APPLIANCE FOR FLAT-CARS.—A. S. BEVILLE, Jacksonville, Fla. One purpose of the inventor is to provide an attachment to flat-cars by means of which stakes will be locked to the car in such manner that they may be quickly fitted to their pockets or removed therefrom and whereby when removed and permitted to drop they will yet remain connected with the car, thus avoiding losing the stakes, which otherwise frequently happens.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 8506.—Wanted, machinery for the manufacture of alcohol from apples, molasses and sugar.

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Inquiry No. 8508.—Wanted, a machine for pointing meat skewers in large quantities, such as 50,000 skewers a day.

Inquiry No. 8509.—Wanted, machinery for drilling vegetable ivory buttons.

Inquiry No. 8510.—Wanted, makers of portable sanitary closets.

Inquiry No. 8511.—Wanted, name and address of the makers of the Perplexity Puzzle recently sold by the Union News Co.

Inquiry No. 8512.—Wanted, name and address of wholesale dealers in galvanized corrugated iron and galvanized iron roofing.

Inquiry No. 8513.—Wanted, manufacturers of the following: trunk board, lamp colors, sheet aluminum, coal-oil burner without chimney.

Inquiry No. 8514.—Wanted, the address of a German firm which manufactures souvenir post cards and one which makes prism field glasses.

Inquiry No. 8515.—Wanted, the manufacturers of the Osmium Incandescent lamp.

Inquiry No. 8516.—Wanted, makers of small magnifying glasses, such as are found in watch charms.

Inquiry No. 8517.—Wanted, makers of the following, for placer mining: sluice plates, reefs for same; tom hooks, tom plates, shovels for digging earth, criminals, cutlasses with iron handles, and battes.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

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(10247) B. A. T. asks: 1. How many ampere hours will a Fuller battery give? A. About 68 ampere hours. 2. Does a Fuller battery give the same voltage after it has been charged some time as it does when it is freshly charged? A. No. 3. Does a porous cup that is used in batteries wear out? A. No. 4. Does battery carbon wear out? A. No.

(10248) I. S. W. asks: 1. At what temperature does frost form? A. At 32 deg. Fahr. 2. In magnetizing a piece of iron or steel with a permanent magnet, does the permanent magnet lose any of its magnetism? A. No. On the contrary it tends to strengthen the magnet. 3. What horse power engine is required to run the 8-lamp dynamo of SUPPLEMENT No. 600? A. Three-fourths horse-power. Also what horse-power to run the 110-volt dynamo of SUPPLEMENT No. 865? A. About one horse-power. 4. How is the horse-power of a windmill calculated? A. Approximately by multiplying the area of the slats in the plane of revolution by the cube of the velocity of the wind in feet per second, and divide the product by 4,000,000.

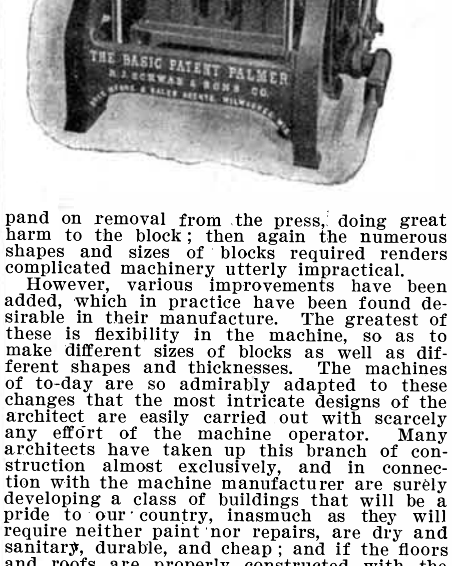
(10249) E. H. H. writes: I wish to break an electrical circuit a certain number of times in a second by means of a spring and electro-magnet, something like the electric tuning fork, but only using one leg of the fork. What number of vibrations (double vibrations) is it possible to attain? C of the treble clef has 517.3 double vibrations in a second. Would it be possible to attain four octaves above that = 8,276.8 double vibrations; that is, break the circuit that number of times? A. With that number of breaks per second the current would be apparently continuous. A dynamo making 1,800 turns per minute makes 30 turns per second, and if there are 24 coils on the armature, there are only 720 impulses of the E. M. F. per second. We call such a current continuous, and it has not a tenth of the impulses you name.

THE PROGRESS OF THE HOLLOW CONCRETE BLOCK INDUSTRY.

Like all other new industries, the hollow concrete building block has had its vicissitudes, perhaps to a greater degree than almost any other.

The fact that it has gone nearly over the entire world in the short space of three years is proof that it has come to stay, and its increasing popularity is evidence of its undoubted merit. Every trade paper of note in this as well as foreign countries has devoted much space to discussions relative to the material, its adaptability to building construction, its sanitary qualities, cheapness, and durability, which, together with its superiority as a substitute for the rapidly-decreasing lumber, has attracted the attention of all classes of readers. That this has had a most beneficial effect no one can deny. The rapidity of its introduction compelled haste in securing a practical education which in turn was not slow to discern the qualities necessary to success in both blocks and the machine for their manufacture. Of all the two or three hundred patents which have been granted for machines and blocks, there is less than one dozen which have proved so successful as to require a factory to make the machine, while scores have come to light for a few weeks and then dropped from sight.

The readers of the Scientific American will remember in the issue of August 29, 1903, an article on this subject by a representative of this paper, sent especially to investigate this new building material and method used to make it practical. This was the first extended illustrated article on this subject in this or any country. The illustrations then given were photographs taken by our artist at a building being erected by the original inventor, Harmon S. Palmer, Washington, D. C. Previous to this time there were but few machine-made hollow concrete block houses in the world, and every one had been constructed under his system and personal supervision with one of his machines. The publicity given at that time had the effect of stimulating the general public to an unusual degree in this direction, with the result as above stated. But out of all devices which come to light, not one has departed from the original conception and fundamental principle, that of a machine with movable sides and cores and a removable bottom plate, on which the block is molded by tamping and on which it is carried away from the machine. Many have endeavored to substitute other means, and thousands of dollars have been spent by early inventors in trying to produce good blocks without tamping. Some have resorted to the slush system, others to filling the mold from an elevation, while others have lost fortunes in trying to perfect some sort of press, but failure has been the general result. Concrete will not flow like wet clay under a press, and it is impossible to deposit it in a mold so evenly that all places will be pressed alike, thus causing porous spots in the stone; and again, the confined air will expand on removal from the press, doing great harm to the block; then again the numerous shapes and sizes of blocks required renders complicated machinery utterly impractical.



However, various improvements have been added, which in practice have been found desirable in their manufacture. The greatest of these is flexibility in the machine, so as to make different sizes of blocks as well as different shapes and thicknesses. The machines of to-day are so admirably adapted to these changes that the most intricate designs of the architect are easily carried out with scarcely any effort of the machine operator. Many architects have taken up this branch of construction almost exclusively, and in connection with the machine manufacturer are surely developing a class of buildings that will be a pride to our country, inasmuch as they will require neither paint nor repairs, are dry and sanitary, durable, and cheap; and if the floors and roofs are properly constructed with the same material, fire insurance, that industrial cancer, will be entirely unnecessary unless the dwelling stands in the midst of many other inflammable buildings. This may seem a bold assertion, but it is not too strong, and the time will come when it will be considered a crime to erect a dwelling that can burn.

The accompanying illustration is one of the latest machines of the above type, just patented by the original inventor, called the "Multiple Automatic." Its points of excellence are its adaptability to innumerable changes. There is no design which an architect is likely to call for that this machine cannot make, and the co-operation is so perfect and so easily understood by the architect, that the machine is almost a necessary adjunct of his office and plans. Its flexibility is so great that one, two, three, or more blocks can be made at one time, of any shape, size, or thickness, with any number of air spaces in the block and in any location—which is impossible with complicated machines or presses. One movement of one lever opens and closes the machine, saving enough time to add one hundred per cent to the usual output. Owing to the interest which many of the devotees are taking in the development of this new industry, five or six of the largest and most progressive companies in this line have just been practically merged into one called the "United Cement Machinery Manufacturing Company," with Harmon S. Palmer, president of the Palmer Company, of Washington, D. C., as president; James F. Angell, president of the Winget Machine Company, of Columbus, Ohio, as first vice-president; James W. Sanderson, president of the Cement Machinery Manufacturing Company, of Burlington, Iowa, second vice-president; James M. McDowell, of Columbus, Ohio, as secretary; and Howard C. Black, general counsel. With the experience of these promoters and the number of factories and offices, together with the numerous patents which they control, this company should be a powerful factor in the hollow-block and cement industry of this country.

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"Dime Blend," for coffee, Columbia Coffee Mills 13,214
"Dr. A. C. Daniel's Renovator Powders," for powders for horses and cattle, Dr. A. C. Daniels.... 13,210
"Dugong," for whips, United States Whip Co. 13,229
"Excelsior Solitaire," for a game, C. C. Kelly 13,227
"Farmer's Choice," for whisky, J. Grossman's Sons.... 13,220
"Genuine German Egg Noodles, Kaiser," for noodles, Milwaukee Noodle Co.... 13,212
"Kar-a-van," for tea, Gasser Coffee Co.... 13,213
"Kirsch Superieur, M. Arpin," for cherry brandy, L. L. Ardin.... 13,219
"Kola-fosfate," for a carbonated beverage, New Orleans Soda Water Co.... 13,215
"Manatee," for whips, United States Whip Co. 13,228
"Old Favorite," for whisky, J. Grossman's Sons 13,221
"Oloroso Sherry,' for sherry wine, Feldmann Importing Co.... 13,216
"Red Raven Tablets," for medical tablets, N. M. Mendenhall.... 13,211
"Shoe Life," for leather preservers, M. F. Peterson & Co.... 13,225
"Silico Finish," for wall finish or plaster, United States Gypsum Co.... 13,230
"Southern Belle," for whisky, J. Grossman's Sons 13,222
"The Mascot Solitaire," for a game, C. C. Kelly 13,226
"Tryo," for toilet paper, Scott Paper Co.. 13,224
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"Russell's Regents," for playing cards, Willis W. Russell Card Co.... 1,849
"Sommer's German Silver Arch Prop," for arch props, J. L. Sommer.... 1,846
"The Professional Baker," for flour, Washburn Crosby Co.... 1,845

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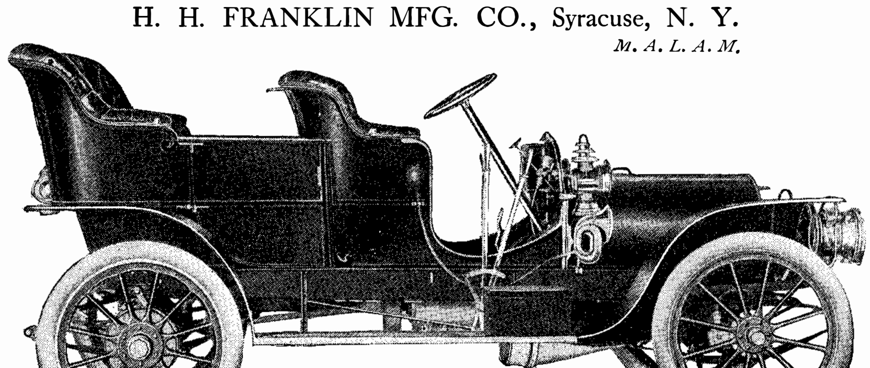

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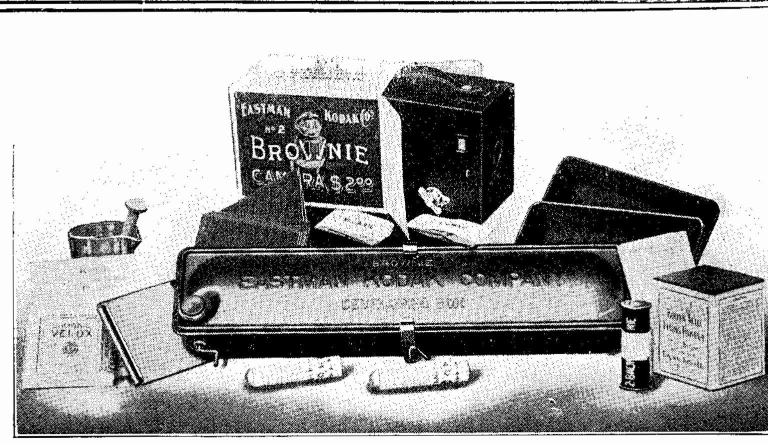

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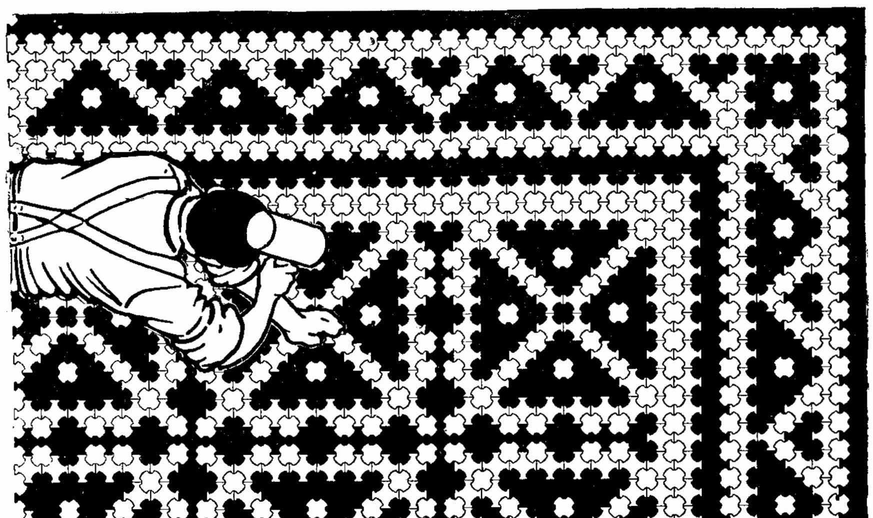

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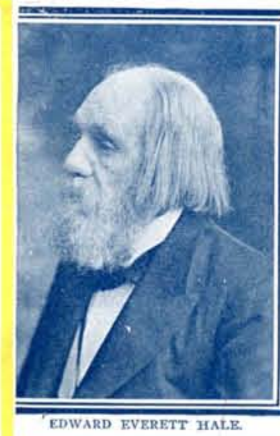

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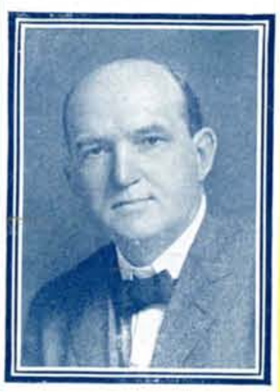

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