Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS

One copy, one year, for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845).....$3.00 a year
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Edition (Established 1885). ..... 2.50 "
Scientific American Export Edition (Established 1878)..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner Franklin Street, New York.

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 toilfully 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