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NEW YORK, SATURDAY, SEPTEMBER 7, 1901.

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

A PROMISING TYPE OF GUN.

We call particular attention to an article on another page describing a new system of gun construction which, both theoretically and by actual test at the Government proving grounds, gives promise of showing superiority over every other type of gun on all possible points of comparison. It is now some four years since we described the manufacture of the 10-inch segmental, wire-wound gun, which was being built by the United States Government for the purpose of determining the value of that system of construction. Since that time a 5-inch, rapid-fire, type gun has been constructed, embodying certain radical improvements, but built on the same basic principles; and both weapons have undergone tests at Sandy Hook. Although the ballistic powers claimed for these guns were far in excess of anything that had been obtained in gun construction, the Sandy Hook tests, as far as they have been carried out, have fully substantiated these claims; and although, in the case of both guns, there have been accidents or interruptions to the tests which might seem at first sight to cast a doubt upon the efficiency of the system, a careful study of the reports and the results shows that these drawbacks have been due to what might be called accidental or external circumstances—such as failure of the gun carriages or changes in powder—and that in no case have they been due to faults either in the construction, the theory, or the guns themselves.

From the official reports on these tests, we gather: First, that the 5-inch Brown gun tested at Sandy Hook in 1893 and 1894 gave a 61-pound projectile an instrumental velocity of 3,194 feet per second, the muzzle velocity being 3,235 feet per second. It is a fact that, after an interval of seven years, this velocity has not been equaled in any gun of a practical length. The report states that a pressure of 82,850 pounds in the chamber of the gun was reached during this test—a pressure which, it must be admitted, would certainly destroy a gun of any other type built in this country. Compared with our new navy 50-caliber 5-inch gun, we find that that weapon has given its 60-pound shell a muzzle velocity of 2,990 feet per second, developing a muzzle energy of 3,710 foot tons, or about 832 foot tons energy per ton-weight of gun. The segmental, wire-tube 5-inch gun, 44 calibers long, when it reached the remarkable velocity above referred to, developed a muzzle energy of over 4,432 foot tons, or 1,055 foot tons of energy per ton of gun. The 5-inch type of gun tested in 1899 fired 300 shots for endurance under a contract which called for a velocity of 2,600 feet per second. The firing sheet turned in by the ordnance inspector who superintended the tests shows that all but three of the last ten shots were fired with velocities of 2,700 feet per second, which proves that, even after 300 shots with smokeless powder, the erosion had not been sufficient to affect the velocity.

As regards the ultimate strength (the ability of the gun to resist bursting effects due to wave action and other irregularities of the powder), it may be mentioned that the original 5-inch gun of 1893 and 1894 was sent to Sandy Hook to be tested by firing 500 shots with pressure between 40,000 and 50,000 pounds to the square inch, the latter being the maximum pressure to which it was to be subjected. The Ordnance Board, wishing to experiment with a new type of smokeless powder, ran the pressure up as high as 82,850 pounds per square inch, as mentioned above, and fired from the gun more shots at pressures of 50,000 pounds and upward than have been endured by all the built-up, hooped guns in the army. At the 292d shot it was found that the repetition of the extravagant charges used in the gun had cracked one of the segments. Nevertheless, although the gun had fired several shots with 50,000 pounds pressure after the cracking of the segment, it was not until the gas cut its way through the wire that the injury was discovered. This remarkable fact is a conclusive proof of the theory that the segmental system of construction, especially with curved, overlaid plates as now used, will permit a fracture of one of the segments without threatening the integrity of the gun itself.

As regards the ultimate possibilities of the system, it may be mentioned that a 4½-inch gun is now being constructed which will be capable of firing an extra-long 55-pound projectile, with a muzzle velocity of just under 4,000 feet per second. The ballistic data for this particular gun have been calculated by Lieut.-Col. James M. Ingalls, U. S. A., and he estimates that when fired at extreme elevation, and with the weight of shell and the muzzle velocity given above, the gun will have an extreme range of 23.9 miles, or just 3 miles more than the range of 20.9 miles estimated by the same authority as the extreme range of the Army 16-inch gun, now nearing completion. This estimate is based upon an assumption of a chamber pressure of 60,000 pounds to the square inch. If the calculations of Col. Ingalls should prove to be correct—as they undoubtedly will—and the 4½-inch gun prove itself equal to the enormous powder pressures demanded, the United States will be in possession of a weapon so far in advance of existing types as to be distinctly in a class by itself.

It is sincerely to be hoped that, in the further government tests which have as yet to be made of this system, every possible facility will be afforded for trying it out to the utmost limit of its capabilities.

SOME CHEMICAL MYSTERIES.

It has happened more than once that just as we had firmly established our sciences upon a basis which seemed as unyielding as the Biblical rock, and had tollfully formulated theories that explained all phenomena with unvarying simplicity, some obscure experimentalist made a discovery which by no possibility could be twisted and molded to fit the existing system and, indeed, even challenged the truth of all established doctrines. Thus it was that Young and Fresnel overthrew the old emission theory of light with their experiments in the phenomena of interference; and thus our theories of chemical interaction, and even our conception of matter, may be modified by the researches made within the last few years in the field of the radio-active substances.

What chemist formerly would for a moment have thought of attacking the law of Avogadro—the law which tells us that if the temperature and pressure be equal, equal volumes of different gases contain the same number of molecules? And yet a modern chemist, Lord Rayleigh, did find it necessary to test the truth of that law by precise determinations of the densities of well-known gases. If he had never studied the behavior of nitrogen, or if he had considered the discrepancies which he observed in determining the vapor density of that gas, as errors due to defective observation, as many a chemist before him had done, argon and the other newly discovered constituents of the atmosphere might still be unknown, and many chemical doubts never aroused. Roentgen, too, found it necessary to revive theories of radiant matter which we thought we had long since refuted, and he supplied us with rays which we cannot yet explain. Becquerel increased our perplexity with his thorium and uranium rays. But when M. and Mme. Curie exhibited to our astonished eyes the results which they had achieved with radium and polonium, we were completely mystified and were compelled to admit that there were more things in chemistry than our philosophy had dreamed of. Other chemists have also experimented with uranium, following methods different from those of the Curies, and have obtained additional active substances.

Still another supposed element has been found to mock our periodic system. It has been discovered that thorium, when subjected to the action of acids, yields helium, and that thorium is often associated with radio-active substances.

Helium and its gaseous companions on the one hand, the radioactive substances on the other hand, are mysteries which have so far completely baffled our chemists. And uranium and thorium, elements with which we once considered ourselves thoroughly familiar, are now to us as curious as if they had been but the discovery of yesterday.

If the eccentricities of uranium, thorium and helium, and the mysteries of Roentgen rays cannot be adequately accounted for by our existing chemical system, the question arises: Can our system be wrong? Chemistry is an exact science—at least we had flattered ourselves that it had been at last raised to that eminence. But an exact science is infallible, and will hear nothing of exceptions. Some day a chemist will be found whose mind, broad enough to grasp the scattered facts unearthed in the course of a century of research, will elaborate a chemical system which may prove as revolutionary in its way as the theory of Young; but which will embrace in its comprehensiveness those puzzling gases and radiant substances so utterly inexplicable at present.

THE DESIGN OF PROPELLERS.

The whole system of screw propulsion used upon the turbine vessels does not conform to that of other high-powered ships, for the screws are not only greatly multiplied in number but they are exceedingly small in diameter, and, judged by the proportions used in regular practice and by the eye as well, would seem to be wholly incapable of achieving such good results. In the recent tests of warships, or boilers for them, the commander of one vessel was urged to order a higher rate of revolution in the engines of one vessel to increase the speed, but he is said to have replied that it would be of no use, inasmuch as the screws would "only churn the water." As regards "churning," so-called, this is an old argument against screws; they may "churn," as it is called, but if they do the more they churn (or turn) the faster the vessel they are in goes. The "Ellide," the fastest steam yacht afloat today, has run at the rate of forty miles an hour on the measured mile; to do this her screws ran at over 800 revolutions per minute, and they are only 42 inches diameter at that. If the churning, so called, was a serious hindrance to efficiency, the vessel certainly could not have maintained any such velocity.

Some discussion of this subject of screw propellers, occurred at the late meeting of the Institution of Naval Architects, England, and an elaborate paper by a Russian engineer, Mr. Drzewiecki—mathematical from start to finish—was adverted to. Briefly, the paper contained two propositions, the first being that there was a certain form of screw having a mean pitch of 1.25 times the diameter, with the pitch disposed in a particular way, which gave better results than any other form. The second proposition was the first repeated, to wit: if the premises were correct that was the kind of screw for general use, and no other, so that one drawing of a screw would suffice for all, the only variation being in the number of blades and the size and number of the propellers to suit different cases.

This is exactly what is now done in this country, and, we may add, in other countries, but it seems to beg the whole question and leave it where it was. Two ships are built upon the same molds and with the same engine powers and screws, but it is found in practice that they do not perform alike; in other words, one vessel is better than the other, and the screws act differently. The why and wherefore of this variation is what all persons interested would like to find out, but as yet no one has. In the discussion above referred to, it was stated that Mr. Froude found, to his surprise, that there was no advantage in one pitch ratio over another, through a very wide range. The principal difficulty in screw design laid in correctly estimating the velocity of the wake (its wake) and the propulsive effect. Prof. Biles was of the opinion that the proposal to make a uniform propeller struck him as being much the same as an effort to make a uniform ship.

The results of years of experiment and research by careful and experienced observers go to show that the propeller cannot be laid down upon hard and fast lines, but that it must be eliminated, so to speak, from many observations upon ships for certain purposes. It is quite true that a vessel may not perform satisfactorily with a standard screw, so-called, or one built after usual methods, and do much better with a bastard screw of no known principles or derivation. This will account for the many testimonials from owners which aver that a certain wheel improved the speed of their ship so many miles an hour over the old wheel; although the increase is usually put far too high, seeing that it has been asserted by good authorities that, as between the very worst and the very best screw that could be designed the difference is not 10 per cent.

MARCONI TELEGRAPHS ON THE BRITISH FLEET.

The recent naval maneuvers of the British navy have emphasized the advantages and disadvantages of the Marconi system of wireless telegraphy when applied to battleships. In the recent French maneuvers complaints were made that messages transmitted between the vessels of the French squadron were intercepted by the English vessels. The same result has occurred during the English maneuvers. One squadron was enabled to receive all the messages that were transmitted between the vessels of the opposing fleet, and was enabled to act accordingly. The messages were, of course, transmitted in code, but the eavesdropping fleet succeeded in deciphering the cryptograms after a little study. The tinkling bell of the instruments upon the various battleships worked as readily as if the messages were intended for those particular receivers. On one occasion messages were intercepted at a distance of 80 miles from the transmitting vessel. The explanation is that the Hertzian waves, as they are transmitted, radiate in all directions in the same way that the ripplings spread over a lake and affected all instruments with which they came into contact. Such a *contre-temps* would be very disastrous in actual fighting, though to a certain extent their utility would be nullified by the utilization

of the secret code, without any more danger than would arise from the transmission of signals by means of the semaphore. It was discovered that the system was unworkable unless conducted by the most expert operators, so delicate are the adjustments that have to be made from time to time. An instrument tuned up for a distance of 20 miles was found to be equally efficient at a distance of 50 miles. Marconi has devoted his energies to the remedying of this salient disadvantage of the system, and states that he is now able to minimize, or to obviate entirely, any possibility of such leakages. The presence of land, and the condition of the atmosphere, was proved to materially affect the intensification of the electric impulses and the accuracy of the signals.

PAN-AMERICAN MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

BY WILLIAM H. HALE.

The Buffalo meeting of the American Institute held in the New York State Building at the Pan-American Exposition was notable both for the papers presented and the international character of the attendance. Last year the institute met at the Paris Exposition, and invited European engineers to attend this meeting. Over 4,000 invitations were sent out to all the prominent engineers of Europe; and though only about fifteen persons responded the foreign delegation included representative men from France, Belgium, Germany, England, South Africa, Hawaii.

The impressiveness of this meeting was emphasized by its environment. The triumph of electrical engineering was conspicuous at the fair, and in all the surrounding region, in the utilization of Niagara for power and light and vast electrolytic works.

The foreign guests were welcomed to New York by President Charles P. Steinmetz at the house of the American Society of Mechanical Engineers, and went by special train to Buffalo, stopping to examine the great works of the General Electric Company at Schenectady, which are under the management of President Steinmetz.

The exercises of the first day at Buffalo consisted merely of an address of welcome by Prof. George F. Sever, chief of the electrical department of the fair. Papers were read on each of the other days. Thursday, which has been designated as Electrical Day, was distinguished by a lack of electricity, causing an interruption of two hours to the illumination that evening.

Papers read include the following: Paul M. Lincoln described a frequency indicator of his own invention now used in the Niagara Falls Power House. It tells whether the machine being synchronized runs too fast or too slow; also it tells the exact place of synchronism.

Caryl D. Haskins, in his paper on "Electric Meters," said that recording meter design has progressed rapidly, so that no such radical improvements may be expected now as formerly. The two essentials meriting most careful study are: First, the expenditure of the maximum permissible amount of work in the foucault disk, and, second, the provision of the best means for instantly compensating for friction variation at the point of use without affecting total calibration.

William H. Browne, Jr., read a paper on "Power Factor Indicators," constructed to show that the wattless component of current due to induction motors is balanced by the use of synchronous motors or converters. The use of such an instrument shows that when induction motors are used alone the inductance factor is always a large percentage of the power factor; and he says that those who use induction motors should at least pay rental for the wattless volt amperes required. The ensuing discussion developed a general sentiment in favor of charging rental for power thus borrowed, even though afterward returned.

Thursday, August 15, "Electrical Day," was taken up with papers and discussions on "The Transmission of Power." E. W. Rice, Jr., described an oil break of his invention now employed by the Metropolitan Street Railroad Company of New York, which retains the usual advantages of the oil switch and minimizes the amount of oil required. This safely controls currents of practically unlimited power at potentials considerably above 40,000 volts, probably as high as 100,000 volts.

President Steinmetz presented a theoretical investigation of some oscillations of extremely high potential in alternating high potential transmissions, in which by elaborate mathematical processes he worked out several conclusions, the most important of which is thus stated: "The electric oscillations occurring in connecting a transmission line to the generator are not of a dangerous potential, but the oscillations produced by opening the transmission circuit under load may reach destructive voltages, and the oscillations caused by interrupting a short circuit are liable to reach voltages far beyond the strength of any insulation. Thus special precautions should be taken in opening a high potential circuit under load. But the most dangerous phenomenon is a low resistance short circuit in open space."

F. A. C. Perrine, in his paper on "Elements of Design, Particularly Pertaining to Long Distance Transmission," called attention to the different nature of the problems involved in great and in small installations, due to the fact that mechanical factors of safety must be more carefully considered, because good insulations are never materials of great strength and can be relied on for their mechanical properties only when the mechanical strains are comparatively unimportant.

Charles F. Scott read a paper on "The Induction Motor and the Rotary Converter, and Their Relation to the Transmission System," in which he maintained that these two kinds of apparatus represent the survival of the fittest, and confirm the judgment of engineers who have advocated them, because they best fulfill the two important functions of an alternating current transmission system; namely, the production of mechanical power and the furnishing of a direct current.

On Friday, August 16, Lewis B. Stillwell gave an elaborate account of the Niagara Falls transmission plant, by far the longest paper read. The company are now building a new power house for 55,000 horse power. The most striking point of the paper was the statement that the improvements made in the new house were mainly in the hydraulic and but slightly in the electrical equipment, proving that for nearly a decade electrical engineering has been established upon a basis as certain and permanent as other branches of engineering; that eight years ago it was possible so to plan an electrical installation involving ultimately the transmission and distribution of several hundred thousand horse power; that at the present time we can effect improvement only with respect to relatively unimportant details, the aggregate results of which, if adopted, would be hardly noticeable as affecting the cost of power. The resulting economy of power would not amount to one dollar per kilowatt year.

"The Development of the Nernst Lamp in America" was presented by Alexander J. Wurts. A striking exhibit of these lamps is made by the Westinghouse company in the Electrical Building, the entire dome being lighted by them. It is said that the lamp has passed beyond the experimental and has fairly reached the commercial stage. The light, brighter and purer than that of the incandescent lamp, has nearly the spectrum of sunlight; yet it costs but half as much as the incandescent. The lamp has been described in the SCIENTIFIC AMERICAN. Mr. Wurts recapitulates its advantages as being absence of shadow, steadiness of light, simplicity and low cost of maintenance, high efficiency of the lamp, and the fact that it is operative on 3,000 alternations.

Saturday, August 17, was devoted to electric railways, with two papers and much discussion. Albert H. Armstrong read "Notes on Modern Railway Practice," with special reference to long distance and either high speed for passenger or great power for freight trains. The best equipment for both is a mixed system, combining third rail and overhead trolley.

Ernst J. Berg read a paper on "Electric Railway Apparatus." He favors for general use the direct current and rotary converter, though admitting that there is a field for alternating-current motors, but it is strictly limited to long distance schemes, or to mountain roads.

Messrs. Janet, of France, and Jaenisch, of Germany, both speaking in their own language, agreed that the three-phase system found most favor on the continent.

President Steinmetz replied that while the General Electric Company were building a three-phase installation for a North Italian road, they had never been able to secure an experimental use of that system in America, even when they offered it to builders at cost price.

A member in discussing the subject stated, on the authority of a railroad official who has been using electric traction for five years, that the cost of hauling freight by electricity is less than by steam.

An invitation was received to meet next year at Great Barrington, and indications are that the council will accept it.

EXTERMINATION OF THE MOSQUITO.

BY JOHN CHAMBERLAIN.

I am convinced that the renewed pursuit of the mosquito, which science is making with so much apparent promise of late, is a mistake in at least one important particular. I shall have to confess that my conclusion is in great part inferential, but it seems so positive that it ought to merit at least more than a passing consideration. The accounts of the habits of this insect all stop short of what is plainly the fact in regard to the life of the larvæ, which I am sure that I can demonstrate, if only in a semi-negative fashion.

I cannot avoid the conclusion that this insect, assuming that this region is the habitat of certain species of Culex, does not confine itself to standing water for the hatching of its eggs and the development of the larvæ, but when that is wanting, is able make the shift of using thick grass and the soil and decaying leaves of heavy forests. To a certain extent this is also true of frogs, and especially the common garden toad. This latter has made its appearance this summer in my city yard, where there has not been a toad for many years and which is far from any standing water. The specimens were of this year's growth.

The mosquito does not always need to resort to moist, loose and shaded soil for the propagation of its species, and in such seasons it is less numerous there than in dry seasons. During the past three seasons I have had an especially good opportunity to note this fact, though unfortunately the conviction of it has come to me so lately that I have not carried the matter to an actual demonstration. During the seasons of 1899 and 1900 there has been a severe drouth, beginning so early that there was no standing water anywhere near us. We did not have water enough for the stock and domestic purposes, and there was not a drop of standing water anywhere in our vicinity till after the mosquito season was over, yet we never had so many of them about the house and garden as then, and the woods were swarming with them. I recall being driven out of the garden one day, where I had been at work near a heavy grass plot, heavy on account of previous washings from the barnyard.

This has not happened this year, though there has been so much rain during the mosquito season of June that it was difficult to work uplands, and lowland cultivation had to be abandoned till July The inference is unavoidable that the mosquito was content to make headquarters in the swamp districts when there was standing water there sufficient for its purposes, and when that failed there was nothing to do but make a selection of the most favorable dry lands, such as heavy grass plots and deep woods. Nobody who saw the myriads of these insects in such places during the late dry seasons could have the least doubt that they were hatched out there, for where else could they have come from? And at the same time the much smaller showing during the present wet season was good evidence that the insect had remained in its favorite reproducing localities.

Now as to the bearing of this point on the proposition to exterminate, or at least greatly thin out, the mosquito by kerosene applications. It will be seen that though the effort may meet with some success where marshes are regular every June, there can be very little done in dry sections, or still worse, occasionally dry ones. The scourge is not by any means so severe in such localities as it is near marsh lands, but it is quite often of considerable account and quite enough to neutralize the effort to stop the spread of malaria and yellow fever by that means, for it will surely be found that if the mosquito can reproduce itself in temperate regions without the use of standing water, it can do so much more easily in the tropics, where the light soil is deeply covered with undergrowth and the shade is deep. In such places the food of the larvæ, decaying vegetable matter, is abundant.

American Association for the Advancement of Science.

The fiftieth annual meeting of the association opened on August 26 at Denver, Colo., with an attendance of nearly 200 members, and the city of Pittsburg, Pa., was chosen for the annual meeting of 1902.

The general session was called to order by the retiring president, Professor R. S. Woodward, of Columbia University, New York, who introduced the new president, Dr. C. S. Minot, of Boston. Addresses of welcome were made by Mayor Wright, of Denver, and others. During the afternoon the new officers were installed.

The following vice-presidents made their farewell addresses: Vice-President Davenport, before the section of zoology, on "The Zoology of the Twentieth Century"; Vice-President Brashear, before the section of mechanical science and engineering, "The Carnegie Technical School"; Vice-President Butler, before the section of anthropology, on "A Notable Factor in Social Degeneration"; Vice-President Long, before the section on chemistry, on "Some Points in the Early History and the Present Conditions of the Teaching of Chemistry in the Medical Schools of the United States," and Vice-President Woodward, before the section of social and economic science.

Several express cars are now in use on the surface lines in New York city, the old mail cars of the Third Avenue road being used for the purpose. Operations are under way to establish terminals in important places in Westchester County.