SCIENTIFIC AMERICAN

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CAISSON FOUNDATION PIERS OF THE AMERICAN SURETY COMPANY'S BUILDING IN NEW YORK CITY.

The people of New York City have become very familiar with modern tall office buildings, the number of which is increasing every year, a type of buildings which bids fair to become the rule among down town structures. A new structure for the American Surety Company designed by Bruce Price, the well known architect of this city, has been commenced on the corner of Broadway and Pine Street, and already the operations on the foundations have attracted much attention from passers-by. These works, conducted by the engineering firm of Sooysmith & Co., of this city, we have selected for illustration, as giving a good idea of the most advanced methods of caisson construction for city buildings.

The building, of which we give a small cut, is to be twenty stories high. Its weight is to be carried on thirteen brick piers, the general plan of which can be seen in our perspective cut. To the right is Broadway, with its stream of pedestrians, wagons and cable cars, while old Trinity, on the opposite side, gazes down on the beginning of a building ultimately to surpass its spire in height.

Referring again to the cut of the foundation, the tops of the piers are seen carried up to their final level. Under each pier is a rectangular caisson of half inch steel seven feet in internal height, and with its outside wall carried up two feet further. From the caisson top a working shaft of steel three by five feet in area rises, and on top of this air shaft is placed the air lock, contained in a cylinder six feet in diameter and ten feet high.

The process of sinking the foundation is as follows: The caisson is established in place, and the ground beneath is dug out and drawn up through the working shaft in buckets. Concrete is laid on top to the depth of two feet within the upward extension of its

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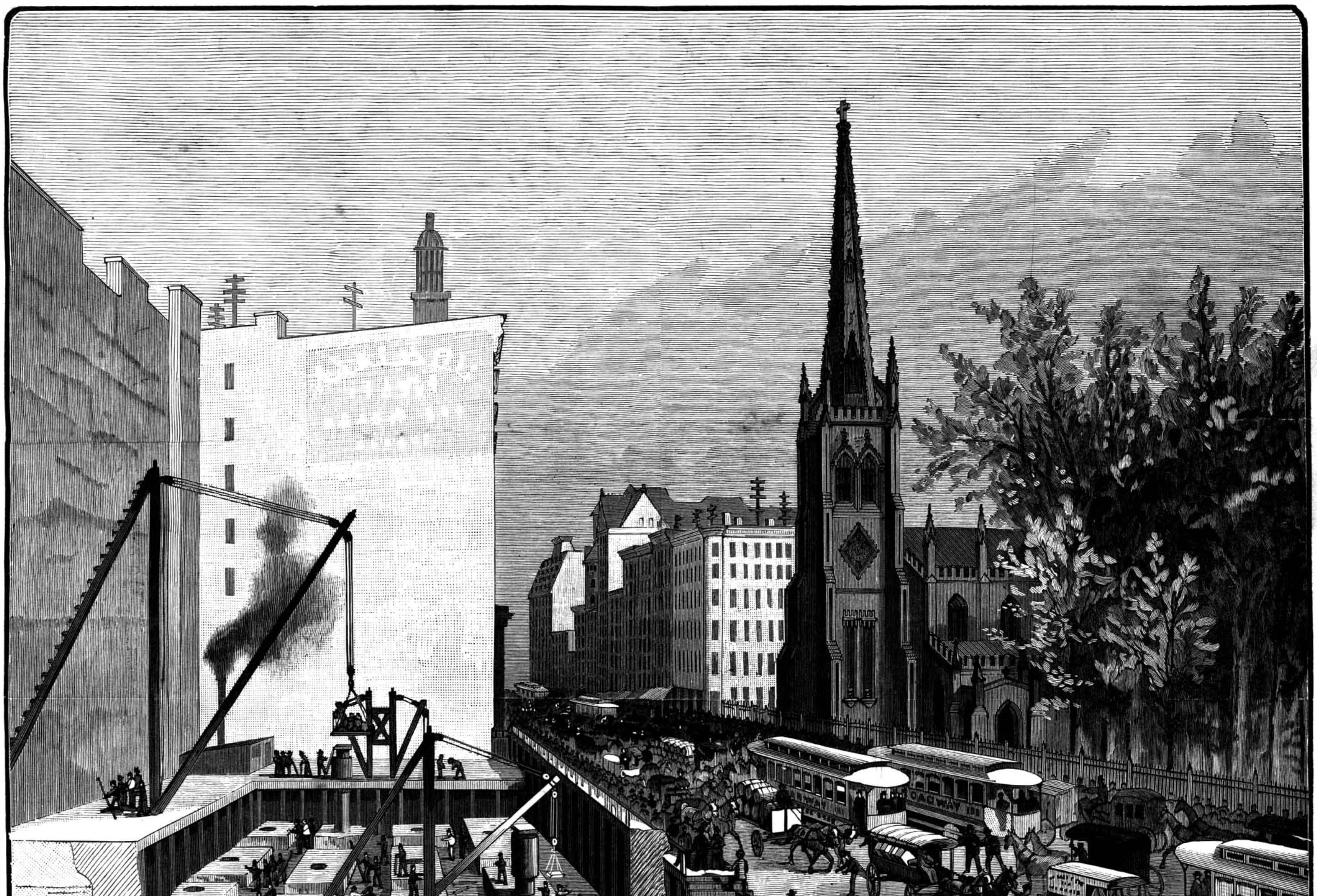

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Scientific American.

ESTABLISHED 1845.

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NEW YORK, SATURDAY, AUGUST 25, 1894.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 973.

For the Week Ending August 25, 1894.

Price 10 cents. For sale by all newsdealers.

THE BROOKLYN MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The forty-third meeting of the American Association was opened on the 16th inst., at the Polytechnic Institute, Brooklyn, N. Y. There was a large attendance of scientists from all parts of the Union.

The mayor of Brooklyn was to have extended the city's welcome to its honored guests, but in his unavoidable absence the duty was gracefully performed by President Truman J. Backus. He spoke of the debt due to representative men of learning, who were truly priests of the Almighty and benefactors of mankind. He said that in the early days of Brooklyn it was hoped that here might be reared a great university. But while disappointed in that respect, this city has made significant expressions of its interest in education. Its annual appropriation for its public school system is $2,500,000. The fame of its Polytechnic Institute, Packer Institute, Adelphi Academy and other schools has gone abroad; as has also that of those spacious buildings erected for industrial education by the lavish liberality of Mr. Pratt. The Brooklyn Institute is unique, with its 26 departments of research, its many courses of lectures, and its more than 3,000 subscribers. He welcomed the Association, trusting that it might while here give an impetus to learning such as should impel men of wealth to build a fitting superstructure on the broad foundation already laid.

President Daniel G. Brinton, of Media, Penn., replied. He said that the habits of the American Association for the Advancement of Science are migratory, like those of the birds, fishes and primitive human tribes. It journeys from city to city, the nation's guest, and representing the nation. It comes with no empty hands, but makes due return for favors granted. Its aim is to increase the popular love of learning, and therefore it frames its rules so as to admit all searchers for truth. No barriers are thrown in the way of those who would enter this republic of science. There is no restriction of color, caste, nationality or sex. The industry of practical workers supplements the diligence of special students. Once a year, for nearly half a century, this association has convened the scientists of the land that they might know each other personally, compare their views, harmonize their differences, and push forward the good work by a united effort. We now number 2,000 members and embrace all prominent lines of research. Our published volumes form an epitome of what science has done for nearly half a century. Our influence is highly educational. We have no inner secrets. We are no mysterious guests. Scientific truth is absolutely open to the world, free as air, visible as light. We have no favored few, no select illuminati. The spirit of true science is modest in its own claims and liberal to the claims of others.

Our first lesson is to follow the facts. New facts bring new conclusions. The opinions of to-day must be modified by the learning of to-morrow. The despair of a scientific assembly is the hobby rider, the man of a pet theory which he is bound to uphold in the face of facts. Yet so supreme is energy that error itself ardently pursued yields a better harvest than truth languidly cultivated.

The ultimate aim of all our labor, of our study of phenomena, our revision of results and rejection of errors, is to discover those absolute laws of motion, life and mind that are ubiquitous and eternal, and that reveal with sunlike distinctness the order that presides over all natural processes. This is the mission of science, noble, inspiring, consolatory, humanitarian and spiritual. We assemble here to lead you to unite with us and to share our lofty enthusiasms. And we interpret your sympathetic welcome as a sign of your participation in our purposes.

In the afternoon the vice-presidents addressed the several sections. Abstracts of some of these interesting papers are given.

PARADOXES IN RESISTANCE.

Prof. Mansfield Merriman addressed the section of mechanical science and engineering on the resistance of materials under impact. It is important to mark the effects of falling bodies in relation to machinery, bridges and buildings. Young first recognized impact as a case of energy which he called "resilience." There is elastic and ultimate resilience. In the former the elastic limit of the material is not exceeded, while in the latter there is rupture. In elastic resistance under impact a sudden force causes twice as much elongation and stress as where a force is slowly applied. The modern methods of static testing were described, culminating in the precise apparatus of Emery and the powerful machine of Phœnixville. The cold-bend test is of great value. The contraction of area is an important element in judging of the quality of material. Impact tests are now required to be made at the mill by at least three of our great railroads, a ram being used weighing 2,000 pounds and falling 20 feet. Such tests lead to conclusions as to temperature, chemical composition and methods of manufacture, and thus lead to a better, cheaper and more uniform product. The discovery of Goss, in 1892, that the driving wheels of a locomotive lift up from the rails during a part of each revolution, when running at a high speed, shows that impacts are more common than had been supposed, and that they require increased resilience. The violent impacts caused by explosion of dynamite and by projectiles striking against armor plate were discussed, with the prediction that in the contest between projectiles and plates, the former will win the supremacy. The paradoxes of resistance were shown to have their origin in a lack of clear comprehension of the laws of mechanics. Herbert Spencer's discussions regarding the persistence of force and of continuity of motion were shown to be inexact, and it was claimed that the law of the conservation of energy is the basis of all dynamic investigation.

FACULTY DETERMINED BY RACE.

Dr. Franz Boaz made the opening address in the section of anthropology. He contrasted the achievements of civilized man with those of barbarians who have not yet subdued nature. Where the civilization is higher we are wont to assume that the aptitude for it is higher too. And, as this depends on the perfection of body and mind, the inference is usually drawn that the white race represents the highest human type. Many anthropologists look for anatomical peculiarities of primitive man that would mark him as being of a lower order, while others claim that there are no such peculiarities. The error is in confounding achievement with the aptitude for it. The same error is committed in judging of social distinction. As the development of the white race is the highest, its mind is supposed to have the most subtile organization. It is asked why the white race actually developed a civilization that is sweeping the world. Have not all races had naturally the same chances? Is it not fair to conclude that those races that remained at the bottom of the scale were incapable of rising to higher levels? Dr. Boaz discussed these questions in detail, tracing the history of civilization from its earliest dawn until now. The advancement in Peru and Mexico was the same as in Asia and Europe, the only difference being one of time. One reached a certain stage some three thousand years before the other. Man has existed for a period to be measured by geological standards only. Formerly the races did not differ so widely as now. Disease also wastes regions newly opened to white men. In fact, several races have developed a civilization of a similar type to the one from which our own had its origin. Favorable conditions facilitated the rapid spread of culture in Europe. In short, historical factors have been more potent than race faculty in leading men on in civilization. Granted that the brain weight of the white race exceeds that of the negroes, does increased brain prove certainly increased faculty? There are facts looking that way, and there are also restrictions on such an assumption. No data have yet been found to prove it to be impossible for lower races to attain a high civilization. The only feasible way will be to investigate the psychical processes of a great number of individuals of different races living under equal conditions. This has not yet been so done as to warrant far-reaching conclusions. It is difficult to prove the progress of a faculty. Many changes are due to environment. It is, therefore, much less likely that advance is hereditary than that it results from education. Finally, there is no good reason to think that other races may not reach the level of civilization represented by the bulk of our own people.

POINTS IN GEOLOGICAL HISTORY.

Vice-President Calvin took for his subject before the geological section the lessons of the Niobrara chalk. These deposits are distributed over an area reaching from Iowa to the Rocky Mountains, and from Texas to Manitoba. But the characteristics now considered mark the beds exposed between the mouth of the Niobrara River and Auburn, Iowa. The typical beds have all the physical features of true chalk. The region was an area of subsidence during the Upper Cretaceous period. There were shallow seas and high contiguous shores during the previous period; but in the Niobrara stage the water deepened and the shores were low and flat. The sea bottom therefore received no mechanical sediments, and lime-secreting organisms of microscopic size flourished abundantly. These gave their skeletons to form the chalk. The hesitancy of American geologists to recognize the Niobrara deposits as chalk is remarkable, as shown by the literature on the subject from 1841 to 1894. The Niobrara chalk is made up in part of foraminifera specifically identical with those found in the chalk of Europe. These, together with the spicules of shells, are embedded in a matrix composed of the minute bodies known as coccoliths, which are the most characteristic organisms found in chalk elsewhere. Some very interesting peculiarities as to the distribution of these minute organisms were considered. The chalk of America was compared with that of Europe, and the practical identity of the two, so far as relates to physical characteristics, composition and origin, was clearly pointed out.

A STABLE MONETARY STANDARD.

A lengthy and elaborate address was made before the section of economic science and statistics, by Vice-President Farquahar, of Washington, concerning the application of scientific principles to the question of a stable monetary standard. A medium of exchange should maintain its value till a contract is completed. In deferred payments any change not contemplated by the contracting parties must be injurious to one of them. Our unit of value should be able to ride the chopping seas of an ebbing and flowing commerce. Public interest is usually with the debtor, because social progress is largely due to his hopefulness. But it should not be forgotten that the creditor class includes, besides opulent men of leisure, thousands of manual laborers whose wages are in arrears. The assumption is often made that the good of society is advanced by money's growing cheaper instead of dearer; whereas there is no essential difference in point of demerit between the two conditions. Every change in the money standard is hurtful. It can never be helpful to the public. A change in value is unmeaning, except in relation to something that does not change. But what is that something? In war times there were the widest changes in what was termed "the price of gold." And with it all other prices rose or fell. But when we came to trade with other countries, there were no such fluctuations. Yet we use today the census tables of 1860, 1870, 1880 and 1890, as if the "dollars" in those tables always meant the same thing; and to make it do so arbitrarily is not scientific.

After discussing in an exhaustive manner the comparative value of gold and silver, the two metals fixed on by the selection of many centuries as best fitted for monetary uses, and doing justice to the able pleas for a bimetallic standard, the conclusion was reached that a monetary standard may be said to be constant when the same amount of money does the same work, supplies the same want and compensates the same effort. By an ideal standard the prices of merchandise ought to have been diminishing and the wages of labor increasing within the last twenty years—a requirement more satisfactorily met by gold. An attempt to work gold and silver on equal terms is of doubtful merit or practicability. Active interference by the governing power is needless. Allowing freedom in contracts in money, construing terms by usage and enforcing them accordingly, and granting facilities for immediate decision in metallic form by marks as to weight and fineness—this is about all that the government ought to do. The usurped power of passing "legal tender acts" should be surrendered, and legal definitions of value should cover only contracts made by the government itself. Men might then treat as money anything they *so agreed to treat*; accepting the government's stamp as evidence that their agreement was kept, and not fearing or hoping for any meddlesome enactment to declare that, though one metal was agreed on, the agreement might be discharged by paying fifteen and one-half times its weight of some other metal. If contracting parties preferred silver to gold, they might make their agreement accordingly and have it so enforced; or if it were decided to give the debtor an option to pay one metal or "put" another, the law might help them there; but it should not infer the put unless the contract expressly provided for it.

The question of the ideal standard of value would then remain as now, interesting and altogether suitable for discussion by scientific bodies; but active business men would never have occasion to wait for our verdict. In a total abandonment by the government of its power to declare a legal tender for private debts is to be found the true practical solution of the problem of a stable monetary standard.

EXPANSION IN METALS BY OBSCURE HEAT.

Vice-President Rogers addressed the section of physics on "Obscure Heat as an Agent in Producing Expansion in Metals under Air Contact." Whatever advantages may be offered by liquid contacts, or by freedom from exposure to the air, it is more useful to regard the expansion and contraction of metals under the conditions in which they are daily used. Water, except at a very low temperature, never rises to the temperature of the air to which its surface is exposed. Its cooling effect increases with the extent of its evaporation. This was illustrated by a series of observations. Other disturbing causes were also mentioned. But under air contact the time required for thermometers and for bars of steel and bronze to pass from complete saturation at one temperature to complete saturation at another is nearly constant, and it is nearly independent of the range between the initial and the final temperatures; e. g., the time from 0 to 5 is nearly the same as the time from 0 to 100. It would be almost impossible to give a satisfactory report of this address without its explanatory diagrams and tabulated results of delicate experiments as to varying thermal forces which seem to govern the process of cooling. While affirming the importance of what has already been accomplished in its bearing on a correct system of measures, and in other directions, the speaker made the honest confession that he was not wholly satisfied with his investigations, but intended to continue them by methods and with instruments best adapted to the purpose, aided by the experience already gained, hoping to be able at a future time to add something more definite to our knowledge of an obscure subject.

Addresses were made before other sections as follows: By Vice-President Comstock, before the section of mathematics and astronomy, on "Binary Stars;" by Vice-President Underwood, before the section of botany, on "The Evolution of the Hepaticae;" and by Vice-President Norton, before the section of chemistry, on "The Battle with Fire."

The address of the retiring president, Dr. William Harkness, of Washington, was given in the evening; which was followed by a reception given by the citizens of Brooklyn to the members of the Association in the Assembly Rooms and Art Galleries.

CAISSON WORK.

A great change has come over the complexion of engineering. In olden times the great triumphs of the engineering world were attributed to individuals, and to-day in England the old custom obtains in a greater degree than in this country. Here the change is very marked. Instead of an individual engineer being the hero of some difficult work, a firm of contractors perform the operations quietly and as a matter of business, having naturally in their employ, or as members of the firm, the best engineers that can be obtained. In the building of the Forth bridge, while Sir Benjamin Baker is credited by the public with the engineering of the operations, he, in his addresses on the subject, has not hesitated to give the contractors the highest possible credit for their ingenuity.

We illustrate and describe elsewhere the sinking of the foundations for one of the great office buildings which are now going up with such startling rapidity in this metropolis. In olden times the making of such foundations would have been well nigh impossible. The conditions were a restricted area of work, surrounded by buildings, ground of uncertain stability, and an enormous weight to be placed upon it. Yet the whole operation is intrusted to a firm of contractors, who quietly execute the operations and carry a series of immense brick piers down to bed rock, 70 feet below the street level.

In the early days of caisson work under compressed air, the lives of the workmen were sacrificed by the wholesale. The conditions for the preservation of health under the trying circumstances of caisson work and the medical treatment of the caisson diseases were little understood. But when the medical faculty took up the problem it was found possible to greatly reduce the danger, so that caisson work now has a widely different aspect from what it once had. In the first place, the men who work in compressed air are more carefully chosen on account of their physical fitness, a preference being given to men of a medium size. During the caisson work they understand very well that they must abstain from any excess in drinking. This they do from necessity of the case. Some of them who are addicted to intemperance will work in a caisson until they accumulate considerable money and will then, after the operation is over, enter into a long period of dissipation. The period of work in the caissons is also short; six hours being allowed under the lighter pressures. The custom with some of the best engineers is to have a supply of hot coffee for the men to drink and facilities for a hot bath as they leave the caisson. A physician is kept constantly accessible for instant treatment for any patient sent up from below.

In the manipulation of the caissons great ingenuity is shown. In the case we illustrate one definite object was to remove absolutely no material except that which is vertically under the caissons. This was to avoid disturbing adjacent buildings. Accordingly a very high pressure of air was kept up, so that the material that was sent up in buckets came up comparatively dry. In sinking caissons in river beds no such care has to be taken, and there the bucket can be dispensed with and the material in semi-liquid state sent up by discharge pipes. By excavating on one side the caissons are tilted in any desired direction, so as to be kept level, or what is the same thing, so as to keep the pier vertical. When bed rock is reached it has to be cut out to the level to receive the edge of the caisson, or may be cut out in steps and built up with concrete, brick, or rubble to receive evenly its load.

But as an example of the gymnastics of engineering the moving of a caisson horizontally when many feet under ground, and carrying a pier of solid masonry many feet in height, deserves notice. To do it diagonal struts bearing against the upper corner of the caisson on the side toward which it is to be moved, while their other ends press against the soil beneath, are introduced. Now if weight were allowed to come on the caisson, it is easy to see that the tendency of the struts would be to push it laterally. But the brick pier above it has also to be moved against the resistance of the soil. Accordingly a number of jets of water are distributed by means of pipes along the advancing side of the caisson, forcing the water upward from beneath its bottom or cutting edge. Corresponding jets are arranged above, forcing water down along the same side of the pier. This loosens the soil. The air pressure is now reduced, and as the weight comes on the struts, they gradually thrust the whole mass forward. By repeating the operation the pier can be moved a considerable distance, as much as seven feet having been accomplished in one instance by the firm whose operations are illustrated on our front page.

Longevity of Females.

The Medical Record says woman has the advantage of man as regards longevity; she suffers less from accidents, injuries, and many forms of disease; she is, in fact, more tenacious than man of the limited enjoyments allowed her. Dr. Brandreth Symonds has collected and studied a large number of statistics to illustrate this interesting fact (American Journal of the Medical Sciences). The comparative mortality of the sexes at different ages shows that in the first year of life the mortality of the female is much less than that of the male, being at birth 92·64 per 1,000 as against 112·80, and at the end of the year 31·87 as against 35·08. This difference continues up to the fourth year. From 5 to 12 the female mortality is greater than that of the male, being at the latter period 3·56 for males and 4·28 for females. At the age of 46 the male mortality equals that of the female, the latter having been up to this time slightly in excess. During the years 46 to 56, the period of the climacteric, the male mortality gains rapidly on the female, being 6·32 per annum for the one and only 3·47 for the other. Hence the climacteric is really a much more serious time for man than for woman. After 56 the female mortality gains on that of the male, but is always slightly below it. Woman has not only a less mortality, but a greater longevity than man. There is, also, a plurality of female births.

A Mirage at Buffalo.

The citizens of Buffalo, N. Y., were treated to a remarkable mirage between 10 and 11 o'clock on the morning of August 16. It was the city of Toronto, with its harbor and small island to the south of the city. Toronto is fifty-six miles from Buffalo, but the church spires could be counted with the greatest ease. The mirage took in the whole breadth of Lake Ontario, Charlotte, the suburb of Rochester, being recognized as a projection east of Toronto. A side-wheel steamer could be seen traveling in a line from Charlotte to Toronto Bay. Two dark objects were at last found to be the steamers of the New York Central plying between Lewiston and Toronto. A sailboat was also visible and disappeared suddenly. Slowly the mirage began to fade away, to the disappointment of thousands who crowded the roofs of houses and office buildings. A bank of clouds was the cause of the disappearance of the mirage. A close examination of the map showed that the mirage did not cause the slightest distortion, the gradual rise of the city from the water being rendered perfectly. It is estimated that at least twenty thousand spectators saw the novel spectacle.

This mirage is what is known as a mirage of the third order. That is the object looms up far above the real level and not inverted, as is the case with mirages of the first and second class, but appearing like a perfect landscape far away in the sky.

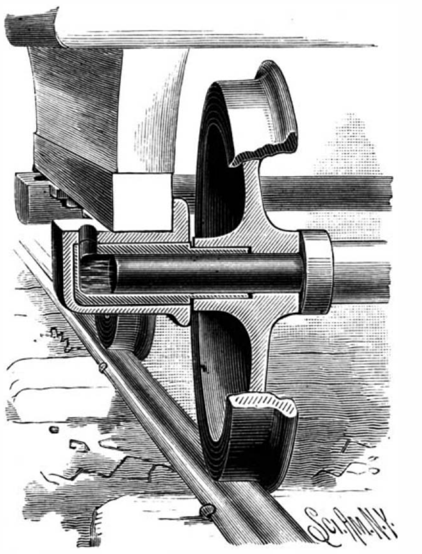
Test of Thirteen-inch Projectiles.

The excellence of our heavy projectiles was amply demonstrated, at the Indian Head proving ground near Washington, Aug. 14, when two 13-inch projectiles penetrated nearly fifteen inches of nickel-steel, passing through a forty-inch oak backing and entered the ground two hundred feet from the plate. When recovered the projectiles were practically uninjured and could, with a little treatment, be used for another round. The plate was made of oil-tempered nickel steel and measured 12 by 7 feet and was 14½ inches thick. The first projectile used weighed 1,100 pounds and the powder weighed 327 pounds. The velocity obtained was about 1,400 feet per second, which gave the projectile a striking energy of 12,000 tons. The shot passes through the plate, as has already been described. The plate was badly ruptured. The point of the projectile, which is as fine as a lead pencil point, was entirely uninjured, not being in the least blunted. The second shot was fired under the same conditions and completely demolished the plate, passing through it as easily as the other projectile, and it was not materially injured. The projectiles, which were made by the Carpenter Company, of Reading, Pa., were selected from the lot of sixty tons as being the worst of the lot. With the gratifying results noted above for projectiles selected on account of supposed faults we may reasonably expect that the remainder would prove even better.

A NEW SPIRAL NEBULA.—At a recent meeting of the Royal Astronomical Society, says Nature, Dr. Roberts exhibited a photograph of a new spiral nebula in Perseus. The convolutions of the spirals are very faint, though clearly visible on the negative. They are symmetrical and proceed from a very faint star-like nucleus.

AN IMPROVED CAR AXLE BOX.

The box and bearing shown in the illustration enables a sufficient quantity of oil to be supplied to keep the bearing well lubricated for a long time. The improvement has been patented by Mr. John F. Gallagher, of Forest City, Pa., and is designed principally for use on mine cars. Within the box is held a bearing adapted to slip over the spindle, the bearing being closed at its outer end, but having in its upper side a hole in which oil may be poured into a receptacle formed by the outer end of the bearing and the end of the spindle. The axle and wheel are held in the correct relative positions by a colla' rigid on the axle and abutting with the wheel hub.



GALLAGHER'S CAR AXLE BOX.

AN IMPROVED STEAM FIRE ENGINE.

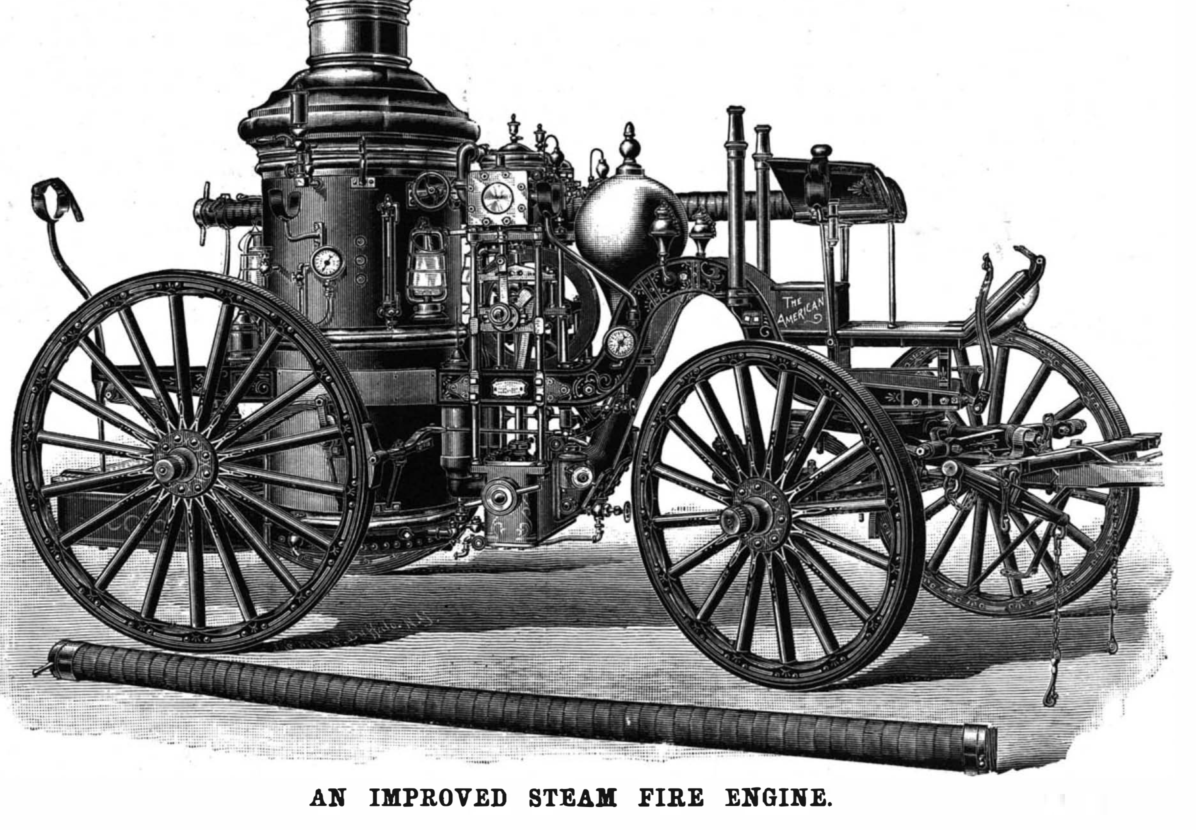
The American Fire Engine Company, with manufactories at Seneca Falls, N. Y., and Cincinnati, Ohio, are about to introduce a new and improved steam fire engine, an illustration of which is presented herewith. It is claimed by the makers to embody the best features yet obtained in these engines. Clapp's coil tube boiler is used with the American Company's patented improvements. The special feature of the boiler consists of spiral coils of water-circulating tubes, ingeniously arranged around the fire box to insure not only safety, but also the greatest possible steaming efficiency. These spiral coils are made of seamless copper tubing, and their form permits free expansion and contraction without causing them to strain any of the steam joints. The spiral pitch or bend of each tube is sufficient to permit of the use of five others of same diameter, so there are in each circular row six of these coil tubes, the number of rows, as well as the diameter of the tubes, depending upon the size of the boiler. Each coil tube is connected at its upper end with the crown sheet and at its lower end with the fire box wall, so that the water in circulation always flows over the crown sheet, thereby preventing its becoming overheated. The connections at ends of tubes are carefully made, by means of jam nuts and corrugated copper washers, so as to insure absolute tightness, and at the same time admit of the tubes being readily removed in case of repairs. The advantages of these spiral coil tubes over any other form, such as straight tubes or a cluster of the same, are numerous. The circulation is more perfect, and the heating surface is more effective; a longer tube can be used, and there is abundant freedom for expansion and contraction.

The pump is of an entirely new double-acting type, invented and designed by Mr. Charles H. Fox, the superintendent of their Cincinnati works. In point of general excellence, and particularly with regard to convenience and facility for examination and repair, the company claim it to be superior to any pump heretofore produced.

The pumps are united in a gun-metal casting, which forms a single body for both, and permits them to be placed much closer as to centers than could otherwise be done, there being an ample suction chamber common to both. In cross section, the pump somewhat resembles a box girder, thus furnishing a rigid base for the entire structure, simplifying the driving mechanism, and enabling it to endure extraordinary strains without vibration.

In providing facilities for the exposure of the pump's interior mechanism, the prime importance of perfect waterways has been fully recognized; although these passages are simple and direct, every detail of the pump's interior is thoroughly accessible without dismounting the same or disturbing the exterior attachments. Any of the valves can be easily and quickly examined, and if necessary replaced, by simply removing the caps and heads, and all joints required for this purpose are made between flat surfaces planed perfectly true. The suction may be connected to either end of the pump. The pump barrels are provided with removable linings, which can be readily replaced with new ones when worn. These, as well as the valve seats, are made of gun metal, no cast iron or other material subject to corrosion by water being used in any part of the pumps. A new piston for the pumps is introduced, which possesses the merit of keeping tight under any pressure without excessive friction, and the friction is not increased, no matter how great the pressure may be. The suction valves are cone shaped, so that the water enters the pump with but very little change in its course. The discharge valves are in a separate chamber. With a view to realizing the highest piston speed, the valve area is greatly increased and the lift of the valve diminished. The cylinders and pumps are detached from the boiler, and are separated therefrom sufficiently to allow every facility for getting at each and every part. All connections, both steam and water, are made outside of the boiler.

The engine, as a whole, is designed to meet the most severe exactions of the hard service in the best modern fire departments, affording the largest degree of efficiency with the minimum of liability to get out of order and having to be sent to the repair shop.



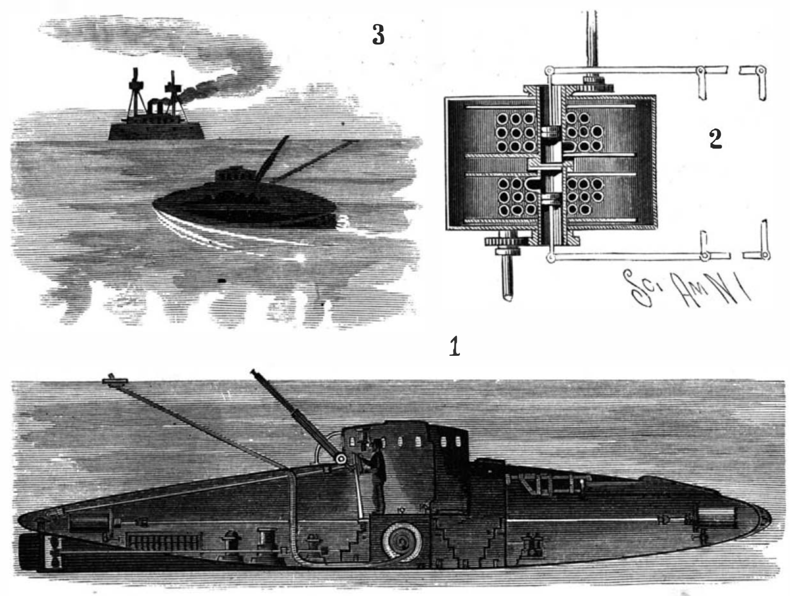
AN IMPROVED STEAM FIRE ENGINE.

Electrical Muscle Making.

Some recent scientific researches, which the Electrical World says can doubtless be trusted, show that the weight of muscles of animals was increased 40 per cent by a proper periodic application of an electric current, the growth being a true development of the muscle. According to this it will now be possible to increase to order size of any desired muscle without tiresome gymnastic exercises, by simply lying in a soft chair and having the current applied. This, we suggest, might be done at night by an automatic apparatus, thus saving time. Persons who are improperly developed may now be balanced or "trued up;" muscles shrunken by age may now be made plump again. Calves, which nature or exercise has failed to develop sufficiently, will now no longer be a drawback to wearing knee breeches, or the short bloomers of the female bicyclist. The question naturally suggests itself, What will happen if this process of developing muscles electrically is continued still longer? If some way is then found to develop the bones, the manufacture of giants by electrical means will be an easy matter.

AN IMPROVED SUBMARINE BOAT.

A boat designed to be submerged with facility to such distance below the water level as may be desired, and which is fitted with appliances for constantly supplying fresh air to the occupants, is shown in the illustration, and has been patented by Messrs. Daniel T. Freese and James D. Gawn, of North Amherst, Ohio.



FREESE & GAWN'S SUBMARINE BOAT.

Fig. 1 is a sectional view of the boat submerged, Fig. 2 being a sectional view of the combined hose reel and air pump, centrally located in the bottom of the boat, while Fig. 3 illustrates the possible employment of such craft. There are near the center of the boat four or five chambers to which more or less water is admitted when the boat is to be submerged, one of these chambers extending up at the side of the air chamber occupied by the operator. Air pressure is relied on to maintain certain equilibriums in the boat in the presence of water, and the operator, having first put on a diving suit, passes from the turret-shaped central air chamber into an adjoining chamber, where the water is kept down by air pressure, thence through a trap door in the bottom of that chamber to the deck of the vessel, when the latter is submerged. The air supply is pumped through a hose extending from the surface of the water down through the shell of the boat, the hose reel having a central cylinder in which a pump piston is operated by suitable machinery to force the air under pressure to the different chambers of the vessel. The hose at its outer end is connected with a float, of sufficient size for the purpose, and adapted to travel along on the water with the boat, but of such construction as to be as little noticeable as possible. The distance of the boat below the water level is shown by an indicator consisting of a tube in which slides a spring-supported piston, whose outer face is pressed upon by the outside water. To make observations when the boat is submerged, a telescopic tube is extended to the surface of the water, the lower tube being supported on pinion jointed bearings, and the outer and inner ends of the tubes having mirrors set at the proper angles. To facilitate balancing the boat lengthwise, the piston in a cylinder at each end is connected with a power lever under control of the engineer, in such way that water may be admitted to one cylinder and at the same time forced out of the other one, these cylinders being large enough to make a difference in the balancing of the boat. For power to drive the boat and work the machinery, an electric storage battery is preferred, a vapor engine being used if desired when the boat is at the surface.

MUFFS first came into use in 1540. They were introduced by doctors, who wanted to keep their hands soft and warm while riding from the house of one patient to that of another. Women soon copied the doctors, and the latter at once abandoned the fashion and began to use great fur gloves instead.

The Thermogen.

In writing of the last Royal Society conversazione, the Lancet mentioned as an exhibit of particular interest to the medical man an invention by Mr. C. T. Snedekor for heating by electricity a quilt or cushion. It was obvious that such a quilt could be used in private or in hospital for many therapeutic purposes. This quilt, which he named the thermogen, the Lancet has since had an opportunity of putting to practical trial under more lengthened observation, and has no hesitation in reporting upon it thoroughly favorably as an appliance that might be of great value in all hospitals, or, for that matter, in all private houses where an electric main is handy. The quilt contains a coil of wire consisting of a special alloy of known composition and electrical resistance, and bent in the fashion of a gridiron. The coil is inclosed in suitable insulating and non-conducting material, the whole being embedded in cotton wool or other soft substance provided with a silk or woolen covering.

The resistance offered by the coil to the flow of the current—the friction set up, so to speak, by the passage of the current through the wire —produces the heat in accordance with the laws of Ohm and Joule, in the same way that heat, and eventually light, are produced in the filament of the electric incandescent lamp when a current is forced through it. The coil contained in the quilt which was examined is constructed to admit of connecting with the terminals of an ordinary installation supply of 100 volts pressure, which effects a uniform temperature in the quilt of about 150° Fah. In the event, however, of the temperature rising beyond that point, which would be the case if there were an increase of pressure in the electric mains, a safeguard is provided in the end of the coil in the form of a "fuse," which would instantly melt, and so automatically shut off the current. The quilt may be readily attached to wall plugs, pendants, or still more conveniently to table lamp terminals. In places where the electric current is not supplied for lighting purposes an accumulator may be substituted with equally satisfactory results. The direction in which such an invention might be medically useful is first, and our contemporary thinks in chief, on the operating table. In lengthened operations, or in those necessarily attended with much hemorrhage, where artificial means to sustain the patient's temperature are required, most surgeons can recollect cases when the blankets and hot water at present in vogue have proved a decided nuisance. In such cases this quilt would be found literally invaluable as a soft, dry, warm, and convenient covering. Again, in cases of chronic rheumatism, or of that undefined neuralgia generally called lumbago, the quilt might prove comforting. Also, in cases of senile slowness of circulation, attended with general chilliness, such an appliance would be very useful.

A Tax upon the Beard.

An Italian journal, in view of the financial difficulties against which the government is struggling, proposes a tax, which, despite its seeming novelty, has precedents. It is a question of the tax upon beards that was in operation for a long time and under various forms in Russia. Peter the Great, knowing the attachment that his subjects had for the hirsute adornment of the face, introduced a tax upon the beard in his empire. The beard is a superfluous and useless ornament, said he, and, starting from this principle, he imposed a tax upon it as an article of luxury. This tax was proportional and progressive, not in proportion to the length of the beard, but to the social position of those who wore it. Each person upon paying the tax received a token, which he had to carry upon his person, for the guards were inexorable, and, always provided with scissors, ruthlessly cut off the beard of those who could not show their badge.

Catherine I. confirmed this tax. In 1728, Peter II. allowed the peasants to wear a beard, but kept up the tax for the other classes under the penalty of work on the galleys in case of nonpayment. Czarina Anne rendered life still harder to bearded men, for not only were they obliged to pay the special contribution imposed upon them, but also had to pay a double tax upon everything else for which they were assessed. This tax was not abolished until the reign of Catherine II.—La Nature.

ELECTRIC ILLUMINATION OF AN ORANGE.

Mr. C. Limb, preparator to Professor Lippmann, at the Sorbonne, has shown us a beautiful lecture experiment which we shall describe.

Upon an insulated support there is placed an orange, into whose poles are inserted movable needles which, through the intermedium of sleeves, are carried by glass standards. One of the needles communicates with the external armature of a strong battery of Leyden jars charged by means of a Holtz machine. Fig. 1 shows the arrangement of the experiment, the orange being seen upon its support in the foreground. After a sufficient quantity of electricity has been accumulated, one of the arms of an exciter is applied to the needle, while the other is placed near the interior pole of the jars. A strong spark bursts forth, and at the same time the orange becomes illuminated with a bright red light that gives it the aspect of a globe of fire (Fig. 2, to the left).

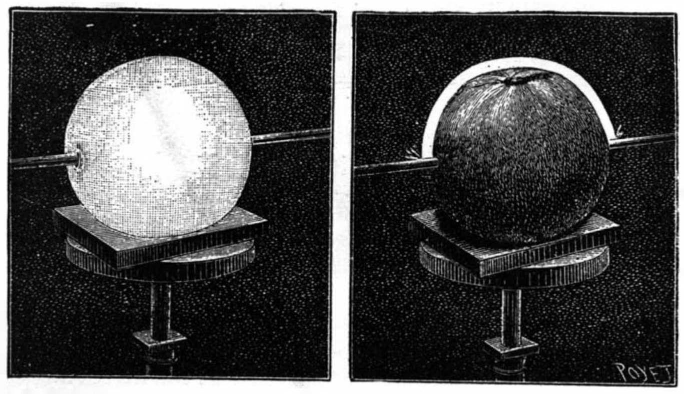


Fig. 2.—THE ELECTRIFIED ORANGE.

To the left the orange has the aspect of a globe of fire, while to the right the discharge is seen passing around the fruit without illuminating it.

If, in a repetition of the experiment, the orange be so turned that its axis shall be at right angles with the direction of the needles, the discharge will pass around it without illuminating it (Fig. 2, to the right).

This latter phenomenon is explained by the difference of resistances of the fibers in the various directions. It is not an isolated one, but, on the contrary, constitutes a general property of ligneous bodies.

The difference in the result of the two experiments shows that the greater part of the discharge passes into the interior of the orange. In fact, if it passed through the skin, or even immediately beneath it, the position of the needles would be indifferent.

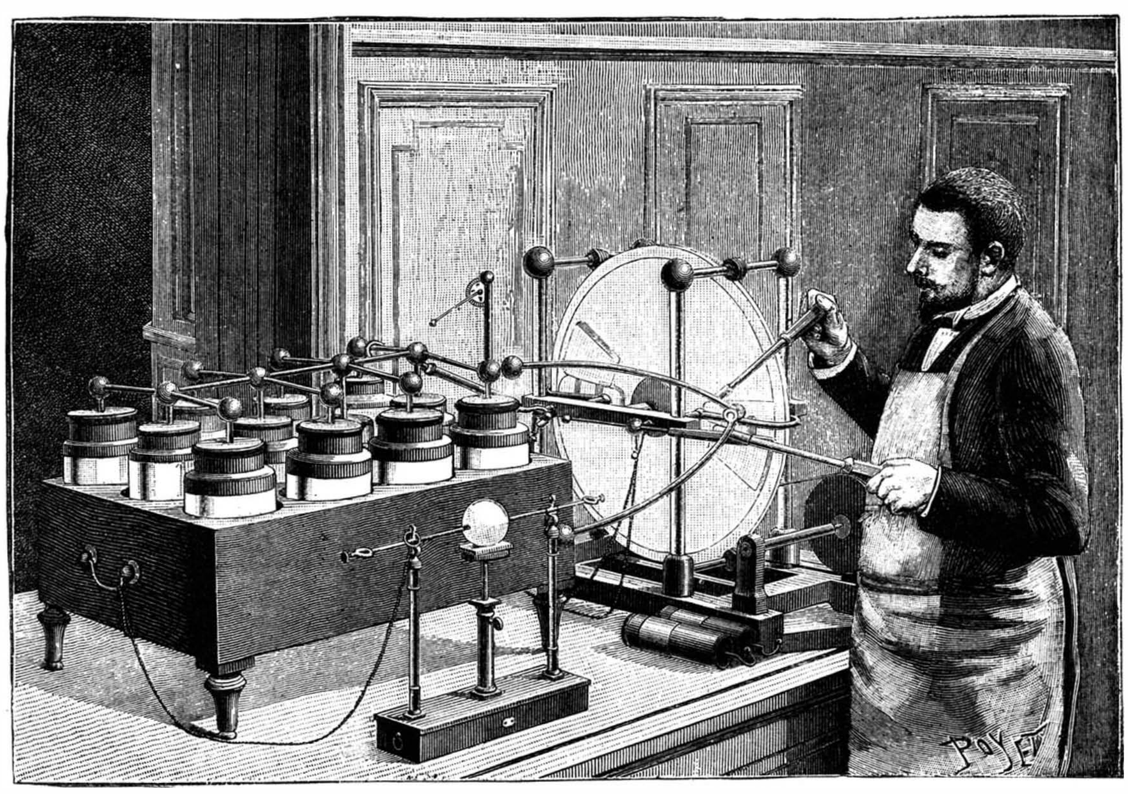


Fig. 1.—ELECTRIFICATION OF AN ORANGE.

It appears probable, therefore, that the light is produced in the interior of the fruit and entirely traverses the skin, which thus shows itself more transparent at the level of the spark than would have been believed at first sight.

The discharges in the direction of the axis damage the orange but slightly. On the contrary, when, by exception, a spark traverses the fruit in a perpendicular direction, it tears it in pieces and destroys it. The experiment succeeds nearly as well with other fruits, which become illuminated with various tints.—La Nature.

Storage Battery Impossibilities.

Occasionally we read, says the Electrical World, in newspapers, predictions of the possibilities of the coming storage battery, and some enthusiasts have even prophesied that when "perfected," ocean steamers will be propelled by this popularly misunderstood apparatus. While, of course, every one with an iota of electrical knowledge recognizes the absurdity of such a claim, yet an illustration of how absurd it is may be of interest, and to furnish this we will apply the necessary calculations to the case of the new Cunarder Campania. The best transatlantic time of which we have a record made by this ship, whose displacement is 18,000 tons, was 5 days 12 hours and 15 minutes, during which the average speed was 21 knots, corresponding to about 26,000 average horse power and a consumption of coal for the trip of about 2,700 tons. Assuming storage batteries of 50 pounds to the hourly horse power, the entire weight of batteries to do the same work, and allowing for no reserve, would be 76,750 tons of 2,240 pounds, or more than four times the entire displacement of the ship. To determine the weight per horse power that a storage battery should have to compete with steam in the case under consideration, we will assume that the entire weight of the boilers and machinery of the Campania is 3,750 tons, which is probably near the actual weight. Adding the coal consumption for a trip, 2,700 tons, we have 6,450 tons as the entire weight of the electrical plant. Assuming the weight of the electrical propelling machinery to be 1,500 tons, we have finally for the total weight of the battery 4,950 tons. With these data we find that the weight of a battery, allowing for no reserve, would have to be 3·16 pounds per hourly horse power. How small this is can be appreciated from the fact that a 150 ampere-hour cell would weigh on this basis only about 1¼ pounds, really about the weight of its lugs. A similar calculation would show the impossibility of storage batteries displacing locomotives, yet the writer knows of a company formed several years ago which spent several thousand dollars in attempting to perfect a battery for such a use. Much of the misconception in regard to the power of the storage battery must be ascribed to the sensational manner in which it was introduced to the public by a very great scientist, his statement in regard to holding "one million foot pounds of energy" in his hand not yet having lost its effect. The great value of the storage battery in its proper field, which is of vast extent, and as yet scarcely entered in this country, should be sufficient to satisfy its most sanguine friends. Only harm can come from making claims beyond its power to fulfill, and much harm in this way has been done, aside from the absurd instances we have here considered.

Mysterious Powder Explosions.

In the manufacture of many of the modern military and sporting gunpowders, says the Electrical Review, London, a substance called nitro cellulose plays an important part. This substance, whether in the form of grains or in sheets, becomes highly electric if exposed to friction by being shaken up, for example. In this condition the grains or sheets will adhere to each other and to almost everything. If they are faced or glazed with graphite or plumbago, the surfaces become conductive for electricity, and the phenomenon described does not take place. It is not the custom, however, to glaze all powders in this way, and it has recently been suggested by Mr. W. F. Reid that many of the mysterious explosions which have taken place in government and other factories may be traced to the ignoring of the electrical excitation which may occur. In government factories it is the rule to exclude all metal from the interior of the sheds where the powder is dried, or, at least, to cover up all metallic surfaces, such as those in the shape of pipes and fittings. Such a shed is often in effect a Leyden jar which becomes charged with electricity when the powder is moved, or the air warmed and set in motion for drying purposes. It is easy to imagine conditions arising in which a spark would occur; the only method of preventing this is by recognizing the necessity for metallic connections everywhere.

Danger of Reversing the Screw when Going at Full Speed.

Captain John Bain, of Glasgow, a well known Clyde nautical assessor, lately communicated a paper on this subject to the Institution of Engineers and Shipbuilders in Scotland. The opinions which he offered on the subject were, he said, obtained from personal experience in the handling of half a dozen large screw steamers, dating from 1873; and in corroboration of his conclusion he cited endeavors which were made in 1875 by Professor Osborne Reynolds, C.E., F.R.S., of Owens College, Manchester, and a committee of the British Association, to investigate the phenomena that had then been observed in the steering of screw steamers. In pointing out the danger attaching to the reversing of the screw while the vessel was going full speed, he instanced several collision cases which had been heard in the Admiralty and other courts, where the reversion of the screw of one or both of the steamers colliding appeared to him to be the ultimate cause of the accidents, and which, he regretted, were not taken into consideration either by those who had charge of the vessels at the time of the collision or by the bar or bench to whom the facts of the case were presented in the course of the inquiry.

In addition to a number of other cases referred to, Captain Bain quoted, as an illustration of the effect of putting the helm hard a-starboard and reversing full speed at the same moment, the collision between the Thistle, of Liverpool, and an unknown schooner; and, as an example of putting the helm hard a-port and reversing full speed, he adduced the case of the collision between the Thorsa, of Leith, and the Otto, of Hull, in the Baltic last year. Although there were dozens of collisions of a similar nature which he could mention, where the reversion of the screw just previous to the collision was perfectly plain, he contended that those two cases were about as clear and traceable to the effect named as any to be found on record. Stated briefly, Capain Bain said that his contention was as follows:

That if the helm is put hard a-port on board a steamer having a right-handed propeller, and going full speed or nearly full speed ahead, and at the same moment the engines are stopped and reversed full speed, the vessel's head will cant to port instead of to starboard as, mechanically considered, it ought to do, or, in other words, that the vessel's head will in 15 or 20 seconds after the screw is reversed stop canting to starboard, and swing 15 or 20 degrees in the direction of the danger which it was intended to avoid. On the other hand, he held that if the helm is put hard a-starboard in such circumstances as those mentioned, the result will be that the moment the engines are "over the center" to go astern the vessel's head will swing to starboard, as if on a pivot, with amazing rapidity, and so increase rather than diminish the distance between her and danger.

Dwarf Races.

According to Dr. T. H. Parke, the genuine pygmy races, about whom we possess reliable information, are the Batwas, discovered in 1886 by Dr. Ludwig Wolf, occupying the Sankuru region in the mid-Congo basin; the Mkaba tribe, near Lake Akkas, of Central Africa, with whom Emin Pasha's people would connect the dwarfs of the Central Forest. Of these the average height has been respectively reported to be: the Mkaba, 4 feet 1 inch; the Batwas, 4 feet 3 inches; and the Akkas, 4 feet 10 inches. Related to them in shortness of stature are the Bushmen of Southern Africa, averaging about 4 feet 7 inches in height; the Andaman Islanders, whose stature is under 5 feet; the Javan Kalangs, the Malayan Samangs, and the Ætas of the Philippine Islands. The Lapps are also notoriously of diminutive stature, so are the Fuegians, the Ainos, and the Veddahs, although a little taller.

Dr. Parke's experiences of the forest dwarfs of Africa during his travels were very varied. He had many narrow escapes from their archers, and certainly owed his life to one of their women. He purchased the latter from a slave owner for a handful of beans, twelve cups of rice, and six cups of Indian corn. But of course he did not buy her into but out of slavery. Dr. Parke was obliged to be very marked in his kindness to her at first to prevent her running away; but when she ceased to be afraid of cruelty, her devotion knew no bounds. Had it not been for her unwearying attention and care, Dr. Parke would have endured absolute starvation through months of forest life.

The first of the forest dwarfs measured was exactly 4 feet high. In marked opposition to the giants, dwarfs are very often strong in proportion to their size, active, well proportioned, and very intelligent. In regard to his own experience, Dr. Parke says:

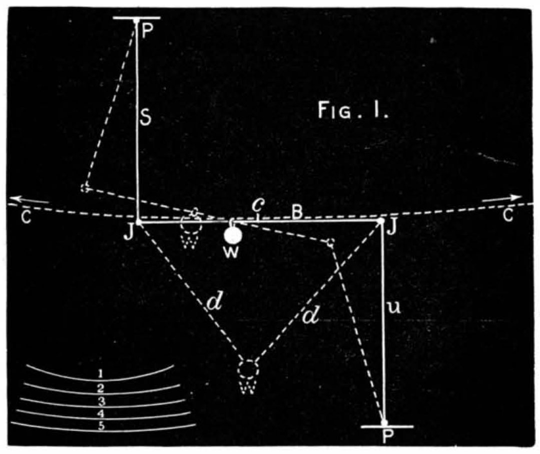
"The intellectual inferiority of the dwarf specimens whom I have myself met with was not at all in proportion to their relative bulk. I would rather try to teach a pygmy than a Nubian any day, and feel certain that after a few months' intimacy I could turn him out as reliable in intelligence and in honesty as his overgrown negro brother."—Illustrated Mission News.

SLOW BEATING PENDULUMS.

BY C. R. SUMMERS.

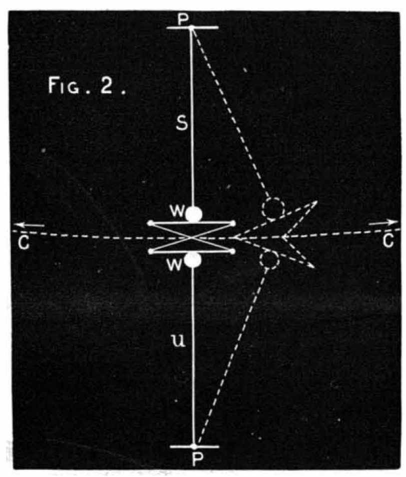
An ordinary pendulum that would make four vibrations per minute would have to be 731 feet long, and would, therefore, be impracticable. The experiments illustrated show how very slow pendulums may be brought within comparatively small compass.

Fig. 1 shows two pendulums, S U, parallel with each



other, one of them, S, being suspended from a fixed pivot, P, the other, U, standing upright from a fixed pivot, P, the two connected together at their free ends to a horizontal bar, B, J J being the joints. The weight, W, can be placed anywhere between the center, C, of the bar, B, and the joint, J, of the suspended pendulum, S. The nearer it is to the center of the bar, the slower will be its vibrations, and the nearer the joint, J, of the suspended pendulum, the faster will be its vibrations. (The motion given in the direction of the length of the bar, B.)

The weight, when placed near the center of the bar

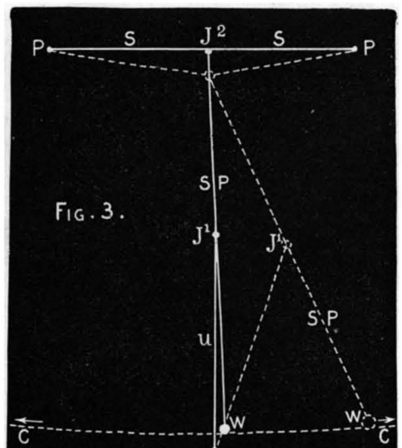


and on the side toward the suspended pendulum, moves in the arc of a circle of immense size; the radius can be calculated by the time of its vibrations.

I have a model of this kind (not delicately hung), which beats four times in one minute, when going its slowest. An ordinary pendulum, going at this rate, would have to be several hundred feet in length.

The segments, 1, 2, 3, 4, 5, show curves made by the weight at different positions on the bar.

The tendency of the lower pendulum to form a knee joint at its junction, J, with the end of the bar, B, when at the outer limits of its vibrations, is overcome by



the weight being hung below to a stiff triangular frame, shown by the dotted lines, d d.

A much better arrangement is made by suspending the hanging pendulum, S, directly over the upright pendulum, U, as shown in Fig. 2, the free ends of the pendulums nearly touching.

A cross bar, fastened across near the ends of each pendulum, the outer ends of the cross bars being the same distance from their pendulum's pivots, P P, as the free ends of the pendulums are from the same pivots.

To the right end of the bar, on the upper pendulum, is tied one end of a cord and the other end is tied to the left end of the bar on the lower pendulum, the cords crossing each other between the ends of the pendulums and resting against them, the pendulum ends being widened to keep them from slipping off.

Weights, W W, are placed on the free ends of the pendulums, being careful to make the weight on the upper pendulum the heaviest, the difference of weight of the two pendulums causing the difference of time of vibrations.

When the weight of the upper pendulum is only a very little more than the lower, the vibrations are slow indeed.

The model I have made of this kind makes slower vibration than the first described pendulums did.

The principle of Figs. 1 and 2 is the same.

The center of weight in Fig. 2 makes a segment of a great imaginary circle, the center of which is a great height above the earth.

I tried still another system, shown in Fig. 3.

Between the stationary points, P P, is fastened a string, S S. The upper end of a stiff bar pendulum, S P, is pivoted at the center of the string at J 2.

An upright pendulum, U, resting on its pivot, P, and extending a little more than past the center of the long pendulum, S P, having a joint at J 1.

When the weight, W, on the lower end of the bar pendulum, S P, is made to sway back and forth, J 2 rises and lowers slightly, the elasticity of the string being sufficient for the purpose.

The degree of curvature made by the weight, W, in its vibrations depends on the distance the joint, J 1, is above the center of the long pendulum, S P. The nearer the center, the slower will be its vibrations, and at the center it draws a straight line. Below the center, the same as the other pendulums, the curve is more in the direction of the curve of the lower pendulum; consequently it falls and will not rise.

So far as I can learn, these are the first experiments on slow beating pendulums. I have not had the opportunity of studying the experiments of others with pendulums, but cannot see why, if this were known before, pendulums of this kind were not used for certain kinds of clocks, or at least for philosophical experiments.

It is certain that they could be made, under favorable conditions, to beat as slow as desired, there being no friction against the air on account of slowness. The only friction would be at the pivots.

Keep the Skin Clean.

The importance of cleanliness for the healthy performance of the functions of life is the subject of a lecture delivered at the London Institute by Professor Vivian Lewes, and published in Nature. We may, says Professor Lewes, live for days without giving our stomach any work to do, the liver may cease action for several days before death ensues, but it is impossible to survive for the same length of time if the functions of the skin are entirely stopped. Indeed, the professor cites the case of a child which, being gilded all over to pose as a statue, died in a few hours. The sudoriferous ducts, of which there are about 3,500 to the square inch of skin, perform the important function of throwing off the moisture produced during the combustion of waste tissue by the oxygen of the blood, and secrete about 23 ounces of perspiration in the twenty-four hours, which evaporates without producing any sensible moisture of the skin. This throwing off the perspiration and its evaporation is a beautiful natural contrivance for regulating the temperature of the body, as the conversion of the perspiration into vapor renders latent an enormous amount of heat, which, being principally derived from the body, keeps it in a state of comparative coolness. A bath heated to 120° Fah. is almost unbearable, but one may be exposed for some time to a temperature of 325° Fah., in an oven. The perspiration keeps the body cool. The 23 ounces of perspiration secreted daily contains about one ounce of solid matter, which is left behind on evaporation. Apart from this there are sebaceous glands which secrete oily and resinous matters, of which the wax in the ear is a type; these, mixing with the solid matter and dirt adhering to the skin, form a compound which tends to clog the pores of the skin; and it is the removal of this, by the morning tub and rough towels, which is responsible for the refreshing influence of the bath.

EARTHQUAKES AND ELECTRICITY.—One of the greatest living authorities on earthquakes, Professor John Milne, of the Japanese Imperial University, in a recent article in the Seismological Magazine, July, says that the results of experiments and investigation on a possible connection between earthquakes and magnetic and electric phenomena do not allow us to admit any such connection. It is not likely that earthquakes ever result from electric disturbances, and it has not yet been proved that they ever give rise to any such, though when large masses of rock are displaced, as in Japan in 1891, slight local changes in magnetic curves have resulted.

Correspondence.

The Best Timber for Fence Posts.

To the Editor of the SCIENTIFIC AMERICAN:

Not finding any information on the lasting qualities of different kinds of wood when used for fence posts, I can give you some of my experience on this all-important subject. I look upon mulberry as being first, black or yellow locust next, then come red and white cedar. The difference between these two last does not amount to much. I have a small grove of European larches (why they are called this I do not know, as their native land is South America). Now, as I am thinking of making some fence posts of this wood, can you or any of your subscribers give me any information on the lasting qualities of the European larch? The European and American are not alike. The European is a drooping foliage, while the American is not. JOHN L. MOORE.

Quincy, Ill., August 6, 1894.

The Gila Monster.

To the Editor of the SCIENTIFIC AMERICAN:

Dr. Edgar A. Mearns, U. S. A., who has been collecting specimens of birds and mammals along the Mexican boundary between El Paso and this city for the Smithsonian Institution, also acting as surgeon to the International Boundary Commission, now re-establishing the boundary monuments, tells his experience with a Heloderma horridum, or Gila monster. When bending over the reptile to cut off its head, the creature blew its breath in his face and he was instantly nauseated. A brother officer received the "monster's" breath full in the face and was at once nauseated and fell over on his back completely prostrated. The doctor does not believe, as many do, that the "monster's" breath is fatal; but he thinks it has a decidedly upsetting effect. Neither does he think the "monster's" poison deadly. It has no fangs, but simply a series of fish-like fangs. There are no poison sacks, and what it possesses seems to reside in the saliva in the reptile's mouth. This poison possibly comes from the bad digestion of the "monster." M. Y. B.

San Diego, Cal., August 6, 1894.

Fruchtzucker.

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue [Aug. 4, 1894], in an article on invert sugar or fruchtzucker, you state that the substance remains permanently liquid. We have received a shipment of a few casks from Dr. Follenius, of Frankfort on the Main, and find that it does not remain liquid. When the casks reached us, we found on opening them that there was over six inches of solid sugar at the bottom of each cask. On filling a saucer with the liquid and letting it stand exposed to the air, we find that it is soon covered with a hard, crystalline crust and that it will become one solid mass.

A saucer of molasses will remain fluid for months or years. Honey will ultimately "candy" and become granular, but not so rapidly as fruchtzucker.

The incrustation on the sides of the interior of the cask, which is from one half to an inch thick, becomes perfectly dry. It resembles in every way the "yellow C" sugar of commerce. So the claim that fruchtzucker will remain as a permanent fluid is very far from the truth. ANDREW VAN BIBBER.

Cincinnati, August 9, 1894.

Natural History Notes.

Irritability of Plants.—In a work published a few years ago, Mr. Elfving showed that the sporangiferous tubes of Phycomyces nitens inclined toward a piece of iron or steel placed in their vicinity, while they were indifferent to a plate of copper placed near them. Again, a certain number of other bodies, such as sealing wax, resin, silk, India rubber, wood, and sulphur, acted like iron, and since, among these substances, there was no common property with which he could connect the effect produced, Mr. Elfving abstained from an explanation, although he was inclined to see in this phenomenon a sort of effect of irradiation connected with the internal structure of the active bodies.

In 1892, Mr. L. Errera attributed the fact to a sort of hydrotropism. It is known, in fact, that the Phycomyces nitens avoids humid surfaces. If, then, we admit that iron diminishes the hygrometric state in its vicinity, it will be understood that the sporangia of the plant will undergo on its side an apparent attraction that will be a real repulsion on the opposite side. But, on another hand, iron is scarcely hygrometric, and, moreover, very hygrometric substances, such as potassa and chloride of calcium, having no action upon the Phycomyces, Mr. Errera's explanation is not admissible.

Mr. Elfving has recently returned to the question in making known some new facts. Thus, platinum, which has no action upon the Phycomyces under ordinary circumstances, becomes active if it has been exposed to the sun. This new property manifests itself upon the illuminated side as well as upon the other, and lasts for some hours. Mr. Elfving sees here a sort of phosphorescence formed of rays invisible to us, but to which the plant is sensitive, and he recalls that Mr. Becquerel, in his studies upon phosphorescence, has said that even if bodies are not luminous in the phosphoroscope, it cannot be said that there exists no effect after the action of the radiation, for the light might excite vibrations of another and lower velocity than those that are perceptible to our eyes, and capable of giving rise either to heat effects or to other molecular actions as yet unknown. However it may be with this explanation and this hypothesis, Mr. Elfving has seen, among other facts, that 70 minutes' exposure to the bright sun of August suffices to render active a plate that 5 hours' exposure in cloudy weather leaves inert. Of course there could be no calorific effect here, since the plate remained inactive after having been heated for hours to the temperature that it reached in the sun. On another hand, the ultra-violet rays had no preponderant action, since the light preserved its action even when it was filtered through a solution of quinine.

Another fact: Heat, which has no action upon platinum, acts upon zinc. A zinc rod heated with a blowpipe to the melting point and afterward cooled gives the Phycomyces, in a few hours, the most beautiful curves that can be obtained. Then, after a few hours again, the same rod becomes inactive. On the contrary, platinum, copper, cobalt, nickel, tin, lead and glass are always inactive, to whatever degree they be heated.

All these phenomena are very surprising, and it is a rather unexpected thing to find ourselves brought to face actions at a distance by observations made upon plants.

American Tertiary Aphids.—Mr. S. H. Scudder has sent to his correspondents, as an extract from the thirteenth annual report of the United States Geological Survey, a pamphlet comprising some account of the Tertiary Aphididæ of North America. It is astonishing that these soft-bodied and delicate-winged insects should be preserved in the rocks, yet Mr. Scudder has seen, from the Florissant beds alone, 107 specimens. The American forms comprise 32 species, divided into 15 genera, while in Europe but 19 nominal species are known. There seems to be an extraordinary variation in the wing neuration of these fossil species, which necessitates a large number of genera. Most of them fall into the sub-family Aphidinæ, only a few of them being placed in the Schizoneurinæ.—Insect Life.

A New Octopus.—Mr. Edmond Perrier recently exhibited to the French Academy of Science specimens of a cephalopodous mollusk of the genus Octopus and of a species heretofore unknown. This new species, which has been named Octopus Digueti, came from Lower California. It is of quite small size and has a short bursiform body, a moderately large head, and arms of equal length. Like its congeners, it hatches its eggs, and during the period of incubation occupies a bivalve shell, generally that of a pecten. The instinct that leads the animal to take up its quarters in a shell is a simple modification of the vaguer instinct found throughout the entire genus and that causes the animal to take shelter in cavities in order to lay its eggs and hatch them therein. As a general thing, the poulp is content with any retreat whatever, such as a cleft in a rock, a space left free between a rock and the bottom, the shell of a crustacean, etc.; but the new species under consideration makes a selection and chooses the shell of a large bivalve. Its instinct is, therefore, specialized and thus takes on an exceptional character, which is worthy of remark.

Roses.—In 1535 but four species of roses were known. La Quintinie, gardener to Louis XIV., raised this number to fourteen. In 1820, Alphonse de Candolle enumerated a hundred and forty species. The number of wild species now known to botanists is over two hundred and fifty, to which may be added at least as many more sub-species or varieties, while the list of garden varieties, mostly with double flowers, numbers over six thousand, and is every year receiving fresh additions.

The rose has been the subject of numerous scientific monographs and floricultural disquisitions, and its cultivation affords employment to thousands of human beings. The species that has been cultivated from the highest antiquity is supposed to be the Rosa centifolia, the cabbage or Provence rose, a flower that possesses in an eminent degree the admirable qualities of the tribe.

Crayfishes that do not Change Color in Boiling.—A certain French writer was once joked for having called the lobster the "Cardinal of the Sea," under the supposition that this crustacean was naturally red during its living state. It is a well known fact that lobsters, crabs, crayfishes, and shrimps become red or rose-colored only upon being boiled, yet Mr. De Confevron, in the Bulletin de la Societe d'Agriculture, describes a species of crayfish that preserves, even after boiling, the bronze-green color that it possessed while living. This singular crustacean is found in at least three mountainous stations—at Bourg-d'Oisans, France, and at Sainte-Marie and at Saint-Etienne-de-Cuines, Italy. Many of these crustaceans are consumed in the upper Alps, and it is quite amusing to see the hesitation of those to whom they are offered at the table and who seem to think that the crayfishes set before them are uncooked. The crustaceans are excellent, however; they attain a goodly size, their shell is well filled out, and the flesh is firm and has a good flavor.

Electrical Voltage.

The New York World prints an interesting article on Nikola Tesla, written by Mr. Arthur Brisbane.

In answer to a question from the interviewer as to what he hoped to see accomplished by means of electricity, Mr. Tesla replied: "You would think me a dreamer and very far gone if I should tell you what I really hope for. But I can tell you that I look forward with absolute confidence to sending messages through the earth without any wires. I have also great hopes of transmitting electric force in the same way without waste. Concerning the transmission of messages through the earth, I have no hesitation in predicting success. I must first ascertain exactly how many vibrations to the second are caused by disturbing the mass of electricity which the earth contains. My machine for transmitting must vibrate as often to put itself in accord with the electricity in the earth."

When asked if he did not feel a little worried about taking a current of a quarter of a million volts, Mr. Tesla said:

"I did at first feel apprehensive. I had reasoned the thing out absolutely; nevertheless, there is always a certain doubt about the practical demonstration of a perfectly satisfactory theory. My idea of letting this current go through me was to demonstrate conclusively the folly of popular impressions concerning the alternating current. The experiment had no value for scientific men. A great deal of nonsense is talked and believed about 'volts,' etc. A million volts would not kill you or hurt you, if the current vibrated quickly enough—say half a million times to the second. Under such conditions the nerves wouldn't respond quickly enough to feel pain. You see, voltage has nothing to do with the size and power of the current. It is simply the calculation of the force applied at a given point. It corresponds to the actual pressure per square inch at the end of a water pipe, whether the volume of the water be great or small. A million volts going through you doesn't mean much under proper conditions. Imagine a needle so small that the hole it would make in going through your body would not allow the blood to escape. Imagine it so small that you couldn't even feel it. If you had it put through your arm slowly, that would be, electrically speaking, a very small voltage. If you had it stuck through your arm with great rapidity, going, say, at the rate of a hundred miles a second, that would be very high voltage. Voltage is speed pressure at a given point. It wouldn't do you any more harm to have a needle shot through your arm very rapidly—that is to say, with high voltage—than it would to put it through slowly. In fact, if it hurt you at all, the slow operation would probably hurt more than the other. The question of danger is simply the size of current, and yet if a big enough current should be turned against you and broken with sufficient rapidity—if it should, so to speak, jerk back and forth an inconceivable number of times to the second—it wouldn't kill you. Whereas, if applied continuously, it would simply burn you up."

An Automatic Telephone.

The Mutual Automatic Telephone Co., of Philadelphia, has an invention which is designed to obviate the annoyance and difficulty attending the obtaining of connection with other parties through the operations of a central office, as under the present system. With the automatic system a small keyboard, containing four keys, marked respectively "hundreds," "tens," "units" and "release," is attached to each telephone. These the subscriber manipulates when calling up a correspondent. For example, if he should want "122" he would press the key marked "hundreds" once, "tens" twice, and "units" twice, and then ring the bell. When through with the conversation he will press the next button, which is the "release," and the line is thrown into its normal condition. Each subscriber has a metallic circuit (two wires) for his use, and when he calls another subscriber the service is absolutely secret, and is, to all intents and purposes, a private line. When one subscriber calls another and no reply is received by the automatic system, it is because the person called up is not in his office or is busy. The manipulation of the keyboard is extremely simple and can be learned in a few minutes. With the "automatic" system there are no operators required at the central station, every subscriber being his own operator. Because of these conditions, a lesser rate can be made for service than the present rental paid for the "manual" system service. With the automatic system no battery will be used at the subscriber's place of business, as it is now used under the manual system; the only battery used in the automatic will be at the central station in operating the automatic switches.

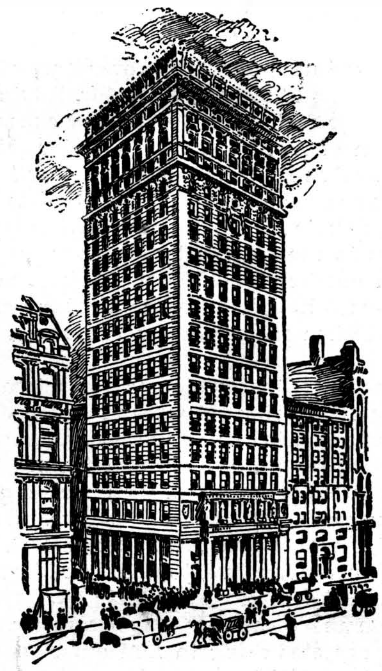
CAISSON FOUNDATION PIERS OF THE AMERICAN SURETY COMPANY'S BUILDING IN NEW YORK CITY.

(Continued from first page.)

walls, and on this brick work is laid. As fast as it sinks the brick work is built over it, so that it is continually subjected to an increasing pressure. Pig iron is sometimes piled on to increase the weight. As it goes down, a new section of working shaft has from time to time to be added. A peculiar form of coupling is used for the joint between the shaft sections, illustrated in one of the small cuts, which will be found self-explanatory. By the use of the return flange seen on the upper section, tap bolts can be used for fastening the sections together, which bolts are put in place from the inside of the shaft. Until water is reached, all is clear sailing, but as soon as the caisson reaches water, which it does about twenty feet down, air pressure has to be applied.

Accordingly the air lock is fastened to the top of the shaft, and thenceforward for the rest of the descent air is pumped in under pressure. Looking at the drawing of the section of the air lock proper, on its right hand will be seen two doors opening downward, while a ladder runs down its side. Through these doors the workmen enter. For entrance the lower door is closed, the compressed air is allowed to escape and the upper door is opened. The person entering goes into the small chamber, the upper door is closed, compressed air is gradually admitted, and when the full pressure is reached the lower door is opened and the way is opened for descent to the caisson beneath. To the left of the division of the air lock just described is a special section devoted to the extraction of material. This is really a separate air lock, complete in itself. Its lower end is closed by a door opening downward, similar to those already described, while its upper end is closed by two heavy doors sliding horizontally, fitting airtight as near as can be, with rubber packing, and operated by pneumatic pistons and cylinders. These constitute the bucket gate and are illustrated in detail in the sectional drawing in the right lower corner of the cut.

They are two heavy sliding doors, air-cushioned as they open, and worked by the two pneumatic cylinders as shown. Where they join in the center is an opening which grips a cable tube provided with a stuffing box, such as is used on a steam cylinder, through which stuffing box a hoisting cable works. The operation of drawing out a bucket of earth is as follows: The bucket being filled by the men in the caisson is drawn up, while the upper sliding doors are closed, and the lower door is opened. The rope working smoothly through the tightly packed stuffing box, draws the bucket up into its section of the air lock, hardly any air escaping. The lower door is then closed, the sliding doors are opened, and the bucket is drawn out into the open air and emptied. As it rises, the doors being opened, the tube carrying the stuffing box goes with the rope; when lowered, the tube is brought back into its place between the sliding doors. As they are closed, gripping the tube, the air is readmitted to the section, the lower door is dropped and the bucket descends. The air lock which we have just



AMERICAN SURETY COMPANY'S BUILDING, NEW YORK CITY.

described is of the Moran patent, Mr. D. C. Moran being in charge of the operations on the ground.

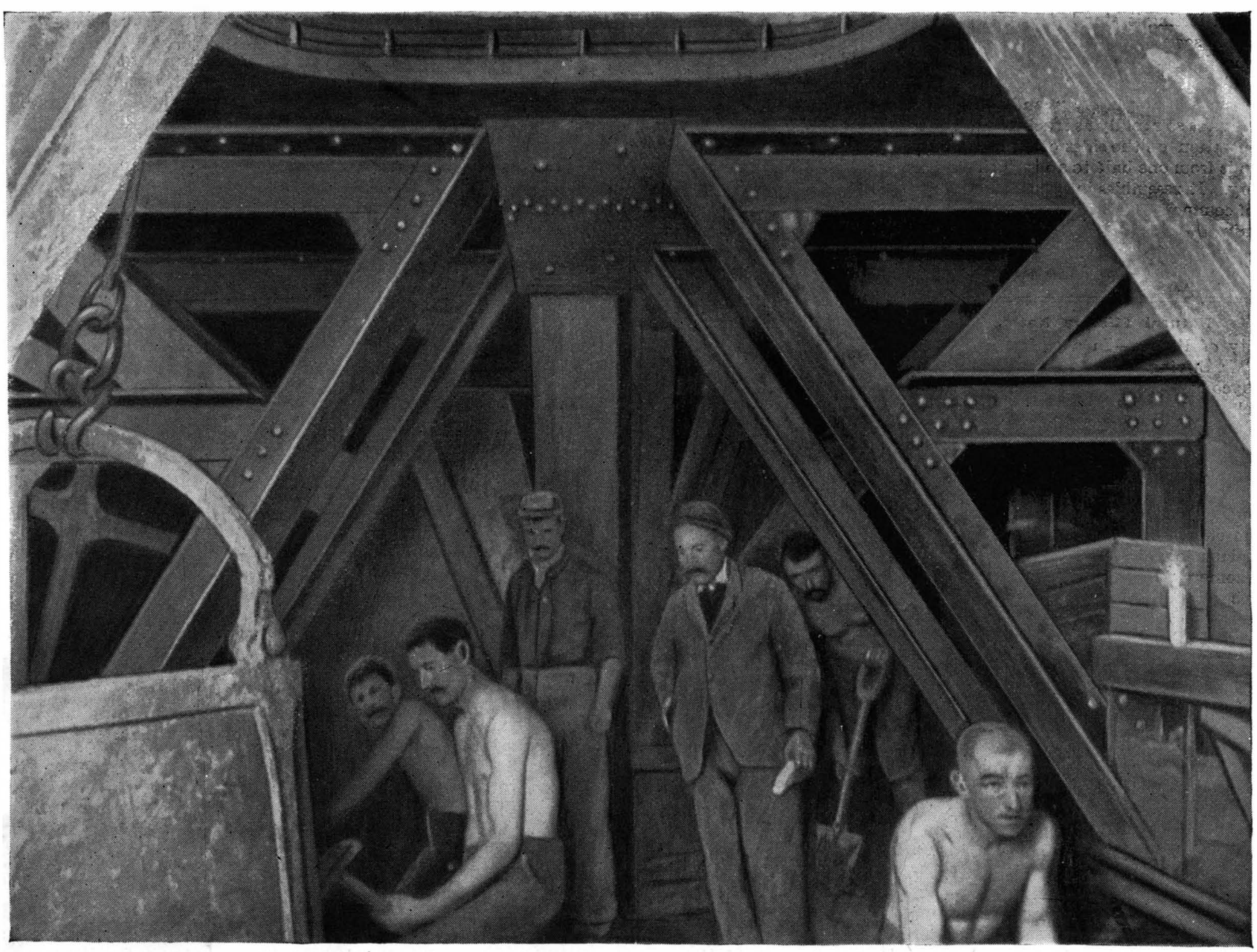
Our large cut shows the scene within the caisson. It is a reproduction of a very remarkable and unique photograph taken by us by flash light, while the caisson was under pressure, the men being many feet beneath the ground. In the lower left hand corner of the large cut is given a view of the general relations of caisson with pier, shaft and air lock. The caissons are carried down 70 feet from the street level to the bed rock. Each one after reaching its position and being established on an excavated bed in the stone is filled with concrete. As much as 52 feet of descent has been accomplished in one week on one of the piers. The general disposition of the piers and their size is regulated by the consideration that no greater strain than fifteen tons per square foot shall be imposed upon them by the weight of the superstructure. By beams and cantilevers the weight of the building is made to come as nearly as possible over the center of the piers.

Differences in Human Nature.

One of the most striking things in all nature is the difference that exists between the various individuals of the same class. It is said that if our power of vision were sufficiently acute, we should perceive that no two blades of grass, no two grains of sand, no two drops of water were precisely similar. We know this to be true of everything which comes within the scope of our observation, both in the organic and inorganic world, and it is only reasonable to believe that the same law reigns through the entire universe. These differences become more obvious to us as we become more familiar with the type. We easily recognize the variations in the trees of the forest, in the birds of the air, in the beasts of the fields, in the features and forms of the men and women who surround us, and the oftener we observe them, and the more closely we scrutinize them, the greater is the diversity that we discover between them. When we know a person well it is impossible that we can mistake him for any one else; his peculiar expressions of face and form and manner are stamped upon our memory and excite our instant recognition.

No two minds run in the same channels, or think exactly each other's thoughts. Truth is many-sided, and multitudes of men and women stand still, viewing continually but one of her phases. Did they but move around her, changing their respective attitudes, they would appreciate one another far better. Excellent people sometimes regret that there are so many differences of opinion upon a single subject. If all were agreed, they say, how smoothly and harmoniously might all work together for the general good! They forget that, were this possible, there would be no consensus of truth, no gathering together of its many features, no comparison of its many aspects. It is just this mingling of sincere convictions that enables men to correct their fallacies, to retrieve their blunders, to arrive at something like wise judgment and correct conclusions. Yet we chafe and fret at these very differences, and attribute to them many of the evils which really belong to our unwillingness to recognize and accept them. Too often irritation, ill feeling, and even anger arise from this innocent cause. Interchange of opinion, whether in ordinary conversation or in discussions and debate, is among the most instructive and valuable means of forming true opinions, yet often it is poisoned by a dogmatism that will brook no contradiction and a temper which regards all dissent as a personal affront.—Philadelphia Ledger.

HOE'S American press was introduced into London in 1858.



THE INTERIOR OF A CAISSON UNDER AIR PRESSURE.

Mirror Writing.

Many left-handed people, says the Lancet, have great facility in writing in this way, and it is really the natural way in which writing would be done with the left hand. It is taken advantage of by such as can use it freely and readily in writing, say post cards, for it is a simple and easy way of concealing the meaning, so long as those through whose hands the document passes are ignorant of the simple solution. For this it is only necessary to hold it before a mirror, when the writing appears as ordinary left to right writing. Hence the name "mirror writing" is the one commonly applied to it. As regards its explanation, it is not easy to understand that mirror writing would be naturally used in writing from a copy, because even if it were, in an automatic way, a comparison of the copy with the original would at once show the difference; but, on the other hand, in writing without a copy the mental image will, in the case of one who reproduces it with the right hand, fall into certain lines and curves produced in a certain way, while if the left hand is used the lines and curves will naturally be written in the reverse way—the way easiest for the left hand. It may be asked, Why then does not every one who tries to write with the left hand not write mirror writing? This, we believe, depends upon the strong association which years of habit have formed between the mental picture of the word and its actual rerpoduction on paper, an association so strong that the mind, as it were, rebels and forces even the left hand to reproduce the familiar form. In left-handed people this reversed writing is, as we have said, not uncommon when the left hand is used. In a certain proportion of others who have never written with the left hand the attempt to write a given word with the left hand will naturally be made in the right to left and reversed form. Thus it is sometimes seen in the case of patients who, having lost the use of the right hand, in trying to write with the left naturally write mirror writing. But it is uncommon, as we have hinted, probably on account of the strength of the bond between the mental image and its concrete symbol.

OGDEN'S MARINE VELOCIPEDE OR BICYCLE BOAT.

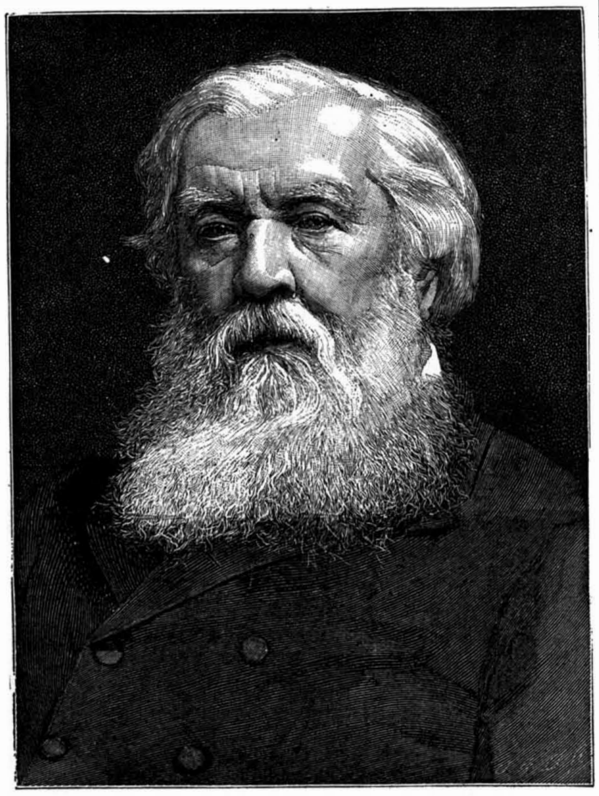
As plainly shown in the illustration, this boat is propelled through the water in the same manner as one propels a bicycle on land. It is a recently patented invention of Mr. H. B. Ogden, No. 204 Carroll Street, Brooklyn, N. Y. The boat is a long, easy running one, with the propelling machine dropped through its bottom into a second very small brass boat or fin keel, large enough for the pedals. The main boat is divided off by bulkheads about one-third from each end, and decked over, so as to be non-sinkable in case of accident. The machinery itself is of the simplest form, as shown in the sectional view at the top, the pedal cranks turning a gear which meshes into a worm of long pitch on the screw shaft, and the steering being effected by a rudder connected with the forward handle. The inventor also provides for turning the screw shaft by means of a sprocket chain and gears if preferred, the pedals being set quartering, so that there is no center. The machine is geared so that the propeller turns 460 revolutions per minute with one stroke of the foot per second, a much less speed than is made by most bicycle riders. The advantages of the lower boat or fin keel are obvious, its buoyancy serving to lift the large or main boat so that the draught of the latter is very slight, while the weight in the fin keel serves as ballast. It also enables the work to be done with a short shaft, with few bearings and no vibrations, the riders sitting low and the propeller wheel being always submerged. The single boat is 18 feet long and the double boat 25 feet long, the latter having an extra seat at each end of the cockpit for passengers, but the boats may be built, if desired, to accommodate crews of six or eight or more.

These boats are designed to furnish a delightful means of recreation and healthful exercise, as well as serve useful purposes. One can much more easily learn to run and manage a boat in this way than attain skill in riding a wheel on land. Especial advantages are claimed for these boats for gunning service, as they are quiet, may be run fast, and the hands may be freed to use the gun at any time.

OGDEN'S MARINE VELOCIPEDE OR BICYCLE BOAT.

SIR A. H. LAYARD, G.C.B.

Sir Austen Henry Layard, who died July 5 last, was born in Paris on March 3, 1817, and became famous as an Eastern explorer, a politician and a diplomatist. The London Graphic says, as a youth he was articled to a solicitor, but about the age of twenty-two he received the office of an appointment in Ceylon, and with a friend set out for India overland. At Jerusalem he parted with his friend and went on alone. He reached Bagdad, visited the great mounds under which



SIR AUSTEN HENRY LAYARD.

Nineveh lay hid, and wandered all over Babylonia and Persia. In 1843 he was asked by the British consul at Mosul to take some dispatches to Constantinople, and in that city he met the great Sir Stratford Canning, who offered him an attaché ship, and sent him back to explore Nineveh. His first work, "Nineveh and Its Remains," was published in 1848, and in 1853 he published his book on the journeys undertaken for the trustees of the British Museum, "Discoveries Among the Ruins of Nineveh and Babylon." All this time he was an unpaid attaché at Constantinople, but in England he found himself a lion, and on his return he held the under-secretaryship for foreign affairs under Lord John Russell for a few weeks in 1852. In the same year he was elected Liberal M.P. for Aylesbury, and during the Crimean war was one of the members who strenuously opposed it, even going out to the Crimea to see the hostilities for himself. In 1855 he refused to serve in Lord Palmerston's ministry, but in the following year accepted the under-secretaryship for foreign affairs for the second time. In 1857 he went to India during the mutiny, re-entered Parliament in 1860, and for the third time became foreign under-secretary in 1861, an office which he held until Lord Derby's government was formed in 1866. In 1865 Mr. Gladstone made Layard chief commissioner of works, and in 1869 sent him as envoy extraordinary to Madrid. He was still there when, in 1877, Lord Beaconsfield sent him as ambassador to Constantinople, and when Mr. Gladstone returned to power in 1880, Sir Henry, who had been made a G.C.B. just before the Berlin Congress, retired into private life. Since that time Sir Henry lived chiefly in Venice, where he had a wonderful collection of pictures, and took an active interest in the Venetian glass manufactory. He was of Huguenot extraction and was president of the Huguenot Society, formed at the bi-centenary of the Revocation of the Edict of Nantes.

The Telautograph.

The wires between St. Margaret's and the general post office, London, were, a few days ago, used for the purpose of some experiments with the telautograph—the invention of Prof. Gray, of New York. The Electrical Engineer, London, says: The experiments took place between the general post office, London, and Cable Hut, St. Margaret's Bay, through which the London and Paris telephone passes. Special instruments were fixed at both ends, and as this was the first time that long distance experiments in telautography have taken place in this country, they were watched with unusual interest. The results were good, the messages transmitted being, in every respect, most successful, and the instruments working without the slightest hitch over a distance of 83 miles. Messages were both sent from and received at St. Margaret's Bay. It will be remembered that the principle of the instrument is that it automatically records a facsimile of the writing contained in messages. In the experiments on Sunday the receiving pencil recorded with ease and clearness different handwritings, giving thick and thin strokes, dotting i's and crossing t's correctly. In this connection Mr. Armytage Bakewell writes: "It has been stated that the recent experiments in the transmission of autographic messages by electricity between St. Margaret's Bay and London were the first which have been made in this country in long distance telautography. Will you allow me to point out that this is a mistake, as more than 40 years ago the copying electric telegraph, invented by the late Frederick Collier Bakewell, successfully transmitted autographic messages between Brighton and London. Invisible messages, which could be rendered legible by the recipient, were also transmitted by that system. Great interest was taken by the late Prince Consort in my father's invention, and the inventor had the honor of exhibiting the instruments and of explaining their mechanical and electrical details to His Royal Highness at Buckingham Palace. The copying electric telegraph was subsequently exhibited at the great exhibition of 1851, and received the highest award, viz., the council medal."

Compressed Air Street Cars.

In a paper recently read before the French Society of Civil Engineers, M. Chatard presented data concerning the compressed air street car traction system now being installed by the Compagnie Generale des Omnibus de Paris on three of its most important lines, namely that running from the Louvre to St. Cloud, a distance of about 6½ miles; that from the Louvre to Sevres and Versailles, about 12 miles long; and that from Vincennes to St. Augustin, about 6 miles long. In the case of the first two lines trains of three cars each will be hauled by compressed air locomotives, while in the other motor cars will be used to which, when the volume of traffic requires it, a trailer can be added. For the first mentioned lines there will be one main power station supplying compressed air to two locomotive charging stations through 2⅓ inch pipe line. The charging stations are about 1⅓ and 2⅓ miles distant respectively from the power station. The latter is equipped with seven air compressors and a battery of eight boilers, besides an air accumulator outfit. The system to be followed is that of Mekarski, which has been in successful operation on the Nantes lines for the past fifteen years. The Vincennes-St. Augustin line will have two power stations at different points along its length, one containing three compressors and the other four. All three lines will soon be in operation.

DECISIONS RELATING TO PATENTS.

U. S. Circuit Court—Eastern District of New York.

ELECTRIC RAILWAY COMPANY OF THE UNITED STATES VS. JAMAICA & BROOKLYN RAILROAD COMPANY.

Townsend, J.:

Claim 1 of Letters Patent No. 407,188, issued July 16, 1889, to Stephen D. Field, for the combination of a stationary dynamo-electric generator driven by a suitable motor, a circuit of conductors composed in part of an insulated or detached section of the line of rails of the railroad track, a wheeled vehicle moving upon or along said insulated section of track, an electromagnetic motor mounted upon said vehicle for propelling the same and included in said circuit of conductors, and a circuit-controlling device placed upon said vehicle, examined in view of the prior state of the art, and held to be void for lack of invention, the only improvement therein being the selection of a generator producing a current sufficient to operate the railway.

Where a caveat described a stationary dynamo-electric machine whose wires connected with the rails of a railway, which with the wheels of the cars were to serve as conductors of the current to a secondary dynamo-electric machine placed on the car itself and geared to its axles, and a patent subsequently issued to the caveator, in which, instead of using the rails as conductors and the car wheels as collectors, a third rail and an additional collector were used, held that the caveat did not describe the same invention patented by the caveator, and its date of filing could not be availed of to defeat a subsequent publication by another of the invention embraced in the patent.

Where a patentee was advised by the Patent Office that his application disclosed, but did not claim, an invention claimed in a pending application by another party, and upon this information added claims for the invention, and the resulting interference was decided in his favor, but subsequently canceled the additional claims because the Patent Office on change of opinion rejected them on reference to a patent and took his patent with his original claims, held that he was not estopped from insisting on his narrower construction of the original claims in order to avoid anticipation of them as not including the invention in the canceled claims nor met by the patent that caused their rejection and cancelation.

Bill dismissed.

Where the patents of several parties are assigned to a corporation, which corporation subsequently reassigns to each party his patents in order that he might resume what he had put into the corporation, held that this was a mere transfer of stock in the corporation and did not estop the corporation from denying the validity of the patents.

Submarine Telegraphy.

The twenty-fifth anniversary of the establishment of submarine telegraphy to the far East was recently celebrated at the Imperial Institute, London, by a banquet, which was given by the Eastern and the Eastern Extension, Australasia, and China Telegraph Companies, followed by a reception which was attended by the Prince of Wales. Sir John Pender, M.P., the chairman of the two companies, presided at the banquet, which was served in the Grand Hall. The hall was decorated with flags of all nations and of the British colonies. The guests numbered about 450.

After the loyal toasts had been duly honored, Lord Kelvin proposed "Armed Science," and Lord Wolseley responded for the toast. He had often thought, he said, how immensely facilitated the great Duke of Wellington would have been in his great campaigns had the present means of rapid communication by railways and steamships existed. Perhaps it was not generally known that we were the first people who made use of submarine telegraphy in war—in the Crimea. The United States ambassador proposed "Submarine Telegraphy in its International Aspect," and the lord mayor followed with the toast of "Submarine Telegraphy in its Commercial Aspect." The chairman, in acknowledging the toast, referred to the early days when submarine telegraphy had its troubles, its disasters, and its triumphs. The United States was conspicuous in the part it took, not only in its scientific, but also in its commercial aspect, and the names of Morse and Cyrus Field would ever be associated with it. (Cheers.) He was himself connected with it at its dawn, and was connected with it in its successful and permanent establishment. When it was almost impossible to raise money for the 1865 cables, the Telegraph Construction Company was formed, over which he presided, and they were indebted to that company for the good work they then and had ever since done. Even in those early days it was proved by their late colleague and managing director, Sir James Anderson, to be possible to pick up and repair a cable in 2,000 fathoms of water, and this important fact largely increased public confidence in submarine cables as a property. For that great work all credit was due to Sir J. Anderson, who devoted the best years of his life to the development of submarine telegraphy. (Hear, hear.)

They were also indebted to Sir William Thomson, Cromwell Varley, Fleeming Jenkin and many other distinguished men for their scientific inventions, which enabled submarine telegraphy to achieve the great scientific and commercial success it had since become. At the present time there were 11 cables in the Atlantic, and another was in course of submersion, so that with the aid of duplex working, for which they were indebted to Dr. Muirhead and others, the carrying capacity was practically equal to twice that number of cables. The first attempt to provide the public with submarine telegraphs to the East was in 1859, when a cable was laid down the Red Sea and along the coast of Arabia and through the Persian Gulf to Kurrachee. Unfortunately this cable worked only a few days in its entire length, and it was afterward abandoned.

The success attending the Atlantic cable caused the idea of submarine telegraph communication to the far East to be again considered and carried into effect by the formation of various companies, which were afterward merged into the Eastern and the Eastern Extension Telegraph Companies. Twenty-five years ago on the previous day the company that laid the submarine system from Great Britain to the far East was registered. At that time the nucleus of the present system of eastern telegraph consisted of about 900 miles of cable, with a capital of £260,000. That day they owned 51,325 miles of cable, and had a joint nominal capital of over nine millions sterling, but which, at the present market quotations, actually represented nearly fifteen millions sterling. (Cheers.) Two years after the registration of the eastern companies the whole submarine system between Great Britain and China was completed and in working order. A year later the Australian colonies enjoyed the benefits of daily intercourse with the mother country and the rest of the world.

It was worthy of note that none of these companies were, in their early days, assisted by any government monopolies, subsidies, or guarantees, as in the case of the original Red Sea cables, so that it might truly be said that the government and mercantile communities of the world owed the benefits arising from direct submarine communication during the past 25 years entirely to British enterprise. (Hear, hear.) In those days submarine telegraphy was looked upon as a very risky investment. To-day it was recognized as one of the soundest investments in the market. South America was also connected by companies associated with eastern telegraphs, and quite recently communication with Chile and Peru had been further strengthened by the establishment of additional lines, under his own presidency, across the Andes. In short, wherever the British flag was flying and commerce warranted a fair prospect of remuneration, cables had been laid, and this policy would be continued in the future. (Cheers.)

At present the total mileage of submarine cables was in round numbers 152,000 miles, of which 90 per cent had been provided by private enterprise and 10 per cent by the various governments, costing altogether over forty millions sterling. The total length of land wires throughout the world was over 2,000,000 miles, estimated to have cost about £65,000,000. If the cables and land lines were added together, a combined capital was represented of £106,000,000. Governments had shown their high appreciation of submarine telegraphy. Indeed, one of our leading statesmen, remarking on its great progress and vast sphere of usefulness, recently said that he looked upon it as one of the greatest achievements of the Victorian age, if not in the history of the world. (Cheers.) When a Pacific cable was really required, the companies which he represented would not be found backward in meeting public requirements.

The Australian colonies during the last 25 years had shown their appreciation of the benefits of submarine telegraphy by assisting the Eastern Extension Company with a substantial subsidy to duplicate its cables between Penang and Australia. The majority of the Australian colonies also entered into an arrangement with the Eastern Extension Company, under a guarantee of half risk, to reduce the rates by 60 per cent. Twenty-five years ago it was considered wonderful to receive a message from India in a few hours; now telegrams arrived in a few minutes. They commenced business by carrying at the rate of 400,000 messages per annum; now they transmitted over 2,000,000. Their communications were maintained by nine steamships, fully manned and equipped with all the latest scientific appliances for at once repairing the cables when broken. Few events of international interest took place in which submarine telegraphy had not played an important part.

It might safely be said that submarine telegraphy had been provided wherever required by commerce, and that it had been enormously beneficial to the public at large. (Hear, hear.) It had, undoubtedly, equalized trade throughout the world, and brought the producer and consumer closer together, enabling the producer to obtain better markets and the consumer the benefits of international competition. It had over and over again prevented diplomatic ruptures and consequent war, and had thus been instrumental in promoting peace and happiness throughout the world. (Cheers.) He could not finish without acknowledging the good work and hearty co-operation which they had received from their Danish friends, the Great Northern Telegraph Company, and he also desired publicly to acknowledge the good work and co-operation which they had always received from their officers and staff throughout the service. (Cheers.)

Families and House Ownership Here and in France.

It appears from statistics just published by the French government that the population of the republic of some 38,000,000 is sheltered in about 9,000,000 dwelling houses. This seems to mean that houses are increasing at a faster rate relatively than population. In 1886 the number of such buildings was given as 7,706,137, which contained on the average 4·93 persons. These later statistics point to no particular increase of population in the past eight years, but to such an increase in the number of houses as to give one dwelling to each group of only a trifle over four persons. This is an interesting exhibit which becomes all the more so when comparison is made with the United States. The population of France is many times more dense than that of this country—much more dense, in fact, than that of the North Atlantic States. It averages about 187 to the square mile; where in this country the population averages 21 to the square mile, and in the North Atlantic States some 107 to the square mile. But the more scattered population of the States is housed in fewer dwellings relatively than the denser French population. The fact seems to be that while the family is still larger in the United States than in France, in both countries it is growing smaller; and in both countries, consequently, the number of dwellings is increasing at a faster rate than the number of inhabitants. For the last five census years the average number of persons to a dwelling and to a family in the United States has been:

	Persons to a dwelling.	Persons to a family.
1890	5·45	4·93
1880	5·60	5·04
1870	5·47	5·09
1860	5·53	5·28
1850	5·94	5·55

These figures point to the conclusion stated above, and the shrinkage in the size of the family accounts for the shrinkage in the number of persons to a dwelling. In France in 1886 the average family numbered 3·9 persons, when the average number of persons to a dwelling was 4·9. What is likely to be the average size of a family in the United States when the uniform density here reaches up more closely to the French figures? The French are a notoriously thrifty and industrious people, and their small families may be looked upon either as a cause or an effect of the thrift, or something of both. But it is still surprising to learn from these late government statistics that of the 9,000,000 dwelling houses in the French republic, 61 per cent are the property of resident owners. Here in the United States, in spite of the vastly superior material or physical advantages possessed by labor, in spite of our natural wealth and our well known industry, we can yet make no such showing as that. Statistics in regard to the ownership of farms and houses in 23 States, fairly typical of all sections of the United States, have been given out by the Census Bureau for 1890, and they show that only 47·5 per cent of the farms and houses together are owned by the occupiers, the remaining 52·5 per cent being occupied by tenants hiring the same at a rental. Taking the farms alone, only 32·3 per cent are worked by tenants; but this is a large proportion for such a country, and it is growing from year to year. But of homes in the cities and villages, 63·2 per cent are rented by the occupants.

The tendency in this country is apparently for the moment away from that situation in life which most clearly marks the existence of prosperity and thrift and independence among the working masses—the large and growing ownership of the farms and homes by their occupants. Is it due to extravagance and heedlessness in individual expenditure or underlying hard conditions of industry and wealth distribution? To the former causes, mainly. Conditions of work here are better, certainly, than in France. But we lack the French thrift, the close living within income. We may hope, however, that the spread of building societies and savings banks and the like, will do much to right these less creditable tendencies in the United States.—Springfield Republican.

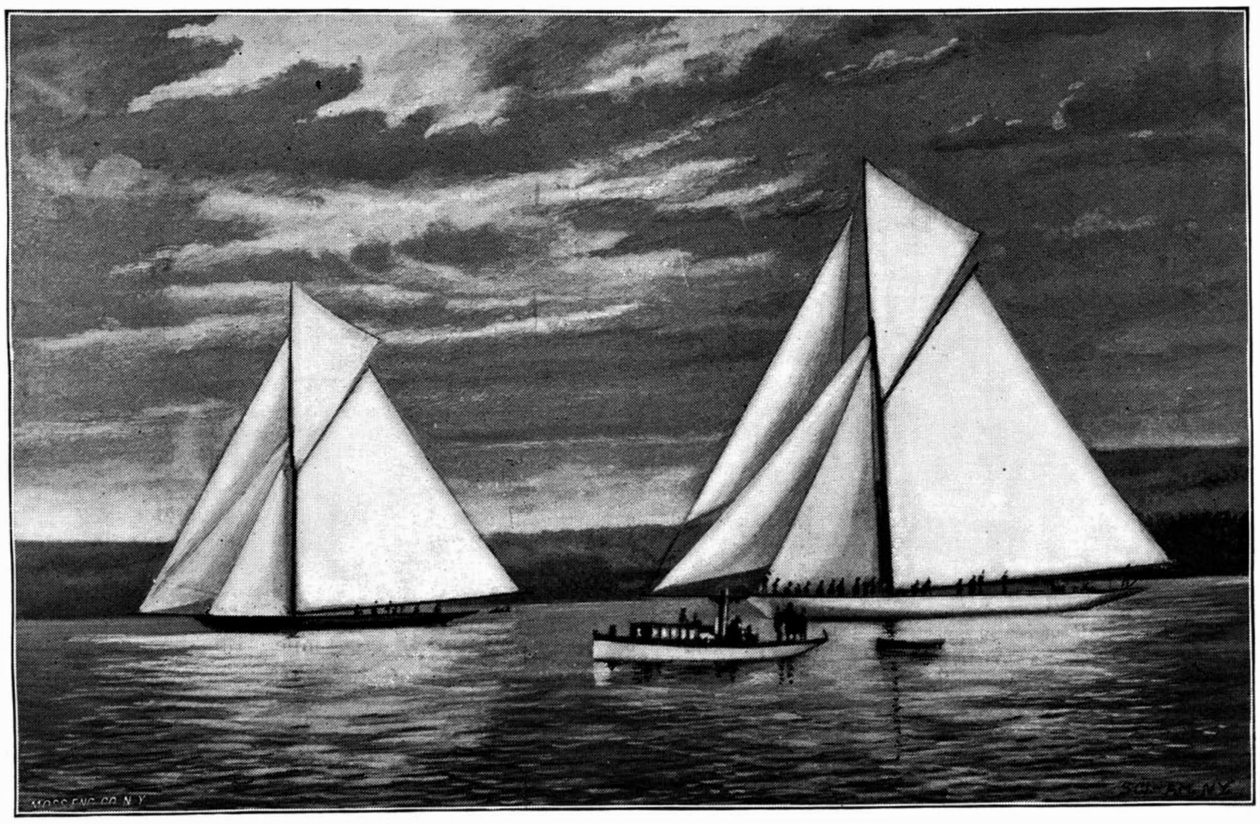
Antidote for Prussic Acid.

Dr. Johann Antal, a chemist and toxicologist of note, has reported to the Hungarian Society of Physicians that he has discovered a new chemical compound, the nitrate of cobalt, which, he says, is a most efficacious antidote to poisoning by cyanide of potassium or prussic acid. He tried the antidote first on animals and afterward on forty living persons who had been accidentally poisoned with prussic acid. In not a single case did the antidote prove a failure.

THE INTERNATIONAL YACHT RACES.

In England the present yachting season has been one of unusual interest, owing to the races which have taken place between the fastest British yachts and the American yacht Vigilant. The champion boat on the British side has been the Britannia, owned by the Prince of Wales, and in several of the contests the royal vessel has beaten the Vigilant. The latter vessel triumphed last year in every race with her British antagonist, the Valkyrie, and it was supposed the Vigilant could easily outsail the Britannia. In almost every race when stiff winds were blowing the Vigilant has been the victor; but in light winds the Britannia has come in ahead. The races of last year, it will be remembered, were sailed off the port of New York. This year the Vigilant went over to England, and it is a curious fact, on one of her races she went victoriously over nearly the same racing ground that the America sailed in 1851, when she gained her memorable laurels over the British boats.

Our engraving, which is from the Yachtsman, shows the Britannia and the Vigilant as they appeared at the beginning of the race off Cowes, August 4, 1894, on which occasion the Vigilant beat the Britannia by 6m. 33s. The prize was a purse of $500 for a race over the Queen's course.



Britannia. Vigilant.

THE BRITANNIA AND THE VIGILANT.

A TRIAL OF MAXIM'S FLYING MACHINE.

A reporter of the Pall Mall Budget recently visited Mr. Hiram Maxim's establishment, near London, and describes what he saw as follows: There was a hissing and a spluttering as some pumps got to work, and then, presently, the port propeller began to revolve with a rapidly increasing whirr-r, and the cry went up to "look out." In a few seconds whirr r-r-r went the starboard propeller also. The platform on which we stood rocked and quivered with the vibration. A hurricane seemed to spring up, laying the hay flat far and wide, and scattering like a whirlwind the shavings in the workshop twenty yards away. Every one grabbed his hat with one hand, and clung for dear life with the other to a rail. Suddenly, when the tornado had reached its height, and the whole machine was shaking and straining at its anchor like a greyhound in the leash, a shrill whistle gave the order to "let go," and the huge structure bounded forward across the meadows with a smooth sailing motion, at a rate increasing up to forty miles an hour.

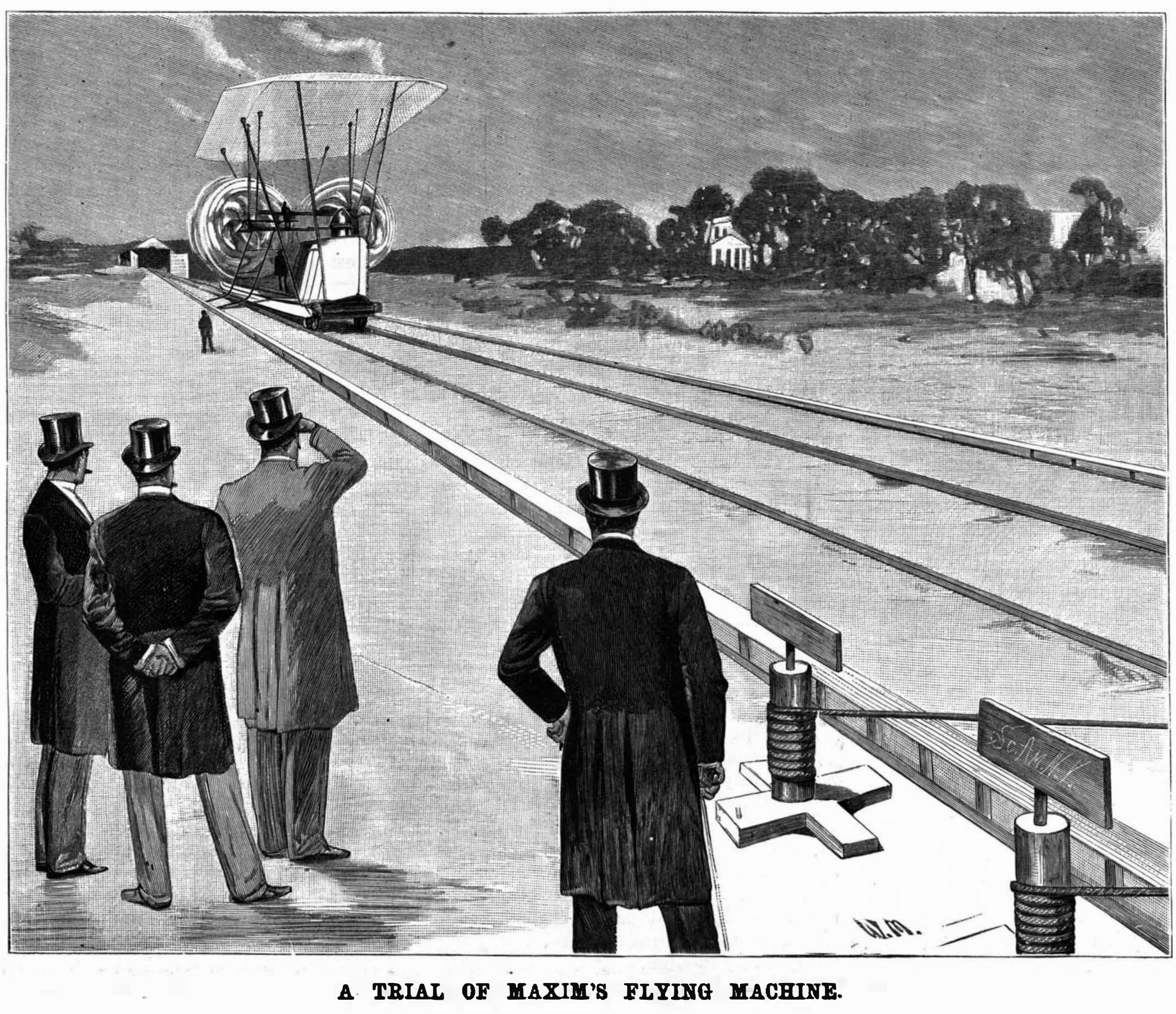
As the end of the track came in view a look of horror set in. There was nothing apparently but a quick-set hedge to arrest our wild career. A rope was stretched across the path. We crash through it. Then another; then another, and finally we come to rest in the easiest, gracefullest manner imaginable, within a few feet of what looked like perdition. Then we all laughed. It was a most delicious sensation, wiping out forever such tender memories as switchbacks, toboggans, and the seductive water chute. It was unique, in fact, and unlike anything that the world has ever seen; for the occurrence just described represents the crude residual impressions of a first trip over the rails on Mr. Hiram Maxim's giant flying machine.

The inventor beamed pleasantly as he noted the effect, for he had a distinguished company on board. There were Lord Kelvin and Lord Rayleigh, Sir Douglas Galton, Professor Vernon Boys, Sir Guilford Molesworth, Earl Russell, Professor Pettigrew, of Edinburgh, and the science representative of the Pall Mall Budget. After the first trip there was a unanimous demand for a second, and the huge structure, weighing but some 7,000 pounds in all, was pushed back along the rails on which it runs to the starting point, where steam was got up once more and the performance repeated.

Then the questions began. How was the power generated? What was it all made of? and (most important of all) Would it really fly? To take them in order, the machinery for developing and applying power is one of the most ingenious bits of steam engineering to be seen. It consists of a novel water tube boiler, built of asbestos cloth at the sides, and the thinnest sheet steel on top. The water is contained in about 2,000 bent copper tubes, only three-eighths inch in diameter, heated by over 7,000 gas jets arranged in rows. The fuel is naphtha or gasoline, which is stored in a liquid form and pumped into a vaporizer which transforms it into gas, and supplies it at a high pressure. All manner of cunning dodges are associated with this fuel supply. For instance, there is an exceedingly pretty automatic escapement which controls the fuel pump according to the pressure in the vaporizer; and the inrush of the gas, at a rate of two miles per minute, is utilized to suck in the necessary amount of air as well, both being under the most perfect regulation.

The feed water for the boiler is supplied through rows of pipes no larger than ⅛ inch in diameter. These are heated by the waste products from the flames with such success that the water is raised to 250 degrees (at which temperature it does not boil, on account of the pressure), and the gas products themselves are so completely robbed of their heat that they do not even blister the Brunswick black on the thin sheet steel covering which represents the top of the boiler. There is a beautiful automatic gauge for registering the amount of feed water passing into the boiler, and another ingenious device by which the pressure of the water itself is made to give the necessary circulation. With this apparatus steam can be got up in the incredibly short space of half a minute. Condensers were used at first, but an unlucky smash about three months ago damaged the apparatus, and now the steam exhausts into the air in two long wavy jets from the corners of the great aeroplane overhead.

So much for the steam generating appliances, which weigh only 1,000 pounds in all, and are placed in the very front of the machine, the boiler end tapering off like the bows of a ship so as not to catch the wind. The engines themselves are an equally remarkable piece of engineering. They are compound two-cylinder engines, poised about eight feet from the floor, and about six feet apart. They are independently governed, and will furnish 150 horse power each, which, considering that their total weight is only 600 pounds, gives the extraordinary efficiency of 2 pounds weight per horse power. This is something which will make engi



A TRIAL OF MAXIM'S FLYING MACHINE.

neers sit up and wonder whether they are dreaming. The high and low pressure cylinders are five and eight inches in diameter respectively, and the stroke is twelve inches long. A beautiful device is used for regulating the by-pass for the steam into the low pressure cylinder.

When going full speed these engines give 425 revolutions per minute to the gigantic propellers that drive the machine along. These are in appearance like two-bladed marine propellers, except that they are square instead of rounded at the ends, and are broad and thin. Inquiry revealed the fact that they were built up out of overlapping strips of American pine, planed smooth, and covered with glued canvas. The propellers weigh 135 pounds each; the length of the blade is close on 18 feet, the width at the ends 5½ feet, the pitch is 16 feet, and the maximum thrust they give is about 2,000 pounds measured on a dynamometer. They are carefully stayed by steel wires to their own shafts, or the first revolution would snap them off short.

The propellers are by no means the least wonderful part of this wonderful machine, and were evolved out of endless experiments. Arranged as a trophy inside Mr. Maxim's house are no less than thirty-two different models of propellers of every sort and shape, which were used in making the experiments.

To turn to the structure itself, the material of which the framework is built is thin steel tubing. It is so light that a length of it taken in the hand gives the same shock of surprise as does a piece of aluminum, which Mr. Maxim considers far inferior to steel for purposes of strength. All the ropes and ties are of the best steel also, capable of standing a strain of 100 tons to the square inch. The body of the machine is practically a "bogie," oblong in shape, with the forepart cut away like a water chute boat, and a long counter at the stern over which the propellers revolve. It has canvas stretched all over it, and a wooden grating to walk on. Four strong flanged wheels run on a pair of broad gauge rails, and at the end of a pair of long "outriggers" are other wheels which run under a wooden railing when the machine leaves the track. By these means it is prevented from rising at present more than an inch off the ground.

So far the description might have served for a skeleton locomotive. What transforms it into a flying machine is the aeroplane. This is made of fine balloon cloth. High overhead, like a gigantic awning, is the main aeroplane, tilted toward the front at an imperceptible angle, and stretched taut. The area of this is 1,400 square feet. This is increased by side wings to 2,700 square feet, the total width of the umbrella being then 150 feet. But besides these there are side aeroplanes arranged in three tiers, and large aeroplanes in front which are pivoted, and serve for vertical steering. When all these are on, the machine would probably rise like a bird. But Mr. Maxim is a careful man. He tests every step and every detail first; and it may be months, or even years, before he ventures to crowd on all his canvas at once and chance the result. At present he is quite content to run his machine on wheels down the little track a third of a mile long, and take his speed by a chronograph, and the pressure of the wind by an anemometer, and the push of the propellers by a dynamometer, and the lift of each particular aeroplane by a registering contrivance. For the whole machine is arranged as it were like a spring balance, and any diminution from the 7,000 pounds of its actual weight on the springs means lift in the air. Frequently it rises entirely, on one side or both, in its efforts to soar from the ground, and then the sensation as the upper rails hold it down is that of gliding in air.

Fools may laugh at a man who devotes whole years of his life and many thousands of pounds to constructing a flying machine which runs on rails; but it has been said of old, he laughs best who laughs last. There can be small doubt that Mr. Maxim holds in the palm of his hand a contrivance which little more is required to make perfect for aerial flight, and he is too old, or rather too young, a bird to spoil it by premature efforts which might end in disaster. What is wanted is a longer run for the machine, and probably more money —for it is doubtful if one man, however wealthy and enthusiastic, could go on for ever spending at the rate Mr. Maxim must have done. It seems a splendid opportunity for some government more alert and vigorous than our own to take the matter up and see it pushed through; for, sad to say, the first and most obvious use of such a machine as this would be for destructive purposes in war. Other possibilities are all subsidiary to this one.

The Russian Magazine Rifle.

The Mouzin (Mosin) rifle is the invention of a French officer, and was adopted by Russia at the end of 1891. Since then it has been manufactured at Chatellerault in large quantities, and is now replacing the old Berdan. The caliber of the Mouzin is 7·6 mm., and it is provided with a five cartridge magazine beneath the chamber. When the magazine is empty it can be used as a single loader, but it is not provided with a cut-off. The cartridges are rimmed, and are held together by a clip like that of the Mannlicher, by which they can be inserted in lots of five into the magazine, from the top of the breech, the clip being forced upward as the cartridges are pressed in. There is a closed base to the magazine. The barrel is protected by a movable wooden sleeve, and during firing the fingers of the left hand are inserted in two long grooves in the forepart. There are four grooves in the rifling, 0·15 mm. deep, with a right hand twist in every 24 cm., the lands being half as wide as the grooves. The leaden bullets have a mantle of "maillechort," and weigh 13·6 gr., a charge of 2·2 gr. of smokeless pyroxyline is used, and the cartridge weighs 25·5 gr., the packet of five weighing 137 gr. With the bayonet, the rifle weighs 4·3 kg., without it, 3·99 kg.; its length with the bayonet is 1·73 m., without, 1·29 m.

Notes on Science and Industry.

Curious Property of Aluminum.—Mr. Charles Margot, preparator at the physical laboratory of the University of Geneva, has recently made a curious discovery concerning aluminum. He has found that if glass be rubbed with a piece of this metal, very brilliant markings will be obtained that no amount of washing will cause to disappear. This property of aluminum of adhering firmly to glass, and to silicious substances in general, is especially manifested when the rubbed surface is wet with water or simply covered with a stratum of aqueous vapor.

Mr. Margot has constructed a small aluminum wheel which revolves very rapidly and with which he makes designs upon glass after the manner of ordinary engravers. The designs are metallic, chatoyant and brilliant, and, by burnishing with a steel tool, they may be even made to have the appearance of metallic inlaid work. The adhesion is absolute. But it is necessary to see that the glass as well as the aluminum point are perfectly clean.

This property of aluminum permits of immediately distinguishing the diamond from strass. While, in fact, aluminum leaves a very apparent trace upon crystals of the latter, it has no action whatever upon the diamond.

Artificial Cotton.—A Mr. Mittchell, according to La Science en Famille, has recently brought out an artificial cotton, which is made from the wood of pine, spruce or larch ingeniously defibrated, and then disintegrated and bleached with a hot solution of bisulphite of soda and chloride of lime. The pure cellulose obtained is treated with chloride of zinc, castor oil, caseine and gelatine, which give it body and cohesion. In this way there is made a paste which is passed through a perforated plate, as in the manufacture of macaroni, and is dried between steam heated cylinders. It now only remains to weave it in order to obtain a fabric that has a very presentable appearance and a certain amount of strength. It may be finished, dyed and printed like natural cotton, than which it is said to be much cheaper.

The Electricity of Waterfalls.—That cascades communicate a negative electric charge to the surrounding air has been known for some time. From some observations that he has had an opportunity of making in the Alps, and from numerous laboratory experiments, Mr. Lenard draws the following conclusions:

Drops of water that fall upon the surface of water or upon a wet body disengage electricity, the water becoming charged positively, and the surrounding air leaving the place of the fall charged with negative electricity.

A jet of water that resolves itself into drops is thus capable, in a closed room, of causing great enough differences of potential to produce sparks.

The least impurity of the water greatly lessens the effect.

Other liquids, besides water, show themselves active in various degrees and take either positive or negative electricity. The simple flow of water in the air, the friction of water against a stone, and the variation of potential of the free atmosphere exert no sensible influence. This latter point is confirmed by Messrs. Elster and Geitel, who have observed several subterranean cascades producing a negative electrification of the air just as aerial falls do.

Mr. Lenard thinks that it is necessary to consider these phenomena, as a whole, as resulting from the difference of potential of the air and water in contact, or, more generally speaking, of any gas or liquid whatever.

Gum Tragacol.—According to the Revue de Chimie Industrielle, a gum under the name of "tragacol," possessing valuable properties, is now being manufactured commercially from the seeds of the carob tree. The seeds or beans, after being removed from the pod, are split and divested of their germ and are then treated several times with boiling water. The resulting mass is then submitted to a vigorous kneading operation and afterward introduced into a hydro-extractor. The gum thus separated passes through a fine metallic sieve, and the exhausted seeds, still saturated with water, are left behind.

The Photographing of a Falling Drop of Water.—Under the patronage of Capt. De W. Abney, president of the Camera Club, of London, Mr. E. J. Marey, president of the French Society of Photography, Mr. J. Janssen, president of the National Union of Photographic Societies of France, and Mr. J. M. Eder, professor at the Photographic School of Vienna, the Revue Suisse de Photographie has opened a competition with the object in view of determining by photography the exact form of a drop of water during its fall.

There are several factors of a nature to cause the form of a drop of water to vary during its fall: (1) The size, which may be determined by the diameter of the drop tube; (2) the velocity, which may be known by noting the distance of the fall; (3) the density, which will be known in employing distilled water; (4) the presence or absence of currents of air; and (5) finally, the temperature of the water.

The water employed must be distilled, and the temperature of it noted in Centigrade degrees. This water must be dropped from a glass or metal tube, whose internal and external diameter must be measured. The outflow of the water must be regulated, by means of a cock, at the rate of about one drop per second, in order to prevent the drops from coalescing. The distance between the starting point of the drop and the point where it is photographed must be accurately measured. The dropping of the water must be effected in a closed room protected against currents of air.

The photographic dimensions of the drop of water are not prescribed, but those will have most value that are nearest the natural size.

The photographs may be taken upon glass, films or paper, and should be addressed as phototypes or negatives without retouching to the manager of the Revue Suisse de Photographie, Place du Molard, Geneva, before the 15th of October, 1894.

Each phototype must carry a very distinct sign, repeated upon a concealed envelope, which must contain, in addition to the name and address of the sender, the precise circumstances under which the photograph was taken, conformably to the prescriptions of Article 2 of the conditions of the competition.

The prizes offered are a silver-gilt, silver and bronze medal and three honorable mentions.

The best photographs will be enlarged to a uniform size and be published.

Influence of Diameter in Single Landscape Lenses.

If a landscape lens of, say, eighteen inches focus and only one inch in diameter will cover a plate twelve by ten inches in dimensions, of what use will it be to increase the diameter of such lens? This is a form of question which has, we know, often simmered through the minds of many photographers, both experienced and inexperienced, and is answered as follows in the British Journal.

The center of the picture is produced by the center of the lens, and its margins are likewise formed by the margins of the lens. It is quite true that a lens of small, even the smallest practicable, diameter may be made to cover a plate sharply to its margin by a proportionate reduction of its stop, but such stop will have to be very small indeed to effect this. The smaller the diameter of the lens, the smaller must be the stop or diaphragm which is necessary to fulfill the condition of equal sharpness throughout, and a very small stop is subversive of all rotundity in the objects included. It gives a map-like, flat sharpness only.

An improvement in this respect takes place by the employment of a larger working aperture, but, in proportion as this is attained, so is all marginal definition degraded, until eventually it becomes little else than a blur.

With a lens of larger diameter this condition of things is altered. The stop is placed at a greater distance from the surface of the lens, its mount being longer to permit of this being done. Here lies the advantage —marginal definition can be obtained with a stop very large in comparison with that necessary for securing an equal degree of sharpness with the smaller lens. Hence much greater pluck and rotundity of the objects in the picture, and a greater rapidity of action. This permits also of groups, and even portraits, being obtained in a light which, with a lens of smaller diameter, could not easily be obtained without a long exposure.

THE New York Edison Electrical Illuminating Company has contracted with the Electric Storage Battery Company, of Philadelphia, for a large storage battery installation.

The installation will consist of 150 elements of chloride accumulators, type G, 41 plates, having a capacity of 8,000 ampere hours at 150 volts, at normal rates, or a total capacity of 1,200 kilowatt hours.

The installation will be furnished with the most modern and complete appliances for the control and operation of the battery, and everything possible will be done to make it a model, and at the same time the most modern and complete battery plant ever installed. The battery is to be installed immediately, to be ready for the heavy winter load.

RECENTLY PATENTED INVENTIONS.

Engineering.

REVERSING GEAR FOR ENGINES.—Daniel H. Grant and Henry Miller, Raymore, Mo. A collar having a lug is keyed on the main driving shaft, and a sleeve adapted to be shifted axially and circumferentially is arranged concentric on the shaft, the sleeve having a spiral cam groove and a straight slot. The spiral groove is engaged to the lug on the collar, and an eccentric is formed in the bore of its disk with a lug engaging the straight slot in the sleeve, the latter being shifted at any time by the operator to move the eccentric and valves in any desired position.

POP SAFETY VALVE AND MUFFLER.—Erastus B. Kunkle, Fort Wayne, Ind. This is an improvement on a former patented invention of the same inventor, the device affording a powerful discharge of steam and the immediate relief of the boiler of overpressure. The valve body carries a cup forming a steam space between it and the valve body, and a cup-shaped valve extends into the valve body cup and forms a steam space between it and the valve body, the valve being provided with an exterior seat flange adapted to be seated on the valve body and its cup.

RAISING SUNKEN VESSELS.—Oscar A. Bulette, Charleston, Washington. A wreck indicator and raising device, patented by this inventor, provides a lifting chain or cable to be automatically attached to the sunken vessel from above without the employment of a diver, the chains to be then connected with any approved hoisting mechanism. A float supports the drum carrying the cable, the spool having a peculiar brake mechanism, and on the vessel is a bill hook from which a cable leads to the float, while the lifting chain or cable has a large terminal link or ring adapted to slide down on the float cable and automatically engage the bill hook.—[Mr. Bulette may be addressed at the SCIENTIFIC AMERICAN office, New York City.]

Railway Appliances.

FENDER FOR TRAM CARS.—William Dryden, Brooklyn, N. Y. This device has body section to be supported by the forward portion of the car, provided with a cushioned chamber in which are cushioned spring-controlled doors, while a cushioned fender extends forwardly and downwardly from the threshold of the chamber. It is designed that a person struck shall be forced to fall upon padded surfaces and prevented from rolling or dropping from the fender, thus receiving no injury. The device is of simple and strong construction, and may be conveniently applied to the dashboard of any car.

Electrical.

SASH BALANCE.—William C. Hodgkins, Washington, D. C. According to this invention two or more hollow coils of insulated wire are arranged in alignment, a magnetic core or plunger being arranged to move through them, while a set of corresponding electric circuits and switches are connected with the coils, there being means for connecting the core with the sash. By means of the apparatus, the opening and closing of doors and windows, and locking or unlocking them, may be effected on operating a suitably arranged push button.

Mechanical.

PERFORATING SHEET METAL —David Henderson, Central City, Col. This inventor has devised a metal-punching machine in which the punch block is made in sections having in their opposing faces longitudinal grooves adapted to receive the punches, clamps extending inwardly into the grooves at each end to engage with the end punches. The machine is capable of rapidly perforating sheet metal screens with slits or openings surrounded by a burr on one side of the sheet. One set of punches may be removed and another inserted with great facility, and the machine is of simple contruction and inexpensive.

CEMENT MILL.—John A. Albertson, of Lansford, and James H. Fisher, of Siegfried's Bridge, Pa. This is a crushing mill in which, within an enveloping case, a rotary cylindrical pulverizer shell is secured upon and driven by a central rotatable shaft, outwardly projecting pockets on the side of the shell radiating from central circular open-ended feeding chambers, there being screens over the radial edges of the pockets and a loose roller rotatable by its gravity within the shell below the shaft. The mill is adapted to pulverize any hard rocky material, separating the powder from the coarser particles and expelling the completely pulverized portion as the operation progresses

SAW FILING MACHINE.—William B. Allen, Allentown, La. This machine is adapted to file the sides of saw teeth, performing the work rapidly and uniformly, and it can be instantly applied and readily adjusted to saws of various patterns, as circular, gang and band saws, etc. Its frame has parallel side bars, to be supported from the edge of a saw, while a file holder composed of two crossheads is fitted and adapted to slide on the bars, a rigid handle connecting the crossheads, there being a lengthwise slot in one of its extended ends through which passes a clamp screw securing the handle adjustably to the crosshead.

NUT LOCK.—Jesse A. Wells, Guyandotte, West Virginia. According to this improvement, the screw-threaded bolt has a longitudinal channel and the nut has recesses on its inner face, a key lying in the channel having a head adapted to enter one of the recesses, while a washer with an internal diameter equal to the combined thickness equal to that of the bolt and the head of the key, and a thickness equal to the length of the head, is adapted to move bodily at right angles to the bolt and hang suspended behind the head of the key.

Miscellaneous.

FOLDING BED.—Samuel Hawver, University, Cal. This inventor has devised a ventilated folding bed, to be warmed with the least possible outlay, and designed to be placed in the wall and built in with the house, becoming a permanent fixture. It is arranged to fold into and out of a recess, with which are communicating flues admitting fresh outside air or air from a furnace or other heater, and when raised out of the room it forms a neat paneled or mirrored section at one side.

GARMENT SUPPORTER AND UNDERWAIST.—Charles F. Richmond, Mattoon, Ill. This inventor has designed a skeleton underwaist to which is secured a stocking supporter and a waistband, to which skirts and other like apparel may be fastened, the whole being supported from the shoulders of the wearer, to carry all the weight of the garments in a healthful and hygienic manner.

RECEIPT PROTECTOR.—Alfred Steiner, New York City. This protector is designed to conveniently cover up portions of a leaf in a receipt or other book to prevent the reading of executed receipts by other parties. The invention consists principally of a series of movable cover or shield plates independent of each other and adapted to each cover or portion of a leaf.

JUG.—George W. Spring and George W. Printz, Crooksville, Ohio. As a new article of manufacture, these inventors have devised a jug which may be burned in a kiln without necessitating the addition of other pieces of crockery to maintain the columns of jugs in position for proper burning, enabling the kiln to be entirely filled with jugs. The jug has a spout which forms its mouth and is adapted to be closed by a stopper.

FOLDING CHICKEN COOP.—Luther Matthews, Paris, Tenn. In this coop the end sections are hinged to fold inward flat on the bottom, and the side sections fold flat on the end sections, there being a pair of screw bolts of unequal length pivotally secured centrally to the bottom, and a removable top having a central aperture and a lock nut adapted to be fitted on either of the bolts. The coop may be easily spread or folded and held locked in either position.

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.

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.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(6190) Rain Gauge.—G. F., J. M. P., S. E. S. & T. J. St. L. write criticising answer to G. F. The answer was erroneous. The angle of the rainfall does not affect the accuracy of the rain gauge record to an appreciable extent.

(6191) E. J. S. asks: 1. In making the tangent galvanometer and resistance coils described in "Experimental Science," will German silver resistance wire answer the same purpose as copper wire? If not, why? A. German silver will answer for the resistance coil, but is not suitable for a galvanometer. In a galvanometer the object is to secure the greatest number of turns with the smallest resistance where great sensitiveness is required. German silver having 13 times the resistance of copper, would necessitate an enormous total resistance. 2. Cannot any small battery motor be adapted to the Crowfoot gravity battery, by winding motor with finer wire to make its resistance proportional to the battery resistance? A. Yes. 3. I have an induction coil with a secondary winding of No. 36 wire. Could I not get the same secondary current if I had used No. 25 or any size up to 36 by making the same number of turns of wire? A. By using small wire the winding is brought near the primary and core. If larger wire is used, it takes up more room and the outer coils are farther removed from the inductor.

(6192) R. W. asks whether it requires a greater expenditure of energy or not to raise a weight of say 8 tons on a car up a hoist or elevator (the balance weight of which is made to counteract the additional weight of the car) than to draw it by a locomotive or other force up an inclined track to the same height. The friction to be minimum in both cases. A. The energy required for lifting a given load, whether on an incline or vertically, is the same. The energy lost in the mechanical appliance for lifting is not the same in all cases. A vertical lift is the most economical in energy, as it saves weight and friction in the car. Locomotive train haulage is the least economical in energy, by the amount of energy required to move the locomotive and train. Rope haulage is nearly as economical in energy as the vertical lift, but each has its particular advantages in the conditions of the horizontal distance that material must be transported. The different systems cannot be exchanged without regard to the horizontal element in the problem.

(6193) J. S. P. says: Please give me a receipt telling how to make elderberry wine. A. Gather the berries when quite ripe, on a dry day; pick them off the stems, and bruise them with your hands. Strain the juice; let the liquor rest in glazed earthenware pans for twelve hours to settle. Allow to every pint of juice 1½ pints of water, and to every gallon of the mixed water and juice 3 pounds of sugar. Put it over the fire in a large saucepan, and when it is ready to boil, clarify it with the whites of four eggs. Let it boil for an hour, and, when nearly cold, put in some yeast to work it; pour it into the cask, reserving some of the liquor to fill up the cask with, as it sinks with working. If you have about ten gallons or so, it should be fit to bottle off in two months' time after it has been closed down. Keep at least a year in bottle.

(6194) W. S. D. asks: 1. How much wire would be required to wind the spool of the telephone described a few weeks ago, to be used on a quarter mile line? A. 188 feet, or about 2 ounces. 2. Could ordinary ungalvanized wire with ground circuit be used for a quarter mile line? A. Yes. 3. What would be the number of Leclanche cells required to work call bell on line of gravity cells? A. 2 or 3 on each end. 4. Which is preferred? A. Leclanche. 5. How many cells would be needed on a metallic circuit of same length? A. Three would probably do.

(6195) B. J. writes: Please give me through the columns of the SCIENTIFIC AMERICAN a simple and accurate rule for figuring the horse power of steam boilers. A. The horse power of boilers as usually rated in trade is based on the amount of heating surface in flues or tubes and shell. The number of square feet of heating surface for a horse power varies largely with different kinds of boilers and with different makers; 10 to 12 square feet for water tube boilers, 12 to 16 square feet for tubular and locomotive forms, and from 8 to 12 square feet for flue boilers are about the range of nominal horse power. The actual output of horse power which may be realized depends upon the steam pressure and the economy of the engine; so that the actual work of a boiler may be two or three times its nominal horse power, as the steam pressure may range from 50 to 150 pounds and the engine consume from 30 to 15 pounds of steam per horse power per hour.

Communications Received.

"Life Guards." By J. J. B.

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AND EACH BEARING THAT DATE.

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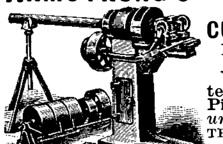

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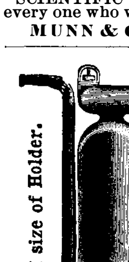

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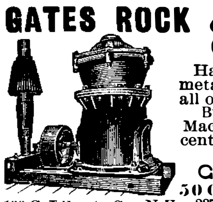

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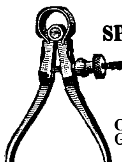

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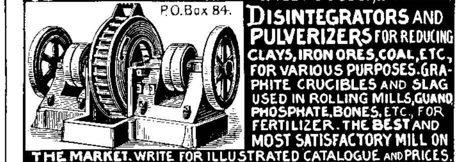

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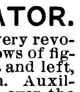

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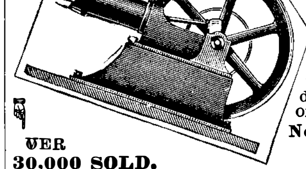

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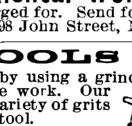

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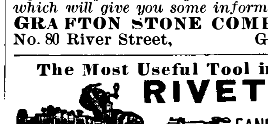

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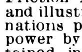

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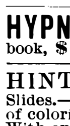

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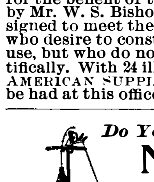

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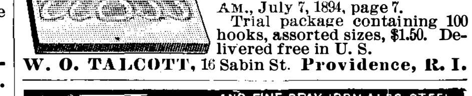

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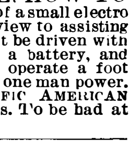

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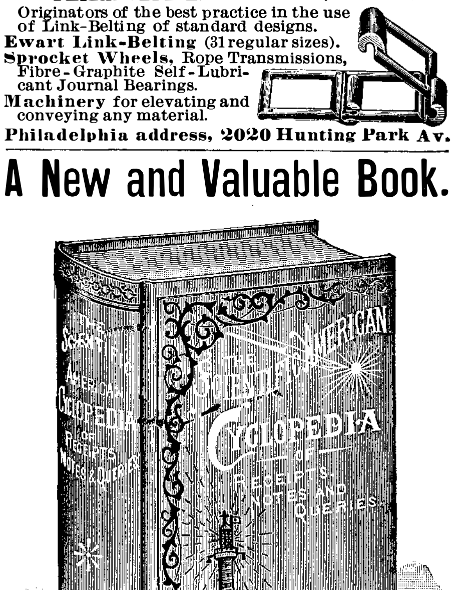

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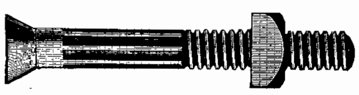

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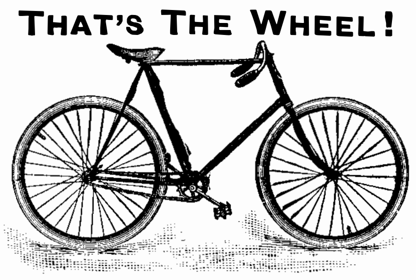

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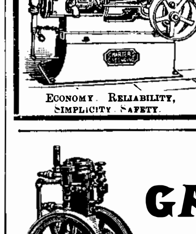

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