SCIENTIFIC AMERICAN

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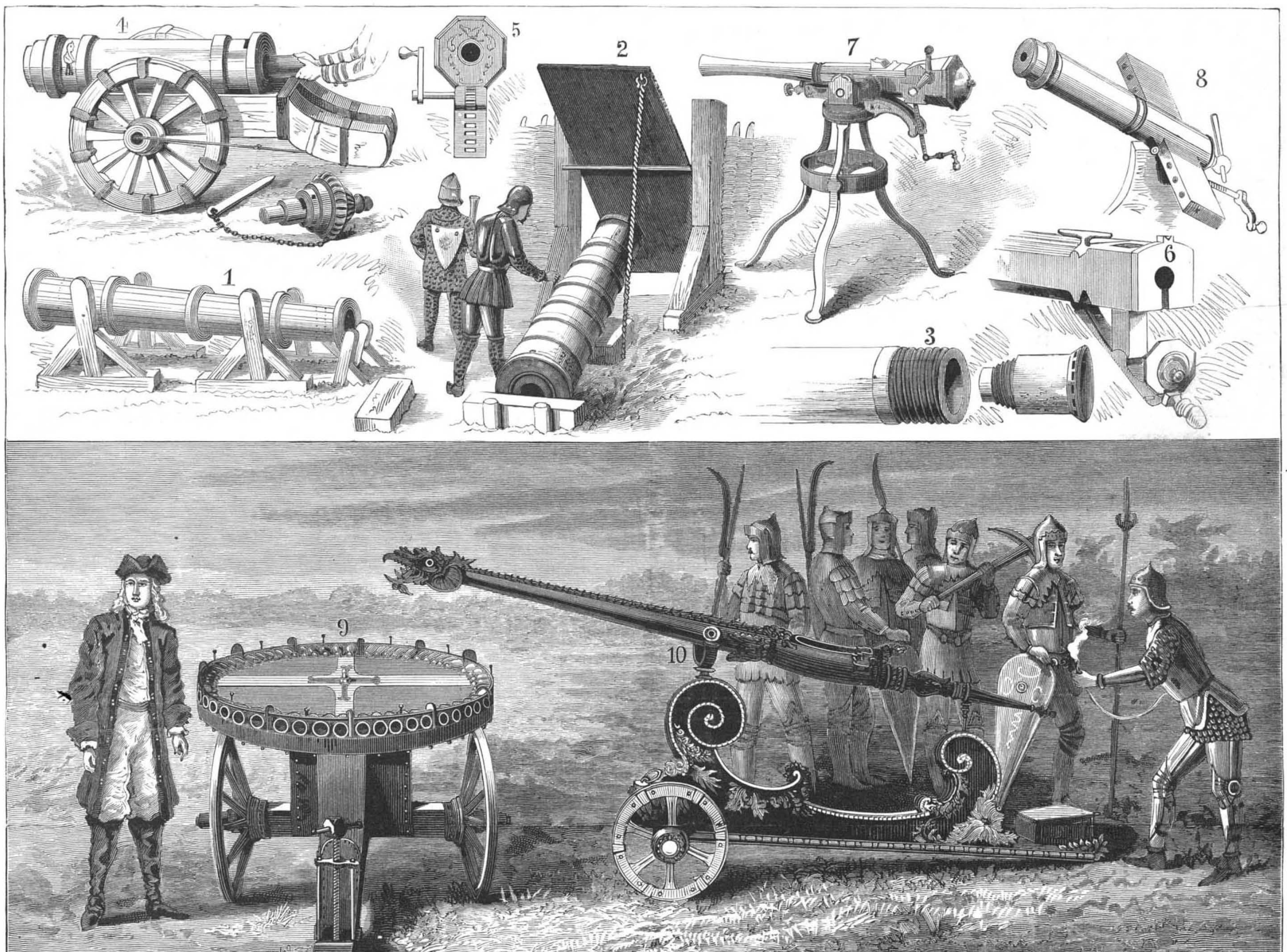

AN ILLUSTRATED HISTORY OF BREECH-LOADING GUNS.—[See page 343.]

Scientific American.

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NEW YORK, SATURDAY, JUNE 2, 1894.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 961.

For the Week Ending June 2, 1894.

Price 10 cents. For sale by all newsdealers.

PUPIN'S IMPROVEMENTS IN LONG DISTANCE TELEPHONING.

The efficiency of ocean cables for telegraphic communication and of long land lines for rapid telegraphy and telephoning is greatly impaired by their static capacity and self-induction. On lines possessing the last named factors in high degree only slow telegraphy is possible; any attempt to use the Wheatstone system meets with failure, and telephoning is out of the question. There is no doubt that the telegraphic world is waiting for the invention which shall overcome these troubles, and enable a telephonic conversation to be held over a line of ordinary construction, from New York to San Francisco. The present long distance telephone lines are of very expensive construction.

Professor M. I. Pupin, of Columbia College, has been awarded two patents on apparatus for telegraphic or telephonic communication which are designed to secure the possibilities outlined above. If the inventions answer the expectations which they raise, then it should be possible to telephone across the ocean, and the breadth of the continent should oppose no bar to telephonic conversation.

Professor Pupin proposes to divide a telegraph or telephone line into sections, electrically separated one from the other. At each point of separation a condenser is introduced of large capacity compared with that of a section of the line proper. The capacities are so proportioned as to "time" the line to respond to alternations or changes of very high frequency. By this division of the line into sections its periodicity as a whole will be determined by the periodicity of its single parts. Over such a line rapid signaling and telephoning can be executed, and it is believed that it opens up a greatly extended range for this class of electric transmission of voice and signal.

Its application to land lines is simple enough, but in the case of ocean cables some complications, to say the least, would be involved. Whether it would be practicable to sink a line of operative condensers at intervals along the ocean bed is a matter of conjecture. It would seem rather an innovation to cut an ocean cable into sections only electrically related by the medium of condensers. This thing is provided for in the patents, as Prof. Pupin proposes to use a coil of high inductance in parallel with each condenser to supply a metallic circuit for the determination of faults.

The inventions are most ingenious and promise to perform an important part in the field of long distance telephony.

NEW ZEALAND LABOR LAWS.

John D. Connolly, Esq,. United States consul at Auckland, New Zealand, has sent to the State Department a report on the labor laws of New Zealand, a copy of which we have received from the Secretary of State. In a few pages it gives a very striking presentment of paternal legislation in the antipodes, which seems to have proved successful and to be liked by the people. The dreams of Bellamy and of other describers of Utopian states, all of which make the happiness of their fictitious peoples depend upon direct governmental interference, seem to have some degree of realization in New Zealand. It would be hard to find a better place to try these theories. The two islands are not very large, and isolated in the ocean may be taken to represent geographically the New Atlantis. The theories of Sir Thomas More, of Bacon, and of Bellamy may be tried there to great advantage, in the absence of sectional issue and in a country which has every reason for being a unit.

It seems that previous to 1881 New Zealand was afflicted with the borrowing mania, English capital had been largely invested in the country, and for some time there was an abundance of money and "good times." About 1881 the crash came, and for ten years panic reigned. Then the government took up the matter, and by enactments tried to cure or palliate the troubles of the country. A law was passed against unscrupulous promoters and directors of stock companies, making them personally liable for their acts. Another law was for the protection of labor, both in the matter of wages and of personal injuries received while at work. Another act regulated factory labor and established compulsory holidays with full pay. These are but examples of the legislation alluded to, as many more acts were passed.

It is claimed that in the last three or four years the country has wonderfully advanced. The government has charge of almost all large operations. Roads and bridges, occupation for the unemployed, asylums, hospitals, railways, telegraph and telephone systems, life insurance and a savings bank are included among its subjects of work. Profits derived from these enterprises are applied to conducting the affairs of the state.

Most are well managed; some complaints are made against the railroads, however. The public works are conducted on the co-operative system. The government gives the work in small sections to gangs of men, who divide the earnings equally among themselves. There are no contractors. For the unemployed labor bureaus are maintained.

It is an interesting experiment and the results will be of the deepest interest. It is still an open question whether the great improvement of the last few years is due in part to the government's action.

PHYSICAL TRAINING IN COLLEGE.

A large number of boys who went to college in the first half of this century earned a part or the whole of their expenses. It was not uncommon for them to walk from their homes, long distances to college, to save stage fare; they cut their own wood; some of them boarded themselves and took care of their own rooms. The vacations were arranged with reference to their working through them with most profit, and not to their resting.

Their concern was how to find the time for study which they craved. These were the men who were the leaders in the nation in the dark days of the rebellion, as their fathers and grandfathers were in the revolution.

But changes in our social fabric have been nowhere, perhaps, more radical than in college life.

In the last quarter of a century we have become a wealthy people. There are still students in our colleges (and they are often those who take highest rank) who are obliged to work with their hands or brains, or both, to pay their bills, but there are sons and daughters of so many rich people that gymnasiums have become as much a necessity as chapels or recitation rooms. No well equipped preparatory school or college is without one, and exercise in them is part of the day's regular duty. In the best ordered institutions this exercise is taken after a physician's examination and according to his prescription. Calisthenics begin in the kindergarten with the sewing and songs and gifts, and they are continued through every grade of the best secondary schools.

Athletics is the new word which tells the story of our having got beyond the time when college life is for any one strictly a working period—one of work with the hands, so as to be able to work with the brain. The "crack pitcher" or oarsman, the captain of the boat crew or the ball nine, is now the man whom his fellow students point out to strangers as the conspicuous man in his class. He not unfrequently has a good standing for scholarship, but that is of less consequence. The regulations which men who are preparing for these trials of skill are obliged to follow ought to be suggestive and helpful to students who have no part in the games and races except as admiring spectators. These are the rules which are imperative for men in training.* "They must be in bed at ten o'clock every night, they must not smoke, chew nor drink beer or coffee; they must avoid pastry and sweets. They are obliged to run from one to three miles per day, in addition to their regular gymnastic movements. They take a complete bath at the close of each day's exercise."

But the gymnasium, the ball and tennis grounds, and the lakes and rivers, are not the only places where the college students of to-day get physical exercise.

The student who has spent two hours in a laboratory working with blowpipe and reagents, with physical apparatus or a dissecting knife, is perfectly sure while he is washing up his utensils and putting his desk in order that he has had some exercise. Much of the scientific work drives students afield, and the worn geological hammer and battered botanical can may be put in evidence to prove that students handle other tools than books. It is largely because the college work is much more practical than it was a generation ago that the age of graduation has advanced. Memorizing theories did not require so long as testing them does.

It is a requirement of one department of the Massachusetts Institute of Technology (it may be of others) that every student shall, from his own investigation, add at least one fact to the sum of human knowledge.

This institute, the Institutes of Technology at Hoboken, Worcester, and Troy, and the scientific departments in many of the leading colleges all offer fine facilities for men whose tastes and talents are not likely to lead them into the learned professions. In all of these, physical and intellectual effort go hand in hand.

The Flow of Water through New Cast Iron Pipe.

This subject was recently investigated by Mr. S. Bent Russell, of the St. Louis (Mo.) Water Works. The pipe was 12 inches in diameter, 1,631 feet long, and laid on a uniform grade from end to end. In a letter to Mr. J. C. Trautwine, Jr., Mr. Russell states that, as there was an opportunity to make some fairly accurate measurements on the discharge of the pipe, he had the necessary observations carried out, and found that, under an average total head of 3·36 feet, the flow was 43,200 cubic feet in seven hours; under an average head of 3·37 feet it was the same; under an average total head of 3·41 feet, the flow was 46,700 cubic feet in eight hours thirty-five minutes. Making allowance for loss of head due to entrance and to curves, it was found that the value of c in the formula $v = c\sqrt{rs}$ was from 88 to 93.

* Rules furnished by Dr. Anderson of Yale University.

The Curious Effect of Metals Upon a Fungus.

Some most interesting experiments upon molecular vibrations as indicated by the effect of certain metals upon a species of fungus are reported in *Nature* by Fredrik Elfving.

It seems that a number of years ago, he published his observations upon the effect of iron, zinc and aluminum upon the *hyphae* (the tubes on which the reproductive organs of the plant are borne) of the *Phycomyces* or *Phycomycetes nitens*. This is a fungus so named from its resemblance in the mode of reproduction to *algae* or sea weed.

When the above mentioned metals (aluminum only slightly showing the effect) were brought within from one to two centimeters of the plant, the *hyphae* curved toward the metals. It is a well known fact that sporangiferous *hyphae* curve away from a surface which *discharges* aqueous vapor, and it was therefore inferred that they would be attracted by a body which readily *absorbs* water. As iron is an example of a metal which takes water from the atmosphere and iron affected the *hyphae* more perceptibly than the other metals, Prof. Errera, of Brussels, who has also studied the subject, published the opinion that the phenomenon was accounted for by the influence of the water in the metal.

Mr. Elfving, not satisfied with this explanation, has been experimenting further. He has placed a stick of caustic potash near the *hyphae*; this, as is well known, absorbs water from the atmosphere with extreme readiness, but the *hyphae* were unaffected by being near it. A cylinder of plaster soaked with a solution of calcium chloride and dry plaster, which also absorbs water quickly from the air, both failed to have the slightest influence upon the *hyphae*. These hygroscopic experiments have been repeated by Mr. Elfving several times, and always with the same result, viz., no curve.

He, therefore, has sought another explanation, and believes he has found it in the molecular vibrations of the metal. His belief is chiefly based upon his later experiments. Platinum is one of the metals that, in its normal condition, is inactive toward the *hyphae*. Burnished steel is almost inactive. But let these two metals be exposed to direct sunlight for some time and they attract the *hyphae* powerfully. The attraction is shown by the side of the metal away from the light as well as that toward it, and lasts for a few hours. When the metals were exposed to sunlight in August for seventy minutes they showed this activity, but being in the light for five hours on a cloudy day had no effect upon them.

It would seem that a sort of phosphorescence imperceptible to the eye but perceptible to the plant is emitted by these metals, for when they are heated out of the sun to the same temperature that they showed while in it, they had no attractive power. Plainly, then, it is the light they possess and not their heat which produces the effect. Furthermore, Mr. Elfving finds that the ultra-violet rays have no part in producing the phenomenon, for, when they have been removed from the spectrum, the metals submitted to the remainder of it produce the same curves.

But this is not all. There are some metals which show this same activity when they are heated. Zinc is one of them. A piece heated in a blowpipe flame until it began to melt, and then allowed to cool to the temperature of the hand, produced beautiful curves in the *Phycomycetes*. Mr. Elfving thinks that there is no doubt that molecular vibrations, produced in the case of platinum and steel by light, in the case of zinc by heat, cause the phenomena, alike curious and interesting. Who would dare to say that the physicist may not one day depend upon the *Phycomyces* as much as the chemist does now upon the fungi from which his litmus paper has been prepared?

Lantern Slide Making.

At a recent meeting of the Woolwich Photographic Society Mr. Andrew Pringle said:

"It is essential that there should not be a mass of black in a lantern slide, there should always be a complete scale of gradation. The tone or color is another important point. Some affect a tone which is neither warm nor cold, and consequently you see a very dirty tone. I do not recommend albumen plates, unless the worker can devote his whole time to them and wishes to incur the displeasure of his wife; but it is the best process. Wet collodion plates will give clear high lights, but they are not so good for keeping the shadows clear. The dry collodion process I recommended to you is well adapted for contact work, and keeps the high lights clear. The collodion process is useful for reductions, albumen is not. If you wish for warm tones, you must give long exposure and prolong the development. I don't recommend dry collodion for cold tones. Gelatino-bromide plates do equally well for reduction or contact for warm and cold tones, but for all that, gelatine is not such a good menstruum as collodion. In selecting the negative, it must be remembered that you cannot get a first class lantern slide from a second or third class negative. If you want a medal-taking slide, you must use a plucky negative; don't try with a soft negative, although such a negative may give you a good print. You might be able to get a good slide from such a negative on the Hill-Norris collodion plate, and then give long exposure, and use a restrained developer. The developer for gelatino-bromide plates is ferrous oxalate for cold tones; it cannot be beaten. I keep the stock solution saturated in a couple of sweetmeat bottles. The iron solution is acidified, and I keep both at 60° Fah. Shake up and filter just before use. In mixing the developer, I prefer one to six or one to eight. The development should be deliberate. The Kent water is not a good water for the purpose of washing, and causes a scum of oxalate of lime to appear on the surface of the plate, but it is easily cleared. In another sweetmeat bottle containing a solution of alum I add a drachm or two of hydrochloric acid—I am not particular as to quantity. Plates immersed in the solution are soon cleared. Over-exposure is shown by the greenish appearance of the image, and, of course, under-exposure is known by the hard black tone. An easily restrained developer should be used for warm tones. I do not recommend metol and amidol for lantern slides, and I pass over those. Suppose a beginner wants warm tones, the best thing to do is to keep on exposing on one or two negatives until he obtains two good slides, and then he will be in a position to judge the quality of negative required. Every lantern slide is improved by putting it in the clearing bath; wash the plate well, but don't overwash, and always varnish the plate."

The "Sleeping Sickness of West Africa."

A singular malady prevails in some portions of Africa, known as the sleeping sickness. Dr. C. Forbes, in the May 12th number of the *Lancet*, explains the nature of it.

The victim of this sickness of West Africa (old or young, for this curious and deadly complaint may make its appearance at any epoch of life, though it is more commonly found between the ages of twelve and twenty years, and is more often seen in men than women) gradually gives way to somnolence, which becomes at last a profound and lethargic sleep, the first noticeable signs of which are a visible and persistent drooping of the eyelids of man, woman, or child in the daytime while at work, enlargement of the glandulæ concatenatæ and other cervical glands at the onset. The general health of the negro at first seems to be fair, though he gradually appears to give way to sleep at unusual hours. This tendency to drowsiness and torpor can be combated to a certain extent at the outset by stimulation and purgation; but the patient thus aroused from this lethal slumber relapses almost infallibly again and again into this somnolent condition, the periods of sleep increase in number and the intervals between them lessen, their extent proportionally lengthening. This state of things continues while the malady steadily gains ground; soon the negro appears to be always asleep, bearing semblance in his life—I should perhaps say existence—to insensitive and fungus-like development only. This condition goes on for a varying period, weeks or months, and he little by little refuses all food, spending his time in slumber. When increasing atrophy sets in, with emaciation, after a short space death from exhaustion and starvation almost invariably occurs at the end of three, six, or twelve months. Here it may be stated that just when moribund the tendency or disposition to lethargy is sometimes in abeyance, and the mental faculties become clear at last previous to their total extinction.

Its endemic area is West and West Central Africa, from Senegal to the Congo, in the Sierra Leone district, and the *Hinterland*, but cases are more frequently met with and more virulent in their nature in the valley of the Congo. They are also more numerous inland than on the coast line. It has never been known to affect any but the negro race, but has been seen in the West Indies, etc., among those who have been brought thither as slaves from the Congo or Sierra Leone districts.

The prognosis is bad, as the disease, once established, progresses actively, almost in spite of treatment, to a fatal issue. Guerin reports 148 cases. The result was death in each. Gore's statistics drawn from Sierra Leone, etc., say that there were 80 per cent of fatal cases—rather underestimating the rate of mortality, I fancy. Personally, my experience extends to only thirteen cases, two of which lived for some time; whether they afterward succumbed to renewed attacks I know not, but I do know that eleven died.

The causation of this curious disease may be said to be wrapped in the deepest obscurity. Many attempts have been made to elucidate it. One suggestion put forth was that it arose from a form of blood poisoning arising from ingestion of a fungus growing on certain grains used by the natives as food; but no absolute proof of this assumption is forthcoming. Nor has change of diet and residence, according to my experience and that of others, had any effect on the steady progress of the symptoms. The complaint is, indeed, involved in mystery, and its problem of causation remains unsolved. The three most acceptable theories are: (1) That it may be due to a septic condition of the blood, borne out by swelling of glands, etc.; (2) is it due, as Dr. Manson was the first to point out, to the presence of filaria in the blood? (3) or it may be (though this is an assumption on my part) a neurosis, eventually affecting the neurotrophic system and causing ultimate emaciation and death; this is somewhat substantiated by appearances and lesions sometimes found post mortem in the brain and its membranes.

The Use of Heat in Operative Surgery.

The successful substitution of heat for antiseptics in the preparation of instruments and surgical dressings has naturally led to the use of heat for sterilizing the wound itself. This is an ancient method. Hippocrates, Oribazius, and later writers down to the time of Paré, were unanimous in recommending the use of the hot iron and boiling oils upon wounds. It may even be questioned if Paré did so great a service, after all, when he substituted for the cautery the use of dirty ligatures.

The systematic and scientific use of heat, however, for rendering wounds aseptic, is a thing of recent date. M. G. Phocas, surgeon to the Hospital Saint-Sauveur, of Lille, has made a particular study of this procedure, more especially in connection with operations for resection. He refers to the experience of Felizet (*Bull. de la Chir.*, 1892), who employed the flame of a gas jet for making the wound surface aseptic. He describes also the method of Dreesnau, a pupil of Trendelenburg (*Centralb. f. Chirurg.*, 1893, No. 3). This surgeon poured into the cavities of the wound oil brought to a boiling point by the thermo-cautery. In the same year M. Jeannel, of Toulouse (*Gaz. des Hopit.*, Nos. 59 and 62), proposed to make the surfaces aseptic by touching them with boiling water.

In 1892 M. Phocas began to employ boiling oil according to the method of Trendelenburg. At the same time he undertook, with the help of his assistant, M. Hennecart, some experiments to determine how much heat the living arteries and nerves could bear without disintegration. Three different methods of using heat were tested: first, cold oil was poured into the wound and then raised to a boiling point by a thermo-cautery; second, boiling oil; and third, boiling water applied directly.

It is sufficient to say that the experiments showed boiling water to be much less injurious to the tissues than the oil. M. Phocas finally adopted the following procedure: In osseous cavities he poured in cold oil and heated it with a thermo-cautery for three or four seconds. In other wounds, but more especially in resections and arthrectomies, he touches the wound with plugs of absorbent cotton upon which he has poured water just at the boiling point. In this way every part of the wound is reached by water at a temperature of about 80° C. Each part is touched for three or four seconds, and the procedure is repeated several times.

M. Phocas states that since he has used the boiling water his results have been "incomparably better" than they used to be.—*Med. Record.*

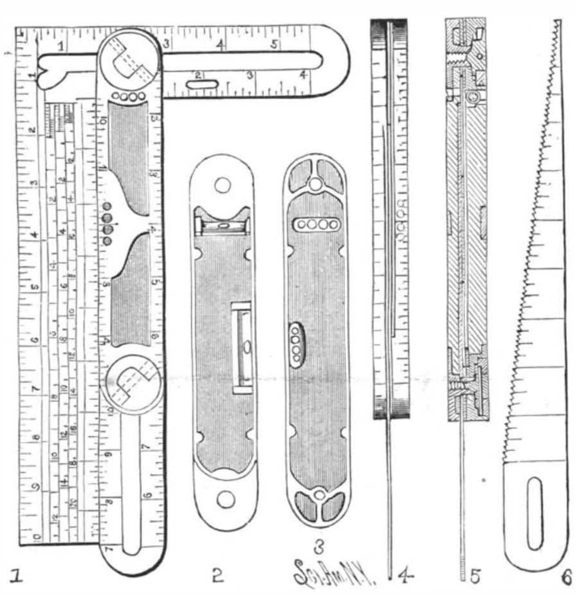
The Pollard Electric Lamp.

The recent suit of the General Electric Company against the Boston Incandescent Lamp Company is based, according to the *Electrical World*, on the method devised by Edward Pollard, now deceased, for passing the current into an incandescent lamp by making the glass stem which supports the filament serve as a conductor of electricity through the application of lines or films of silver to the same. An iron leading wire is then fused into the inner end of the glass stem by simply heating the glass, inserting the iron wire to the extent of about one-fourth part of an inch and squeezing the glass upon it so that the silver-coated surface shall be in permanent contact with it. It is claimed that by the use of the Pollard invention the entire cost of platinum is saved, the cost of the silver used being negligible. The affidavit of Peter H. Walsh, submitted in the suit, gives the following account of the manufacture of the stem:

"I have witnessed in the manufacture of the Pollard lamp the operation of painting a narrow strip of printer's ink upon the inner surface of the glass tube, the introduction of the metallic silver in the state of an impalpable powder or molecular state of division, also the subsequent burning off of the printer's ink, leaving a film-like deposit of metallic silver upon the glass, and the remaining operations involved in forming the stem, and was not only interested, but much surprised at the rapidity with which these operations were performed. As observed by me during my visit to the works, the deposition of silver upon the glass tube was accomplished at the rate of about a thousand per day by one girl. The process is highly ingenious and original, and from a scientific point of view very interesting and beautiful. I made several determinations of the weights of silver deposited upon each tube by accurately weighing the tube before and after deposition upon a delicate balance, and found the maximum weight of metal to amount to 12 milligrammes, or about 0·19 of a grain, and having a value of 0·026 of a cent."

AN INGENIOUS COMBINATION TOOL.

The illustration represents an improvement combining a variety of tools, as T squares, try squares in various forms, framing squares, bevels, plumbs, levels, etc., adapted to be used for various purposes. It has been patented in the United States and foreign countries by Mr. Townsend Harris, of Brainerd, Minn. Fig. 1 is a plan view of the tool, Fig. 2 showing one-half of the stock and Fig. 3 the other half, while Figs. 4 and 5 are side elevations, and Fig. 6 shows a keyhole saw adapted to be secured to the stock. At one end of the stock is arranged a bevel blade and on the other end is the square, the stock being made in two principal sections in the form of wooden-lined metallic casings, held one upon the other by apertured sockets engaging threaded lugs. On the lugs between the casings is also fitted a middle blade with a graduation, while on one lug is hung the square and the other lug forms a pivot for a slotted bevel blade. There are two levels, one at right angles to the other, their glass tubes being protected by elastic cushions against shocks of the stock. The faces of the stock, as well as those of the square and slotted bevel blade, have graduations representing inches and subdivisions, and one face of the shorter member of the square has a protractor graduated in degrees and subdivisions. It is also possible to use with the stock a number of squares having their members of different lengths, and different lengths of bevel blades, only one square and one bevel blade being used at a time in connection with the stock. The parts may be adjusted to set the bevel blade to the protractor to form an indicator to give the two angles of forty-five degrees and one hundred and thirty-five degrees, and the graduation on the protractor is so arranged as to give any angle, and also the angle of a polygon at the same time, or adjustments may be made whereby the



HARRIS' COMBINATION TOOL.

device may be readily used for drawing purposes and for transferring angles from the drawings to the work.

What is Injurious to the Eyes.

A writer in the *Reading Times* reports a statement made by an eminent oculist to the effect that typewriting has an injurious effect upon the eyes.

The operator is obliged to glance incessantly back and forth from the keyboard to the shorthand notes, and this is a muscular exercise of the most fatiguing sort. For this reason the oculist urges it is desirable for the typewritist to cultivate a familiarity with the keyboard similar to that possessed by the accomplished pianist with the keyboard for his instrument, so that it will be necessary to look at the keys as little as possible.

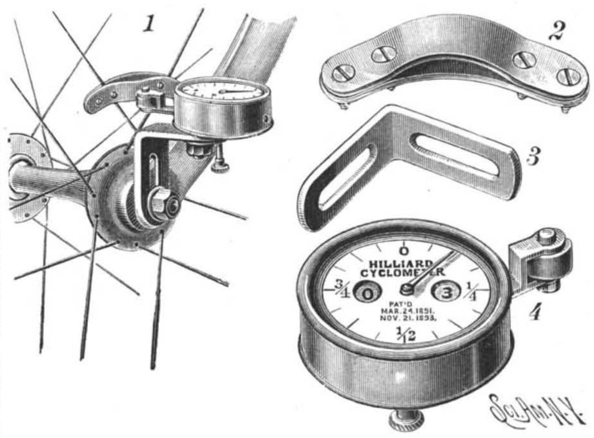
While the injury that may result to the eyes of a hard-working typewritist who is not sure of her fingers and her keys is not to be regarded too lightly, it is not likely to be nearly as serious as that resulting from the practice indulged in by so many in these days of railroad travel of persistent reading on trains. This practice is most trying on those delicate muscles that regulate the shape of the eyes' lenses and so affect the focalization of the organ. The danger is greatest, of course, on those railroads whose ballasting is imperfect and whose rails are roughly laid, producing much jarring and consequent rapid changing of the distance between the eye and the paper.

In some cases the eyes of a victim of the railroad reading habit are so affected as to focus at different distances, and then his sufferings are most acute, and though much relief may be afforded by the treatment of a skilled practitioner, nothing but a discontinuance of the habit will afford a perfect cure.

In the case of a person who suffered tortures for two or three years from eye disorder, due to train reading, neither rest nor professional skill availed until by accident the yellow window shades in the office in which he was employed were removed, when he was able at once to work with greatly increased ease and comfort, and in a few months was entirely cured.

THE HILLIARD CYCLOMETER.

This finely finished and very neat little device, of which the case and attachments are nickel plated, can be attached in five minutes' time to any bicycle, and will afford an accurate register of the distance the rider



THE HILLIARD CYCLOMETER.

passes over. It is manufactured by the Hilliard Cyclometer Company, 1128 and 1130 N. 40th Street, Philadelphia, who make it in two styles, the No. 1, adapted to register twelfths of a mile up to 1,000 miles, and the No. 2, which registers sixteenths of a mile up to 100 miles. Fig. 1 shows the manner of its attachment to the fork on left hand side of front wheel, Fig. 3 representing the slotted angle piece by which its adjustment in position is easily effected, and Fig. 2 showing the interfering band, to be fastened to the wheel in such position that, at each revolution of the wheel, the band will move and roll over the lever projecting from the cyclometer casing. The device is placed where one can see it all the time, and it is an exceedingly simple matter to adjust it in position. Its action is positive, and every wheel in it is locked to prevent rattle. The instrument has met with great favor among bicycle riders during the past two seasons.

THE SEVENTH AVENUE BRIDGE OVER THE HARLEM RIVER, NEW YORK CITY.

Some time ago we illustrated the 155th Street viaduct in this city; it provides an elevated roadway leading from the high ground at 155th Street and 9th Avenue to the abutment of the 7th Avenue bridge over the Harlem River, a structure long known as the McComb's Dam bridge. The improvements included an approach to the bridge, and the line of communication across the Harlem River is now on the point of being completed by a viaduct on the north side of the river and by a steel bridge crossing it. The two viaducts and bridge together are one of the greatest engineering operations hitherto carried out by this city. In the cut we present a view of the bridge proper, which spans the river, as it appeared in process of erection, with some of the false work still in position.

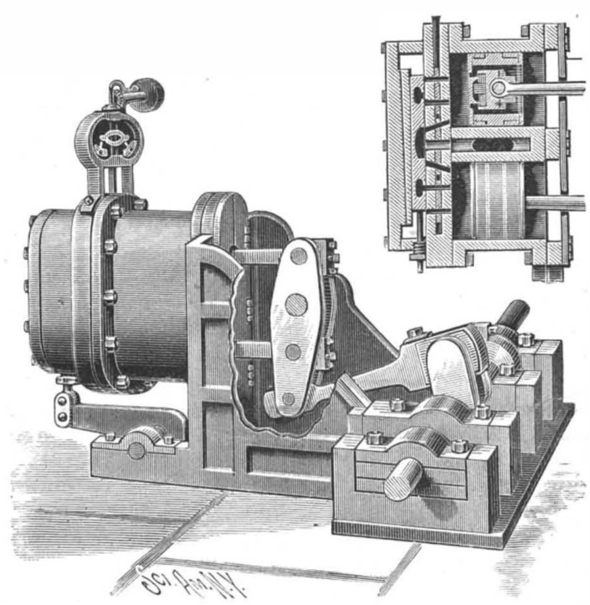
The structure is of steel supported by granite piers, which rest upon deep foundations, two having been established by compressed air caissons, and one by a deep coffer dam.

The principal object in the illustration is the steel draw span, which is carried on a central pier. Between the outer limits of the end piers of this truss is a width of 400 feet, the span from center to center of the end piers being 415 feet, and a clear height of 28 feet above tide water is given. The center pier width measures, from the outside of the fenders, 70 feet, so two very wide openings, each of 165 feet, are provided when the draw is open. The bridge provides a 40 foot roadway, with a 9 foot sidewalk on each side. It is carried on coned rollers, a double drum intervening between floor and rollers supporting the weight. The construction was an interesting operation. As the floor was established, two lines of rails were laid on the outside edges, and a traveling scaffold carried by wheels traversed the length of the bridge, and from it the pieces were hoisted into position. The total weight of the draw span is 2,400 tons. It is floored with iron buckle plates covered with asphalt for the roadway. A steam engine established on the pier beneath the bridge turns it, 1½ minutes being required for the operation.

Our thanks are due to Mr. Alfred P. Barler, of this city, who is the engineer of the structure, for information given.

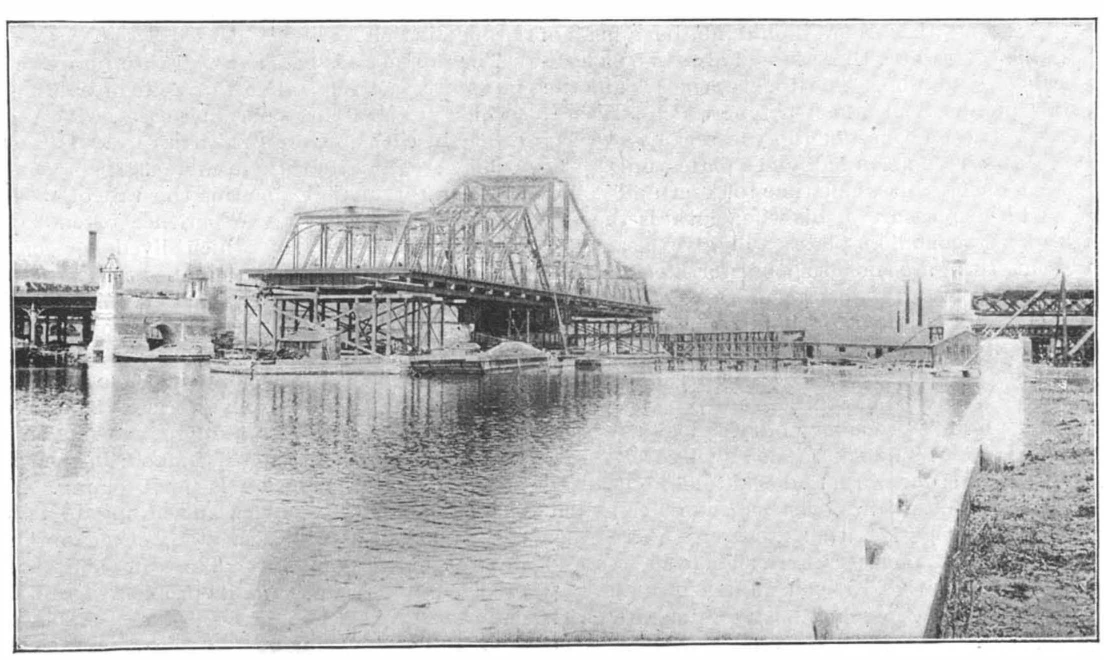
A QUICK SPEED STEAM ENGINE.

This engine, patented by Mr. John P. Devoissaud, of Sherman, Texas, is designed for high pressures and for the development of a maximum of power with an economical use of steam. Forwardly located on the box-like bed plate are two steam cylinders, one upon the other, and of equal diameter, preferably integrally formed, and having an exhaust passage common to both in the wall that divides them, as shown in the small sectional view. In the oblong head plate bolted on the front ends of the cylinders is a vertical channel, which receives a flat, thin throttle valve, the exterior surface of the plate containing the valve seat for the main valve, sliding in a rectangular steam chest, the valve being maintained at all times in loose contact with the seat. The valve seat and head plate are oppositely slotted at two points near each end, providing two live steam ports that in pairs intersect the bore of each cylinder at points equally removed from its axis, and at points equally distant from the nearest live steam ports are exhaust ports inclined toward the common exhaust port. A flat stem projecting upward from the throttle valve is detach-



DEVOISSAUD'S QUICK SPEED STEAM ENGINE.

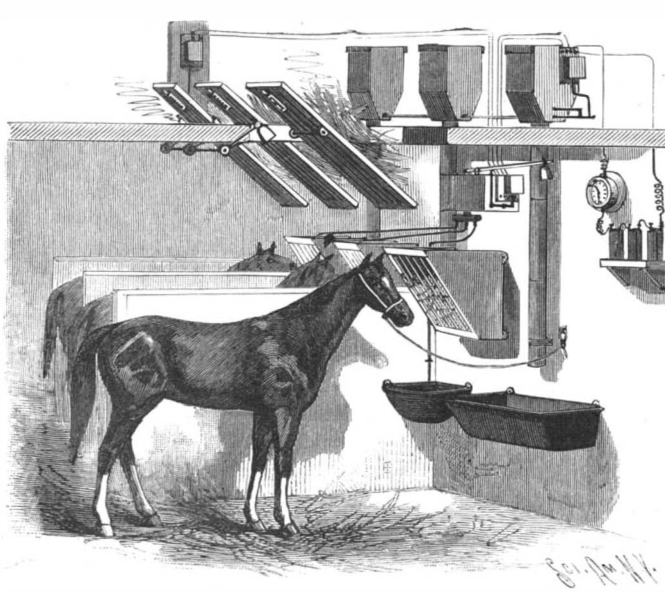
ably connected to a governor of novel construction, which forms the subject of a separate patent issued to the same inventor. The rear ends of the cylinders are closed by swinging doors to exclude dirt, and a flange affords means for a stable connection with the bed plate, which is upwardly extended as housing frames on each side, and shown partly broken away in the illustration. The main valve is so adjusted that it will alternately admit steam into one cylinder and connect the exhaust port of the other cylinder with the common exhaust passage, so that the pistons are successively acted upon by the steam, and, as the traverse of the piston heads is short, as compared to their area, a high speed is designed to be attained with low frictional resistance.



THE GREAT SWINGING BRIDGE OVER THE HARLEM RIVER, NEW YORK CITY.

FEEDING AND WATERING LIVE STOCK.

The illustration represents some novel electrically operated devices, adapted to work automatically with a time mechanism, for feeding and watering live stock, or a manually operated circuit closer may be utilized in connection with the improvement if desired. A patent has been granted for this invention to Mr. Arthur C. Winch, of Saxonville, Mass. For feeding hay a pivoted rack is employed, journaled at a convenient point above the manger, the rack being tilted to discharge its load by the release of a catch on a weighted oscillating shaft which has a crank extending into the path of a releasing and locking bar held in a case operated by the electric mechanism, a number of racks being preferably arranged in series and operated by one locking box and bar. The grain is fed to the manger in a similar way from compartments each adapted to contain grain enough for one animal, any number of such compartments being provided. Leading from the bottom of each compartment is a discharge pipe, the slide covering the opening to which is connected with a shaft actuated by a bar from a locking and releasing box. The water is also similarly supplied from a tank arranged at a suitable elevation, the valve being controlled by a lever actuated by the locking and releasing mechanism. Each locking and releasing box has a similar mechanism, and each locking box has an automatic switch adapted to shunt or switch the current from one locking box to the next, so that the hay, grain, and water supplying mechanisms may be operated in succession. Any form of circuit-closing clock may be used in connection with the apparatus.



WINCH'S ELECTRICALLY OPERATED MECHANISM FOR FEEDING AND WATERING LIVE STOCK.

THE LONDON GIGANTIC WHEEL.

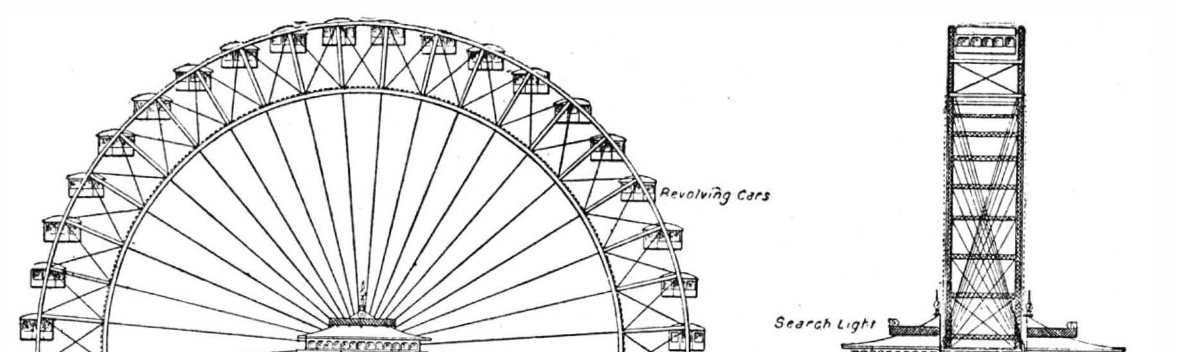
A company has been formed in London under the name of "The Gigantic Wheel and Recreation Towers Co., Limited," to construct and work a wheel somewhat similar to the celebrated Ferris wheel. It is to be erected at Earl's Court Exhibition, and the first length of one of the legs for the towers was recently placed in position. The *Engineer* says: The general design of the whole structure is by Lieutenant J. W. Graydon, and the contract has been taken by Mr. W. B. Basset, managing director of Messrs. Maudslay, Sons & Field, who is represented on the works by Mr. Efford. The wheel will be on the site occupied by the lighthouse last year, and the constructors hope to have it in working order by the end of June. It is to be 300 feet diameter, while the diameter of the Ferris wheel was 250 feet, and it will have accommodation for 1,600 people, instead of 1,368.

But it is not only in size that the Gigantic differs from the Ferris. The structures which carry the axle bearings are very different in appearance. The English wheel will be carried on two towers, 175 feet high, having on their tops, and at intermediate stages, saloons, surrounded on three sides by balconies. Communication with the tops of these towers will be by lifts as well as by staircases, and they will be connected by a passage running through the axle of the wheel. This is to be 7 feet diameter, and will be built up of mild steel bars and plates; while in the Ferris wheel the axle is a solid steel forging, 32 inches diameter and 30 inches at bearings.

Another great point of dissimilarity is in the manner of driving. On the Chicago wheel there was a circular cast iron spur rack, with teeth 24 inches pitch, actuated by a chain, which was driven from a steam engine. The new wheel is to be driven by a steel wire hawser $1\frac{7}{8}$ inches diameter. There will be two of these, one on each side, passing round grooves on the sides of the wheel, at 195 feet diameter, but it is only intended to use one at a time. The motive power will be taken from two 50 horse power dynamos, and of these also it is calculated that one will be sufficient, and the other merely in reserve. The electric force for these dynamos will be supplied by Messrs. G. C. Fricker & Co., who, as in former years, have the contract for lighting the buildings and grounds; and the directors propose to introduce some novel effects in the way of lighting up the wheel by electricity.

The towers are being made and erected by the Arrol's Bridge and Roof Company, of Glasgow. Each tower stands on four concrete blocks, 15 feet deep, 15 feet square at top, and 18 feet by 19 feet at the bottom. The ground excavated is of firm, compact sand, mixed with shingle. Each leg will be held to its concrete base by eight steel bolts $2\frac{1}{4}$ inches diameter and 12 feet long. The shear legs, with which Messrs. Arrol have commenced to erect the towers, are themselves an interesting example of light girder work. Each leg is 94 feet long, 24 inches square in the middle, and tapering to 16 inches square at each end. They are formed of four $3\frac{1}{2}$ inches by $3\frac{1}{2}$ inches by $\frac{1}{2}$ inch angles, joined by $2\frac{1}{2}$ inches by $\frac{3}{8}$ inch bars, stiffened by $\frac{3}{8}$ inch plates at intervals. They stand 24 feet apart at the foot and 5 feet at the head, where they are joined by a cross piece. The first length of the tower leg which has just been erected is 5 feet 2 inches by 4 feet by 46 feet. It forms a box girder, with 6 inches by 6 inches by $\frac{1}{2}$ inch angles and $\frac{1}{2}$ inch plates, with a 5 inches by $2\frac{1}{2}$ inches by $\frac{3}{8}$ inch T stiffener on each side, and cross plates every four feet.

The axle is being made at Messrs. Maudslay's works in Lambeth, and the order for the carriages has been given to Messrs. Brown, Marshall & Co., of Birmingham. Of these there are to be forty, each 25 feet long, 15 feet wide, and 10 feet high, accommodating forty passengers. There will be eight stages from which they can be entered, so that the wheel will stop five times during each revolution, which will take about twenty minutes.



THE LONDON GIGANTIC WHEEL.

ANAGLYPHS.

The word anaglyph (from Greek ἀνά, "up," and γλύφειν, "to carve," that is, to carve in relief) is somewhat too pretentious, perhaps, for what it represents. It concerns, in fact, neither a cameo nor a bass-relief, but a stereoscopic photograph or stereogram of a peculiar kind.

Stereoscopy, that interesting and unfortunately so forsaken branch of photography, reserves for us in anaglyphs (for it is necessary to call these new prints by their name) an application which is both interesting and curious, and for which we are indebted to Mr. Ducos du Hauron.

It has been known for a long time that the sensation of relief and of aerial perspective is due to binocular vision. Each one of our eyes, in fixing an object, does not see it at the same angle, and consequently not in an identical manner, and it is from the sensorial superposition of the two images thus obtained that springs the notion of depth.

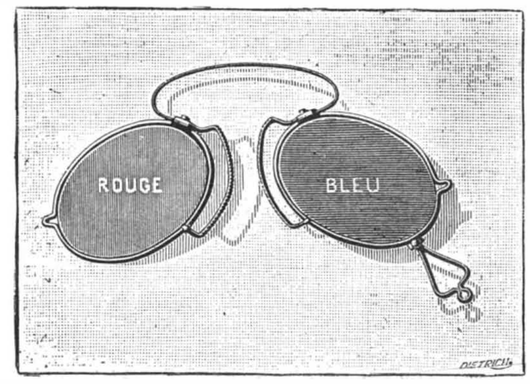


Fig. 1.—EYEGLASSES FOR EXPERIMENTING WITH ANAGLYPHS.

The general problem of stereoscopy consists, then, in showing to each eye the image of an object such as it would see it, and from the cerebral or subjective superposition of these two images will arise the impression of the real relief of the thing represented. But here supervenes a little difficulty. If we present two slightly dissimilar images to our eyes (let us admit that it is a question of two photographs taken from two points distant from the space between the eyes), each eye will not see solely the image corresponding to that which it would receive of the reality, but rather the two at once, on account of the extent of the visual field.

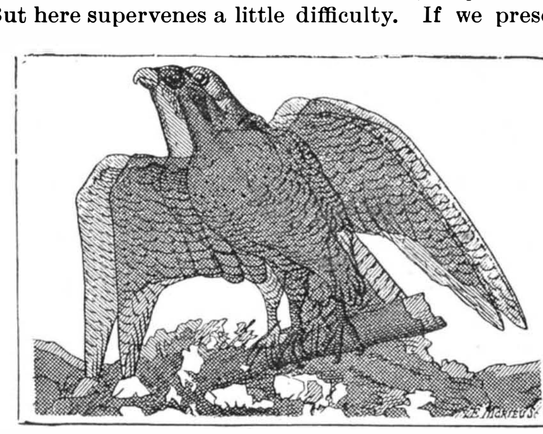


Fig. 2—SPECIMEN OF AN ANAGLYPH FIGURE—SUPERPOSED RED AND BLUE COLORS REPLACED BY TINTS.

Moreover, if the left eye desires to fix the center of the left image, the right eye will immediately converge toward the same point instead of directing itself toward the center of the right image. If we suppose, as is necessary, that the distance from the centers of the two photographs is equal to that of the separation of the eyes, it would be necessary, in order that each might regard corresponding points in each of the images, that the view should be directed at a point situated in infinity, for, in this case, the optical axes are parallel. Now, the eye contains an optical apparatus, the crystalline lens, which does not admit of a fixed focusing for all positions, but which, on the contrary, possesses the wonderful property (called accommodation) of furnishing an instantaneous and automatic focusing for any distance whatever, and such distance it calculates in a mathematical, trigonometric manner. It is precisely the convergence of the eyes that furnishes it to it.

Vision, consequently, is caught between two equally defective alternatives; either each eye is directed toward the center of each of the images, and then what we see is flat, because, the optical axes being parallel, distinctness exists only in very remote objects; or else we observe distinctness, but then the two eyes are directed upon a single one of the two photographs.

In order to obtain at once a clear vision of a single image by each eye, we are, therefore, obliged to employ an artifice. The ordinary apparatus known as the Brewster or refraction stereoscope permits us to solve this problem. In fact, upon interposing between the eyes and the photograph two prisms whose edges are turned toward each other, we shall succeed, upon properly selecting their angles, in having the virtual superposition of the different points of the two images, and consequently the relief, while allowing the eyes to converge to the same degree as in ordinary vision, which is precisely the result sought. The angles of the prisms may vary within certain limits, for we can obtain an exact adaptation in causing their distance from the images to vary. By this process, in spite of everything, three images would be seen, a central one in relief and two flat ones. These two latter may be got rid of by placing between the prisms, and at right angles with the photograph viewed, an opaque partition that limits the field of each eye.

It is possible to see stereoptically by dissociating, through practice, the convergence of the accommodation, that is to say, by bringing about an artificial strabismus; but such a process is lengthy, tiresome and not very practical.

After these considerations, and to return to the anaglyphs, we may define them as a colored image stereoscope. Let us suppose that, upon the same sheet of paper, we print two stereoscopic figures in two different colors, so that their corresponding points shall be at a very short distance from each other (Fig. 2). Let us admit that the colors selected, which should be very different, are blue for the left image and red for the right. At first sight these two prints, which, from what we have just said, will be naturally entangled with one another, will be confused and offer a not very agreeable and not very comprehensible mixture. But, if we view them with a pair of eyeglasses having a red glass in front of the left eye and a blue one before the right (Fig. 1), the scene immediately changes, and to the primitive chaos succeeds a harmonic and striking impression of relief and perspective. What has taken place? Something which at first sight is a little paradoxical, or at least odd. The left eye, provided with its red glass, will be able to see only the left image, which is blue; the second or red image, representing the other print, becomes invisible, because a red figure upon a white ground is not perceptible in red light. For the same reason, the right eye sees only the image that is destined for it, and the stereoscopic superposition ensues instantaneously. The convergence and accommodation are satisfied at the same time, because the two prints present but an insignificant spacing in the limits of which the focus is still sufficiently exact. Besides, the images may be of any size, since, whatever be their dimensions, they can always be printed as close to each other as may be desired, or, better, one upon the other.

In order that the effect may completely succeed, certain conditions are requisite. The prints must be of quite light shades and the glasses must be of dark ones. Consequently, it is necessary to use an intense illumination, otherwise, seeing the great absorption of light, the result will be dull and somber.

If the rays reflected by the prints and admitted by the glasses were absolutely monochromatic, the images would appear in black upon a ground represented by a mixture of the two colors adopted. In fact, an image emitting blue rays only must become black in red light, since all the rays that it sends back are arrested by the red glass, that is to say, it will present itself under the appearance of a colorless print upon a monochromatic ground. Will this new kind of stereoscopic prints, which require the aid of phototypy and quite a profound knowledge of colors, have a practical result? We know not. It is evidently not a process for amateurs, but it is interesting from a theoretical and scientific point of view. It will prove a curiosity to the unscientific, to whom it may be presented as a sort of puzzle, the solution of which is found in a pair of eyeglasses. For such a purpose it may be destined to meet with a certain amount of success.—*La Nature.*

Improved Process for Steel Castings.

At the recent meeting of the Iron and Steel Institute, a paper was read by Mr. G. J. Snelus, on the Walrand-Legenisel process for steel castings. This process consists of adding to the metal in the converter at the end of the ordinary blow a definite quantity of melted ferro-silicon, then making the after-blow, turning down when the extra silicon has been burned out, and adding the ordinary final additions of ferro-manganese, etc., as circumstances required. The advantages of this process are that first an ordinary Bessemer pig can be used with 2 to 3 per cent silicon, thus insuring a seel perfectly free from carbon; secondly, the combustion of the added silicon produces such a large amount of heat at the right time, and so rapidly, that the metal becomes very fluid; the third advantage claimed is that as the silicon burns to a solid, it leaves the metal perfectly free from gas, and the steel is sound and free from gas cavities; fourth, that in consequence of the metal being so fluid and already free from oxide of iron, the ferro-manganese or other substances added, such as aluminum, are more effective and remain in the final steel. Another advantage secured by this process is that in consequence of the fluidity of the metal much more time and facility is given for casting operations. The author gave detailed descriptions of experiments he had seen made with this process, and quoted figures in support of his contentions. The system of casting is, however, confessedly expensive, and it would seem to be more especially suitable for those engineering works where it is desirable to have a steel foundry attached, and in which the demand would naturally not be so continuous as in the case of an establishment devoted entirely to the production of steel castings. It may be stated that the price of steel as it stands in the ladle is given as 4s. 6d. per cwt., while the cost of a complete installation of moderate size would be about £3,500.

Ball Bearings for Wagons.

"Ball bearings are successful only when the balls themselves are of the highest quality, and the shells and axles are of the best steel hardened and ground to the highest perfection. The limit of error in the best does not vary more than one-quarter of one-thousandth of an inch, or one-fourth the thickness of tissue paper. Such perfection is very costly and the least dirt destroys the whole gain, for if the balls be stopped by any impediment, they are very soon ruined. Such accurate work is not likely to be properly protected or properly cared for in farm vehicles. Hence it is questionable whether the failures would not more than overbalance the advantages; besides, in the cost of drawing a load, a part is friction and a part is overcoming the ground resistance. The poorer the road the greater is the ground resistance, and this has a great bearing on the percentage of advantage; for supposing that, in the case of a trotting sulky, the friction is half the resistance and the ground resistance the other half. Now if we reduce the friction one half, the power required to draw the sulky would be reduced one-quarter, or twenty-five per cent, whereas if in drawing a lumber wagon the friction is ten per cent and the ground resistance ninety per cent—which on a farm and farm roads is about what it amounts to—then by reducing the friction one half we have reduced the actual power required only five per cent.

"The time has not come when it will pay. It will be an infinitely better investment to use the same money to put wide tires on the wheels and cut off the forward axles so as to bring the forward wheels the width of the tires nearer together than the hind ones.

"I have just been over a dirt road where one hundred tons of limestone are drawn every day, and the ruts were horrible when only common wagons were used. The road is now splendid, all owing to the use of half the number of wagons built as above described, while the ball bearings could at the best reduce the power required to draw farm wagons only from five to ten per cent. The wide tires and short axle wagons would reduce the cost of hauling on the farm roads forty to fifty per cent, and the cost of the changing to ball bearings would equal the cost of the new wheels and front or back axles."—*Prof. Sweet, in Rural New Yorker.*

The Columbia's Official Trial.

The commerce destroyer Columbia returned from her forty-eight hour trial on May 22. Under natural draught, using the three engines and the eight boilers, she developed a sea speed of 18½ knots per hour which is certainly as satisfactory as when she made 22·31 knots off the Maine coast last fall, when forced draught, picked coal and trained stokers were employed. On the return trip from the trial off the New England coast a speed of 19 knots per hour was made, but at that time the Columbia registered only 7,300 tons, while on May 18 when more fully loaded she registered 8,400 tons. The conditions were varied in the last trial so that the capabilities of the vessel were fully tested. The coal endurance was shown to be remarkable. At a speed of 10 knots an hour she can steam on thirty-five tons of coal per day. The amount of power developed by the engines has not been yet made public. The battery was also tested, some minor defects being developed. We illustrated and described the Columbia in our issues of the SCIENTIFIC AMERICAN for November 25 and December 2, 1893.

French Prosperity.

The United States consul in Bordeaux makes, in a recent report, some interesting observations on the growth of French prosperity during the past twenty years. Since the fall of the Second Empire, for example, the production of coal in France has increased 90 per cent and its consumption by 71 per cent. The tonnage of the goods transported by railway has increased 87 per cent, the number of travelers by rail has doubled, postal business has augmented by 140 per cent, the cash reserve in the Bank of France has doubled, between 1869 and 1891 the funds in the French savings banks increased fourfold, people throughout the country are in easier circumstances, and "if the burden now laid upon the taxpayer is heavier than formerly, he has, to say the least, greater resources at his disposal. Under no *regime* has wealth in France developed with such rapid strides as under the present system of government."

Correspondence.

The Destruction of Incandescent Lamps by Static Discharge.

To the Editor of the Scientific American:

In SCIENTIFIC AMERICAN of May 5, A. C. R. speaks of the static charge in an incandescent lamp destroying the carbon filament. I have tried the same thing of holding a lamp over a moving belt. The lamp acts as a Leyden jar, and holding it by the glass globe can be charged with a current that will be discharged when the brass base is touched. I have repeated the experiment many times without injuring the filament of the lamp, but find that a burned out lamp will answer equally as well.

One of the old style incandescent lamps, made two or three years ago, if charged and laid away so the base does not touch anything, will hold the charge for several days.

The best way to produce the "northern lights" effect is to charge two lamps separately over a belt and touch the bases together in a dark room.

Villisca, Iowa. H. C. STODDARD.

To the Editor of the Scientific American:

In correspondence column of your issue of the 5th May, A. C. R. asks, after stating instances of incandescent lamps burning out immediately after being brought near to or in contact with an object charged with static electricity: "What is there about this static display in a vacuum that destroys carbon filaments?"

In reply will say I have had a number of lamps destroyed by being hung near running belts. I find that the carbon of the lamp is attracted by the belt, and if not broken by the violent bending, a minute fracture is made in the glass whenever the heated carbon touches it, and though this fracture is usually a minute speck difficult to detect, it is sufficient to admit enough air to burn out the carbon in a short time.

Decatur, Ill. ROBT. FARIES.

Tuberculosis in Relation to Animal Industry and Public Health.

This is the title of a valuable "Bulletin" written by James Law, Professor of Veterinary Science at Cornell University, and issued by the Veterinary Division of the Agricultural Experiment Station of that institution.

The pamphlet is evidently the result of careful study of the subject. The following topics are treated with satisfactory fullness, many experiments upon which the statements are based being given:

"The Prevalence of Tuberculosis in the Lower Animals;" "The Germ Bacillus Tuberculosis;" "Accessory Causes of Tuberculosis;" "Lesions and Symptoms;" "Tuberculin;" "Danger from Flesh;" "Danger from Milk;" "State Measures for the Prevention and Extinction of Tuberculosis in Farm Animals."

A copy of this important pamphlet, numbered "Bulletin 65," will be sent free to physicians and members of boards of health on application to I. P. Roberts, director, Ithaca, N. Y.

Failure of an Eighteen Inch Armor Plate.

For several weeks those interested in the army and navy have looked forward to the test in which the largest gun made in the United States should measure its strength against an 18 inch Harveyized armor plate; but they were disappointed. The test occurred at the Indian Head proving ground, near Washington, on May 19, but the 12 inch gun was substituted for the 13 inch. The result was an utter failure of the plate, involving a loss to the Bethlehem Company of $20,000. The first shot smashed the plate, leaving cracks four inches wide; the second projectile finished the plate. The shot was a Carpenter armor-piercing projectile, and was propelled by 269 pounds of brown prismatic powder. The muzzle velocity was 1,465 feet per second; the shot struck with an energy of 12,660 foot tons. The plate was 16 feet long, 7½ feet wide, and the larger portion was 18 inches thick. The plate was set up against a solid oak backing, 3 feet thick, which was in turn secured to a heavy framework abutting on the cliff. The plate was broken into three pieces by the first shot. For the second shot the charge of powder was increased to 419 pounds, the muzzle velocity was 1,926 feet per second, and the striking energy was 21,182 foot tons. The shot was directed toward the largest fragment, it was broken in two, the backing was almost all destroyed, and the projectile was shattered to pieces.

The test of this one plate does not necessitate the rejection of the entire order—600 tons of armor, worth $300,000—as the Bethlehem Company can supply another plate; but should the second prove defective, the entire lot will be rejected. The delay will affect the completion of the Indiana particularly. The Harveyized process will not be discredited until after the test of another plate. Thinner plates treated by this process have proved very satisfactory, so there is no immediate cause for alarm.

NOTES ON THE HISTORY OF THE BREECH-LOADING GUN.

Let a Jules Verne or a Bellamy don the cap of prophecy and describe the probable state of affairs in A. D. 2000, and he has at once a host of readers. These idle vagaries are really surpassed in interest by the study of the manners, customs and inventions of a past time. The middle ages and the dawn of the modern period furnish abundance of material for the investigation of the curious. We have from time to time attempted to rescue some of the singular inventions of past time from oblivion, and we now present illustrations of breech-loading cannon in all ages, and shall endeavor to trace the history of the weapon from its inception to the present time.

It is indeed an extraordinary fact that the first guns of which we have any authentic record were breech-loaders. The breech-loading gun has passed through a period of desuetude, but to-day it stands without a rival and is truly the survival of the fittest. There is hardly a single principle of the modern breech-loading or machine gun which was not in use before 1700, and many of these principles are two hundred years older.

Tradition has named the battle of Crécy (1346) as the first occasion on which the weapon that was to revolutionize the art of war was used; but it is very probable that the use of cannon antedates the battle of Crécy by several years. Many historical works have stated that the battle of Crécy was won chiefly through the agency of a few small cannon; but this is very improbable, as a battle of that period was practically a succession of duels in which the individual was everything, and upon his valor in the hand-to-hand conflict the fate of the battle depended much more than in the modern long range battles. The English cannon used at the battle of Crécy, which we illustrate in Fig. 1, were made of forged iron and were open at both ends. The breech was probably closed with an iron block wedged in. The cannon was bound and re-enforced by bands. The mounting of the gun was very crude and could hardly have permitted of much accuracy of aim. The early cannon were called *bombardes* and *pierriers*, the latter name being used because stones were frequently used in place of other missiles. A little later the nomenclature became involved in inextricable confusion and the same kind of cannon are often described in different localities as *serpentines, coulverines, faucons, passe volants, basilics, spirales* and *bombardes.* Fig. 2 shows a blind or mantlet to a breech-loading cannon known at the time as a *schirmdach.* The gun and its mantlet belong to the second half of the fourteenth century. The swinging contrivance was by no means new, as it was used in siege work from Roman times to protect the *balista.* The figures are accoutered in the armor of the period.

The next gun, Fig. 3, is a Flemish breech-loading cannon. This curious engine, whose fire chamber screws into the barrel, is of forged iron, and was made at Ghent between 1404 and 1419. Holes will be noticed on the end to allow of its being screwed up tight with a spanner. Thus we have the principle which is used to-day in many systems of ordnance.

In Fig. 18, for example, is shown a piece of modern ordnance using a screw breech block almost exactly similar to this early piece. Fig. 12 shows a marked advance in mounting; the two pairs of uprights with holes to receive supporting pins allow of considerable adjustment.

This bombard is illustrated from a MSS. in *Bibliotheque National*, of Paris. In loading it movable cylinders (*manchons*) or movable chambers were used, in which the charge was previously laid; and these fitted by means of a wedge into the body of the piece. The removable chamber feature, which is, of course, the precursor of the modern cartridge, is also shown in Figs. 13 and 16. The gun shown in Fig. 13 dates from 1370 and is remarkable on several accounts, but chiefly because of its trunnions, which refutes Demmin, who says that trunnions made their first appearance in the middle of the fifteenth century. This interesting gun was raised from the Goodwin Sands. Fig. 16 shows a gun of similar character and is of great interest, as it was dredged up at Albany in 1879. It is an iron four pounder, ribbed, with short trunnions and a long handle. The breech block or case is missing, but is restored in our drawing from a similar gun in England. The slot in the side is where the wedge is inserted. This gun is at present at Governor's Island, New York Harbor. The Corean gun at Annapolis is almost exactly like Fig. 16, and has proved a source of controversy.

Fig. 15 shows a Dutch cannon made in 1650. The bore is continued through the cascabel, being closed at the breech after loading by a wedge moving horizontally, being on the same general principle as that of Krupp. Figs. 5 and 6 show modifications of the same principle. Fig. 5 is a cannon of the eighteenth century, in which the breech block is elevated by a rack and pinion. Fig. 6 represents a cannon which is in the museum of Woolwich Arsenal. In this gun we have the principle of the Armstrong gun. The bore is continued through the breech end and the breech piece works in a vertical slot, and is attached to a lever beneath. The vent runs first vertical and then horizontal to the axis of the bore. The date is 1619, and in this gun the principle of the modern rapid fire cannon may be said to have originated. Fig. 4 is a breech-loading cannon of the sixteenth century. The breech block is entirely removed while loading, and is secured with a pin before firing. The carriages were at this time much improved. Before proceeding to an examination of the double cannon, machine guns and other curious arms which we illustrate, it may prove interesting to glance for a moment at a modern breech mechanism, and we select the regular United States pattern for an example. Fig. 18 represents the regular arrangement of a rifled gun. The breech mechanism is regarded as being highly satisfactory. The breech block is provided with an interrupted screw for locking in the breech. One-sixth of a turn of the upper handle will lock or unlock the breech. A translating roller withdraws the block with great rapidity, as the screw thread is double. The block slides along the guide rails of the tray till the ends of these rails strike against the shoulders of the grooves. The shock due to this striking disengages a latch, the tray and block are then swung back to allow of the gun being loaded.

We now come to some curiosities in the way of guns. Fig. 11 shows a mortar or cannon, elbow-shaped. It is figured in Marescalchi's *Institutionum reipublicæ militaris*, published in 1515. The mortar was breech-loading and was provided with a movable chamber. The advantage of the elbow is very doubtful. Fig. 10 shows a glorious example of art metal work. This curious *dragonneau*, which is still in the Royal Armory of Madrid, was cast at Liège, France, in 1503, and figured in the siege of Santander in 1511. The carriage consists of a single piece of carved oak, and by its delicacy and finish worthily sustains this masterpiece of the bronze founder's art. The gun is particularly interesting from the fact that not only was it loaded at the breech, but has a double barrel. The costumes and armor of the men-at-arms are taken from manuscripts of the period. They are armed with crossbows, bills or war scythes and *gisarmes*, a kind of halbert.

The old manufacturers of ordnance at an early period saw the advantages of light rapid-fire guns and they produced some remarkable pieces. Fig. 7 shows a small iron breech-loading cannon on revolving gun carriage. This piece was left at Munich in 1632, by Gustavus Adolphus. All the usual adjustments in modern machine guns were provided for. Fig. 8 shows a small Swiss copper cannon adapted for firing ten successive charges. The length of the barrel is 27 inches, and it bears the signature of Welten, inventor, 1742. Fig. 14 is an interesting machine gun of 1718. Letters patent were granted to Mr. James Puckle for this gun. The light gun with its folding legs, the universal adjustments and the "Sett of Chambers ready charged to be Slip'd on when the first Sett are pull'd off to be re-charg'd," is an extraordinary manifestation of the ability of our forefathers unassisted by Messrs. Nordenfelt, Maxim, Gardner *et al.* In the quaint language of Mr. Puckle the gun is intended for "bridges, breaches, lines, passes, ships' boats, houses and other places." The claim of the inventor to universality of application would horrify a United States Patent Office examiner of the present day. The method of manipulation will be readily understood by reference to the illustration, the successive charges being forced into the breech of the gun by a translating screw. The folding tripod and the facilities for adjustment have been only very slightly improved upon in the nineteenth century. A set of the chambers is shown at the side.

One more arm remains to be considered, the *mitrailleuse.* The serpentine organ of the seventeenth century illustrated in Fig. 17 was provided with forty-two cannon, to be fired six at once. This fine example is in the Arsenal of Solure. The large beam in the center may have possibly been an auxiliary cannon or simply a shaft for aiming the mitrailleuse, the original illustration, unfortunately, showing little detail. The circular mitrailleuse illustrated in Fig. 9 is of the time of Peter the Great, and is probably of the period of Mr. Puckle's machine gun. The small mortars were loaded at the rear of the gun and were fired in quick succession from the front. It is very possible that five or six were fired at once.

Perhaps the time will come when our descendants will look back with pitying glances at the ordnance of A. D. 1894, as we now regard the archaic pieces which belched forth water-worn stones on the field of Crécy.

A Remarkable Gas Well.

A phenomenal gas well was recently drilled by the Chicago Oil Co. near Fostoria, O. The *Chicago Record* says the well is on the James Wallace farm in Hancock County. The drill had only reached the depth of 350 feet and the well had just been cased. The drillers heard the roar of gas as the drill tapped the reservoir, and ran for their lives from the derrick, but none too soon, as the ponderous drill was hurled like a shot from a gun to a height of nearly 100 feet above the tree tops. The casing followed in quick succession and was scattered and bent in a tangled mass. No sooner had the ponderous volume of gas given vent to its strength than it ignited from the fires of the boiler near by and a steady volume of fire shot up over 150 feet high.

Enough oil is thrown out with the gas to make a lake of fire surrounding the well and it is impossible to get closer than 100 feet to the burning well. The entire plant of the drillers, including the engine and boiler, is encircled by the flames, and everything is a total loss. The surrounding land is boggy, and for a quarter of a mile surrounding the well in many places the gas is coming up through the earth with such force that ground and water are thrown to a height of ten feet or more, and these patches resemble boiling springs. The water gurgles and dances from the escape of the gas fully a quarter of a mile away from the well. The entire woods is filled with the gas coming through the ground, and people have left the place, fearing at any time that the entire vicinity may spring into a mass of seething flames. The roar of the gas can be heard for nearly ten miles and people are coming from miles around to see the gusher.

Oil men old in experience declare that nothing like it has ever been known. It is in entirely new territory, and is supposed to be a crevice or pocket which will soon blow itself out. At its present rate of speed it can never be brought under control.

The American Fisheries Association.

The first meeting was held in Philadelphia, May 15. Mr. Fred. Mather, superintendent of the Cold Spring Harbor Hatchery, N. Y., read a paper, the subject being "Improved Method of Hatching Smelts." The little smelt carries a great many eggs, from 30,000 to 60,000, and from 100 ripe females probably 5,000,000 could be obtained. Until last year the fish were stripped and the eggs impregnated by hand, but this year all the eggs were gathered from the troughs, passed through wire screens to separate them, and put in the jars. At intervals of two or three days, or whenever the eggs seemed inclined to gather in bunches, the operation was repeated, gently forcing the eggs through the screens with the fingers, and after a few such screenings the foot of the egg, an adhesive projection, shaped like the stem of a wine glass, seemed to be destroyed, and the eggs were left free and clean as those of the whitefish or shad.

United States Commissioner McDonald read a paper "On the Relation of the Community to the Fisheries." He said:

The commercial fisheries of the country give employment to 182,407 persons, represent an investment in vessels, boats, fishing gear, buildings, wharves and other property of $58,355,000, and yield products of the annual value of $45,000,000 in first hands. The cost to the consumer is probably about $130,000,000, and it is thought that the fisheries of the whole United States furnish support to over 1,000,000. Individual ownership of the open waters is not practicable, even if it were desirable. It is vested in the State, and they should be farmed for the general use and benefit, and equal privileges before the law should characterize the policy of the State in enacting such regulations as may be found necessary for the conservation of the fisheries. The community is concerned only as to the abundance, quality and price of the products drawn from the waters. When conditions are impaired, then it is incumbent on the State to adopt measures to arrest the decline. This done, we may attempt the regeneration by artificial propagation on a sufficiently extensive scale to repair the waste by natural casualties and man's operations. Where this can be shown to be adequate, there should be no further interference with the fisheries by legal restrictions than is necessary to insure equal privileges in fishing.

Whether we can rely entirely on artificial propagation I am inclined to doubt, and this is illustrated by the history of the shad fisheries of the Atlantic coast since 1880. This fish does not spawn in brackish or salt waters. Under the present conditions but a small proportion of the shad entering the river reach the spawning ground. Fully 80 per cent are taken in the brackish water. Thus we must depend entirely on artificial propagation to repair the loss. Its permanence and marked improvement since 1880 is unquestionably the result of this. Since 1885 there has been a steady increase in the value of the shad taken on the Atlantic seaboard, and at present it is nearly double what it was in 1880. Yet I cannot disguise the fact that every year we have more reason to apprehend that exhaustive fishing will reduce the number running in the river till we shall no longer be able to rely on artificial propagation. The same condition exists in the Columbia River. What is true in regard to our river species is true in regard to all coast species. Since 1880 the number of persons employed in all branches and related industries has increased 38·77 per cent, as compared with the number employed in 1880. The capital involved has increased 53·43 per cent, while the total value of the products has increased but 17·14 per cent.

PHOTOGRAPHING A HUMAN HEAD UPON A TABLE.

In the SCIENTIFIC AMERICAN of March 3 Mr. Gilmore showed how, with a box placed on the front of a camera, "duplicate" pictures might be taken. Again, in the SCIENTIFIC AMERICAN of March 24, the same gentleman showed how the head of a living person might be represented as resting upon a platter on a dining room table; the tablecloth hanging down in front of the table so as to conceal the person who is sitting under the table. When I read these two descriptions, I wondered why Mr. Gilmore did not combine his two ideas, viz., of the "duplicate" and "decapitated" pictures -- throw the tablecloth aside and prove by photography that the head on the table is in no way connected with the body under the table, as shown by the accompanying representation.

This picture was made in this way. A table is provided with a top as shown here, having a portion of the top, as A, removable.

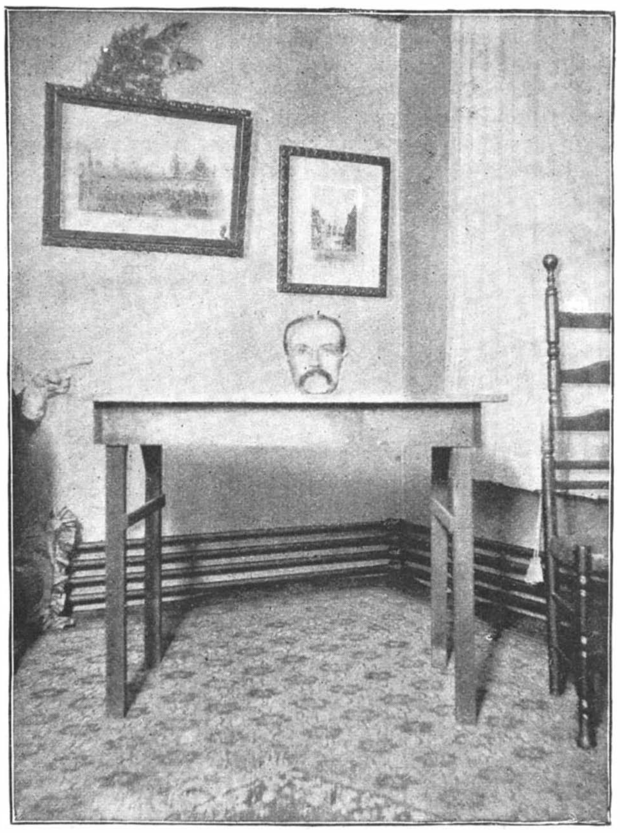
The person whose head is to be photographed sits in a chair underneath the table. The board, A, is removed to allow the person's head to pass above the table. The board is again placed in position on the table, and the closer the person's neck fits the hole, B, the better.

A camera is arranged with a box as described in the March 3 number of this paper; but in this (the above) case the camera is turned so that the two doors in the box, C and D, open up and down, instead of sideways. The camera is raised or lowered until the crack between the two doors of the box is on a level with the edge of the table. Now the upper door, C, of the box is opened wide so as to expose to the sensitive plate, when the shutter is worked, the head above the table and all objects in range of the lens above the edge of the table. After the exposure is made with these arrangements, the person whose head has been photographed has nothing more to do with the picture, and he may leave the room. The top door, C, is now closed, and the bottom door, D, is opened wide. By this move you protect the upper part of the plate from a second exposure and leave the way clear to expose the lower and as yet unexposed part of the plate.

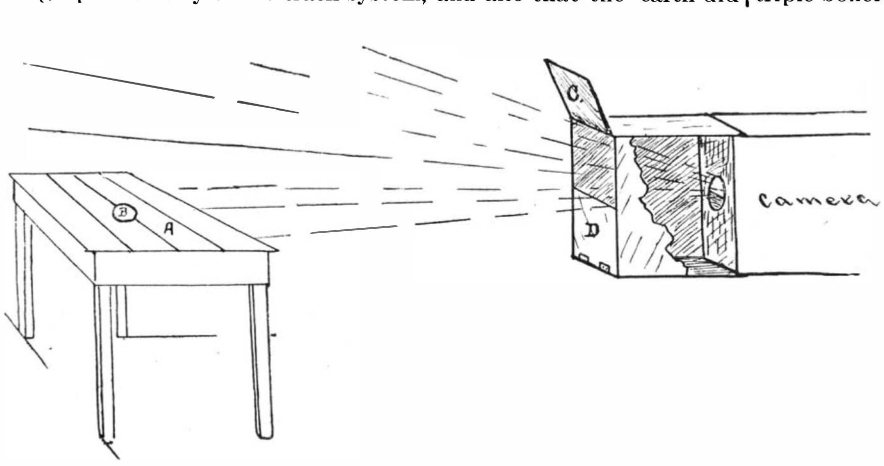
The shutter is again worked, and this time everything in range of the lens below the edge of the table has been photographed, and, of course, not showing any one under the table. This picture was taken by flash light.

JAMES BURT SMALLEY.

Bay City, Mich.



PHOTOGRAPHING A HUMAN HEAD UPON A TABLE.



Electric Railway Dangers.

At a recent meeting at Washington of the National Electric Light Association Mr. J. H. Vail, M. Inst. C. E., of New York City, brought forward a number of interesting cases of electrolysis. Among them were the following:

A plumber in a Pennsylvania city was repairing a water pipe in a house; and, on breaking a joint, an electric arc formed across the ends of the pipe. The house was not in the direct path of the railway circuit. Investigation followed; and it was proved beyond question that there was insufficient electric conductivity of the track system, and also that the earth did not afford a good return, though the tracks were well grounded. It was found that the railway current was traveling along all pipe systems in its effort to complete the circuit to the dynamos in the power station. Actual tests were made with standard instruments. From 135 readings of the ampere meter, it was found that the water pipes leading into the station carried an average current of 93 amperes. Further tests showed that, with 23 cars in operation, 40 per cent of the total current was carried by underground pipes.

Another interesting case was brought to light by a fire in the basement of a house. After it was extinguished, it was found that the current of an electric railway system had been carried along the iron water pipe entering the house. It is believed that, by vibration of the floors, this pipe and a gas pipe were brought repeatedly into contact—each time forming an arc between them. In this way a hole was eaten into the gas pipe and the gas was ignited. After an analysis of the whole matter, Mr. Vail felt justified in recommending the adoption of the complete metallic circuit as the standard for the best railway practice.

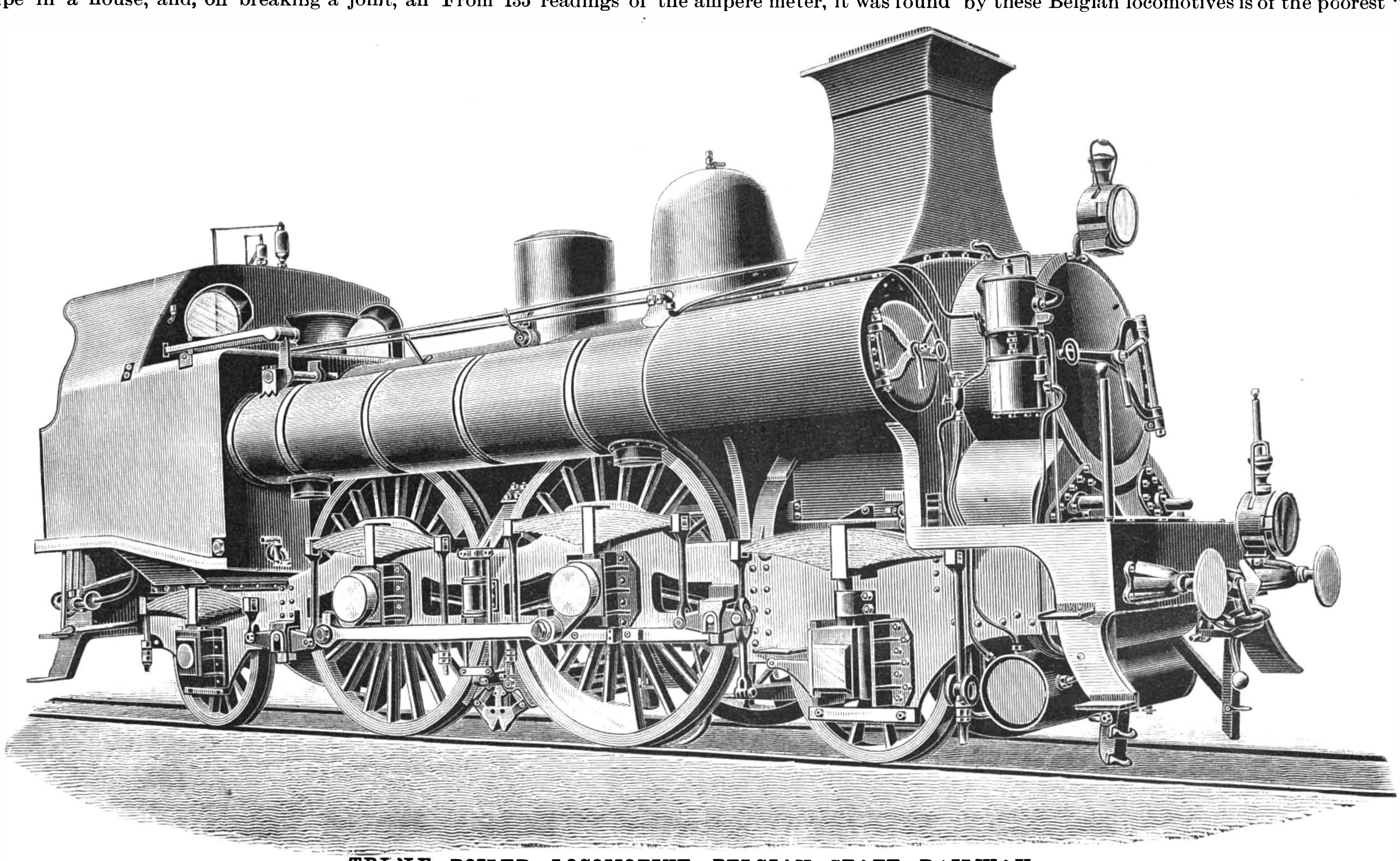
TRIPLE BOILER LOCOMOTIVE, BELGIAN STATE RAILWAY.

The curious-looking locomotive which we illustrate was built in 1888 by the Societe St. Leonard, of Liege, Belgium, and exhibited at the Paris Exhibition of 1889.

In calling for competitive designs of new engines, the authorities required that the competing locomotives should be able to haul a gross load of 150 tons up a gradient of 1 in 200 at 56 miles per hour, without diminution of steam pressure or of the level of the water in the boiler for a distance of three miles at least. The triple boiler engine ran up the grade stated at 61 miles per hour, and took trains of 150 tons gross (that is, including engines) up inclines of 1 in 62 at 40 miles per hour, and, on other occasions, loads of 182 tons up the same gradient at 31 miles per hour. At 59·4 miles per hour, with 150 tons, on a grade of 1 in 200, the power of the triple boiler engine exerted 1,339 horse power.

The engine illustrated has a boiler with three barrels, which have the same fire box tube plate, and the same extension smoke box in common. The chimney is square, spreading out at its base to embrace the side divisions of the smoke box, an arrangement which should improve the draught in the side flues, although it may be doubted if the exhaust steam acts so efficiently in a square chimney as in a round one, and it is certain that it obstructs the view somewhat. The smoke and steam, also, are said to be thrown less clear away from the engine than with the round forms.

The coal consumption is given as 254 to 322 kilogrammes per hour per square meter of grate surface, in other words, it burns an average of 3,167 lb. per hour, which, taking the commercial speed as 44 miles per hour, corresponds to 72 lb. per mile; 1 lb. of coal is said to evaporate 5·6 lb. of water upon the average, or 6·6 lb. as a maximum, results no better than obtained with American locomotives, but the coal burned by these Belgian locomotives is of the poorest "slack."



TRIPLE BOILER LOCOMOTIVE, BELGIAN STATE RAILWAY.

unmixed with briquettes, as commonly practiced in France. As regards economy, the results given by the engine are said to be excellent. There are, it is true, certain details of construction that could be improved, even in the existing engine, as, for example, the square chimney, and the absence of running boards permitting the engine to be got at when under way. There is also, sometimes, an unequal expansion of the tube plate, due to a superior draught in the central series of tubes. A trouble also with engines of abnormally large grate area is the difficulty of obtaining a sufficient draught in the smoke box. The locomotive in question is one of the most unconventional developments of locomotive practice since the time of Stephenson. It was designed with a view of obtaining great steaming power without mounting the boiler dangerously high. Continental and American trains make greater demands on the steam-producing capacity of the boilers than is the case in England ; hence these multiple boilers of Flaman, the St. Leonard's Company, and others, have been produced.

The principal dimensions of the engine are as follows :

Fire box, width inside	9 ft. 3 in.
" " outside	9 " 10 "
" length inside	5 " 10 "
" " outside	6 " 3 "
" height, front	3 " 7 "
" " back	2 " 9 "
Grate area	56 sq. ft.
Boiler, central	4 ft. 3 in. diam.
Boilers, side	2 " 3 " "
Tubes, central	180
" side series (48 each)	96
Total	276
Tubes, length	15 ft.
Working pressure	130 lb. per sq. in.
Heating surface, fire box	121·6 sq. ft.
" " boilers	1931·0 "
Total	2052·6 "
Cylinders, diameter	19·6 in.
Stroke	23·5 "
Drivers	6 ft. 10½ in. diam.
Weight, engine	56·8 tons.
" tender	29·5 "
Total	86·3 "

We are indebted to *Engineering* for our illustration and the foregoing particulars.

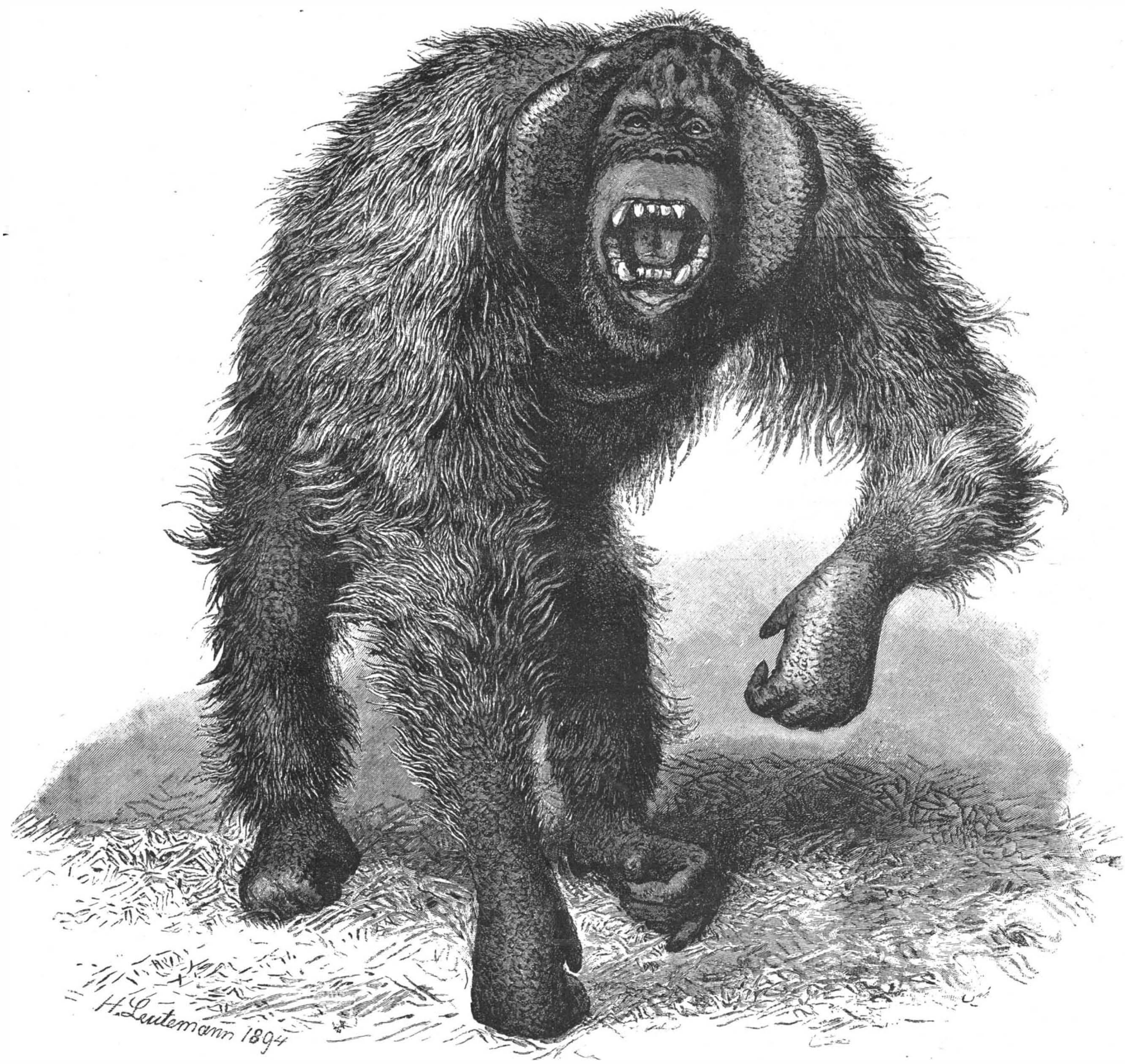
THE ORANG-OUTANG IN THE LEIPSIC ZOOLOGICAL GARDEN.

We publish to-day an engraving (for which we are indebted to the *Illustrirte Zeitung*) of the gigantic orang-outang in the Zoological Garden at Leipsic. This and two others that died last winter from the effects of the severe weather are the only full-grown orang-outangs that have ever reached Europe alive.

Any one who has formed his idea of a full grown ape of this kind from small or partly grown ones will be surprised when he sees our engraving, for it would be impossible to imagine such a remarkably shaped head with little ears that are entirely covered, such a hideous face with the cheek and throat pouches.

This animal is not as tall as one would suppose from a first glance, for he measures, when standing upright, only a little over 4 feet, but with his long arms stretched upward he measures to the tips of his fingers 6 feet 8 inches. When in this position the disproportions of his body are very noticeable, the thickness of his head, the breadth of the shapeless face, the wonderful development of the powerful chest and the broad back, the thick bull-like neck, but especially the length and strength of the arms compared with the shortness and weakness of the calfless legs. The large and strong, although slender, hands are covered with wrinkled skin that gives him the appearance of wearing kid gloves that are much too large for him. His feet or his hind hands are much longer than his fore hands, and he always keeps his toes turned under, so that he does not stand on the soles of his feet, but on the outer edges. It is impossible for an orang-outang to stand upright or to turn about without supporting himself by means of his arms, nor does he ever walk with a stick, as he is often represented. The number and arrangement of his teeth are the same as those of men, but his teeth are all stronger, and his eye teeth project like those of a beast of prey. The orang-outang shown in the illustration has lost one of his upper eye teeth, and his other teeth are much worn. Many scars on his hands and feet show that he has led an eventful life and received honorable wounds. His left thumb is bent and one of his toes is crippled.

Although possessed of such physical strength and so belligerent, the orang-outang is a vegetarian, living on fruits, buds, and young sprouts, but varying his diet by robbing birds' nests and hunting insects. In captivity he eats soaked rice, milk, raw eggs, oranges, dates, and he is very fond of bananas and white bread.



THE NEW ORANG-OUTANG IN THE ZOOLOGICAL GARDEN, LEIPSIC.

British Report on the World's Fair.

The British Royal Commission to the World's Fair at Chicago has just issued its report. It is very long and complete, comprising 61 large pages, with 45 sections and appendices, and its tone is decidedly favorable to the Exhibition. It gives an excellent description of the exhibits, and concludes by saying :

"It is impossible for those who did not visit the exhibition to understand the enthusiasm which pervaded it and the genuineness of its character. It would be an easy matter to criticise its shortcomings, but it is undeniable that it was a courageous inception, splendid in execution and successful in its results."

The report also says that Europe did not appreciate the proper value of the Exhibition, European interest seeming to fall back after the opening of the Fair.

Insomnia Produced by Shortening Hours for Sleep.

Adages are not always to be depended upon for good advice. Do not be deterred from taking all the rest necessary for your particular case by the saying "Nine hours are enough for a fool." To take enough sleep betokens wisdom, but "to sleep" does not mean to lie lazily in bed when once you are awake. "Nature takes five, custom seven, laziness nine and wickedness eleven," is wrong in at least two of its assertions. There are very few instances in which nature does not demand more than five hours' sleep. It is true that sleeping, like eating, is very much a matter of habit, and you may train yourself to dispense with more than five hours' sleep, as you may to omit the third meal of the day. How long you will flourish under such a regime will depend upon the strength of your constitution. You may fare like the man's horse, who, when it had been reduced to a diet of one straw a day, in the most ungrateful manner died on his hands.

A person may need nine hours' sleep out of the twenty-four without being either lazy or foolish. Indeed, he is a wise man if, feeling that he requires them, he is sensible enough to take them. Goethe, when performing his great literary feats, took nine hours' sleep. A full grown adult, in a healthy condition, will seldom require more than eight. If, however, he discovers that he is not sufficiently refreshed by eight hours, he should take more. It is a pretty safe rule to sleep as long as you are sleepy. "There are people," says a writer, "who are wise enough to eat when they are hungry, but who have never attained that higher reach of wisdom to sleep when they are sleepy." Unless you are a very lazy person, indeed, you are not likely to take more sleep than your constitution requires, for, of course, dawdling in bed is not sleeping.

By shortening the necessary hours for sleep you may bring upon yourself the dreaded disease, insomnia. There are scientific writers on this subject who claim that the best remedy for this is to learn to sleep in the daytime.

This is very well where from some cause—work, or watching, or pleasure—you may have failed to get your needed sleep for a night or two. There is undoubtedly a great virtue in naps, even short ones, and the art of napping in the daytime, although I could never acquire it, is a desirable one, and, like most arts, is a matter of practice. Still, it is a bad practice to get into the habit of turning night into day; and, if you are not kept awake by care or illness, but merely have lain awake because you could not sleep, I should recommend you to fight the consequent drowsiness of the next day, in order that you may, if possible, resume your natural rest at night. Sleeplessness is generally the result of an unfortunate habit of "thinking," generally on unpleasant subjects, after one has retired for the night. Dr. Frank Hamilton, a great physician and a wise man, said: "Gloomy thoughts prevent sleep. The poor and unfortunate magnify and increase their misfortune by too much thinking. 'Blessed be he who invented sleep,' but thrice blessed be the man who shall invent a cure for thinking."—*New York Recorder.*

Cordite.

During the trial of Nobel v. Anderson, Sir Charles Russell admitted, on the part of the military authorities, that Mr. Hiram S. Maxim was the first man to combine tri-nitro-cellulose, or gun cotton of the highest degree of nitration, with nitro-glycerin to produce an explosive equivalent to gunpowder in the propulsion of bullets from military firearms. Cordite in its present form is a mixture of nitro-glycerin with tri-nitro-cellulose and vaseline, formed in the first place into a jelly by means of a solvent known as acetone, and spun into cords or wires—the solvent being evaporated out. Gun cotton of the highest degree of nitration will not combine directly with nitro-glycerin, but the two substances can be readily combined by the use of a suitable solvent, such as acetone. Mr. Maxim was the first to experiment with and the first to patent a smokeless powder combining these two very high explosives, the acetone being evaporated out (No. 18,663 of 1888).

He was also the first to combine a small quantity of a suitable oil or paraffin wax with the other materials, which he also patented (No. 4,477, 1889). He was also the first to recover the solvent during the process of evaporation by condensing the vapor and redistilling it by means of a suitable apparatus, which he also patented (No. 18,663, 1888). Mr. Maxim was the first to press the mixture of nitro-glycerin and nitrated cotton into cords, the object being to get rid of the air in the manufacture of blasting gelatin, and this is the subject of a patent (No. 2,628 of 1889).

All these several inventions are used by the British government in the manufacture of the smokeless powder which is known as "Cordite," in reference to its particular form, and, by a curious coincidence, the size of the cord used in the 0·303 Woolwich cartridge is identical with that made by Mr. Maxim's original machine, patented in 1887. These experiments were undertaken by Mr. Maxim at the request of the military authorities, and cost five thousand pounds of solid cash. A perfect little laboratory was erected; scientific instruments were provided for taking velocities; and a special apparatus was designed and manufactured for taking a diagram of the pressures set up by the powder, as an alternative of the usual method of pressure gauges. Exhaustive experiments were made with every possible combination of nitro-glycerin and tri-nitro-cellulose dissolved in acetone from 1 to 60 per cent of nitro-glycerin. All kinds of oil were tried, and castor oil was found to give the best results. At the official trials Mr. Maxim's powder beat all others, but Mr. Maxim was informed that the authorities could not accept any smokeless powder containing nitro-glycerin. Nevertheless, they have, by some means or other, "arrived at" cordite.

It has been decided after a lengthened trial that cordite, of which tri-nitro-cellulose is one of the ingredients, is not an infringement of Mr. Nobel's patents, which are expressly confined to di-nitro-cellulose.

Mr. Maxim's position as the first and true inventor of the admixture of tri-nitro-cellulose and nitro-glycerin by dissolving the same in acetone having been admitted by Sir Charles Russell, as before mentioned, it is perfectly true that the Maxim-Nordenfelt Company have sent in a claim to the government to be paid a royalty for the article manufactured by the military authorites under the name of "Cordite." It remains to be seen whether it will be necessary for the company to follow the example of Mr. Nobel, and enforce their claims in a court of law.—*Arms and Explosives.*

Novelties in Dentistry.

The talk of the Convention of Dental Surgeons, lately held in Washington, gave a notion of the revolution in dentistry that has taken place within the past few years. By the use of an electric light in connection with the little mirror introduced into the mouth, the teeth and alveolar processes are brilliantly illuminated and rendered translucent. Thus anything wrong about the teeth may be quickly discovered. Perhaps the dead tooth may be hidden in the jaw, never having been erupted, and may have been the obscure cause of trouble for years. The light reveals it at once. Facial neuralgia, by the way, is nearly always due to a dead tooth.

Electricity is most valuable as a motive power for tooth-boring tools, which, strange to say, cause less pain the faster they go. Most people now grown up can recall the excruciating pain caused by the excavating instrument which the dentist of a generation ago slowly revolved between his fingers. The "burrs" now made for such work are much finer than they were half a dozen years ago, being capable of cutting through steel bars. Furthermore, the laborious method of turning them out by hand has been superseded recently by a machine which produces them at a cost of 19 cents apiece.

Electricity is employed also for pulling teeth. To the battery are attached three wires. Two of them have handles at the end, while the third is attached to the forceps. The patient grasps the handles, the electricity is turned on suddenly, and the dentist simultaneously applies his forceps to the tooth. The instant the tooth is touched, it, as well as the surrounding parts, become insensible to pain. A jerk, and it is out.

One dentist at the convention remarked that there is not one tooth lost now where there used to be one hundred. If only the root is left, a new upper part of porcelain or gold, called a "crown," is fastened upon it, so as to be quite serviceable. Supposing that not even the root is left, a gap in the mouth is filled in with one or more "dummies," securely fastened by a gold "bridge" or otherwise to the sound teeth. Complete sets of false teeth are rare nowadays.

The demand for "tooth crowns" comes largely from baseball players, football athletes, and bicycle riders, who are very apt to have their teeth broken off short. But the last and most ingenious resort of the dental surgeon is "implantation"—*i. e.*, the setting of new teeth into the jaw. For this purpose real teeth are employed, and not artificial ones. Cocaine having been first applied for producing local anæsthesia, a hole is drilled in the jaw bone, and into this socket a good tooth, newly drawn from somebody's jaw, is set. If the patient is young and vigorous, the osseous structure soon closes around it, and by the time the gum is healed the tooth is ready for use. It should last from three to ten years. In the case of an elderly or feeble person it may be fastened in place by silver wires passing around the jawbone.

One of the most important improvements in modern dental practice is on the point of being accomplished. It will consist in the substitution of porcelain for gold in the filling of teeth, especially in places where repairs are likely to show. For this purpose a piece of thin platinum foil is introduced into the "cavity," and so manipulated as to take the exact form of the hole, as if it were intended as a lining. Then it is carefully withdrawn, so as not to disturb its shape. Thus is obtained a mould, from which a porcelain cast may be made to fill the cavity exactly. This is secured in place by cement. The trouble is that no cement as yet invented is proof against the dissolving power of the fluids in the mouth.

The human jaw, while receding and losing its brute-like character, has been steadily growing narrower. This latter change is going on even now, so that most people have not room enough in their mouths for the equipment of teeth with which nature has provided them. Many persons are obliged to have two or four teeth drawn to make room for the rest. The "wisdoms" being superfluous for lack of space, nature is making them of poorer material in every generation. So these "third molars," as dentists term them, begin to decay usually and have to be filled or pulled as soon as they appear.

Inasmuch as real teeth are so easily lost, it is a comfort to know that artificial ones cost only 15 to 18 cents each at the manufacturer's. One maker in New York sells 8,000,000 teeth every year. They are porcelain, composed chiefly of kaolin. The enamel is put on with metallic oxides, the process being so delicate that no two teeth are exactly alike in coloring. After being finished thousands of them are taken together and matched in shades. There are fifty different shades, corresponding to variations in the coloring of natural teeth. Defects are often made in false teeth so as to render them more deceptive to the eye. The best plates are of rubber. Celluloid is the prettiest material for the purpose, but it does not resist the acids of the mouth.

A tooth is a living structure. Inside of each tooth is a cavity filled with pulp which gives it life. Nerves and blood vessels connect this pulp with the general system and circulation of the body. The ivory surrounding the pulp is covered over by a surface of enamel. Both ivory and enamel are harder than any other bones, because they contain a greater quantity of bone earth. Enamel on the tops of the teeth is one-sixteenth of an inch thick. It consists of little six sided prisms placed side by side, and held together by an exquisitely fine cement. The pulp of the tooth becomes diseased, and toothache follows. Tartar is a secretion made by three glands in the mouth, full of small living organisms which assimilate matter in the saliva and deposit it on the teeth in the shape of phosphate of lime.—*Providence Journal.*

Windmill Irrigation.

A bright Nebraska farmer writes as follows: "I have a wind power plant run by a 14 foot wheel, with an 8 inch pump that throws 4,400 barrels per day in a medium wind. I have two reservoirs, one 60 by 150 and one 80 by 150 feet. With this plant I have watered from ten to fifteen acres, and it can be managed so as to water still more by using and applying the water to some of the land during the winter season. It is necessary to use reservoirs, so as to have a larger volume of water whenever you irrigate. By this means you have more pressure and can water more land at one time and do it quickly.

"To build reservoirs, take from the inside of the dimensions that you wish to put into the reservoir the earth to make your banks with, by plowing and scraping it up from your bank, and by so doing you spoil no land on the outside. Two men and a team can make a reservoir 100 by 100 feet in eight or ten days, or less time. The Gause pump that I am using can be used in an open well or with drive points.

"To make your reservoir hold when you begin to pump water into it, commence tramping with horses as fast as the water covers the bottom of the pond until you get it into a loblolly of mud two or three inches deep, and this will then settle into the pores of the ground and stop very nearly all the seepage. Do not put manure or straw into the bottom of the pond if you ever expect to stock it with fish, as they will surely die.

"A plant like mine, or similar, with reservoirs, pumps, etc., complete, ought not to cost over $250, counting pay for the farmer's labor that he does himself on the plant. I am lifting the water 17 feet. This pump will raise the water 25 feet from the valve successfully.

"In irrigating a great many kinds of fruit trees, berries, and in fact all small fruits, use furrows or small ditches instead of flooding the land, and by so doing save at least one-third of the water that it would otherwise take to flood the land. I have eight acres in fruit, and in the last three years I have always had enough water to flood this orchard. Where there is a sufficient supply of water underneath and you do not have to go too deep for it, say 20 to 30 feet, I would advise the use of points instead of digging open wells. Where a man is gardening, or wishes to grow an orchard of ten acres, one of these plants will pay for itself in one dry season, and the farmer who has a plant of this kind is always sure of vegetables and berries for his own family use, and I consider this one of the most essential things to the farmer, for in any country to make true farming a success the farmer must grow his own vegetables and fruit for home use."—*Irrigation Age.*

PROPOSED TUBULAR RAILWAY UNDER THE ENGLISH CHANNEL.

The junction of England with the continent of Europe has already been the subject of numerous projects. Without going back to the project for a subterranean route recommended in 1892 by Mr. Mathieu, engineer of mines, it will suffice to recall the more recent project for a submarine tunnel proposed by Mr. Watkins, and for a gigantic bridge, whose promoters were Messrs. Schneider and Hersent, as well as the modification of the latter proposed by Mr. Bunau-Varilla.

All these projects have been abandoned, as much on account of the objections urged against them as by reason of the incomprehensible hostility that the English have always manifested toward all enterprises of this kind.

But Sir Edward Reed, a member of the English

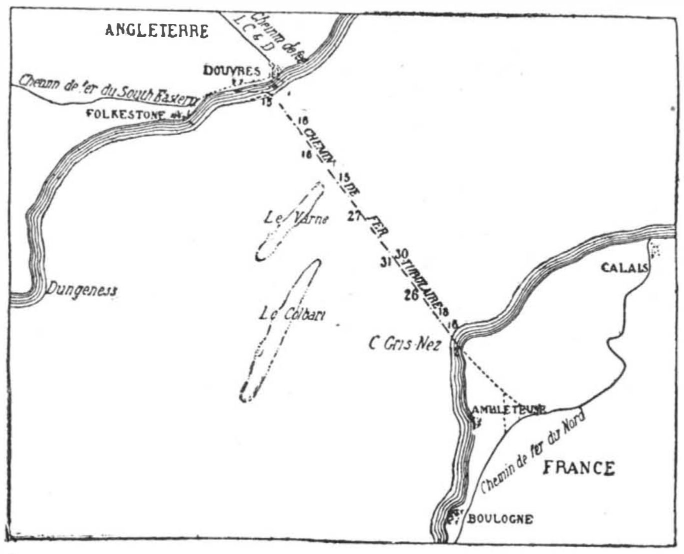


Fig. 1.—MAP SHOWING THE DIRECTION LINE OF THE PROPOSED CHANNEL TUNNEL.

Parliament, former Lord of the Treasury and engineer in chief of the Admiralty, has taken up the question again with a project which has been received with favor by a large number of members of Parliament, and which therefore seems to have serious chances of success, and the more so in that it avoids the difficulties and objections that were urged against its predecessors.

The project consists in simply submerging, between a point of the French coast situated in the vicinity of Cape Gris-Nez and another on the English coast located between Dover and Folkestone, two tubes that would constitute two absolutely separate tunnels, each serving for the passage in one direction of trains drawn by electric locomotives.

Referring to the map (Fig. 1) it will be seen that the configuration of the bottom in this part of the channel presents on each side a regular declivity that ends in a gentle slope at a line of greater depth. The soundings made at distances of a mile apart gave as successive depths, starting from the English coast, 82, 88, 88, 95, 98, 88, 98, 138, 160, 184, 174, 175, 160, 138, 98 and 82 feet. It will be seen, then, that the mean slope of each tunnel would not much exceed 0·08 inch to the foot. There would therefore be found excellent conditions for traction.

The tube would be of steel plate with double walls (Fig. 2), and the intervening space would be re-enforced by I beams and filled in with concrete. The putting in place would be effected by sections of 300 feet, hermetically sealed at each end and floated to the place where they were to be submerged.

One of the extremities of the section having been fixed upon a sort of caisson that will afterward perform the functions of a pier, the caisson is weighted so as to cause it to sink. The other extremity continues to emerge (Fig. 3), and receives the end of the following section, the junction being made by huge hinges. The caisson of this section is sunk, and so on. When all the sections are in place, the formation of the joints is begun.

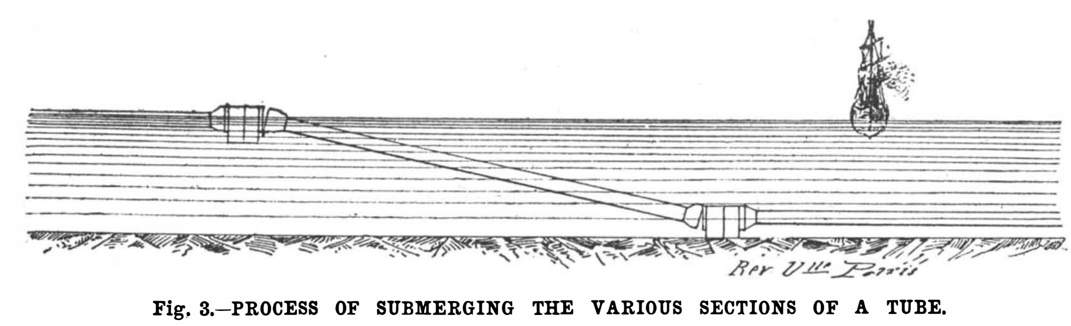


Fig. 3.—PROCESS OF SUBMERGING THE VARIOUS SECTIONS OF A TUBE.

What we have said about one tube applies also to the other, but, in reality, Sir Edward prefers to sink the sections of the two tubes simultaneously in properly cross-bracing them, in order to form a sort of rigid girder that would present much greater resistance to transverse stresses.

The caissons forming piers are designed to support the tubes at a slight distance from the bottom of the sea. This arrangement possesses the double advantage of doing away with any preliminary dredging, since it will be possible to give the piers the height necessary to avoid the slight changes of level of the bottom and of assuring a free circulation of the marine currents beneath as well as above the tubes. It permits, besides, of so regulating the system that the upward thrust partially balances the weight of the trains in each section. The stresses to which the tube will be submitted by the fact of such passage will be diminished by so much, and, therefore, much better conditions of resistance will be obtained than in an ordinary bridge.

The use of two distinct tubes will prevent all chances of accidents and will have the great advantage of realizing the important problem of the aeration of the tunnel, without any expense and in as satisfactory a manner as possible. In fact, each train will have somewhat the effect of a piston that forces the vitiated air before it and sucks in pure air behind it to take the place of the former.

The total cost of the installation of the tubes is estimated by Mr. Reed at seventy-five million dollars, which is less than half the cost anticipated by Messrs. Schneider and Hersent for the construction of a bridge across the channel.—*Revue Universelle.*

Artificial Marbles.

Mixtures suitable for the production of artificial stones having a basis of powdered marble or other stone, and Keen's cement, or Portland cement, are mixed with zinc chloride and zinc oxide, or with magnesium chloride, and separate portions, tinted with as many different colors as may be required, are dashed on to the bottom of a mould so as to produce a veined pattern, which, after filling up the mould, constitutes the ornamental surface of the artificial marble. The block may be veined throughout by the insertion and subsequent withdrawal of silk threads or wires covered with silk soaked in appropriate colors. The product may be polished by treatment with a hardening liquid, *e. g.*, zinc chloride followed by polishing with a mixture of alcohol 75 per cent, oil 5 per cent, plaster 5 per cent, white gum lac 5 per cent, turpentine 5 per cent, and yellow wax 5 per cent.—*F. Grand' Montagne, Brussels, Belgium.*

Electrical Sanitation.

A practical application of electricity to sanitation has recently been made. Two systems have been tested upon a very considerable scale, in both of which the electrolytic action of the current has been utilized.

The two methods at present before the public are Mr. William Webster's, which is being carried out by the Electrical Purification Association (Limited), and that ascribed to Mr. Eugene Hermite, and worked by him in conjunction with Messrs. Paterson and Cooper.

As has occurred so frequently before, both these inventors appear to have conceived the same idea about the same time. Each of them took out three patents in the year 1887, but, though each had the same object in view, and although in their early patents they seemed almost to be running on the same rather than on parallel lines, their recent practice is quite distinct.

Mr. Webster treats the sewage directly. He places parallel iron electrodes within a conduit or shoot, through which the sewage is passed, the electrodes being alternately connected with the positive and negative poles of a dynamo. The nascent ammonia thus evolved at the negative electrode produces an alkaline reaction, which effects the precipitation of the solid suspended matter, while at the positive pole nascent oxygen and chlorine are evolved, producing an acid reaction, whereby the organic impurities held in suspension or solution are readily decomposed and purified.

This system has been tested on a large scale, both at Crossness and at Salford. The amount of sludge formed is said to be smaller than in any precipitation process, and the effluent so pure as not to require further treatment by filtration. The process has been reported on in the most favorable manner, as regards the chemical tests of the effluent and the ease and uniformity with which the results are obtained.

Mr. Hermite's system consists in the treatment of sea water or other chloride solutions by electrolysis. The water thus electrolyzed in reservoirs is conducted as a disinfecting liquid by suitable pipes to places requiring disinfection, where it is stored in cisterns and used in place of ordinary water. The system has been experimentally tested at Havre, Lorient, Brest, and Nice and has been reported upon most favorably in every case. It is now being tried at Worthing, where an installation has been set up under the auspices of the mayor and corporation. As in the previous system, an oxygenated compound of chlorine is held to be produced which burns up the sewage matter and absolutely destroys all microbes.

Several questions have to be considered from a scientific and practical point of view, in connection with both these inventions, before their general application can be effected. The scientific view of the subject, after all, resolves itself into the answer to a single question: Is the process quite trustworthy to remove the maximum of organic matter from the sewage, and

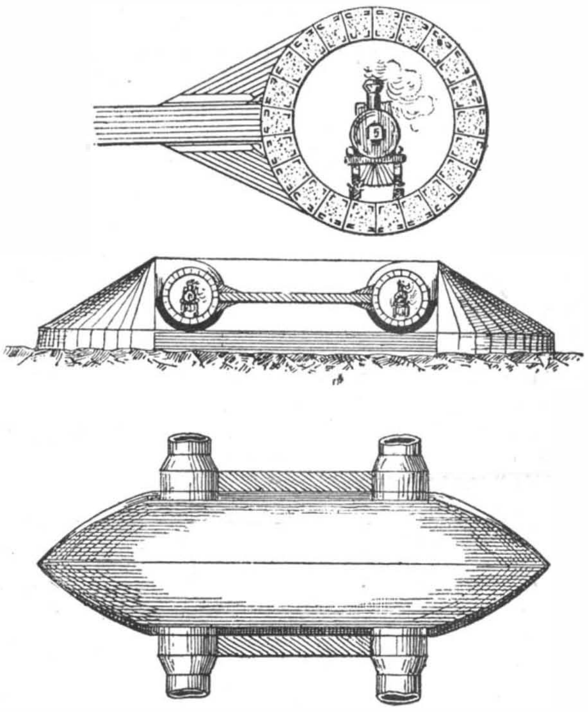


Fig. 2.—TRANSVERSE SECTION AND PLAN OF THE TUBES AND OF A PIER.

thoroughly sterilize it? As regards the practical point of view, the removal and utilization of the sludge will have to be faced, in the first process referred to; while in the second, in which sludge is said not to be produced, a second water supply to houses, and the chemical action of this disinfecting water upon the pipes, tubes, and reservoirs through which it has to pass, will have to be very fully considered before the system can be adopted.—*Nature.*

Banked Fires.

One of the things which is generally overlooked in the management of a factory steam plant is the treatment which the plant receives at night when the fires are banked. In some places, says the *Engineering Record*, the dampers are left wide open, and a current of air is allowed to draw in over the fires through the tubes of the boilers, and thence to the chimney. In other cases the dampers are closed, but they leak to such an extent that a considerable quantity of air finds its way through the boiler. It is needless to say that the effect is to cool the boilers, but the extent to which this operates, even where the leakage of air is comparatively slight, is seldom appreciated. An instance may be noted which shows that the matter is of considerable importance to those who are seeking the highest fuel economy. The case was one where the fires were banked at 6 p. m., and no steam was used from the plant at night save that which was condensed in the main steam pipes, and this was returned to the boiler by means of an automatic pump. The boilers were of the water-tube type and they were fitted with hand dampers in addition to a main damper in the flue. The common practice was to shut the main damper and leave the firedoors open with a pressure of 100 pounds at the time of banking. The main damper was not perfectly tight, and there was sufficient air drawn in to cool the boilers, so that when the fires were opened at 6 the next morning the steam pressure had fallen to 10 pounds. Subsequently the practice was changed by closing the hand dampers as well as the main damper, and closing also the fire and ash doors, no other condition in the operation of the plant being changed. The result was that, instead of having a pressure of 10 pounds at the time of pulling down the fires, there was a pressure of 40 pounds, and the bank of coal, which was previously more or less consumed, was in apparently the same condition as when the banked fire was first covered.

THE typewriter prism, to enable the operator to see and read work as it is written, as described in our issue of May 12, was shown applied to a **Remington No. 2, and not on the Smith Premier machine.**

RECENTLY PATENTED INVENTIONS.

Engineering.

QUICK SPEED STEAM ENGINE.—John P. Devoissaud, Sherman, Texas. This is a high pressure engine in which are two steam cylinders of equal diameter placed one upcn the other, having a single head plate, a main steam valve, a throttle valve in a channel between the head plate and the seat of the main valve, and a governor device driven from the engine shaft and directly actuating the throttle valve. The peculiar construction and arrangement of the parts is designed to give a high degree of efficiency with a minimum expenditure of motive force, the travel of the piston heads being short in comparison with their area, and giving a high speed with low frictional resistance.

STEAM ENGINE GOVERNOR.—The same inventor has obtained a separate patent for a governor for use in connection with this double cylinder single-acting steam engine, wherein a plate-like governor having suitable steam ports is introduced within a vertical channel in the single head plate, closing one end of the two cylinders. The governor is very sensitive and steady in action and adapted for direct connection to a vertical sliding cut-off valve, and contains reliable means for an exact adjustment of its parts, being also adapted for use in various types of engines.

Agricultural.

CORN HUSKER.—John P. Schurkens, Westphalia, Kansas. This is a machine preferably adapted to be drawn by a single horse, and in which the husking and ear-removing mechanism is made to approach the ground more or less closely by manipulating the rear extension of the shafts. It is adapted, when driven along a corn field, to remove the ears simultaneously from two rows of standing corn, removing the husks therefrom without injury to the ears and leaving the stalks with their roots in the ground. The machine is strong and inexpensive to build.

CULTIVATOR OR SEED PLANTER. — Linden Kirlin, Beattie, Kansas. This inventor has devised an improved self-adjusting connection between the main frame of a cultivator or planter and the frames carrying the cultivating and planting devices proper, adapting the latter frames to shift laterally automatically as required to enable the devices to work at different distances apart. The seat-supporting bar which connects the frames may also be shifted forward and back as required to enable the driver's weight to be thrown upon the front or rear portion of the runners. An improved sand and dust guard is likewise provided for the bearings of the rotating cultivating device or revolving disk.

Miscellaneous.

ORGAN.—Jerzy Polukanis, Bloomfield, N. J. This is an improvement upon a formerly patented invention of the same inventor, in which is employed a pneumatic valve having a casing and a sliding leak piston, while, according to the improvement, a self-acting pneumatic valve is provided with a swinging leak piston pivoted in a casing attached to the wind box, containing the pallets connecting the wind box with the wind chest, connected in the usual manner with the pipes to be sounded. The improvement is designed to facilitate the quick sounding of the pipes to permit the performer to execute any desired passage of music in the proper time, the pallets responding instantaneously to the action of the air pressure on the manipulation of the keys.

WATCH CASE SPRING. — Edward A. Remick, Newark, N. J., and Peter Fleck, Long Island City, N. Y. This spring is made in two semicircular sections placed end to end to form a complete band or ring, one section having a fly and the other section a lock latch. Screws or other locking devices are not needed to hold the spring in place, and it may be utilized to support a movement, rendering a dust band upon the movement unnecessary and permitting a movement to be placed in a case quickly and conveniently. No fitting is required to place the spring in the watch case center, as it may be simply sprung into position. It is inexpensive to manufacture.

BICYCLE GEAR.—Erick J. Swedlund, Atwater, Minn. Journaled in a hollow chainwheel rotating loosely on the pedal shaft is a bevel gear wheel in mesh with a bevel gear wheel on the pedal shaft, while a sliding bevel gear wheel carried by the frame is adapted to be thrown in and out of mesh with the bevel gear wheel in the chain wheel, and a spring-pressed rod mounted to slide transversely in the chain wheel has a projection adapted to engage teeth on the bevel gear wheel on the pedal shaft. The invention is an improvement on a former patented invention of the same inventor, to enable the rider to travel with lessened speed and greater power, as may be desirable in going uphill or over rough roads.

WIRE FENCE.—Ephraim L. Schanck, Lewis Center, Ohio. This fence consists of a series of stretchers or woven frames formed of wire strands twisted one about the other and wire stays connecting the adjacent runners of each frame, the stays having at their opposite ends open-ended hooks or pockets adapted to connect with the runners of adjacent frames. The fence may be put up without special tools, a hammer only being necessary to fasten the frames to the posts or uprights.

MARKING PATTERNS. — Mrs. Louise Schaefer, Oneida, N. Y. This inventor has devised a method and an apparatus for marking patterns on fabrics, which consists in providing a marking board having a coloring pigment held on its surface, doubling the fabric and spreading it on the board, laying a flexible marker on the top layer of the fabric, the marker being also impregnated with a coloring pigment, placing the pattern on the marker, and then running a spur wheel around the edge of the pattern. A cheap, simple, and very convenient method is thus provided for readily marking patterns on fabrics, especially applicable for marking patterns on dress goods and other fabrics to be made into garments.

PEN.—Addis M. Henry, White Sulphur Springs, Mont. This is a simple and effective ruling pen for simultaneously producing a series of parallel lines, or for making a single heavy line, the pen to be used for ruling, writing and marking. It is preferably made of non-oxidizable spring material, provided with deep corrugations or folds at the point, the folds being cut through adjoining the point, while it may be shaped like ordinary pens at the heel, so that it will fit a common penholder, or in such other desired forms as will best serve in any special work.

BRUSH.—Arthur W. Hahn, New York City. This brush is especially adapted for cleaning nursing bottles and similar receptacles, and the bristle or cleaning section is removably connected with the back section, permitting a brush section to be readily removed when unfit for use, and another section substituted. The bristles are bunched and secured in brush form independent of the back section, and the brush section is so attached to the back section that a cleaning surface is obtained practically on three sides of the back and at one end.

MATCH SAFE.—Alfred Hansen, Sidney, Neb. According to this invention a revoluble cylinder is arranged within a casing and supports the matches, while a slide having a pin is adapted to project into the cylinder through slots to engage a match and push it upward through a trap door in the casing, the slide also serving to revolve the cylinder on its downward stroke. The device thus automatically delivers and lights a single match at a time.

COMBINATION FURNITURE. — Edward L. Still, New York City. This inventor has devised an article of furniture which may be used as a lounge, right or left as desired, and which may also be employed as a bath tub or a wash tub, while it may likewise be made serviceable as a washstand or as a bed. The construction is exceedingly simple, and it may be easily and conveniently changed into any one of its several forms of use.

LEAF TURNER. — Lafayette Swindle, Franklin, Ind. This is an improvement in music leaf turners having pivoted swinging arms to which fingers are so pivoted as to adapt them to project upward and lie between the leaves. It is applied by opening the book at the place to be referred to and raising one of the fingers, opening to another place to be opened to and raising another finger, and so on until as many fingers are inserted as there are leaves to be opened to.

WINDOW SHADE FIXTURE. — Francis M. Wilkinson, Birmingham, Ala. According to this invention a permanent roller support is put upon the window frame, adjustable to receive any length of shade roller which may be used. It is a right-angular bracket with a longer shank parallel to the roller and with teeth or notches on one of its edges, and with a shorter section at right angles having a bearing for the roller journals. A single staple or keeper is driven into the window frame to sustain the device, obviating the necessity of mutilating the frames by nails or screws, as is frequently necessary in putting up the shade rollers of different occupants of a house.

FRUIT STONER. — Joseph Boeri, New York City. For conveniently and easily removing the stones from olives, cherries, peaches, etc., this inventor has designed a device comprising a pair of pivoted jaws, one of which has a transverse aperture, while a female die secured to the apertured jaw projects into the opening. There is an annular recess or chamber between the female die and the jaw to which it is secured, and a male die secured to the other jaw is adapted to enter the female die.

CHIMNEY COWL.—Joseph A. Hodel, Cumberland, Md. In this improved cowl the vane is so incased that it will not form an unsightly projection beyond the top or to one side, and the draught regulator is so supported that it can turn freely and be readily adjusted when bearings are worn, while a ready outlet is provided for water that may beat into the top, and any accumulation of soot is prevented.

DESIGN FOR A CARPET.—William F. Brown, Newark, N. J. In this design the body is decorated with cultivated roses, with festoons of foliage connected by ribbons, the festoons encircling groups of wild roses separated by fanciful figures. The border has a fan figure ornamented with roses, with festoons of cultivated and groups of wild roses, and has an ornamental dado at the outer edge and an ornamental scroll at the inner edge.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

THE TANNINS. A monograph on the history, preparation, properties, methods of estimation, and uses of the vegetable astringent. By Henry Trimble, Ph.M. Vol. II. Philadelphia: J. B. Lippincott & Co. Pp. 172. Price $2.

This volume treats of the tannins, including nine species of oaks and one species each of mangrove, canaige, and chestnut. It also has a copious index to the literature of the subject. As was the case with the first volume, it is more especially suited to the study of the chemist and the botanist than adapted to fill any wants of the practical tanner, but in a field where so much is needed as there is in the study of the tannins every contribution is of value.

THE AMATEUR TELESCOPIST'S HANDBOOK. By Frank M. Gibson. New York: Longmans, Green & Co. 1894. Pp. xi, 163. Price $1.25. No index.

This book is designed for the use of students in astronomy whose instrumental equipment does not go beyond a two or three inch altazimuth. It is believed that four or five hundred celestial objects are described as brought within the reach of the amateur astronomer with the instrument described. The book is written in popular style and will be found useful and interesting. The catalogue of celestial objects forming its concluding part is especially to be commended, but the lack of an index can only be regretted. In the preface the author puts in a plea in favor of the reflecting telescope, but excludes it from the main portion of the work as being an instrument as yet unused to any extent in America.

RICHEY'S GUIDE AND ASSISTANT FOR CARPENTERS AND MECHANICS. A work of practical information, giving almost every geometrical and practical problem likely to arise in the work of the carpenter, and quick and easy methods for their solution. The use of the steel square, etc., tables showing strength and weight of materials, methods of framing, useful recipes, etc. By H. G. Richey. Pp. viii, 177. New York: William T. Comstock, Price $2.

The carpenter as a mechanic has, perhaps, been somewhat neglected by writers of technical works, but here, at least, we have a work of practical value, giving the solutions of problems that may occur during the work of a carpenter, with numerous diagrams and illustrations. As examples of the practical nature of the work, the various illustrations of shingles, of carpenter's knots, of splicing of timbers and of the different types of work may be cited. Tables of weights, measures, etc., and a number of legal forms form part of the book. The work has an excellent index.

THE MICROSCOPE AND MICROSCOPICAL METHODS. By Simon Henry Gage. Fifth edition, rewritten, greatly enlarged, and illustrated by 103 figures in the text. Part I. of the Microscope and Histology. Ithaca, N. Y. 1894. Pp. viii, 165. Price $1.50.

This work is devoted to microscopic manipulation. The day has now come when serious work with the microscope demands the best possible appliances, and the use of such appliances, microscopic mounting, lighting and focusing, care of the microscope and the eyes, micrometry, use of the camera, and other details are here excellently treated, with numerous illustrations and a very adequate index. Throughout the printing is done on only one side of the page as a rule, so that the student can make notes as he desires on the reverse of the pages.

PRACTICAL METHODS IN MICROSCOPY. By Charles H. Clark, A. M. Boston: D. C. Heath & Co. 1894. Pp. xiv, 219. Price $1.60.

What we have said of the preceding book applies, to a certain extent, to this. It is an excellent treatise, well illustrated with numerous familiar and practical details on the subject of microscopic work. It covers all the different fields and treats very fully of different microscopes, and is adequately indexed. It will be found exceedingly useful.

THE DISEASES OF PERSONALITY. By Th. Ribot. Chicago: The Open Court Publishing Co. 1894. Pp. v, 157. No index. Price, paper, 25 cents; cloth, 75 cents.

This very attractive little volume treats of psychology, especially in its manifestations of disease. Organic disorders, the personality of attached twins and of monsters, emotional disorders of the intellect, insanity and hysteria are included. The work is well and attractively written and should interest the professional reader. The good arrangement of the contents to some extent compensates for the want of an index.

ARCHITECTURE NAVALE. THEORIE DU NAVIRE. Par J. Pollard et A. Dudebout, Ingenieurs de la Marine, Professeurs a l'Ecole d'Application du Genie-Maritime. Tome IV. Dynamique du Navire: Mouvement Rectiligne Horizontal Oblique, Mouvement Curviligne Horizontal; Propulsion; Vibrations des Coques des Navires á Hélice. Paris: Gauthier-villars et Fils, Imprimeurs-libraires du Bureau des Longitudes, de l'Ecole Polytechnique, Quai des Grands-Augustins, 55. 1894. Pp. vi, 440.

This forms the fourth volume of a very exhaustive treatise of naval architecture, which, using the higher mathematics, treats the subject of ship building from the most scientific standpoint. The volume is too long and exhaustive to lend itself to reviewing. It is a very elegant example of its kind, both of printing and illustration.

A MANUAL OF MICROCHEMICAL ANALYSIS. By Professor H. Behrens. London and New York: Macmillan & Co. 1894. Pp. xxv, 246. 84 illustrations. Price $1.50.

This exceedingly attractive book treats of the examination of precipitates and crystals by microchemical analysis. The advantage of the use of the microscope in such work is that it greatly increases the power of distinguishing between individual precipitates, to a certain extent eliminating the necessity of group reactions. Naturally the illustrations, which are characteristic and good, form an important part of the work, and it is they that commend it to the chemist as a most valuable adjunct to his everyday work on a large scale. As it is an English book we find in it the inevitable reference to the Cornhill firm for the microscope, but we find no description of Professor J. Lawrence Smith's microscope, a most curious omission, strongly indicating the insular authorship of the book.

PROGRESS IN FLYING MACHINES. By O. Chanute, C.E. New York: The *American Engineer and Railroad Journal.* Pp. v, 308.

This attractive book consists of a series of articles on flying machines proper, as distinguished from balloons, which articles have from time to time been published in one of the technical journals. Dealing with this subject, a large part of the work is naturally devoted to the useless attempts of inventors, but ending as it does with the most recent and serious experiments in aeroplane work, it becomes a very valuable *resume* of the present status of the science. It is profusely illustrated and its index, in its way, is a model.

MATHEMATICS FOR COMMON SCHOOLS. Part I. An elementary arithmetic. By John H. Walsh. Boston: D. C. Heath & Co. 1894. Pp. v, 212. Price 40 cents.

MATHEMATICS FOR COMMON SCHOOLS. Part II. Intermediate arithmetic, including exercises in solving simple algebraic equations containing one unknown quantity. By John H. Walsh. Boston: D. C. Heath & Co. Pp. vi, 213 to 458. 1894. Price 40 cents.

MATHEMATICS FOR COMMON SCHOOLS. Part III. Higher arithmetic, including easy algebraic equations and simple geometrical problems. By John H. Walsh. Boston: D. C. Heath & Co. Pp. viii, 459 to 803. 1894. Price 75 cents.

In every way these are most excellent books. The problems are largely those used in special schools, the entire country having been drawn upon for examination questions. The United States Civil Service, the Postal Service, and States Civil Service, all figure in its pages, so that it is a *resume* of what may be required of the aspirants for public school and civil service examinations. They form an admirable series to be read by the general reader to coach himself in arithmetic.

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Notes & 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.

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Minerals sent for examination should be distinctly marked or labeled.

(6054) F. L. B. says: Will you kindly give me, through your Notes and Queries, a formula for developing negatives and films, of instantaneous work, something that can be used by amateurs? A. Combined hydrokinone and eikonogen developer:

Sulphite of soda	300 gr.
Carbonate of soda	200 "
Sodium hydrate	30 "
Bromide of soda	5 "
Hydrokinone	20 "
Eikonogen	30 "
Water	10 oz.

This developer possesses the rapid action of the eikonogen combined with the sustaining energy of the hydrokinone, and keeps indefinitely. 2. In using Solio paper, what should be used on the glass to keep the prints from sticking thereto when rolled out to dry? A. Answer by the Eastman Co. "The glass may be prepared with a solution of benzine 1 ounce, white wax 10 grains. This should be rubbed on freely and polished off with a chamois skin. But as the results with glass are always more or less uncertain, we prefer to use ferrotype plates, which are more easily kept clean than the glass."

(6055) W. J. S. says: Will you please decide the following controversy? One claims Easter Sunday comes the first Sunday after the full moon, after March 25. Another claims it comes after the 21st day of March. Which, if either, is correct? A. Easter day is always the first Sunday after the full moon which happens upon or next after the 21st day of March; and if the full moon happens upon a Sunday, Easter day is the Sunday after. But note that the full moon for the purposes of the ordinary rules and tables for finding Easter is the 14th day of a lunar month, reckoned according to an ancient ecclesiastical computation, and not the real or astronomical full moon.

(6056) C. F. L. writes: 1. Is a 16 candle power 50 volt incandescent lamp more efficient than a 16 candle power 100 volt lamp of same make? If so, how much? Is any other advantage gained, aside from the higher efficiency of the lamps, by using 50 volts instead of 100 volts on secondary circuits? A. One lamp is as efficient as the other. The lower voltage lamps require larger conductors; this, as involving more cost, is a disadvantage. 2. Is there a certain voltage for which lamps of every given candle power can be made most efficient? If so, for what voltages respectively are lamps of 10, 16, 32, 50, and higher candle powers best suited? A. There is no such voltage. 3. In an alternating current lighting system, with ordinary frequency, would there be any objection, on account of impedance, or other causes, (a) to inclosing each wire in a separate iron pipe; (b) to inclosing both wires in same pipe; or (c) to inclosing one wire in iron pipe and using pipe as other conductor? A. All could be done without any practical harm. 4. Would same be true if pipe were made of non-magnetic metal? A. Yes.

(6057) G. C. S. asks: What are the chemical changes that take place in the Leclanché battery? After MnO_2 has parted with its oxygen, as in the Leclanche battery, is it possible to convert back to MnO_2? Can it be done by applying heat? A. The following is the general reaction: $2NH_4Cl+Zn=ZnCl_2+2NH_3+2H$. The hydrogen is oxidized by the manganese dioxide about as follows: $2H+2MnO_2=H_2O+M_2O_3$. You can renew the battery to a certain extent by passing a reverse current through it, as if it were a storage battery, or by pouring a strong solution of potassium permanganate into the porous cup, after draining it. Heating will not restore the binoxide.

(6058) M. S. Powell asks: 1. When the motor described in SUPPLEMENT, 641, is provided with a cast iron field magnet, can it be run as a dynamo to charge storage batteries? A. While the motor in question could be run as a dynamo, we do not recommend it. 2. If so, how many will it charge? A. It might charge two cells. 3. Which is the best form of storage battery to run small electric lamps—one with plates or made as described in SCIENTIFIC AMERICAN, vol. lxii., page 148? A. We advise the purchase of storage batteries rather than attempting to make them at home. The one you refer to is not suited for lampwork. 4. How many six candle power lamps will six cells of storage battery made like those described in SCIENTIFIC AMERICAN, vol. lxii., page 148, run, and for how long a time? A. Allow one square foot of immersed positive plate for four candle power for ten hours.

(6059) F. W. B. writes: Having been a subscriber to your valuable paper, the SCIENTIFIC AMERICAN, for the past fifteen years, permit me to ask for solution of following, through your columns for that purpose: We have a stand pipe here one hundred feet high and twenty feet in diameter. I wish to know how many horse power I may expect from a six inch pipe at bottom of stand pipe, provided same is filled with water the whole 100 feet. Please give your method of figuring the same for different sizes of feed pipe. A. The spouting velocity of water under a 100 foot head is 4,812 feet per minute. If the total power from a 6 inch pipe near the stand pipe is required (no length of pipe or method of developing power being stated), the 6 inch short pipe will deliver 944 cubic feet of water per minute and will empty the stand pipe in 69 minutes. If the stand pipe is kept full, you will have 150 horse power from the flow; or you will have 75 horse power for 69 minutes if there is no inflowing water. This shows the necessity of definite statement on the part of inquirers as to what they want. 0·16 of a cubic foot of water discharged per minute under a 100 foot head is equal to 1 horse power. The volume of discharge and equivalent horse power are as the squares of the diameters of pipe or nozzle, so that a 3 inch nozzle on the 6 inch pipe will discharge 238 cubic feet of water per minute with 37 horse power. A 2 inch nozzle will discharge 104 cubic feet per minute with 16 horse power, or by dividing any required horse power by the decimal 0·16 gives the quantity of water in cubic feet per minute. To ascertain the size of nozzle for any horse power, divide the spouting velocity per minute by the quantity of water required in cubic feet per minute. Divide 144 by this product, which will give the area of the nozzle in square inches.

(6060) W. S. asks: 1. What is the chemical composition of sea water, and what is its electric action in relation to earth electricity? A. Principally water and sodium chloride. The following is the analysis of water from the British Channel:

Water	964·745
Sodium chloride	27·059
Potassium chloride, etc.	8·196
	1000·000

By itself it has no electric action. 2. Will the air pressure be the same upon a hollow or a solid body of identical shape and dimensions if a vacuum is created in the former, as, for instance, an exhausted electric lamp bulb or a solid piece of glass of same shape and size? A. Yes. 3. Taking a cylindrical box, open at one end, with a well fitting piston closing the opening, and exhausting air in box, I get the full atmospheric pressure on outside of piston, do I not? A. Yes. 4. What is the air pressure at sea level per square inch? A. About 14·7 pounds per square inch, varying continually. 5. Will a vacuum vessel, if immersed in water, have to overcome more resistance than if it were filled with air at atmospheric pressure? A. No.

(6061) M. A. McG. writes: Is impure air heavier than pure air, and why? The point in question is, where is the proper place to open a ventilation flue into a room for the purpose of carrying out the foul air? A. Impure air, owing to the presence of carbon dioxide gas, is often a little heavier than pure air at the same temperature. But as impure air in rooms is apt to be heated, by being exhaled from the lungs or by being produced from gas flames, it is lighter generally than the pure and colder air. Consequently, it accumulates near the ceiling and is quickest removed by a ventilator placed there. But here another trouble comes in. A ventilator near the ceiling may cause a draught through the room and leave much of the contents ventilated imperfectly. We suggest Billings' "Ventilation and Heating," $6.

(6062) X. Y. Z. asks: 1. Would it make any difference if you were to put the parts of a battery, *i. e.* the carbon and zinc, into a large tank or into the glass jar which belongs to the battery, each having the same solution in proportion? A. It would make no difference. 2. And would it make any difference if the carbon and zinc were placed as far as possible away from each other? A. It would increase the resistance up to a certain distance after which the resistance would be constant. 3. What would be the resistance of a regular bell wire about one-sixteenth of an inch in diameter and 100 feet long? A. About 0·16 ohm.

TO INVENTORS.

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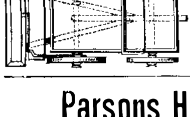

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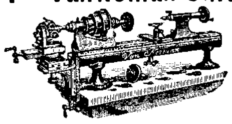

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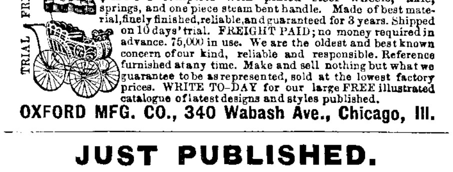

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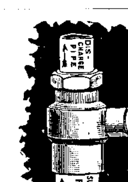

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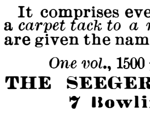

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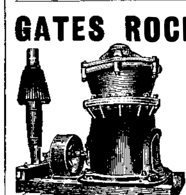

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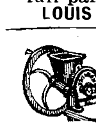

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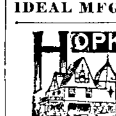

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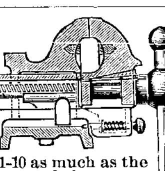

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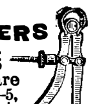

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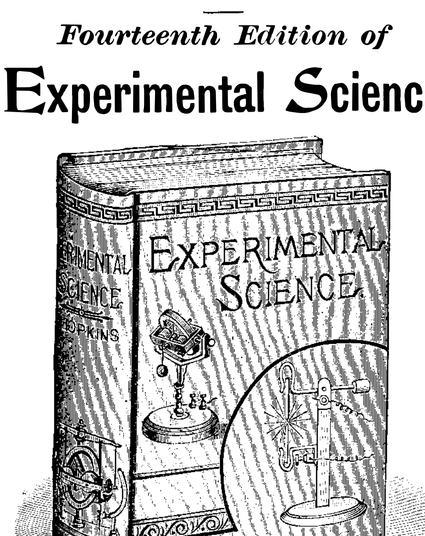

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