SCIENTIFIC AMERICAN

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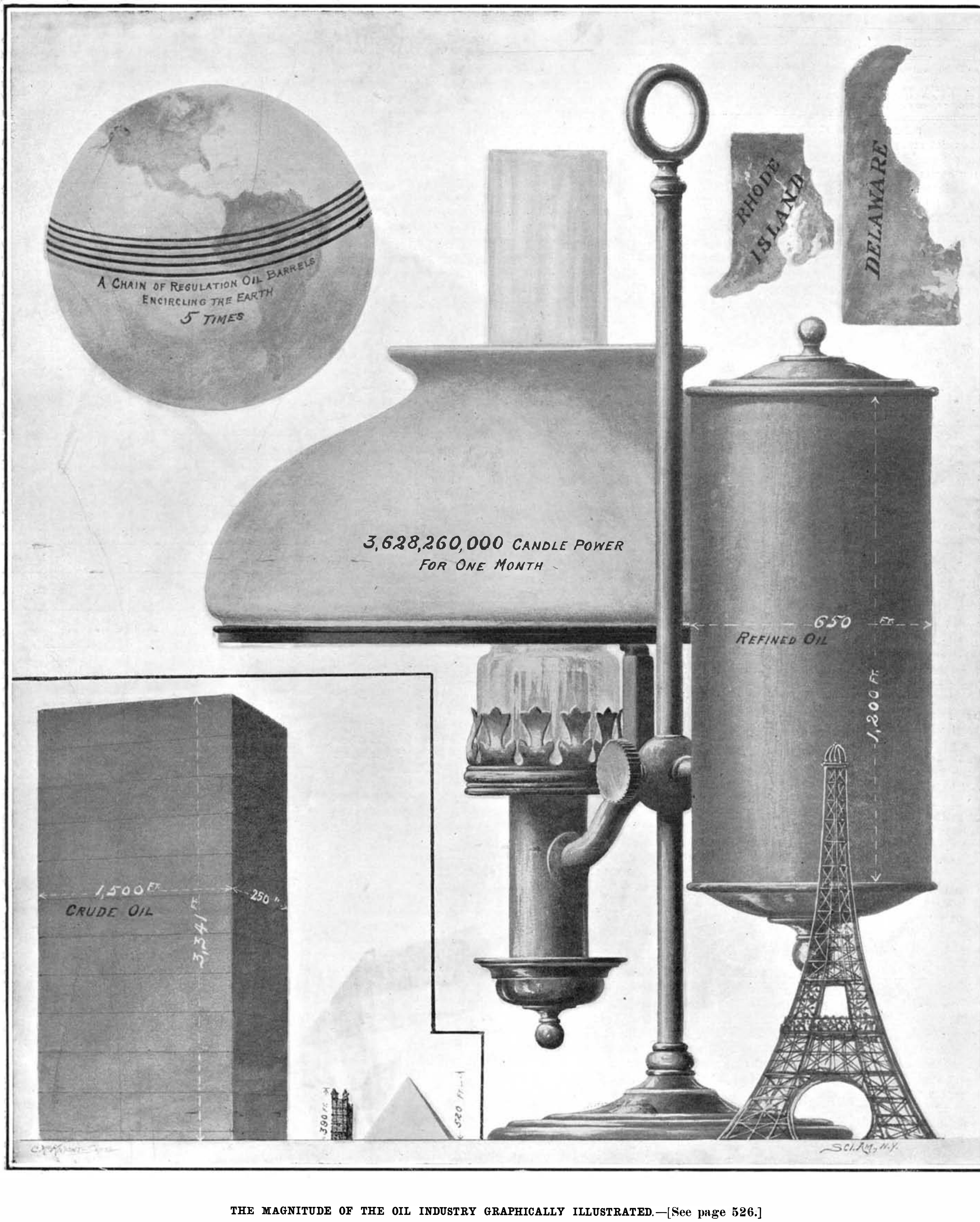

THE MAGNITUDE OF THE OIL INDUSTRY GRAPHICALLY ILLUSTRATED.—[See page 526.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, DECEMBER 30, 1905.

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.

SANITARY AND SCIENTIFIC.

It is not many years since the Street Cleaning Department was accustomed to gather together the refuse of the homes and the thoroughfares of New York city, load it into barges, tow it out past Sandy Hook, and dump it into the sea. This primitive method of disposal of the city's wastes was adopted in the belief or, perhaps, to speak more truly, under the pretext, that the heavier refuse would sink to the bottom, and the lighter portions would be taken in hand by the kindly winds of Heaven, and distributed everywhere but in the vicinity of Greater New York. As a matter of fact, the greater part of the floating matter came back, to form an unsightly and unsavory fringe along the foreshore of New York harbor and of the many seaside resorts located on the neighboring coasts. Largely owing to the efforts of the late Col. Waring, whose memory must ever be enshrined in the hearts of a grateful municipality, if not in its public places, we have changed all this, and to-day the barbarous method of dumping at sea has been practically abolished. Under the more scientific methods now adopted, the city's waste is waste no longer. What part of it is not sold is put to city uses, and much of it is actually made to render a profitable return. The heavier matter, which used to find its way to the bottom of the sea outside Sandy Hook, where, at times, it caused trouble and misgiving to mariners by tending to form bars and shoals, is now used in the production of new land for the use of the city. Thus, at Riker's Island, the filling in with the city's heavier refuse has resulted in the production of 84 acres of land, each of which is estimated to be worth $10,000, and by the year 1910 it is estimated that the total amount of made ground will have reached 270 acres. Down at Coney Island the same work of reclamation is being carried on, and 80 acres of the sunken meadows that border Coney Island Creek has been reclaimed and brought up to grade. We understand, moreover, that the United States government is prepared to purchase ashes from the city to fill in the large section of ground which it is making at the southerly end of Governor's Island. So much for the heavier refuse. The lighter refuse has also been rendered profitable. In the first place, the privilege of picking over the rubbish is let by contract, and a good price is paid for the same. What the contractor rejects is used as fuel in the boiler room of the city's new plant at the Williamsburg Bridge. The operating expenses of this plant are paid by the money received for the picking-over contract. The plant serves to light the Williamsburg Bridge, the Street Cleaning Department's stables, and the public schools in the immediate district. It cost $83,000, and it produces a revenue equivalent to $52,000 a year. The Chief of the Street Cleaning Department is certainly to be congratulated on the fact that the present methods of disposal of city wastes are at once scientific, sanitary, and commercially profitable.

CAR BRAKES AND STEEL DUST.

In the course of an official report made not long ago to the New York Rapid Transit Commission, on the sanitary condition of the Subway, the author, Dr. Soper, draws attention to the amount and character of the black dust, which he considers to be a matter of no little importance. Probably most of the Subway passengers have noticed this dust, which already in twelve months of operation has done much to discolor the light tints and tiled surfaces of the Subway. They will be interested to learn that chemical analysis shows that this dust contains 62.78 per cent of metallic iron, the particles of which it is composed ranging in size from fragments that can almost be seen with the naked eye to pieces less than 1-25,000 of an inch in diameter. The greater part of this pulverized iron is the result of the grinding up of brake shoes, the daily loss in weight of which is surprisingly large. The "smudging" effects of this dust are due to the presence of about one per cent of oil, which is sufficient to give it secure lodgment upon all surfaces. Dr. Soper states that an amount of this dust which is too small to be weighed with accuracy is capable of producing a black mark upon white linen which can be seen at a distance of twenty feet.

Another point mentioned in the report as having been investigated in its relation to sanitary conditions is the temperature, which in summer is found to be decidedly higher in the Subway than on the street outside. During the hottest week, August 4 to 10, of this year, the average daily temperature for the outside air was 73.2; in the Subway it was 83.1. This increase in temperature is mainly, and probably almost entirely (though the doctor does not say so) due to two features of Subway operation, which more than any others contribute to the excellence of the service, namely, the rapid acceleration of the trains by the electric motors, and the rapid stopping of the trains under the powerful action of the Westinghouse brakes. Each of these operations is accompanied by the generation and radiation of heat, both from the motors and from the brake shoes. The heating of the motors is not only inconvenient to the passengers during the hot weather, but it represents a loss of a certain proportion of the power that is taken up from the third rail. The heat generated at the brakes presents another actual loss, to say nothing of its effect in raising the subway temperature, and the inconvenience occasioned by the metallic dust into which the shoes are ground.

Dr. Soper suggests as a method of solving the difficulty of overheating, the introduction of some regenerative control, by which the motors shall act as generators during the period of retardation, and thus serve the double purpose of stopping the train and converting the momentum into electrical energy. The proposal to brake the trains by means of the motors is not a new one, and it is said to be open to the objection that heat will be generated in the motors when they are acting as generators, to an extent that will make the reduction in heating over that produced by the brake shoes of inconsiderable quantity. At the same time we note that one of the vice-presidents of the Erie Railroad has stated that, during an inspection which he recently made of the Valtellina three-phase railway, where the regenerative system is used on down grades and in reducing speed, he found that there is a decided saving, not only through the return of energy to the line, but also in the reduction of wear and tear to brake equipment and the tires of wheels.

We are decidedly of the opinion that, whatever may be the merits of the regenerative system as a means of reducing brake-shoe wear, and eliminating the present dust and heat, there is another method which should by all means be given fuller consideration in designing the new Subways that are now under consideration. We refer to the method of assisting acceleration and retardation by placing each local station at a summit of a short grade, so that in approaching a station the train is running up grade, and in starting from a station is running down grade. The principle has been applied in the present Subway at a few stations in a very limited degree. It would be entirely feasible to increase the grade and length of these approaches, even if it should be done to the extent of eliminating all level track between stations that are only a quarter of a mile apart, as many of them are. An investigation of the problem will show not only that it would be possible to make an enormous reduction in the amount of necessary braking power, but that the amount of current required for starting the local trains and bringing them to the desired velocity could also be greatly reduced.

THE REORGANIZATION OF THE BRITISH NAVY.

Further important steps in that reorganization of the British navy which has been in continuous progress during the past three years have resulted in a saving during the present year of $17,500,000; and a further economy of $7,500,000 will be effected during the next twelve months. Notwithstanding this heavy reduction in the expenses, the strength and efficiency of the navy have been considerably enhanced. The department realizing that success and efficiency are largely dependent upon the *morale* of the men, and their willingness to throw their energies into the work in hand, have carefully scrutinized the record of every man in the service, and have discharged from the fleets all those men (over 1,000 in all) who were considered to be undesirable; and with regard to the vessels themselves, the Admiralty have continued the policy of dismantling vessels that do not come up to the modern standard of a useful unit for fighting purposes. This policy was inaugurated over a year ago, when no less than one hundred vessels were sold out of the service in one fell swoop. A further number of ineffective vessels have been discarded, so that now the navy is composed entirely of the most modern types of warships. The crews of the dismantled vessels have been drafted to the reserve fleet in home waters. This fleet will be kept in commission ready for instant service, and each vessel will be manned by a full crew.

An important step has been taken with regard to the constructional programme. During the past few months the naval executive have been carrying out careful investigations, among both private and government shipyards, to ascertain the shortest time in which the various types of vessels could be built and armed complete, ready for sea. The Admiralty are themselves practically testing the matter with the construction of the 18,000-ton battleship "Dreadnought" at the Portsmouth government dockyard. This vessel was commenced early in October last, and is to be launched, completed, and armed ready for commission within eighteen months from the laying of the keel. The inquiries among the private yards have proved so satisfactory, that the department intend in future to play the waiting game, ascertain what the other powers are doing, and then act accordingly.

The Admiralty intend to build four large armored cruisers annually, and this number will not be exceeded unless unforeseen contingencies arise. Owing to the rapid strides in the development of warship equipment both offensive and defensive, in future the shipbuilding programme will be confined to one year, and the construction of a number of vessels will not be spread over a number of years, as has heretofore been the practice. There will never be any difficulty, however, should exigencies so demand, in increasing this output to coincide with the naval developments of other powers.

Owing to the alterations in the balance of power due to the recent war and the removal of the political vortex from the Far East to Europe the various fleets have been completely rearranged and the home fleets considerably strengthened. These are now composed as follows, the armored cruisers including the powerful vessels of the "Powerful" and "Diadem" classes.

FLEET IN COMMISSION AT SEA.

Squadrons.	Battleships.	Armored cruisers.	Large protected cruisers.	Smaller cruisers.	Scouts and gunboats.	Destroyers and torpedo boats.	Total.
Channel	17	6	2	2	1	24	52
Particular service	—	—	5	1	—	—	6
Training ships	—	—	5	—	—	—	5
Home waters	—	—	—	1	14	20	35
Atlantic	8	6	1	1	1	25	42
Mediterranean	8	4	3	—	1	31	47
Eastern	—	5	3	9	—	17	34
Cape	—	—	1	3	—	1	5
(In addition—submarines)	—	—	—	—	—	—	17
Total	33	21	20	17	17	118	243
Fleet in commission in reserve in home waters	12	14	8	8	8	104	154
Total of effective vessels	45	35	28	25	25	222	397

The Admiralty have made arrangements to carry out maneuvers in June next upon a scale which has never been attempted before in the history of the British navy. The whole of the various fleets in different parts of the globe, together with the reserve fleet in home waters, comprising 397 vessels, are to act together in their respective waters. In this series of maneuvers the recently elaborated scheme for the protection of trade will be severely tested, and it is being arranged for the shipping interests to co-operate with the fleets for the elucidation of this difficult problem.

THE HEAVENS IN JANUARY.

BY HENRY NORRIS RUSSELL, PH.D.

There are now two telescopic comets in sight at once. Schaer's comet, at present south of the equator and very faint, is still observable with powerful telescopes, and a new comet was discovered by Giacobini at Nice on the morning of December 7. It was in the morning sky, near Arcturus, and was moving slowly toward the sun.

The first rough calculations of its orbit have come to hand, and show that it is now rapidly approaching the sun. It will reach its perihelion about January 20, and at that date will probably be within twenty million miles of the sun and many times brighter than it is now; but as it will be on the far side of the sun, it will not be a conspicuous object. After its perihelion passage it will be south of the sun, and visible only in southern latitudes, so that its whole period of visibility in our northern skies is only a few weeks.

This is the case with many comets, and it is therefore necessary, from the astronomical point of view, that the news of a comet's discovery shall be telegraphed over the world at once, so that observations shall be secured. To wait for the mails, or for the printing of even a weekly periodical, would be altogether too slow.

A regular organization exists to meet this need. When a comet is discovered in this country, the news, together with the comet's position in the sky, and the rate and direction of its motion, is telegraphed at once to the Harvard Observatory. The corresponding "central station" in Europe is at Kiel in Germany. As soon as the news is received, it is distributed broadcast to all the institutions which subscribe to this scientific form of news service and cabled across the Atlantic for similar distribution in the other hemisphere. The first observers of the comet likewise send in the results of their observations to the central office, so that in two or three days there are available enough observations to serve as a basis for an approximate orbit. Then with the distribution of information about this orbit, and of the ephemeris, or series of predicted places of the comet derived from it, the work which demands telegraphic speed is usually at an end.

The actual messages are much shortened by the use of a telegraphic code. This not only saves money, but works for accuracy, as long series of numbers are very liable to errors of transmission. But as an additional check, every message ends with a "control word," which represents the arithmetical mean of the numbers given in the preceding words, so that the existence of an error in the message can thus be detected.

THE HEAVENS.

The winter constellations now display their full magnificence. Orion is a little east of south, with Taurus above on the right, and Canis Major below and to the left. Sirius is now well up in the southeast, and below it appears the irregular cross of stars which marks the position of the Great Dog's hindquarters.

Above Sirius on the left is Procyon, the only bright star in Canis Minor, and higher up are the twin stars of Gemini. The upper one, Castor, is a very fine double, whose two components revolve about one another in a very elliptic orbit in a period of about 350 years. They are now beginning to approach one another, and in about sixty years (according to the best calculations) they will be three or four times as close together as they are now, while the line joining them will be at right angles to its present position. Each of these two stars is attended by an invisible dark companion, whose existence is made known to us by the spectroscope. One of these revolves about its primary in about three days, and the other in about nine. Finally, the faint star which attends the system at some fifteen times the distance between the bright ones is moving with them, and must be in motion about them in an orbit whose period must be numbered by tens of thousands of years.

Below Gemini is Cancer, marked only by the small star cluster called Praesepe, and below this again are Leo, just rising, and the head of Hydra to the southward. Auriga, Perseus, Cassiopeia, Cepheus, and Cygnus lie in successive order along the Milky Way, the last just setting in the northwest. Aries, Andromeda, and Pegasus are south of them, and then Pisces, Cetus, and Eridanus, in the very dull southwestern sky. Ursa Major is on the right of the pole, and Ursa Minor and Draco are below it. The only conspicuous planet is Jupiter, near the meridian, though Saturn and Mars are visible in the southwest in the early evening.

THE PLANETS.

Mercury is morning star throughout January, but is best visible in the early part of the month, especially about the 4th, when he is farthest from the sun. He rises about one and one-half hours before sunrise, that is a little before 6 A. M., but he is so far south that he will be low down near the horizon and hard to see. Later in the month he gets too near the sun to be well seen.

Venus is morning star, but is practically invisible, as she rises only 40 minutes before the sun on the 1st, and is even nearer him for the rest of the month.

Mars is evening star in Aquarius, and sets at about 9 P. M. in the middle of the month. He is moving eastward among the stars at about three-quarters the rate of the sun's apparent motion, so that the sun overtakes him very slowly, and he remains an evening star for several months. Though now far from his greatest brightness, he is in a part of the heavens where there are no bright stars, and Saturn alone competes with him in the southwestern sky.

Jupiter is in Taurus, south of the Pleiades, and comes to the meridian at 8 P. M. in the middle of the month. Transits or eclipses of his satellites, visible in the evening, occur on the 1st, 8th, 10th, 16th, 17th, 24th, and 31st. They have a tendency to come on the same days of the week, because the first satellite makes four revolutions about Jupiter in 7 days 2 hours, the second satellite two revolutions in 7 days 2½ hours, and the third satellite one revolution in 7 days 4 hours. Hence at the end of a week all three come back very nearly to their original positions, but at a later hour in the evening. The fourth satellite, whose period is 16 days 18 hours, does not come into any such arrangement.

Saturn is evening star in Aquarius, and sets about 8 P. M. on the 15th. He is about 10 degrees below and to the right of Mars.

Uranus is in Sagittarius, too near the sun to be observed. Neptune is in Gemini. On the 15th he is in R. A. 6h. 37m., dec. 22 deg. 12 min. north, and crosses the meridian at 11 P. M. Only in powerful telescopes can he be distinguished from faint stars, except by his motion from night to night.

THE MOON.

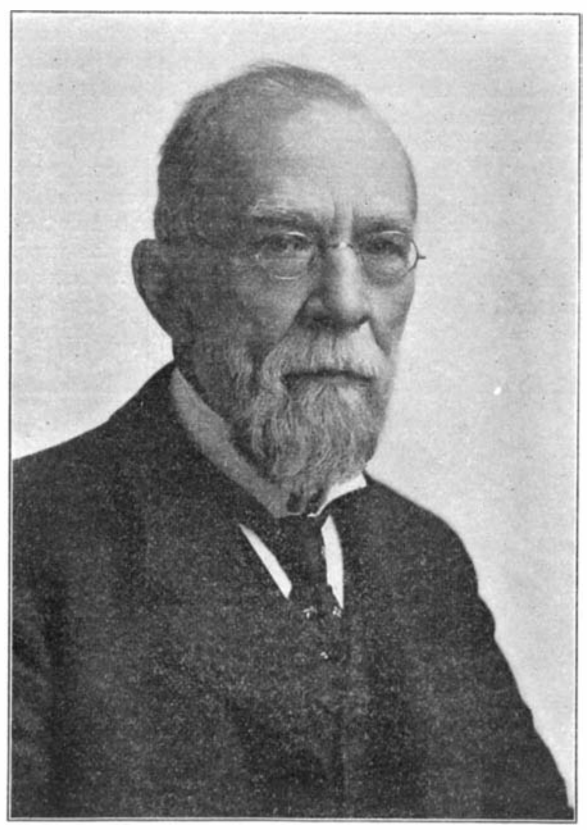
First quarter occurs at 10 A. M. on the 3d, full moon at 11 A. M. on the 10th, last quarter at 4 P. M. on the 17th, and new moon at noon on the 24th. The moon is nearest us on the 20th, and farthest away on the 4th. She is in conjunction with Jupiter on the 6th, Neptune on the 9th, Uranus on the 22d, Mercury on the 23d, Venus on the 24th, Saturn on the 26th, and Mars on the 28th. The conjunction with Saturn is close, and an occultation will be visible in the southern part of the United States; but as it will happen in the day time (about 2 P. M.) it is doubtful if it can be seen.

Princeton, 1905.

CALVIN MILTON WOODWARD.

BY MARCUS BENJAMIN, PH.D.

The American Association for the Advancement of Science has held since its inception in 1848 fifty-four meetings, and of these only one, that of Charleston, in 1850, was held in the Southern States. The changing of the time of meeting from summer to winter has made it possible for its members to gather occasionally in the South, and therefore the fourth winter meeting will be called to order in the old historic city of New Orleans on December 29. Last year its deliberations were presided over by William G. Farlow, the distinguished cryptogamic botanist of Harvard University, who will yield his high office this year to



CALVIN MILTON WOODWARD.

Calvin Milton Woodward, famous as an educator and as an engineer.

Prof. Woodward was born in Fitchburg, Mass., on August 25, 1837. His father, who was of English ancestry, was a sturdy farmer and a highly-respected town official. The boy, like many other New England lads, spent his summers on the farm doing his full share of the work, and then was sent to school during the winter months. In time he passed through the high school, and in 1856 entered Harvard, where the muscle and brawn acquired on the farm at once gained for him a place on the college crew, and in four races he rowed in the winning boat. Studies were not neglected, however, and he was graduated in 1860, delivering an address at Commencement on "Archimedes as a Mechanical Engineer."

Soon after graduating he was made principal of the Brown Classical High School in Newburyport, Mass., and after a year's service secured a leave of absence and enlisted as a private in the 48th Massachusetts Volunteers. He was soon elected first lieutenant, and later captain, and served in Louisiana until August, 1863, when the regiment was sent home and mustered out of service. He participated in the siege and capture of Port Hudson, and in the patrol of the Mississippi River.

On returning to Newburyport he resumed his duties as principal of the high school, and taught Latin, Greek, and mathematics until July, 1865, when he resigned to accept an appointment in St. Louis, where he has since remained. In the autumn he began his career as vice-principal of the Smith Academy of Washington University. During the illness of Chancellor Chauvenet, charge of the mathematics division was given to him. The assignment proved a fortunate one, and in 1868 he was made assistant professor of mathematics in the university, receiving three years later an appointment to the full possession of the chair.

In 1868 also he prepared a plan for the organization of a polytechnic department which was accepted, and in 1871 he became dean of the new department. Later Nathaniel Thayer, of Boston, contributed largely to the funds for erecting a new wing to the old university building, and in his honor the chair held by Prof. Woodward was named the Nathaniel Thayer Professorship of Mathematics and Applied Mechanics. In the active occupation of this chair Prof. Woodward still continues, and all of his teaching is done in connection with the College and the School of Engineering and Architecture.

While dean of the School of Engineering Prof. Woodward came to realize and appreciate the great defects of secondary education in the United States. Accordingly in 1879 he organized shop work, first for the students in the engineering course; and finding that the subject matter was easily within the grasp of boys from fourteen to sixteen years of age, he planned a secondary school in which tool work and drawing should be integral parts of the course of study. In a word, he planned the St. Louis Manual Training School, and was successful in finding friends to furnish means for its endowment. The school was opened in 1880 with a corps of teachers chosen by him, and with a course of study which he prepared. He became its first director, an office which he has ever since held, although in recent years the personal attention given by him to the school is less than formerly. The St. Louis Manual Training School is the pioneer of its kind in the United States, and has served as the model in organizing other similar schools. In his own words, he believes the best practice is to "put the whole boy to school," for then, as another has added, "you will have a whole man by and by."

Prof. Woodward is the author of "The Manual Training School" (New York, 1887) and "Manual Training in Education" (1890), both of which have been favorably received and are accepted authorities on the subject.

In addition to his work in connection with the university, the greater opportunities which his youthful enthusiasm had hoped for in St. Louis soon manifested themselves in many fields. In 1878 he was elected to the Board of Schools of St. Louis and served one year, failing of re-election in consequence of his opposition to the practice of teaching German in the elementary grammar schools. Later he was active in securing a new charter for the Board of Education, and on its adoption in 1897 he was chosen a member of the first board, and was re-elected in 1899 and 1905, serving twice for a term of a year each as president. The work of the St. Louis Board of Education is well known, and Prof. Woodward's influence on it is easily recognized and appreciated. In 1892 he was appointed a member of the Board of Regents of the University of Missouri, and has served for six years on that board, the greater part of the time as its president.

Prof. Woodward was prominently connected with the Louisiana Purchase Exposition held in St. Louis in 1904, serving as chairman of the International Jury of Awards to pass upon aeronautic matters, and also as president of the Aeronautic Congress. His eminent services in the cause of science and education gained for him in 1884 the conferment of the honorary degree of Doctor of Philosophy by Washington University.

He has been very active in many State and educational associations and is now a member of the National Council of Education. For many years he has been a member of the St. Louis Engineers' Club, and for a time was its president. Likewise he has been president of the Society for the Promotion of Engineering Education, as well as holding membership in the American Society of Civil Engineers and the American Society of Mechanical Engineers.

His connection with the American Association for the Advancement of Science began with his election in 1882 to membership. Two years later he was advanced to the grade of Fellow, and in 1899 he was chosen to preside over the Section on Social and Economic Science, and in 1903 over the Section on Mechanical Science and Engineering, with the rank of vice-president on each occasion. In 1904 at the meeting held in Philadelphia—where twenty years previous he had received his first preferment—the council, recognizing his eminence, elected him president of the association, an honor worthily earned and most fittingly bestowed.

In addition to many papers that he has published, among which may be mentioned "The Theory of Planetary Equinoxes," "The Theory of Compressed Air," "The Efficiency of Gearing under Friction," "The Rise and Progress of Manual Training," "The Meaning and Value of Manual Training," and "The Intellectual Value of Manual Training," he is the author of "The History of the St. Louis Bridge," a royal quarto volume of about four hundred pages, which Senator Hoar described as "the history of a great and noble achievement, calculated to fill the breast of every true American with emotions of pride and delight."

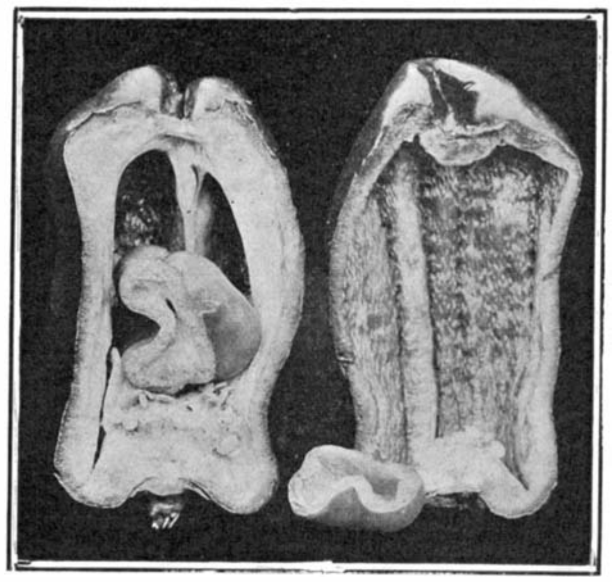
NEW ELECTRIC CAPSTAN AT ANTWERP.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

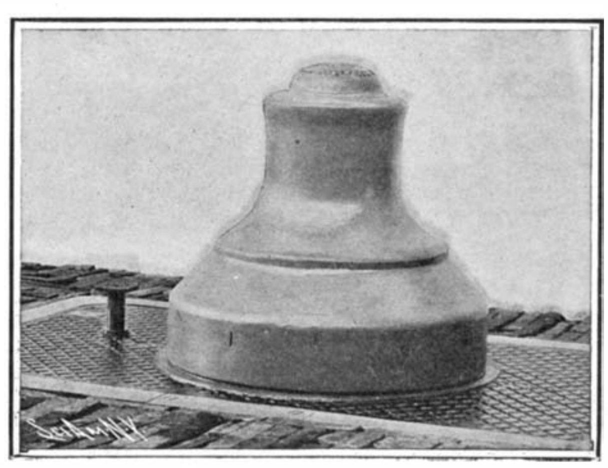
In general the capstan plays only a secondary part in the large seaports. This is not the case at Antwerp, where we find a great number of them, and they are constantly in use. For instance, on the Escant wharf there are at least twenty-seven. In order to see the importance of the capstans on the Antwerp quays we may mention the special conditions which occur here. A great part of the ground at the wharves is covered with large storehouses or sheds which serve to store the freight. The storage sheds are separated from the Escant River by a set of rails upon which travel the large hydraulic cranes of the port. Between the large rails of the cranes a track has been laid for the railroad cars, which can thus pass along underneath. Another railroad track lies back of the series of storehouses. The latter is the track of the main railroad which connects the wharves with the South Depot. As it was not possible to take the railroad cars from one of these tracks to the other through the sheds in order to load or unload them on the quays, another method had to be used, and for this purpose a series of platform trucks running across upon rails between the tracks was made to carry the cars over from one track to the other. The carrying trucks are moved back and forth by means of capstans. When we remark that as many as 1,200 cars per day are shifted between the tracks it will be seen what an important service is given by the capstans. In view of this, and as the amount of freight to be handled at Antwerp is always on the increase, it was decided to look for a better method of operating, and as the system of electric capstans had already been used with considerable success on some of the leading railroads, in France and elsewhere, it was thought that they would give a much better and quicker method of operating. Accordingly, the Municipal Technical Department, under the direction of M. Royer, the chief engineer, had a series of tests made with a new form of electric capstan, built by the Haarlemsche Machine Fabrik, which had already attracted some attention. The company designed and built several different forms of this apparatus before finally coming to the best form to be employed under the conditions which prevail at Antwerp.

After several trials they at last adopted the type of electric capstan which we illustrate here. When closed and ready for action the capstan has the form of an upright cable-drum formed of a single cast-iron piece. An iron platform, imbedded in the brick paving, surrounds it, and on one side is a push-pedal which the attendant uses for throwing on the electric motor. The second view shows the convenient arrangement which is adopted for overturning the apparatus as a whole upon its trunnions, so that the lower part is brought up for inspecting the motor and the mechanism. The sectional view shows the arrangement of the electric motor and also of the mechanical device which was adopted for operating the motor and giving the needed changes of speed. The first form of capstan which was designed used the ordinary method of controlling the motor speed, that is, by a circular switch having a certain number of contacts and throwing a variable number of resistance coils into the current circuit. In practice this was found to have some disadvantages, as if the attendant did not work the lever properly he was apt to start or stop too quickly and thus give a bad shock upon the motor. Besides, the system of connecting all the motors in parallel on the circuit was found to use a cable of too high a section and therefore expensive. In the present form, M. Thury adapted his well-known method of connecting all the motors in series upon the line. In this case it is possible to change the speed of the motor by simply shifting the current brushes around the commutator as is done in an ordinary dynamo, but here the shifting can be done completely around the circle, so as to start the motor, bring it to different speeds, and then slow it down. This method has many advantages, the principal one being that on starting the motor, the power taken from the line is proportioned to the effective work which is done, and there are no heavy shocks at starting.

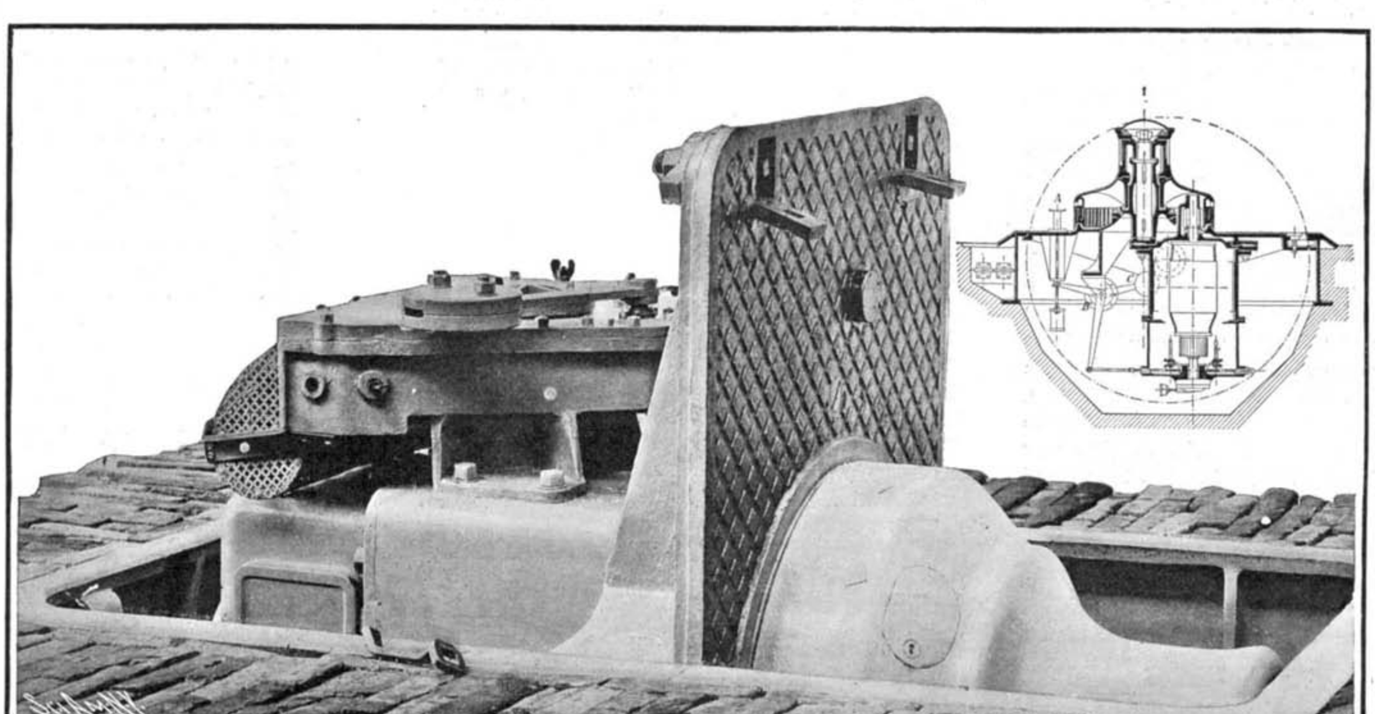
The present form of capstan has an electric motor which will give about 20 horse-power, working at 450 revolutions per minute when at full speed. The motor is placed vertically in a cast-iron support which is bolted to the main plate. A bronze pinion on the upper end of the motor engages with a large gear which is mounted directly on the capstan. The motor is tightly inclosed in its case and has a set of openings for reaching the inside. Into the casing passes a rod which carries a rack for shifting the brushes of the motor about the center. By means of a lever the rod is joined to the main foot-pedal, *A*, so that upon pressing it down the brushes come from the zero position up to the maximum. Mounted on the lever is a switch, *B*, which puts the motor in short circuit at the upper point, thus throwing it out of action. As the lever is provided with a counterweight, *C*, when the pedal is free, the motor is always thrown out. A dash-pot which is placed below the pedal prevents it from being pushed too quickly, but it does not retain the action of the counterweight when it falls. The case might happen where the capstan was set in motion without having the rope around it and thus would run free from load. In this case it might run at a dangerously high speed, but an apparatus has been provided for taking off part of the current in this case and automatically cutting down the speed. Another device cuts off all the current from the capstan when it is not in use.



A PEPPER WITHIN A PEPPER.



Electric Capstan, Closed and Ready for Action.



Capstan Overturned to Bring Up the Lower Part for Inspection.

NEW ELECTRIC CAPSTAN AT ANTWERP.

A DOUBLE PEPPER.

The accompanying photograph explains itself so fully that only a few words of elucidating text are required. The picture shows one of those peculiar pranks which nature sometimes plays, in this case two peppers, one of which has grown within the other. Naturally the inner fruit is even more distorted than the usual pepper.

Researches on Rubber Plants.

It has been known for some time that besides the usual tropical rubber-producing plants, we find two others, the *Funtumia* and the *Landolphia*. Certain species of these plants give a milk which coagulates and forms a very elastic rubber, while the milk of other species gives simply substances which have not the nature of rubber. Until within recently it was considered that we have two distinct species, but since 1891 some facts have been published which seemed to show that the plants of the same species might be indifferently rubber-bearing or the contrary. If this fact were confirmed, it would be a great drawback to the cultivation of these plants, seeing that the results would always be uncertain. A French savant, A. Chevalier, has been making a series of observations during seven years in widely different parts of tropical Africa, and he considers that the above idea is erroneous, and that all the plants of a rubber-bearing species will produce rubber if under favorable conditions. Among others he studied the *Landolphia owariensis* and finds that in the greater part of its geographical area, from French Guinea to the Congo, experimenting upon thousands of plants growing in the forests or plains, at altitudes varying from the sea-level up to 4,000 feet, he was always able to extract a rubber of good quality, and other botanists, such as H. Lecomte and R. Schlechter, came to the same results. Besides, the two species known as the *Eulandolphia* of Stapf always contain a rubber of high quality coming from the bark of the trunks. When below the second or third year the young branches of all these Landolphia are lacking in rubber, but after that time it commences to appear. But it seems that in all the rubber plants this condition prevails. The *Manihot glaziovi* is another plant which was observed and cultivated during the last voyage in West Africa. Contrary to some statements, there is no relation between the form of the tree and the amount of milk which it gives, regarding the three-lobed or the five-lobed plants. Besides, the form of this plant seems to vary considerably. While all the plants do not give the same yield, this variation does not belong specially to this species. In general, the production of rubber by any of the caoutchouc plants is an individual quality. This may differ from one plant to another, but whenever a species yields a good quality of rubber, all the trunks and native branches of the plants are found to contain more or less of it.

Amelioration of Old Age.

If old age could be secured without much of the burden now attending it, there would be the gradual ripening and mellowing of all the functions of the body and mind. If, in short, the human organism could be so constructed and cared for that it would continue its functional activity like the wonderful "one hoss shay" until the time of its final dissolution, such a consummation is devoutly to be wished. The medical profession will find its best exponent in the service of senectitude. An old age without illness or dementation, a ripening without decay, a completion of the functional activity without the breaking down of any organ are steps toward which the medical profession may well direct its energies.

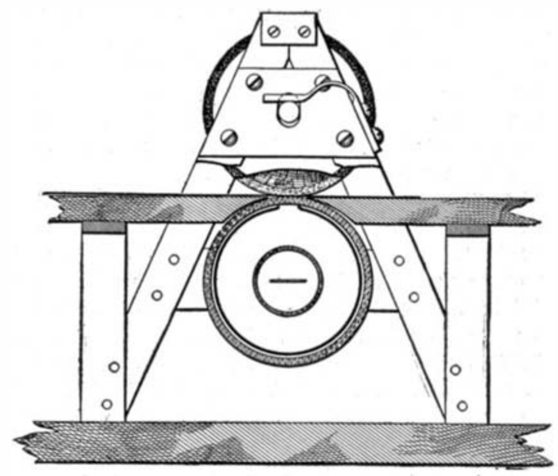
A RAPID PHOTOGRAPHIC PRINTING APPARATUS.

The apparatus is designed to produce duplicates of drawings principally, which will be reversed as to color but positive as to letters, figures, writings, etc., without the use of a printing frame and with greater facility. It is also adapted to make positive prints from film or flexible negatives.

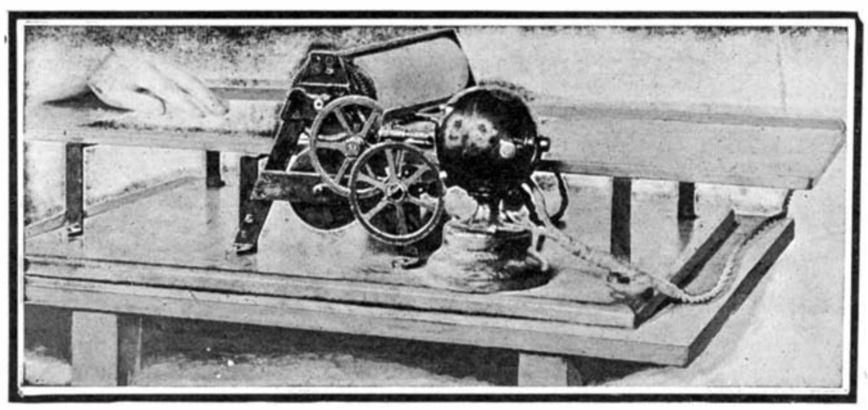
As will be noticed in the accompanying illustration, the machine consists mainly of two rollers, about three inches in diameter, similar to the rolls in an ordinary clothes wringer, mounted one above the other; the upper one is solid, covered with soft felting material, and runs in slotted bearings at each end, having pressure springs above to exert pressure on the lower roll. This latter is more complicated, but runs in solid bearings. It consists of a glass cylinder about one-eighth of an inch thick, having a metal plug in one end with suitable ventilation openings, and a shaft to fit in a bearing in the supporting frame. The other end of the glass roll is open and is held in position by outside roller bearings, supported in the frame. On the interior of the transparent roll is a shade held stationary, extending the full length of the roll, which has a slot in its upper part directly under the contact point of the two rolls. Supported upon another removable frame is an incandescent candle-shaped electric light bulb made long enough to equally illuminate the slot in the shade within the glass cylinder, or, in other words, to illuminate only the section of the drawing or film at the actual point of contact of the two rolls. The electric lamp is inserted at the open end of the glass roll. In the diagram showing a section of the glass roll below, the small circle is the electric light bulb, and the solid circle with a break in it the light shield. Gears at one end of the rolls cause the latter to rotate with equal speed. In front and behind the rolls are platforms arranged for feeding in the drawing as the rolls are rotated. It is highly essential in this machine that the rolls shall revolve with a continuous, steady music-box-like motion, in order that the light may act equally upon the whole sensitive surface. An uneven movement will show in the form of lines across the print. It was found that a small electric motor produced the right effect, although the machine could be operated as well by a spring or weight suitably geared up. It will be observed that the shaft of the small motor (similar to an electric fan motor) attached to one side of the platform has a spiral worm screw on its end which engages a gear wheel; from this gear the speed of rotation is still reduced by other interchangeable intermediate gears, until the right degree of movement is ascertained for a given thickness of drawing or negative to be run through. The diagram shows plainly the principle of the apparatus.

In operation the sheet of drawing is laid upon the platform, then over it is laid a sheet of slow bromide paper with the sensitive side upward, the motor is started, and the drawing and sensitive sheet are pushed or fed to the two rolls. The time of exposure, or of the passage of the drawing through, is about thirty seconds. The exposed sheet is then developed and duplicates are obtained by simply repeating the operation, all in a dark room. The time of exposure can be varied by inserting resistance in the motor circuit to make the motor rotate faster or slower if the drawing is thin or thicker.

In the case of film negatives, the intensity of the light may be reduced by interposing between the lower glass light roll and the negative one or two sheets of translucent celluloid. When the right thickness has been determined by experiment, duplicate prints may be made with certainty. By exposing through the back of the sensitive sheet the print shows the writing as white, reading the right way, while the ground is black, or the reverse in color of the original.



DETAIL OF CONSTRUCTION OF PHOTOGRAPHIC PRINTING APPARATUS.



APPARATUS FOR MAKING BROMIDE PRINTS WITHOUT A PRINTING FRAME.

INSECTS FOUND IN AMBER.

BY JACQUES BOYER.

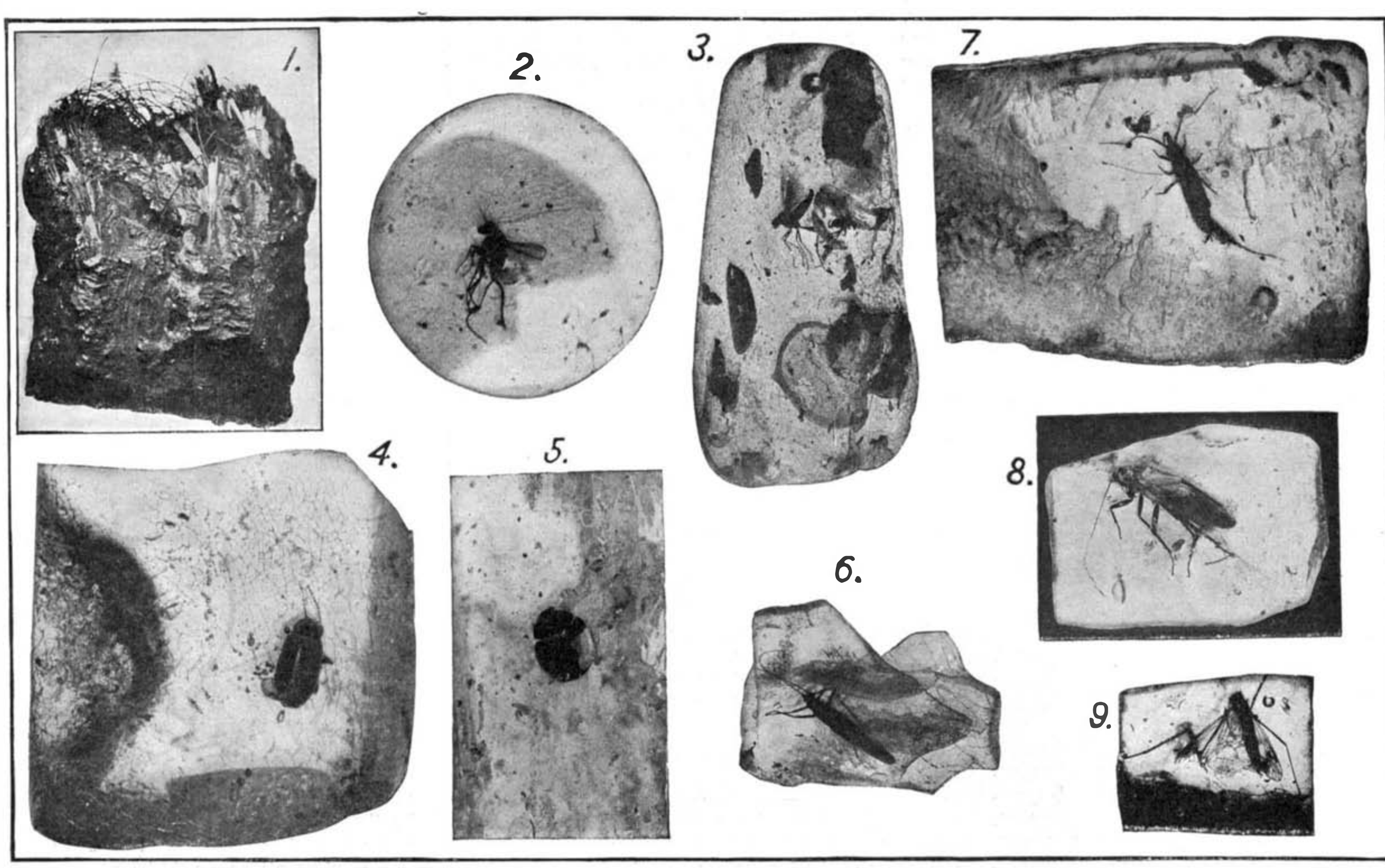
Aristotle attributed to amber a vegetable origin; Averroes and Cesalpin believed it to be a species of camphor. Theophrastus considered it the fruit of a submarine plant. Dioscorides thought that it was a product of acacia, while Buffon took it to be the wax of the ant and hardened honey. To-day, according to the opinion of geologists, it can be asserted that amber is derived from the solidifying of the resin of a pine which grew near the Baltic region during the tertiary epoch. According to the approximate estimate of M. J. Sollas, the continents 400,000 years ago had a different orography, and all northern Europe from certain culminating points was under water. The peaks of the Apennines, the Alps, and the Pyrenees were alone visible. Prof. R. Klebs has advanced the theory that an island, or perhaps even a vast territory, existed, which communicated with the Scandinavian country and extended as far as the south of England. On that now submerged country there grew gigantic conifers, which exuded the precious yellow resin that both the Phœnicians and Romans were to use to enrich their dress and ornament their houses.

These trees rotted, and after a series of generations fossilized, leaving their effused sap, which formed little by little the immense beds of amber, which are being excavated to-day.

Fig. 1. This opinion is corroborated by certain specimens of amber containing vegetable *débris*, as one of the photographs shows. However, the most curious phenomenon of all is that the amber is the tomb of millions of insects. Thus is formed the most ancient entomological museum of the world.

Until now it has only been possible to give pictures more or less exact of insects surprised in their aerial dances by this viscous trap, more than four thousand centuries ago. However, now, thanks to the orthochromatics, we have been able to photograph these insects, although they are in specimens of amber of various depths, whose colorations vary from a light yellow to a dark brown. We reproduce here the exact specimens exempt from all explanation, and absolutely authentic.

On account of the new geological disturbances, the amber was imbedded in fields of lignite, where the waves unceasingly washed it out, only to be thrown back again on the shore, principally in the environment of Koenigsberg. It is by this magic mirror of these minute mummies that we have reflected the fauna of ancient times. The insects are very well preserved



1.—A specimen of amber with vegetable debris. 2.—A Diptera surprised in its flight (magnified 3, 8). 3.—An amulet of amber secreting two gnats. 4.—Bruchida (magnified 3, 8). 5.—A Coccinilla enlarged three times its natural size. 6.—Perlida (magnified 1, 6). 7.—A Petrobius (magnified 2, 8). 8.—Blatta (enlarged twice). 9.—Sipula.

INSECTS FOUND IN AMBER.

because the oily ether killed them rapidly. Once they were ingulfed by the wind in a "womb nobler than Cleopatra's," as the poets say. (Figs. 2 and 3.) For instance, look at this Diptera surprised in his flight, or the amulet of amber which embalms two gnats. Is not nature an admirable entomologist? What collector could arrange more artistically the legs of a frog in his collector's case?

Fig. 4. The micrographies show the most common species of insects found in trees. Here also is a Bruchida resembling the Coleoptera and closely related to the Bruchida whose larvæ cause so much trouble to our peas, beans, and other grains. Here (Fig. 5) is also a Coleoptera, which one might take for a lady-bug killed only yesterday.

Fig. 6. Let us observe this Perlida with its reddish orthopteras, smoked wings and elongated body. Nothing is easier than to identify it with its photograph.

Fig. 7. The following picture, reproduced after a specimen taken from the cabinet of Dr. Capitan, is harder to explain. It is probably a Petrobius, which has moved in its death struggle, which would account for the indistinct outline of its body.

Fig. 8. We can distinguish the hairs on the legs of the Blattid. Besides, it would be extraordinary not to recognize in the tree this perfect type of cosmopolitan insect. Finally, among the Diptera, to which we alluded above, we have a great variety to chooose from. For example, there is that magnificent Sipula (Fig. 9) whose species is distributed over the whole globe. One can distinguish even the nerves on the wings, and also his little broken legs, a proof that he fought desperately to escape death in that resinous and translucid sepulcher.

Let us admit, when we finish our visit to this the most ancient of entomological collections which mortal can dream of, that these butterflies, ants, and flies of amber, of which several resemble the species found in warm countries, are proofs that millions of centuries ago the shores of the Baltic had a tropical climate.

THE MAGNITUDE OF THE OIL INDUSTRY.

The total production of petroleum during the past year far exceeded that of any previous period of similar duration. This great increase over former years is fairly well apportioned, and occurred in practically all the individual oil-producing countries. If the flow of the wells in certain districts fell off, the decrease was more than counterbalanced by the discovery and exploitation of oil-bearing strata in other regions. The United States made great advances not only in total production, but in her percentage of the output of the world. During 1904 this country was credited with nearly 54 per cent of the total, which aggregated the stupendous number of over 219 million barrels of 42 gallons each. Of this quantity the United States produced 117 millions.

It is almost impossible to grasp the magnitude and extent of nature's bounty in this respect. The engraving published in this number of the SCIENTIFIC AMERICAN purposes to demonstrate graphically what it would mean if this enormous number of barrels of oil or their contents were gathered in one place, though it is difficult merely to conceive of such a possibility. If we could form a vast chain, each link being represented by one of these 42-gallon barrels, with all the units in contact with the two immediately next to them, we would have a band of such magnitude that it could be passed around the earth equatorially no less than five times, and even then there would still remain a length over a thousand miles. If all the oil contained in these 219 millions of barrels could be poured out upon the ground, it would be possible to cover with a thick film of oil a surface greater than the entire combined area of the States of Rhode Island and Delaware—something less than a hundred billion square feet.

If we should desire to place this vast quantity of liquid in a single tank, we would have to build a structure 1,500 feet long, 250 feet wide, and over 3,300 feet high, a huge rectangle beside which the greatest edifices constructed by man, modern or ancient, would dwindle to insignificance. As the engraving shows, the Park Row Building and even one of the great pyramids of Egypt can merely be used as units of measure when compared to this enormous receptacle.

To further illustrate the magnitude of the last year's production of oil, the artist has shown a student's lamp of the usual type, capable of holding the entire quantity of illuminating oil refined from the total output, and has compared with it the famous 1,000-foot high Eiffel Tower. The tank of this inconceivable illuminating device would be cylindrical in form, 1,200 feet high, and 650 feet in diameter, and would contain over 3,025,000,000 gallons of refined oil. If we should light this lamp it would burn steadily, night and day, for one month and would give forth in light 3,628,260,000 standard candle power; or to understand better the significance of a flame of this power, it would give light equal to that produced by nearly three million of the electric arc lights in general use.

Why Do the Hands of a Jeweler's Dummy Watch Point to 18 Minutes Past 8 o'Clock?

It seems to be a general impression that the exact minute when Lincoln was shot is marked by the hands of every jeweler's sign-watch—an impression which seems to have been given by jewelers themselves.

The baselessness of this yarn, which has gone all over the country, is to be seen at once from the fact that President Lincoln was shot by Booth at about 11:30 o'clock in the evening, and died about 10 o'clock the following morning. Therefore the clocks do not represent the time of the event. That they were not intended to represent such time is proven by the fact that jewelers' dummy clocks have shown that time since the early part of the century.

All the clocks prior to 1861 did not show that time any more than they do to-day. Some of them show five minutes of one, some fourteen minutes to nine and other positions, but in nearly all the hands are equidistant from the figure twelve. As far as 18 minutes after 8 or 18 minutes of 4 is concerned, this is probably used because in this position the hands are most symmetrical, the first being one-third the distance from 12, and the second two-thirds. In this position they leave a long sweep above for the imprint of the jeweler's name and address, and do not interfere with the diagram of the seconds dial when such is used.

How the Lincoln story got into circulation we do not know, unless it was the offspring of some reporter's imagination. It has undoubtedly been kept alive for business as well as sentimental reasons.

A certain dummy-clock maker in New York has obtained considerable advertising on several occasions by telling a story to reporters about a jeweler rushing into his father's place after Lincoln was shot, and asking him to paint the face on the dummy clock he had ordered at 18 minutes past 8 to represent the hour that Lincoln had died; that his father liked the position of the hands in that way and used it on subsequent clocks, making a stencil from which all markings were done. The story, as it goes round, in most cases is to the effect that after Lincoln was shot, a meeting of the National Jewelers' Association being then in session, the jewelers resolved to perpetuate the time on their signs, and the resolution was adopted to this effect; but inasmuch as there was no National Jewelers' Association at that time—in fact, there was no meeting of jewelers of which we have any record—the story is a yarn on its face, even if the proof was not clear that such a position of the hands had been common prior to 1861.

The Current Supplement.

The current SUPPLEMENT, No. 1565, opens with an article on the hydro-electric power plant of the Brembo River, by Dr. Alfred Gradenwitz. Excellent illustrations accompany his presentation of the subject. Mr. Louis A. Hicks' paper on Reinforced Concrete Construction is concluded. An excellent *résumé* of the purpose and construction of the Simplon tunnel is published. Mr. Schoop's exhaustive analysis of the Edison accumulator is concluded. The use of the earth in high-tension transmissions is discussed by Emile Guarini. An exhibition was held recently in Paris which was of more than usual archæological interest. The instructive relics which were there exhibited are described and illustrated by the Paris correspondent of the SCIENTIFIC AMERICAN. Mr. S. F. Emmons concludes his historical summary of the theories of ore deposition. Henri Coupin writes on insect paper makers, tells how decayed wood is chewed and converted into pulp, and gives, besides, the details of the hornet's method of making paper. Some interesting expansion experiments, which can be cheaply conducted by anyone, have been devised by M. Rémy. These experiments are described.

Charles Craske.

Charles Craske died on December 17 at his home in Woodbridge, N. J. It was Mr. Craske who, in 1862, at the suggestion of Horace Greeley, first cast from a mold a page of the Tribune, and thereby became the inventor of stereotyping.

Charles Craske was born in London in 1822. He came to the United States in 1852 and settled in New York, where he started an electrotyping business. In a short time every big paper in the country had adopted stereotyping.

Winner of the Glidden Trophy.

It was due to a typographical error and the phonetic similarity of the two names that, in our recent review of the year, the credit of winning the Glidden trophy was given to a Peerless instead of a Pierce car. The Glidden contest was fully described in our issue of August 12, 1905, when the winning of the trophy was properly credited.

Lake Titicaca, the largest lake in Peru, and the highest navigable lake in the world, is to be tapped for the purpose of securing electric power.

Engineering Notes.

What shall be the cast of mind and what the mental equipment of the testing engineer? Upon the first of these topics it is difficult to say much that is positive. It is perhaps easier to say what kind of mind will not succeed in this branch of engineering. We will perhaps all agree that he should be independent, self-reliant, gifted with the power of analysis of facts as well as with the power of drawing conclusions from the data at hand. He should be ingenious in devising methods to demonstrate the points at issue and a careful observer of data. He must keep himself free from bias or prejudice and take especial pains that he does not deceive himself. He should be fond of experiment and have a genius for it. Many times during our nearly thirty years' attempt to do something in the line of the work of a testing engineer we have had occasion to paraphrase the Latin apothegm, and say: "Experimenters are born, not made." He should keep constantly in mind the end to which his experiments tend and understand clearly the effect of every step in the progress of his tests, and its influence on the final result. Above all, he should be a thinker. No man who, when a problem is presented to him, simply searches his memory for whatever he may have learned in the schools, or have perchance picked up in his reading which bears on his problem, has any especial call to be a testing engineer. We are quite ready to allow that the power of seeing analogies between your own problem and one that some one else has had, and perchance successfully solved, is a legitimate and useful, not to say time-saving, habit of mind. But the point we want to make is that the one who habitually and continuously approaches every problem through memory or by studying up what others have done is far less likely to succeed as a testing engineer than one who habitually attacks a problem by an analysis of its elements.

The designs of locomotive superheaters are chiefly due to Wilhelm Schmidt, who has developed two distinct arrangements, both of which are of that type in which a portion of the number of flues is utilized for superheating. The design most generally used abroad is known as the Schmidt smoke-box superheater. Its special feature consists in the use of a tube of large diameter leading from the fire-box to the front tube sheet, by which a considerable portion of the flue gases is delivered at a high temperature into an annular chamber at the front end, within which the superheater tubes are placed. The steam from the dry pipe passes into the rear end of a header, placed near the top of the smoke-box on the right side, which header is divided into a front and back portion by a transverse partition. From the back of the header the steam passes through the small superheater pipes to the rear end of a corresponding header on the left side, and from the front of that header through other superheater pipes to the front section of the right-hand header, and thence to the cylinders. The superheater pipes are curved to surround the gases flowing from the large tube, which then pass upward on each side and then into the smoke-box proper. As in all superheaters of this type, a damper is provided to close off the flow of gases through the superheater when the engine is shut off, as at that time there is no steam in the superheater pipes, and they would be damaged by the hot gases if they were allowed to pass through freely. While this type of superheater has been extensively used in Germany, it has only been applied to one engine in America (No. 548 on the Canadian Pacific Railway), and although the results obtained from it have been exceedingly satisfactory, and any desired amount of superheat can be obtained by an adjustment of the amount of gas passing through the large tube, it is doubtful whether it will actually make very much headway in this country. There is considerable complication in the front end, and a number of steam-pipe joints, which, while they have not given any trouble so far, are certainly objectionable, and since in the other design of superheater developed by Mr. Schmidt these difficulties are overcome, it appears probable that the latter, which is known as the smoke-tube superheater, will be the one generally employed.

To Our Subscribers.

This is the last issue of the year—the sixtieth of the SCIENTIFIC AMERICAN'S life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year. To those who are not familiar with the SUPPLEMENT a word may not be out of place. The SUPPLEMENT contains articles too long for insertion in the SCIENTIFIC AMERICAN, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the SCIENTIFIC AMERICAN and SUPPLEMENT the subscriber receives the benefit of a reduction in the subscription price.

Correspondence.

The First Steel Bridge—A Letter from Its Designer.

To the Editor of the SCIENTIFIC AMERICAN:

In your esteemed journal, Vol. XCIII., No. 6, August 5, 1905, page 99, I read, under the heading of "Engineering Notes," a statement that "steel as structural material was first used in a portion of the St. Louis bridge in 1874," and that "the first bridge built entirely of steel was the Glasgow Bridge over the Missouri River, completed in 1879."

In relation to this notice, I have the pleasure to communicate to you that in 1865 I designed, and in 1866 built a railway bridge entirely of steel, with a span of 137½ feet, crossing Göta River, in Sweden, about six miles above Trollhätta Falls for the Uddevalla-Wenersborg-Herrljunga Railway. The following article about this matter was published in Engineering, September 28, 1866, by an English civil engineer who, during a journey in Sweden, inspected the bridge shortly before opened for traffic.

The very singular, if not unique, bridge illustrated having been just placed over a waterfall at the Gotha Elf, at a place just above Trollhätta.

The bridge was designed by Major Adelsköld to meet very peculiar conditions. The distance to be spanned was no less than 137½ feet, and this not over a violent stream only, but just at the point where a torrent begins to fall over a ledge of rock of great height. It was, of course, out of the question to think of erecting any intermediate support whatever. In order to get the bridge across, therefore, it only remained to lift the girders bodily over, and it is apparent that, as a consequence, it became necessary that the girders should be as light as possible. For this reason iron was at once rejected as the material of construction, and the bridge was made, instead, of puddled steel, from the celebrated works of Surahammar, in the north of Sweden, at Bergsund's works at Stockholm. The dimensions are calculated for a strain of eight tons per inch, every portion having been tested to sixteen tons per square inch before being put in place. The total weight of the structure is only fifty tons. An iron bridge of the same dimensions could not have weighed much less than double this, and its cost would have considerably exceeded that of the steel bridge.

The form of girder adopted will strike English engineers as strange; and notwithstanding its general resemblance to a Warren girder it can perhaps scarcely be regarded as one. The upper member is altogether in compression, acting merely as a strut to keep apart the ends of the chain below, which really carries the load through the medium of the triangular struts and ties. Suitable cross bracing is introduced, of course.

The beams (the upper members) were carried over the fall by means of a simple scaffolding, consisting of two 60-foot timber masts on both sides of the river, secured at the tops by iron ropes.

The end of the beam was suspended in a pulley in the top of the masts, and by a capstan they were pulled over the water.

As the noise of the water prevented giving orders by voice, the signals between myself and the engineer on the opposite shore were given by Morse telegraph signs by hand.

The first beam was taken over in half an hour and the second in 15 minutes.

The masts and the capstan were hired from a yard in the vicinity, and the entire cost for the placing of the upper beams was 455 kroner ($120). The chains and the struts, and ties, were afterward, with the beams as scaffolding, put in position and connected by pins.

It is a good many years since then, and I am now an old man, 81 years, but reading still every number of the SCIENTIFIC AMERICAN with the greatest interest and could not help sending you this communication.

C. ADELSKÖLD,
Major R. E., Member Academy of Sciences, Associate of Institution of Civil Engineers in England.
Stockholm, 2 Villagatan.

Teaching Science.

To the Editor of the SCIENTIFIC AMERICAN:

I have read with much interest the two communications to your paper on the teaching of science in schools below the colleges. One letter was written by a professor in a college, the other by a teacher in a large high school, and it seems to me fitting that an opinion be expressed by one of the incompetent instructors mentioned by the Trinity professor.

The greater part of my teaching has been as principal of small high schools, where the teaching force is far too small in proportion to the number of subjects on the curriculum, and the equipment of the schools very inadequate. In these schools I have several times taught the physics and other sciences as well as Latin and other subjects. I am sure then that I am prepared, in some degree, to state the position of the teacher of science in such schools.

First, as to the thoroughness with which the sciences are taught. I contend that they, including the subject of physics, are taught as well as the languages, history, or mathematics. I claim that the teachers of science are as well prepared, in proportion to the thoroughness of instruction received at the colleges and universities whence our high school teachers come, as are those who teach the other subjects. I claim that any professor in any one of the subjects mentioned above could "set an examination based on well-known college text-books with questions of a fundamental character," and after looking over those papers, feel that "he had waded through morasses of mental confusion." No doubt he would think the "result discouraging."

The teachers of these small high schools are uniformly graduates from our best colleges. When they enter on their work, they are usually fresh from a college class, we will say one in physics. Now, if the teaching at college has been what it should be, as it no doubt is in Prof. Perkins's class room, these young graduates will have a clear, definite, accurate working knowledge of their subject (physics) and will present this subject in such a way that their pupils, at the end of a year, will be able to pass one of Trinity's freshman examinations with flying colors (?) How is it? With myself, I have found that many things were more or less vague at first, though I had had good advantages and an excellent instructor in my college course. Now, if a student four years older than high school students, and with all the advantages in science that a college can give, is not entirely clear on all the fundamental principles of physics, how can we expect great clearness of thought on the part of young pupils with only the advantages of a small high school? Let the colleges set the example for the high schools by a more thorough training of the students they send us as teachers.

Everything I have said about the teachers of science is applicable to the teachers of the other subjects. Each new teacher must make mistakes, must get his experience, somewhat at the expense of the school, it is true; for the small school loses him as soon as he has had experience enough to get a position at a better salary in a larger institution. Also each teacher in a small school must work with immature minds, and we know the results are often discouraging.

This has been my experience as a principal. Each department in my schools has complained that the pupils were not well taught in the next department below, and the primary or kindergarten teacher thought that the parents might teach the children something, at least manners, at home. We principals complain that the colleges in their normal courses do not well prepare the teachers they send us.

Second, as to the "causes of this unsatisfactory condition in physics." The first cause mentioned is the textbook used. I might say that principals and boards as a rule get the book recommended by the teacher. Why does the college professor not instruct his students, at all events the would-be teachers, as to the best textbook to use? I have found often that the new teacher fresh from college could not remember the author of the text he used in college, to say nothing of the publisher of it. Whose fault is this? Again, I am sure that should we high school teachers use a little trigonometry in our physics classes, there would come a cry from the department of mathematics at Trinity, "Do not introduce your pupils to trigonometry in this manner, for the little knowledge they get will be a drawback to their work in mathematics when they enter college. The subject will seem familiar to them, and they will not work so hard as if they had never known of a function."

The lecture method. Well, I wish that every college professor would profit by the advice of Mr. Perkins and drop much of that manner of teaching. We would then have from our colleges better teachers.

I will agree that too little time is given to our science courses, but not too much to the laboratory work. The same is true in other courses.

The inefficiency of the teacher. This has been discussed. If boards of education have been careless in selecting a teacher of science, they have been equally lax in choosing instructors for other courses. They generally hire the best teacher that their apportioned money will allow.

"The main reasons for teaching science in school are to awaken the pupil's interest in nature, give him some information about its chief laws and phenomena, and train his mind to think clearly and with concentration," says Mr. Perkins. Exactly! It is not open to question in the least but that our courses in nature study in the grades do "awaken the interest of pupils in nature and give them some information about its laws and phenomena." As for thinking clearly and with concentration, only a very few of the high school pupils in their last year are able, in any large degree, to do that. One year added to the age of a pupil from fifteen to eighteen years of age, according to his physical development, increases his capacity to think with concentration more than a hundred per cent.

The nature study all through our schools aids in the power of correct observation. The observation may not always be accurate, but inaccurate observation is better than no observation at all. Some of the strongest men in science have observed incorrectly at times, and have drawn wrong conclusions from observations. It is the habit of inquiry that we wish to cultivate, and continual inquiry will in the end lead to correct conclusions.

If we cannot have experts in science as teachers of science in our schools, are we to have no science? With all due friendliness and respect to the learned professor from Trinity, I must say that he has not been watching at close hand the trend of educational movement. Teachers have fed their children on the dry fodder of the three R's for centuries. True, there is nourishment in them, good for the mental health. They will keep alive and cause to grow, but why should children be refused a food just as nourishing and much more palatable, when in taking that food it aids in digesting all that is offered them?

No science in the grade schools? No science in the high schools? To what would this lead? A very small percentage of pupils enter the high schools, a still smaller percentage go to college. Think of it! The large majority of our pupils would enter life with no adequate conception of the wonders of the world about them. To-day such a man would be unable to read understandingly the papers that come to his home each morning. The current magazines dealing with the progress of his nation would be sealed pages to him. He would pass to his work through the streets of his town or city blind to half that he saw. The trolley car would be beyond his comprehension, the automobile a mystery, even the little electric door bell would be a puzzle. When he took his outing in the park, the nest-building bird, the blooming flower, the sparkling fountain, the floating clouds, the gravel walk beneath his feet, all would be commonplace, just parts of a whole, something to glance at, something to smell, something to quench the thirst, a thing that hides the sun, a firm foundation on which to walk.

But how different to one whose eyes have been opened, to one who has had his thoughts directed to the wonderful laws of nature, even by the ill-taught science in our grade schools! The bird's nest has a new interest. It is the home of the bird, domestic life is there, family life is there, thrift is there, happiness is there, joy of the father and mother bird, the feeding and rearing of the children. It is a well-regulated household. The flower has more than passing interest. How has it grown? Does it live over winter? What is its shape? How does it propagate? Is it a weed, could Burbank make an aster of it? The fountain, why does it flow? There must be a spring somewhere or a standpipe. What is it, this water? H_2O, two gases. What kind of clouds are those? Cumulus, cirrus, nimbus? If cirrus, it may rain to-morrow. Here in this gravel is a fossil. I stepped right on it. This came from another part of the world. It was carried by the ice when it was over this country ages ago. There was life in this little stone once. An animal lived here. Any one of the grade pupils in our schools who has had the nature study work would think many such things. I know whereof I speak, for I have been with them and have heard them thus express themselves. How bare and desolate must be the life of those who learned none of these things.

True, these same pupils who would understand much about the things they see, might not be able, when held down on a written examination, to express themselves accurately about the laws which govern the birds in their flight, the flower in its blooming, the hydrostatic pressure in the fountain, the dew point of the air, the movement of the glacier, but they have some sensible notion of the laws that govern the phenomena of nature, and this is infinitely better than no knowledge at all; and as for those that go on to higher institutions of learning, what facts they retain will not hinder their after study; what mistaken notions they have, it is the business of the college professor to correct, or else, should we prepare them too well, said professor would have too easy a task, and might not earn his salary. BENJAMIN G. ESTES, Principal.

Hamburg High School, Hamburg, N. Y., November 23, 1905.

The extent to which lumbering interests suffer from fire depends largely on the region in which they conduct their operations. Broad statements concerning this are subject to exceptions, yet in general it is true that Pacific Coast lumbermen suffer most, and those in the southern hardwoods least; while the losses of operators in the Lake States, and the Northeast, fall between the two. The Pacific Coast lumber manufacturer is the heaviest loser, not only because the fires are more severe, but also because his mills and yards are located in the heart of the forest, since he can not "drive" the streams. In California and eastward surface fires prevail in the virgin forests, but rarely destroy extensive stands of timber, although individual trees are severely injured and often killed. In the Northeast and Great Lakes States fires commonly do not reach their maximum of injury until the lumberman has left; hence he is not so great a sufferer. In the southern pineries the frequently-occurring grass fires are rarely severe, and are seldom troublesome to lumbermen. Old turpentine orchards, where the boxes and excoriated surfaces expose the trees to fire injury, are the exception. Such timber, however, is usually purchased at a low figure and cut before fire does it material damage.

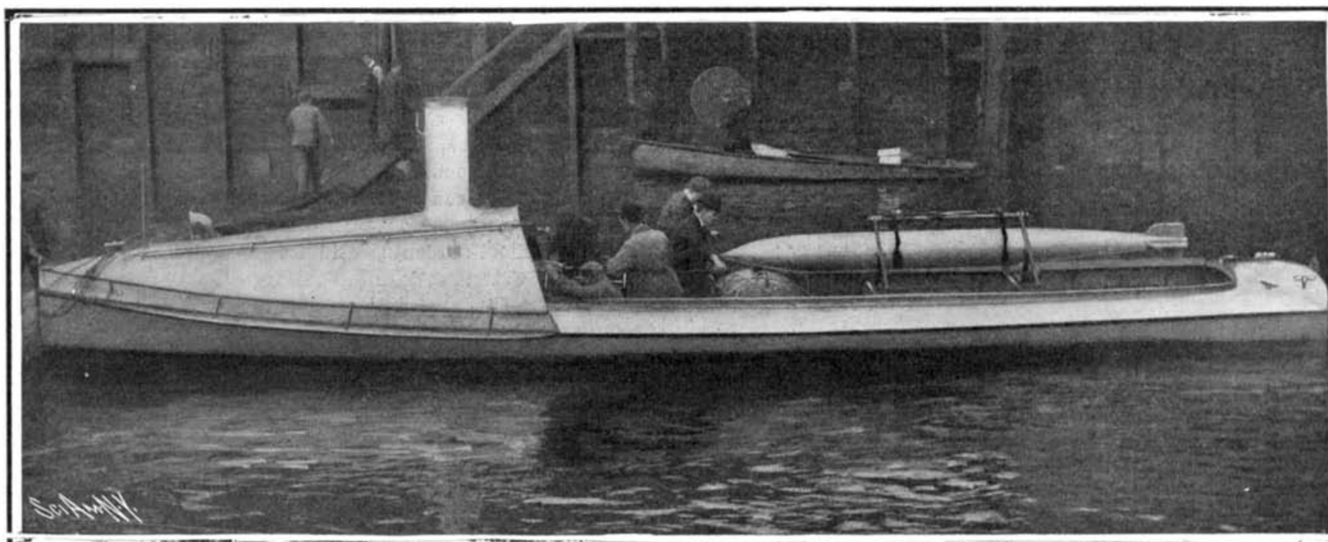
THORNYCROFT 120-HORSE-POWER GASOLINE-PROPELLED TORPEDO LAUNCH.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

An interesting development of the application of gasoline motors to small naval vessels has been carried out by the Sir John Thornycroft Company, Ltd., the well-known torpedo-boat constructors at Chiswick-on-Thames. This is a gasoline launch carrying a 14-inch Whitehead torpedo. The launch has a length of 40 feet over all, with a beam of 6 feet 2 inches, draft of 2 feet 7 inches, and a displacement of 4½ tons. The hull is constructed of galvanized mild steel, and the craft lies very low in the water, thus affording but a small target to the enemy. A turtle deck is fitted forward and is continued over the engine in a portable piece, extending as far as the after end of the engine, where on the port side is placed the steering wheel and reversing lever. A water-tight bulkhead is provided, so that in case of damage to the stem the boat will not sink. The stern of the vessel is made very broad in order to overcome the difficulty of stability when launching the torpedo over the side. Further, in order to prevent the splash from the bow wave being blown inward, "whiskers," or detachable spray-boards, are fitted.

The propelling engine consists of a four-cylinder Thornycroft gasoline motor of their standard marine type. The stroke is 8 inches, with a bore of 8 inches. The engine is of the lightest construction consistent with the maximum of strength, and is so well balanced that at 900 revolutions, at which the 120 brake horse-power is developed, there is only the slightest trace of vibration. The cylinders are of cast iron, with the water jackets cast round them. They are bolted directly to the aluminium bed-plate. The pistons are of cast iron of light construction, with cast-iron packing rings. The connecting rods are of special stamped steel, with steel gudgeon pins and white-metal bearing surfaces. Owing to the fact that all the reciprocating parts are made of the very highest class of material, it is possible to reduce the weight to a minimum, with an attendant appreciable minimizing of vibration. Both the inlet and exhaust valves are mechanically operated by cams and tappets, while in order to reduce the number of spare parts, the valves are made interchangeable. The cam-shafts are arranged in the crank chamber, so that they are well lubricated by the same splash arrangements as are provided for the other moving parts.

There is a centrifugal apparatus on the cam-shaft for governing purposes. This is connected to the throttle valve by means of a dash-pot arrangement, which prevents "hunting" when the engine is running light. Cooling of the cylinders is effected by means of a pump. Electric high-tension ignition is fitted. Reversing and stopping are effected by means of a Hele-Shaw friction clutch. The utilization of this type of clutch enables instantaneous maneuvering to be carried out, without any shock, while it is not subject to the great want of efficiency which is inherent in all reversing propellers. The engine itself only weighs 25 hundred-weight complete, which is equivalent to only 23.25 pounds per brake horse-power. The engine is arranged to run on either gasoline or the heavier fuel, paraffin. Owing to the care exercised in the design of the vaporizer, and the explosive mixture arrangements, the engine is rendered very economical in running, the consumption in the case of gasoline averaging less than one pound per brake horse-power per hour. The capacity of the fuel tank is 100 gallons, this being sufficient for a run of ten hours. The motor is started by means of compressed air contained in a reservoir placed in the stern of the launch. The compressed air is obtained from a Brotherhood compressor driven by a 6-horse-power single-cylinder Thornycroft gasoline motor. The exhaust gases are carried into the outer atmosphere through the funnel.



THE 120-HORSE-POWER THORNYCROFT TORPEDO LAUNCH. LENGTH, 40 FEET; DISPLACEMENT, 4½ TONS.

THE 120-HORSE-POWER THORNYCROFT GASOLINE TORPEDO LAUNCH, SHOWING ARRANGEMENT OF ENGINES AND FUEL TANK, AND THE TORPEDO-CARRYING AND LAUNCHING GEAR.

The 14-inch Whitehead torpedo is carried in the after part of the boat in the manner shown in the accompanying illustration, and is launched by lowering over the side by means of side drop gear, the body being first directed bow-on to the object which it is desired to hit.

The launch has a speed of 18 knots per hour, and should prove a convenient and useful acquisition to a battleship. In view of its small dimensions, it could be easily stowed on the deck of a battleship, and quickly launched when desired. At the same time, owing to the small target it offers to hostile guns, and its silence in running, it should prove a formidable antagonist, being able to approach an enemy, launch its torpedo, and escape. The British Naval Department, realizing the possibilities of gasoline-propelled launches of this description, propose carrying out a series of tests with them to ascertain their possibilities and efficiency under war conditions.

The field of general plant growing probably offers more opportunities than any other. In every town or city having a population of from 3,000 to 10,000 there may be found in most cases good openings for the ambitious and progressive young man who desires to supply a home market with general crops which may be grown partly under glass and partly in a very intensive way out of doors. The demand in towns and cities of this size, of course, is not for any great quantity of any one thing; hence, the necessity for producing a variety, as ornamental plants for use in home yards, plants for cut flowers, vegetables, etc.

PILLS AND POTIONS: HOW THEY ARE MANUFACTURED BY THE MILLION IN MODERN CHEMICAL LABORATORIES.

BY HUGO ERICHSEN.

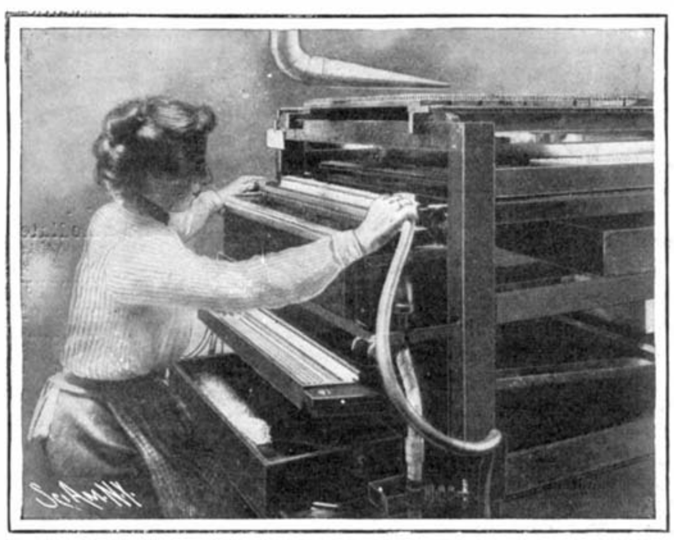
It is a trite saying that the old adage concerning the oak and the acorn is often paralleled in the establishment, not only of individual business enterprises, but vast industries. The prominence Detroit enjoys as a drug center is an illustration of this. In the late sixties a middle-aged gentleman, who had accumulated a small fortune in the upper peninsula of Michigan, came to Detroit in quest of a profitable investment. Accidentally he came in contact with a physician, who was imbued with the idea that the medical profession required a better grade of pharmaceuticals, and who infected him with his enthusiasm. In company with another small investor these business men established a laboratory, on an ordinary-sized city lot, and began the uphill work of convincing the medical men and druggists of the United States of the excellence of remedies prepared on a large scale, a system that not only proved economical, but insured dispatch in the filling of prescriptions, and brought about a revolution in the art of pharmacy. From these humble beginnings that particular establishment grew until it became the largest manufactory of galenical pharmaceuticals in the world, and formed the nucleus around which the smaller laboratories clustered, and from which the supremacy of the City of the Straits in the drug trade was finally evolved. As a mammoth establishment includes all the features that go to the making of smaller institutions of the same kind, a description of the giant laboratory above referred to will convey a comprehensive idea of the wonderful resources of the pharmacists' art, and of the extent to which they have been developed.

The immense laboratory alluded to has a total frontage upon the Detroit River of over 750 feet, and covers in all 14 4-5 acres of land. If this area were laid out in the usual city blocks, over 1½ miles of sidewalk would be required to go around the various squares. The total floor space of the laboratory is 622,000 square feet. Here nearly 2,000 persons are employed the year round, enough to people a good-sized small town.

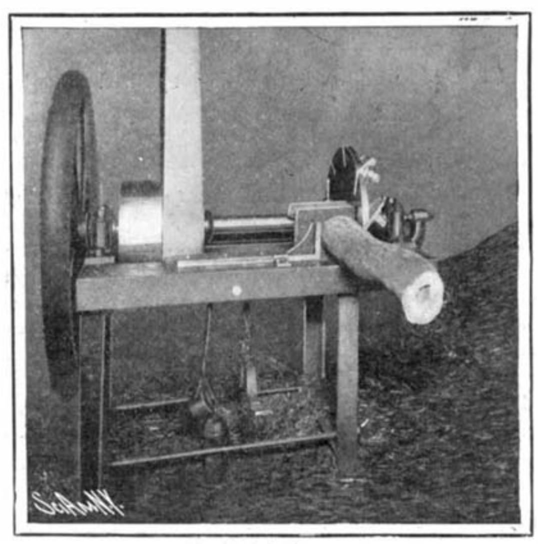
Filling Vials With Hypodermatic Tablets.

The plant itself consists of a group of brick structures in which the manufacturing operations are carried on, the office building, and a substantial as well as beautiful scientific laboratory, that is wholly devoted to research and was erected and equipped at a cost of $250,000. The various departments into which the laboratories are divided may be separated into three classes: First, manufacturing or producing departments; second, non-producing departments; and third, auxiliary departments. The auxiliary departments include the mechanical departments of all kinds, the paper-box department, the printing, binding, and mailing departments. The finishing department occupies a relation between the producing and auxiliary departments.

The digestive ferment department is devoted to the manufacture of pepsin, pancreatin, and other digestive ferments. Pepsin made here is capable of digesting 4,000 times its weight of hard-boiled eggs. The drying room of this department contains eight rows of drying closets, twenty-four closets to each row, making 192 closets in all. Within each closet are placed twenty-five sheets of glass, 20 x 28 inches in size, 4,800 sheets in all, with a total area of nearly one-half acre, upon which the pepsin solution is spread. Warm air is abundantly supplied to each department by means of a huge blower, which

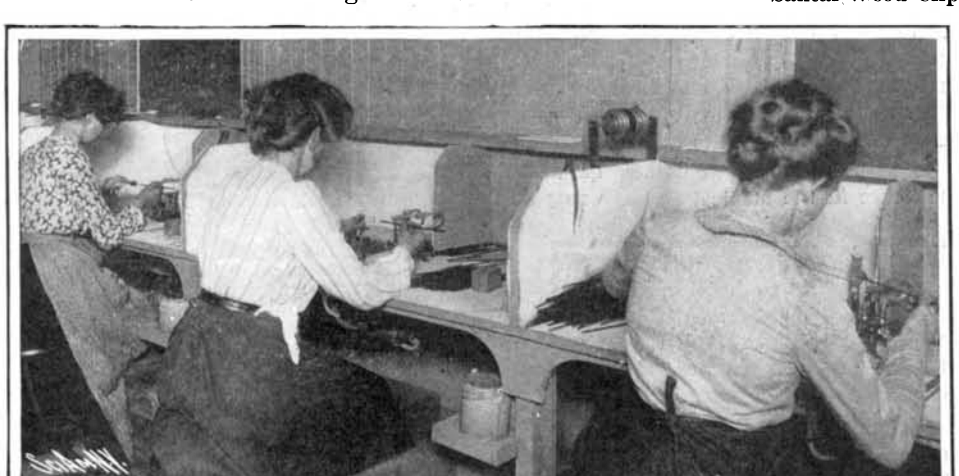


Gelatine-Coating Machine.



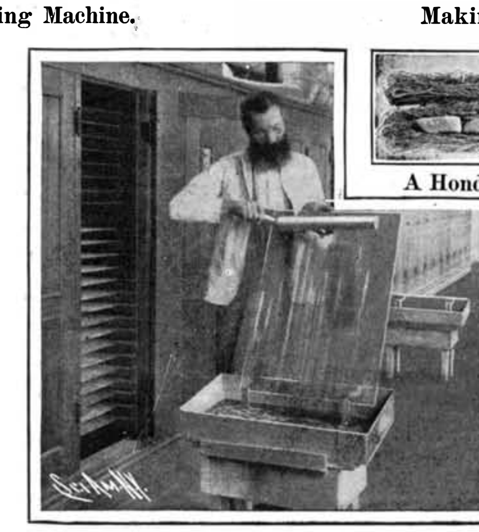
Santal-Wood Clipping Machine.

Making Tablet Triturates.



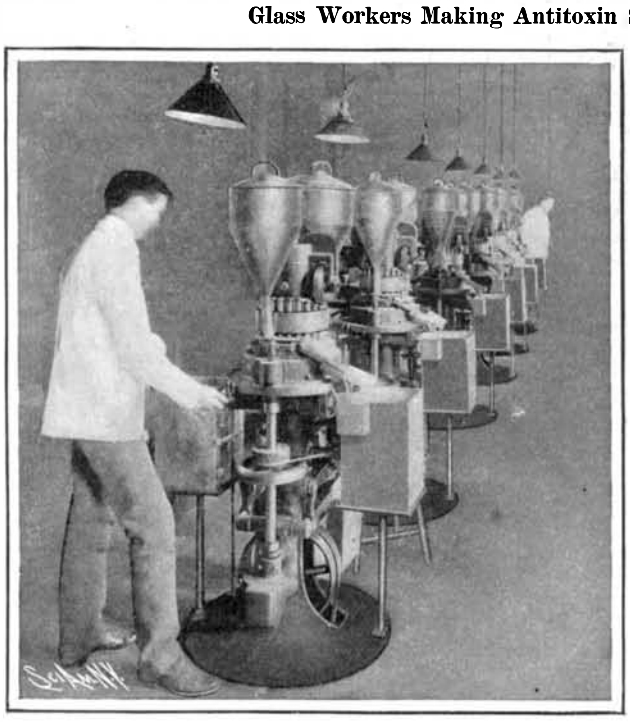
Glass Workers Making Antitoxin Syringes.

A Honduras Fraud.

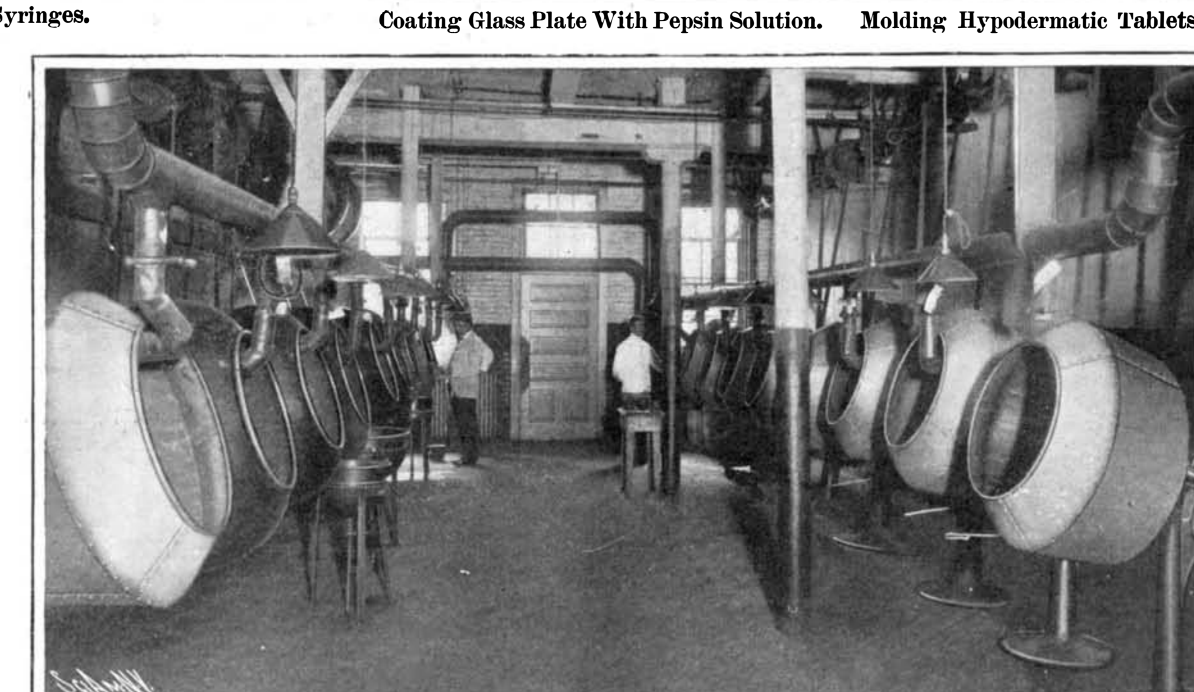


Coating Glass Plate With Pepsin Solution.

Molding Hypodermatic Tablets.



Rotary Tablet Machines.



Chocolate Coating Pans for Coating Pills or Tablets.

PILLS AND POTIONS: HOW THEY ARE MANUFACTURED BY THE MILLION IN MODERN CHEMICAL LABORATORIES.

forces the air through large pipes beneath the floor. The air passes over each sheet of glass and out at the top of the closet. By this means any desired temperature can be maintained in the closets. Upon the inside of each closet door a thermometer is placed, to enable the attendant to keep a close watch upon the temperature of the compartment. When the pepsin is dry, it is scraped from the glass and marketed in the form of scales.

Over one-half acre of space is set apart for the storage of mountains of crude drugs. In all there are about 600 different drugs represented in the crude-drug loft. The bales and boxes, piled as high as the capacity of the vast room will permit, contain gums, barks, roots, stems, leaves, flowers, seeds, and wood. Crude drugs submitted for purchase are examined by an experienced botanist before they are accepted. This inspection is made to guard against the use of adulterated or inferior drugs, which come from every quarter of the globe. Sometimes the crudest sophistications are practised, as, for instance, the adding of stones to Honduras sarsaparilla root in order to increase the weight.

The analytical department is one of the most important in the entire establishment. Every chemical submitted for purchase is rigidly tested to determine its measure of quality, and every finished preparation is likewise examined to insure its conformity with the exacting requirements demanded by the standards of the house.

The extract department as a whole, including the milling, pressed herb, and fluid extract departments, occupies one-seventh of the entire floor space of the plant. Prior to the extraction of the drug in the fluid-extract department, it is packed in suitable percolators and exhausted according to the most scientific methods. Barrels containing drug menstrua and percolates are handled entirely by a system of overhead trolleys to expedite the work. These percolators have a total capacity of about 150,000 pounds of drugs. In addition to fluid extracts, the establishment turns out enormous quantities of solid and powdered extracts.

Pure santal oil is extracted from the native East Indian wood in immense stills. Pure santal oil is highly esteemed by physicians. Unfortunately, much of the oil in the open market is so poor as to be unfit for medicinal use. When the firm realized this, they determined to send to India for the genuine native sandalwood, which cannot well be sophisticated. The logs are brought to Detroit, reduced to a coarse powder by suitable machinery, and from it is then distilled a fine, pure, transparent santal oil.

The boiler room, with its roaring furnaces "filled with eager fire," communicates with the engine room. Here in continual motion are the great pulsating engines and whirring dynamos, which give life to the various mechanical appliances of the big establishment. Here also is generated the electricity for the 7,000 lamps that illuminate the entire group of buildings.

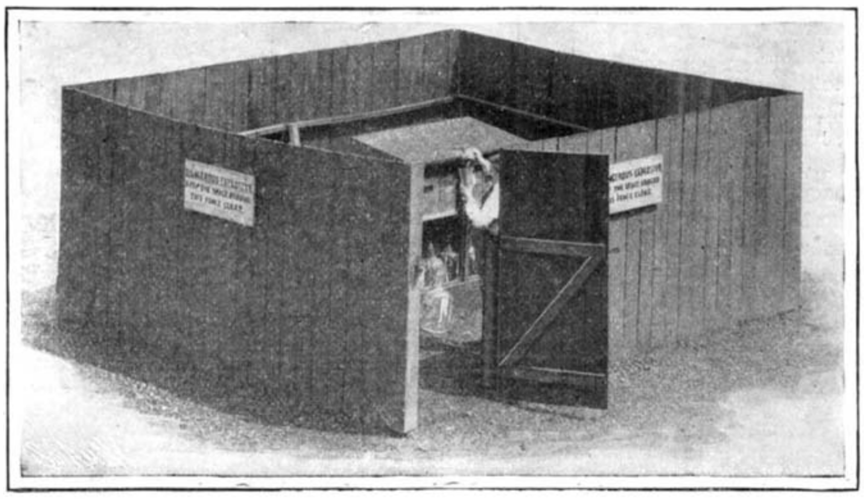
The process of pill making is very interesting. The powdered drugs are carefully mixed, and moistened with a fluid of special composition. The mass thus formed is worked to a proper consistency upon revolving iron rollers, and afterward divided into portions of definite weight. These are fed into a machine which delivers the mass in long, slender cylinders or "pipes," varying in diameter according to the required size of the finished pill. The pipes are accurately divided by another automatic machine into segments which are rolled into pills, either ovoid or spherical in shape. Sugar-coating is applied in revolving copper pans, such as those used by the manufacturers of confectionery. As the pan revolves, the pills roll and tumble over each other, collecting the coating material on their surfaces, and eventually become highly polished by mere friction with one another. Gelatin coating is applied by means of special machines of recent design, which are so ingeniously constructed that a perfect coating can be applied to thousands of pills with remarkable rapidity.

Tablets are made by compressing dry powdered drugs in powerful machines operated by electric power. The materials are first reduced to fine impalpable powders; these are mixed together and "granulated," or converted into a granular powder by a special process to facilitate the feeding of machines. The granulated powder is placed in a hopper, from which it automatically flows into a receptacle. A steel die descends with great power and forcibly compresses the powder into the firm, smooth tablet, which though quite hard is easily broken up and dissolved in the stomach. The rate at which tablets pour from the machine is remarkable. One modern type of rotary machine designed and built in the firm's own shops has a capacity of 200,000 perfect tablets daily. Tablets are coated with chocolate or sugar in the same way that pills are treated.

Molded tablets, or "tablet triturates," are made entirely by hand. The dried and powdered drugs are made into a mass with alcohol; this is pressed into molds, and the tablets thus formed are dried spontaneously. They are not coated.

Hypodermatic tablets—a soluble form of medication intended for administration under the skin—are molded under glass. After the tablets are made, they are dried, bottled, and labeled.

The biological department is divided into two sections, experimental and manufacturing. In the experimental department investigations are carried on along bacteriological, pharmacological, and chemical lines. The manufacturing section is occupied with the production of various curative serums, vaccines, and other biological products.



Where the Nitroglycerin is Kept and Handled.

MANUFACTURE OF PILLS AND POTIONS.

The herbarium, which is a valuable adjunct of the manufacturing departments as well as the department of experimental medicine, contains over 25,000 specimens, made up from as many genera as possible, and including plants from every country in the world.

The record of materials and the final statistics of cost are kept in the bureaux of the Board of Control, which is the executive office for the entire laboratory. A liberal sample of every product finished in bulk is also transmitted to the control department for approval, and part of this is retained with a complete record, for future reference.

The financial department is largely engaged in keeping track of details so far as the financial matters are concerned, and assumes to control the credits and collections.

All the advertising of the house in the medical and pharmaceutical press is placed by the publication department, and embraces about 150 publications in the United States alone.

In the department of correspondence the clicking of many typewriters continues unceasingly from morning to night, and many hundred dictated letters are sent out from here every week, to physicians all over the civilized globe. This vast correspondence is entirely exclusive of the thousands of letters from other departments, which are constantly passing through the mails.

In order to avoid accidents, all volatile or dangerous substances are stored in detached buildings or inclosures that are remote from the laboratory.

A thoroughly efficient private fire department, composed of 70 men, fully equipped with apparatus and constantly ready for service, is naturally the pride of the indefatigable gentleman who was placed in charge of it when it was organized away back in 1882, and was mainly instrumental in its successful development. It demonstrates how it is possible to convert an extra-hazardous risk into one of the safest in the country, and to effect a great reduction in the rates of insurance by means of a fire-fighting equipment which is comparable to that of a small city.

The visitor to this great drug-manufacturing establishment is usually surprised to find a fully-equipped machine-shop ensconced within its walls. The firm also does its own printing and binding, makes its own paper boxes, and glass bulbs for antitoxins, tubes for vaccines, vials for tablets, etc. Its wood-working shop is equipped with first-class machinery, and turns out boxes, cases, tubs, huge vats, and cabinet work, does all kinds of repairing and makes alterations. Tinsmiths, roofers, plumbers, electricians, engineers, stokers, and watchmen are also on the firm's pay roll. Even the professions are represented, and not only pharmacists and chemists, but physicians and lawyers are regularly employed in certain lines of work involving the exercise of the special knowledge which their education and training afford. The force of employes is swelled by scores of bookkeepers, accountants, special clerks, stenographers, typewriters, correspondents, and nearly 300 traveling salesmen, each of whom contributes his share toward the success of the grand whole.

All preparations, after they are finished, are delivered to the stock division of the shipping department for purposes of storage and handling. Here are kept on hand all the products of the various departments ready for immediate delivery.

The shipping and order department handles many hundreds of orders a day, and the total tonnage of products going out of this department is enormous. Shipments are made to every country in Europe, and extensive connections are maintained with Cuba, Porto Rico, South American states, Mexico, Australia, and India.

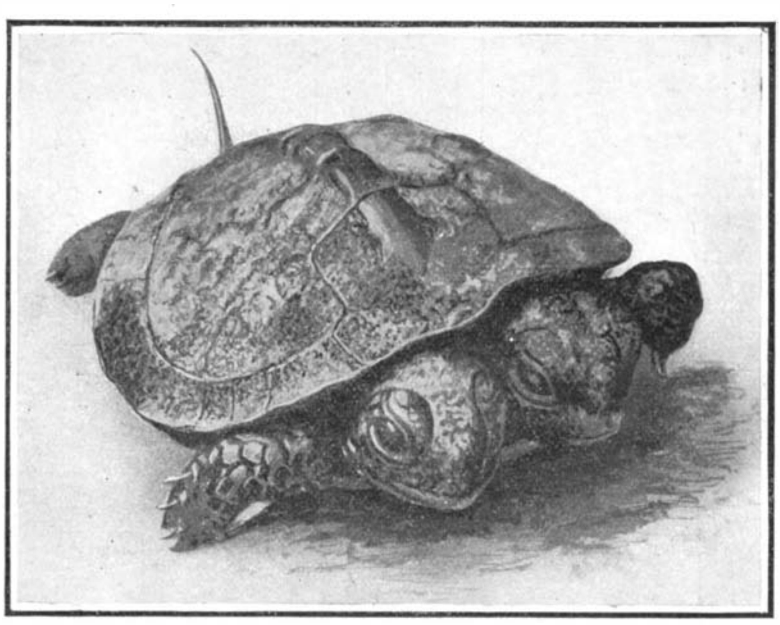
Thus, from this scene of bustle and commotion, these pharmaceuticals go to the most distant parts of the globe, bringing succor and relief to millions of human beings.

As the firm, to which allusions have been made repeatedly in the course of this article, has no direct connection with the general public, but limits its business exclusively to the medical profession and drug trade, I am unfortunately precluded from referring to it by name. Nevertheless, I wish to acknowledge the kindness and courtesy with which extensive material was placed at my command, of which I have availed myself to the fullest extent.

A DOUBLE-HEADED TORTOISE.

That Nature is not without a latent sense of humor is often demonstrated by the strange abnormal creatures and freak growths she produces, and rarely does a week pass by that some one of the many illustrated publications does not contain a photograph of a curiosity of this character. Accordingly, this issue of the Scientific American adds one more to the list of oddities in the accompanying engraving of a two-headed box tortoise, the property of Mr. E. S. Schmid, a taxidermist of Washington.

The turtle, which is of a common and well-known variety and whose scientific name is *Terrapene Carolina*, was found in Fairfax County, Virginia, near Mount Vernon, and with the exception of its superfluity of heads appears to differ little from the ordinary representatives of its kind. The truth of this, however, could only be ascertained at the cost, we fear, of the creature's life, for its armor-like shell would make an investigation of its internal economy hazardous if not impossible. The animal appears to be about four months old, and measures some two by one and three-quarters inches, the shell being possibly a trifle larger than would ordinarily be the case. The two heads are nearly of the same size, and as far as can be seen are perfect in all respects. Its other visible members do not exceed the usual number, and it is probably not incorrect to conclude that the multiplicity is confined to the heads. These do not feed together, but do so separately and alternately, and appear, furthermore, to be otherwise independent. The photograph clearly shows the disposition and the perfect state of both the heads. The apparent protuberances on the lower portions of these are merely grains of sand from the bottom of its cage which have adhered to the mouths.



A DOUBLE-HEADED TORTOISE.

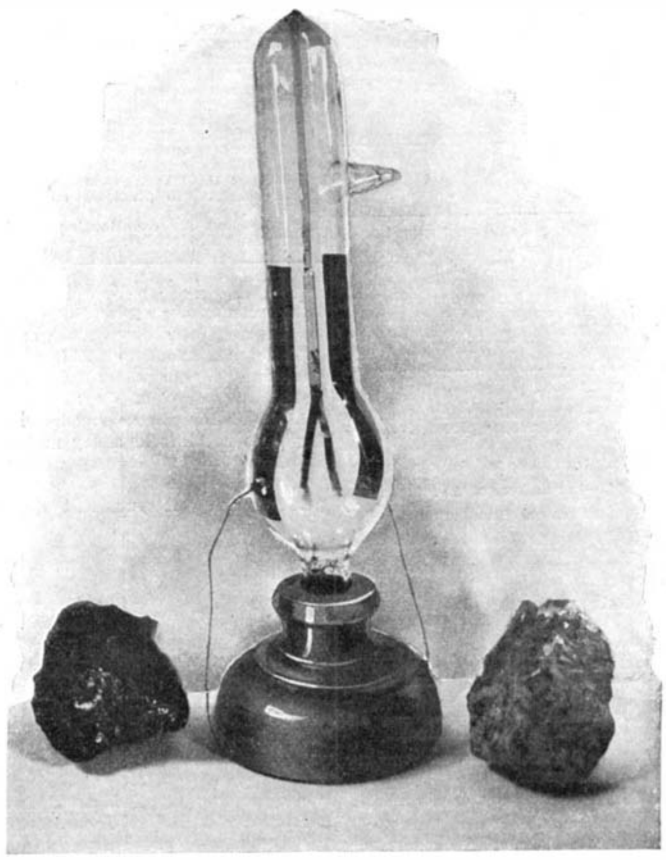
A RADIUM CLOCK.

Some few months ago the Hon. R. J. Strutt gave an interesting lecture before one of the British royal societies on the negative rays emitted by radium, and exhibited a small model by means of which he showed how the dissipation of these rays could be applied to a mechanical use. The demonstration was purely an experiment, but since then, however, the device has been perfected for commercial purposes. The outcome ~~of these perfections~~ is the introduction upon the market by Mr. Martindale, a manufacturing chemist of London, of a radium clock. This little device is fundamentally the same as the Hon. R. J. Strutt's experimental device, and it shows the dissipation of the negative rays emitted by radium. The instrument is very small, being inclosed in a mahogany frame measuring about six inches by four inches. There is a small glass tube in which is placed about one-twelfth of a grain of radium, and supported in an exhausted glass vessel by a rod of quartz. At the lower end of this tube is an electroscope, consisting of two aluminium leaves or films. The surface of the glass vessel is treated with phosphoric acid, to render it conductive.

At intervals of one minute the silver leaves under the action of the radium move apart and touch the sides of the glass vessel. This action is caused as follows: After the Beta rays are carried away, the positive charge which is left behind is passed on to these two leaves. Under this stimulus they expand until one of them touches the side of the glass vessel. This contact causes the charge to be conveyed to the earth. The leaf then falls back to its original position by gravitation, when the cycle of operations is once more repeated, and continued until the circuit is broken. Owing to the constant and exact regularity of the movements, the instrument resolves itself into a clock which will act incessantly if untouched, until wear is exhibited by the moving parts. The life, however, is estimated at several thousand years. Once set in motion, the instrument requires no attention whatever, and its time-keeping qualities are infallible. If a coherer, similar to those in wireless telegraphy, is introduced, the clock can be made to ring an electric bell at every discharge, the current being transmitted to the bell through aluminium wires. One of these delicate instruments, which are obtainable for fifty dollars, was recently brought to this country.

A NOVEL LIFE-FLOAT.

The rules and regulations of the United States Steamboat Inspection Service require that every steamer shall be supplied with lifeboats of an aggregate capacity proportional to the tonnage of the steamer, a capacity presumably sufficient, in case of necessity, to carry all the passengers and the entire crew of the vessel. But as lifeboats are rather bulky and occupy a great deal of valuable space, vessels are permitted to substitute for one-third of their lifeboat capacity, the equivalent in approved life-rafts. Although lifeboats are far preferable to rafts in cases of shipwreck, yet the latter are not without their advantages. They do not require any particular care in launching, but may be merely thrown over the side of a vessel. Then if a raft should upset in the frantic endeavors of panic-stricken men and women to clamber aboard, it would not have to be righted before it could be used, as in the case of a boat. However, the privilege of using rafts in place of boats has been abused, to a large extent, owing to the fact that the official regulations do not specify how much space should be provided for each passenger. The only stipulation made is that all the life-rafts should have a buoyancy of 187½ pounds upon oceans and 156 pounds upon inland waters for every person allowed. Since the principal advantage of the raft lies in the economy of stowage space occupied, a natural outcome of this regulation has been to increase the buoyancy of the raft without proportionately increasing its general dimensions. The ordinary type of raft consists of two flotation cylinders, usually of hollow metal, between which a platform is provided. By merely increasing the diameter of the cylinders, the rated capacity of the raft is greatly increased without appreciably adding to the amount of space it would occupy on the deck. One of our illustrations shows a raft of this type measuring, over all, 16½ x 5½ feet. Owing to the large cylinders, which are 16 inches in diameter, this raft has a rated capacity of thirteen persons upon the ocean and sixteen persons upon bays and lakes. The illustration shows the little raft supporting its ocean consignment. Three more persons would have to be added to bring the number up to the rated capacity for bays. By in-

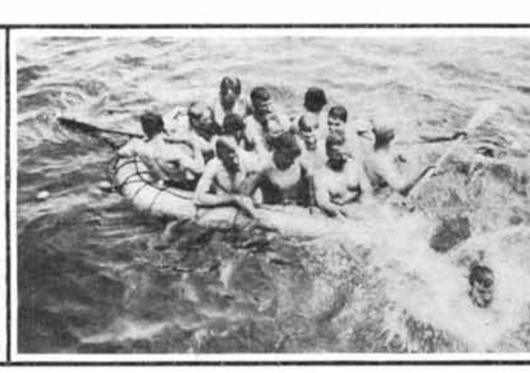


THE STRUTT RADIUM CLOCK, WHICH IS CALCULATED TO RUN TWENTY THOUSAND YEARS.

creasing the diameter of the cylinders, the center of gravity of the loaded raft is raised, and since the area of the boat is not increased, the result is a very unstable raft, liable to be upset by the slightest unbalancing of the load. The illustration shows how carefully the men are arranged to keep a perfect equilibrium. Such a careful balance would be impossible in the excitement of shipwreck, and even were it possible for the entire thirteen men to find refuge on the raft, they would certainly be upset by the first wave that struck them. Many rafts of this type are made with cylinders 22 inches in diameter without increasing the over-all dimensions of 16½ by 5½ feet. These are given a rating of 26 on oceans and 31 on bays.

A new type of life-raft has recently been invented, of which the center of gravity is so low that it is impossible to upset it. As shown in two of our engravings, this raft or float resembles a huge life preserver, being constructed with a flotation cylinder formed into an oval-shaped ring. A slatted wooden platform is suspended three feet below the cylinder by means of a rope netting, as indicated in one of the photographs. The flotation cylinder consists of a continuous copper tube divided into from twelve to thirty air-tight compartments, according to the size of the float. The tube is stiffened by means of longitudinal flanges. To protect the tube it is coated with a non-corrosive paint, and then covered with a layer of compressed cork two inches thick. This serves as a buffer for the copper tubes, and also adds to the buoyancy of the raft. The cork is wrapped with waterproofed cloth, and over this, heavy canvas is wound. A final coat of waterproof paint renders the float entirely proof against action of the weather or water. The platform or floor of the float is of such size that it will fall through the flotation ring, so that no matter how the float strikes the water, it will always be right side up. The occupants stand on the platform within the ring. Each float is fitted with oars and painters lashed to the cylinder. The cylinder protects them from the wash of waves, and prevents them from being swept away. Since about half the load is under water and partially sustained by its own buoyancy, the flotation cylinders do not have to be as large as do those of the ordinary type of raft. In fact, the government has made a special provision for this particular life-float, allowing it a buoyancy of 145.5 pounds per capita on the ocean and 121 pounds on lakes. But this float will safely carry even more than its official rated capacity. The larger float illustrated measures 8.1 feet x 12 feet over all, and the cylinder measures 20 inches in diameter. Its rated capacity is 23 persons on the ocean and 27.7 persons on bays. In the photograph the float is carrying 40 men. The smaller float, which has a government rating of eight men on the ocean and ten on lakes, is carrying thirteen men of an average weight of 175 pounds per man. This type of life-float occupies but little space on a vessel. Owing to their ring shape, a number of floats of different sizes may be nested together to save stowage space. A still more economical arrangement, adapted particularly for private yachts, is to fit the float with a buoyant cushion which is specially designed for the purpose, thus forming a deck divan. The cushion is covered with leather or duck, and a like covering is provided for the cylinder, thus completely disguising the float.

Men carried, 40. Official rating, 28 on bays.



Men carried, 13. Official rating, 10 on bays.

THE NEW TYPE OF LIFE-FLOAT.

Men carried, 13. Official rating, 16 on bays.

A COMMON TYPE OF LIFE-RAFT.

Influence of Nitrogen on the Physical Properties of Iron.

In the course of experiments made on the determination of nitrogen in iron Mr. H. Braune, according to a recent issue of Stahl und Eisen, discovered alterations in the physical properties of the metal. An iron wire which was nitrated with dry ammonia gas included an initial amount of 0.08 per cent carbon and 0.027 per cent nitrogen, while after nitrating the percentage of nitrogen was found to be 0.267 per cent. Although the original wire readily stood 15 or 16 inflexions, a nitrated wire could not stand any more than 2 or 3. The electrical resistance was at the same time found considerably to increase, viz., by 32.3 per cent, corresponding to an increase by 3.23 per cent for each 0.01 per cent of nitrogen.

The magnetic properties of iron are influenced by nitrogen in a similar way to carbon, the magnetical saturation being decreased and the residual magnetism augmented. This accounts for the wide divergences that are noted between the hysteresis figures of thin sheet metal, though the analytical results be the same.

The influence of nitrogen on the mechanical properties was investigated on a piece of weld iron, it being shown that the tensional strength is increased by nitrogen, at a rate nearly proportional to the increase in nitrogen, while the tension is decreased more rapidly than would correspond to the increase in nitrogen.

The quality of the iron (product of tension by tensional strength) is thus diminished by increasing amounts of nitrogen, this diminution being, however, in the case of ingot iron much more considerable than with weld iron.

The physician of the future will find his greatest service in prolonging human life. The asylum and the poorhouse are not to be regarded as shining lights of advanced political economy, but there is something in life besides mere political economy, and the prolongation of existence is regarded as one of the chief functions both of the medical profession and of public charities. On the other hand, it must be considered that there is a distinct economical loss in cutting off from existence a man before he has run the full course of his career. To train a man for usefulness requires now fully a quarter of a century, and it seems only fair that he should have at least twice that time for the manifestation of his activities. If, therefore, he be cut off at thirty-five, forty, or forty-five, the community is robbed of service to which it is entitled.

RECENTLY PATENTED INVENTIONS.

Of Interest to Farmers.

CULTIVATOR.—J. B. PELLEGRIN and L. R. PELLEGRIN, Chauvin, La. In this case the invention is an improvement in cultivators of the hand-propelled type. The inventors provide a cultivator simple in construction, easily adjusted, and easily operated. The placing of the supporting-wheel behind the hoes lessens the draft and permits a more even passage of the hoes. It is adapted for use in any form wherever a cultivator is desirable, but more especially to the cultivation of onions.

DEVICE FOR ADJUSTING SIEVES IN THRESHING-MACHINES.—J. A. STEELSMITH, Wichita Falls, Texas. One purpose of the invention is to provide a mechanism for adjusting the sieves in a threshing-machine either up or down at either end of the sieve-frame, which mechanism is capable of being operated by one individual from the outside of the machine, and, further, to so construct the device that when the motion of the machine is not too rapid the adjustment of the sieves can be made while the machine is in motion.

WIRE FENCE.—B. B. WOOD, Bozeman, Mont. The present invention has for an object the provision of a novel construction at the ends of the tie or clamp whereby the same may be clinched or tightened when applied to the fence at the crossing of the line and stay wires. It is an improvement in wire fences, and particularly in that class of such fences illustrated in a former patent granted to Mr. Wood.

Of General Interest.

TRUCK.—O. THIBAULT, Fall River, Mass. Mr. Thibault's invention refers to trucks, and more particularly to those adapted for handling heavy rolls—such, for example, as those of paper employed upon printing-presses. Its principal objects are to provide such a device which will be strong and compact and upon which objects may be readily rolled, instead of requiring to be lifted and then conveniently moved about.

BULKHEAD-DOOR.—D. W. STIBBS, Puerto Cortez, Honduras. The design is to enable a person to pass from one side of a partition to another without at any time opening a through communication between the compartments or spaces on opposite sides. It permits escape from the interior of a disabled submarine boat to the external space below water without allowing unrestrained inrush of water to flood the boat. It is applicable for location in the bulkheads of a ship anywhere and for the closure of ship's magazines in such a way as to preclude open or through communication between magazine or turrets or compartments where an explosive flash would be likely to strike back into the magazine.

COMPOSITION FOR PRESERVING PILES AND TIMBER.—P. S. SMOUT, Everett, Wash. In this instance the invention refers to that class of pile-protectors which consists of a suitable composition of matter applied to the exterior of the pile and forming a covering therefor which is intended to resist not only the action of the water, but the ravages of marine insects, particularly the teredo.

TICKET-CASE.—W. T. SHERWOOD, Sidney, N. Y. The improvement has reference to a ticket-case for holding tickets which come in continuous strips, each ticket being broken from the strip by tearing it along a series of perforations or the like. Many attempts have been made to produce cases for carrying this kind of tickets, but they have all been open to certain objections. The present invention is not open to these objections, and the case is convenient to handle and an efficient holder for tickets.

PRESERVING COMPOUND AND PROCESS OF MAKING THE SAME.—A. C. HAGER, Missoula, Mont. This invention has reference to a process for preserving eggs, the more particular object being to enable the eggs to be kept fresh for comparatively long periods without injuring them as articles of food. Upon actual trial Mr. Hager has found that eggs prepared under this process can be kept perfectly fresh for six months or longer.

UMBRELLA-LOCK.—F. A. WILSON, New York, N. Y. The object in this case is to provide a simple device intended to prevent the taking of umbrellas, accidentally or otherwise, from umbrella-stands, hat-racks, and similar places. The device consists of a sleeve comprising a pair of hinged sections, the sleeve having a lip adapted to lie adjacent to the handle of an umbrella, and means for locking the sections together.

Household Utilities.

CABINET.—H. MARSTALL, Henderson, Ky. In this instance the improvement has reference to cabinets such as used in furnishing dwellings or living rooms. The object of the inventor is to produce a cabinet carrying a mirror which will be normally concealed from view, but which may be readily drawn out into a convenient position.

WINDOW-SCREEN.—G. F. MONNIN and A. J. C. MECCHI, San Francisco, Cal. One object here is to provide means for detachably connecting a framed window-screen with the lower sash of a window and for hanging the screen-frame in a receiving-pocket formed in the wall of the building below the sill of the window therein having the improvement applied thereto, whereby the screen when connected with the lower sash may be raised into position for service a corresponding degree when the sash is raised and be returned into the pocket when the sash is lowered.

Railways and Their Accessories.

CAR-FENDER.—E. CAMPANARI, New York, N. Y. The intention in this case is to provide a street-railway car-fender so constructed that when not required for use it may be easily and conveniently folded against the dashboard of the car by the motorman without his getting off the car, and, further, to so construct the parts that the fender may be attached to either end of the car.

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.

Business and Personal Wants.

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.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 7623.—For manufacturers of electric railways, such as used in amusement places, for children's use.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 7624.—For makers of tin foil.

Drying Machinery and Presses. Biles, Louisville, Ky.

Inquiry No. 7625.—For parties to make a number of porous jars, made of clay, such as flower pots, or material similar to cups used in old-style Grove or Leclanche battery.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 7626.—For makers of small, flexible steel tubing, to hold water, about a foot in diameter; also for celluloid tubes, transparent, the same size as the steel tubing.

Inquiry No. 7627.—Wanted, the name and address of the makers of the Eagle Claw Fish Hooks.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 7628.—For makers of papier maché.

Airships, Gas Balloons and Generators. Carl Myers, Balloon Farm, Frankfort, N. Y.

Inquiry No. 7629.—Wanted, a list of saw-filing apparatus, or descriptions of same.

WANTED.—Purchaser for Monazite, Molybdenite and Wolfram. Apply Monasite, Box 773, New York.

Inquiry No. 7630.—Wanted, a saw or tool, for sawing, grinding or sand slab stone.

WANTED.—Patented specialties of merit, to manufacture and market. Power Specialty Co., Detroit, Mich.

Inquiry No. 7631.—For makers of the iron and steel Ferris wheels.

I sell patents. To buy, or having one to sell, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

Inquiry No. 7632.—For makers of paper bottles for milk.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company, Foot of East 138th Street, New York.

Inquiry No. 7633.—For makers of cardboard cups, for bottoms and lids of cylindrical strawboard boxes.

WANTED.—Ideas regarding patentable device for water well paste or mucilage bottle. Address Adhesive, P. O. Box 773, New York.

Inquiry No. 7634.—For manufacturers of all kinds of novelties.

I have for sale the U. S. and all foreign rights of new patent Improvements in Water Tube Types of Boilers. Great economizer. J. M. Colman, Everett, Wash.

Inquiry No. 7635.—For makers of oil engines, also grinding and crushing mills, of the latest type.

Competent salesman would represent or accept agency in New York for a good concern. Cash advances unnecessary. Address F. F. H., Box 773, New York.

Inquiry No. 7636.—For manufacturers of hand looms.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery tools and wood fibre products. Quadriga Manufacturing Company, 18 South Canal St., Chicago.

Inquiry No. 7637.—For manufacturers of lead piping machinery.

Absolute privacy for inventors and experimenting. A well-equipped private laboratory can be rented on moderate terms from the Electrical Testing Laboratories, 548 East 80th St., New York. Write to-day.

Inquiry No. 7638.—For manufacturers of cotton mills or cotton belting.

Manufacturers of all kinds sheet metal goods. Vending, gum and chocolate, matches, cigars and cigarettes, amusement machines, made of pressed steel. Send samples. N.Y. Die and Model Works, 508 Pearl St., N.Y.

Inquiry No. 7639.—For manufacturers of casing of brass, steel or iron (iron preferred) about ¾ inch outside, ½ inch inside.

We will manufacture and market a small, patented article, such as would sell to the Hardware, Department Stores and general trade. Royalty basis.
The Perry-Austen Mfg. Co.,
32 Park Place, New York City.

Inquiry No. 7640.—For manufacturers of wireless telegraph outfits, for short distances up to 10 miles.

WANTED.—Interest in flourishing manufacturing business; or join with reliable party starting industry of merit. References of both must be satisfactory to each other. Every reply positively confidential. State nature of business. Address Flourishing, Box 773, N. Y.

Inquiry No. 7641.—For manufacturers of steam shovels.

WANTED.—A man of experience; capable of running a factory that is manufacturing heavy machinery. Should have $25,000 to invest in the business which can be shown to be profitable. We don't want the money without the man. The experienced man is the first essential. Address Heavy Machinery, Box 117, Station A, Hartford, Conn.

Inquiry No. 7642.—For manufacturers of clam shell excavator.

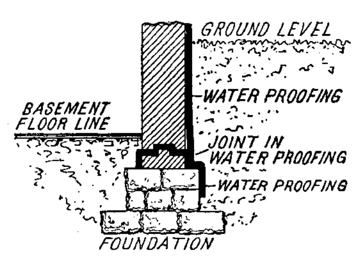
Inquiry No. 7643.—For manufacturers of stucco machinery.

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.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(9861) J. J. C. says: Will you kindly inform me through your Notes and Queries how I can keep the basement walls of a house, which I am about to build, perfectly dry and prevent the rain water from seeping through them? The level of the basement floor is several feet below the ground level, and the building is to be built in a dry and sandy soil. A. In reply to your inquiry we would say that you will be able to keep your basement walls perfectly dry if you will cover them with



water-proofing applied as follows: Put on three coats of burlap or two coats of builders' paper and one coat of burlap, each coat being laid in and thoroughly covered with hot asphaltum. Care should be taken to see that the builders' paper or burlap is lapped at least six inches, and also to see that the different layers break joints. In order to be sure that the dampness will not rise up through the brick wall itself, we would recommend your using a damp joint, such as is shown in the above sketch. This damp joint consists of the same material as the water-proofing on the outside of the wall described above, and should be applied as indicated in the sketch in order not to break the bond in the wall. If your building were not located in a dry soil, we should also recommend covering the top of the concrete used for your basement floor with water-proofing the same as specified for the outside wall, making a joint between this water-proofing and damp joint where it comes through the brick wall. This would make your basement walls and floor absolutely impervious to water or dampness, but would not of course prevent the condensation of moisture from the atmosphere if the temperature of the basement is lower than that of the outside air. The latter can only be prevented by good ventilation.

(9862) R. R. S. asks: 1. Would a man standing exactly at the North Pole or twenty feet from the Pole be sensible of the earth's rotation from west to east? A. A man at or near the North Pole of the earth would see the stars move in circles, clockwise, sensibly parallel to his horizon without rising and setting. The sun would rise and set once a year, the moon once a month. While above his horizon they, too, would move clockwise around the sky. In this way the earth's rotation on its axis is just as sensible to a man at the Pole as to one at any other point of the earth. 2. Why does the moon rise farther in the north in the winter? And why does it appear nearer the zenith when it is nearest to us? A. The moon rises at the same points of the horizon every lunation. Half of its month it is north of the equator and half of its month it is south of the equator. We only notice the rising of the moon when it is near its full. The full moon is always opposite the sun. In winter the sun is south of the equator, and full moon is north of the equator, in the same part of the sky where the sun is in summer. Hence the full moon runs high in winter. The moon does not appear nearer the zenith when it is nearest the earth. Perigee may be at any phase of the moon, since new moon occurs in all points of the orbit in each cycle of the series. 3. How long does it take the sun to make a rotation? A. The time required for a spot to pass from the center of the sun around to the center again is on the average 27.25 days. This is the synodic period of the sun's rotation. The true, or sidereal period, is determined from this to be 27.35 days. Different observers obtain slightly different results, varying from 27.23 days to 27.38 days. The sun's rotation is very peculiar in that the velocity is not the same for different latitudes. This would show that the surface of the sun is not solid, but in a fluid condition. This is discussed in Prof. Young's book on the sun, which we send for $2.

(9863) V. V. S. asks: What causes every alternate section of a direct-current 1.9 horse-power motor to become discolored, i. e. darker than the adjacent sections? The motor is running on 220 volts with very little load, only about 10 per cent of its rated load. A. You ask, "What causes every alternate section of a direct-current motor to become discolored?" We presume by "section" you mean the copper bars of the commutator. The discoloration is probably caused by local heating due to sparking more on one bar than on the next. This may be due to dirt, or to one bar being a little higher than the next, or to other causes. Sloane's "Handy Book of Electricity," which we send for $3.50, will tell many of these. Crocker's "Dynamo Tender's Hand Book," price $1, is quite full on diseases of dynamos. Every one having to run a dynamo or motor should have a copy of this work.

(9864) W. F. J. asks: 1. Why does a charge of electricity (static) pass to the outside surface of a hollow conductor? If the conductor were a solid would the charge pass to its outside surface also? A. A static charge of electricity is on the surface of any conductor, solid or hollow. The reason is the self-repulsion of the parts of the charge for its own parts. Each unit of electricity is as far as it can get from every other unit of electricity. 2. Why is there no lightning in winter? A. There is lightning in winter. We have seen vivid lightning in mid-winter in Massachusetts, lighting the snow to the greatest brilliancy. It is not a common occurrence. 3. Why is the external characteristic of a shunt dynamo a loop? A. The external characteristic curve of a shunt-wound dynamo is a loop because of the fact that all the current goes to the fields when the external circuit is open. The voltage is then the maximum, but there is no current. When the external circuit is closed the external resistance is high and the field coils now begin to receive current, which weakens the voltage. As more and more current passes through the external circuit, less current passes through the field. A point is finally reached where the reduction of external resistance takes so much from the field that the E. M. F. falls more rapidly than before and current begins to decrease also. From this point both current and E. M. F. fall steadily to zero by cutting out resistance. See Sloane's "Handy Book for Electricians," which we send for $3.50.

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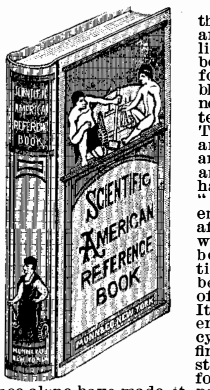

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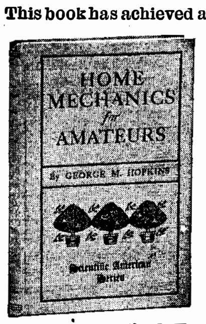

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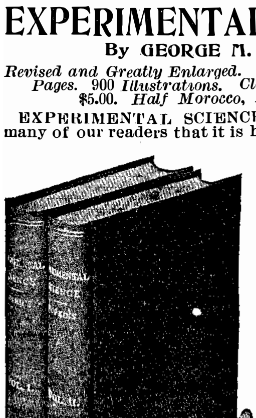

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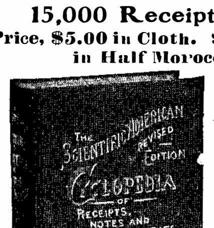

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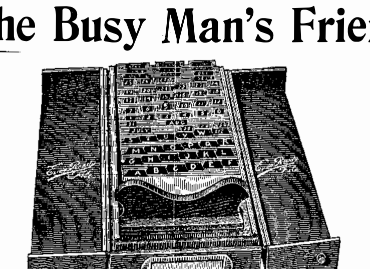

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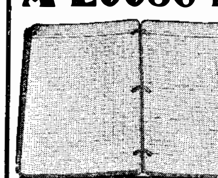

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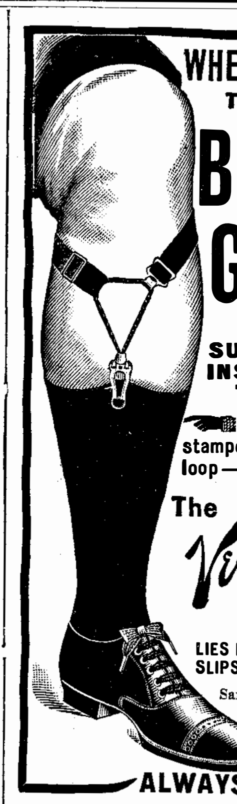

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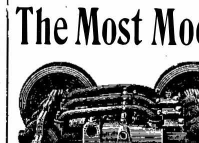

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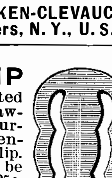

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