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SCIENTIFIC AMERICAN SUPPLEMENT

No. 871.

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RECENT ARMOR PLATE TRIALS.

Much has appeared of late, in the daily press, about an armor plate trial which took place at Indian Head proving grounds, on July 23, 1892, and about one which took place at Redington proving grounds, on July 30, 1892. As most of what has been said about these trials is inaccurate, and some of it absolutely incorrect, we have taken the trouble to investigate, and now place before our readers the facts as far as it is possible to obtain them.

It must be remembered that the development of armor in this country has advanced with tremendous strides, and we are now in an assured position far in advance of foreign governments. This is due to the energy, intelligence, and labor of our manufacturers and ordnance officers. In consequence of our advanced position, it is wise and desirable that certain details of manufacture should be kept secret, and hence it is difficult to obtain correct, and impossible to obtain full, information concerning our armor plates from either the government officers or the manufacturers.

The average person knows nothing of it, and the scientific engineer scarcely realizes what an exact science modern ordnance and gunnery is. As an illustration let us cite the following: The Bethlehem Iron Co. have recently equipped a proving ground, or experimental battery or testing range, at Redington, Pa., about six miles below Bethlehem, on the Lehigh River. Two navy guns were mounted there, one of eight inches caliber, the other of six inches caliber. The rough forgings for these guns were made by the Bethlehem Iron Co., and were then sent on to the Washington navy yard, where they were smooth-machined and assembled at the gun factory. They are in all respects—dimensions, strength, and fittings—exactly like the standard navy eight inch and six inch guns. To determine the velocity of a projectile, two screens or frames are placed in the line of fire, the first at a distance from the muzzle of the gun of about 70 feet, the second 100 feet further on. These frames are crossed with fine wire, and the wire of each frame forms a separate and complete electric circuit with a chronograph located in a house a quarter of a mile away. The projectile, as it passes through the first frame, breaks the fine wire, thus breaking the circuit, and the instant of this breaking is recorded on the chronograph. In like manner the projectile, as it passes on through the second frame, 100 feet distant, breaks the second set of fine wires, and thus that circuit is also broken, and the instant of this breaking is likewise recorded by the chronograph. As the interval of time between these two instants is usually less than one-seventeenth of a second, the chronograph must be a very delicate instrument and must give very accurate results to be of any value whatever.

The velocity of a projectile from any given gun depends on a number of factors, the principal ones being, however, the weight of the charge and the kind of powder used. In firing the first shot from the eight inch gun at Redington, it was desired to get a velocity 1,715 feet per second.

The gentleman in charge of the Redington experiments, who, by the way, is an ex-officer of the navy and has an excellent reputation as an ordnance expert, calculated the amount of powder of a certain grade or quality necessary to give the above velocity. The powder used was brown prismatic, and the chronographs were of the Boulenger pattern. The gun was loaded and fired, and the chronograph gave an observed velocity of 1,702 feet per second. Here was a result within less than eight-tenths of one per cent of the calculated result. An error of less than a hundredth of a second in the record of the chronograph, a few ounces more or less in the weight of the projectile or the powder charge, a few thousandths of an inch variation in the diameter of the projectile, any one of these would account for the difference between the observed and calculated velocity of the projectile. This one example would warrant us in calling the science of gunnery an exact science. This was the first shot fired, and greater exactness was obtained in succeeding shots, because the different parts could be more neatly adjusted by the information obtained from preceding shots, but the first shot had no such advantage.

In the armor plate trials which took place at the Annapolis proving ground in September, 1890, and at Indian Head proving ground in November, 1891, all the plates were severely damaged, some much more than others. For a description of these trials the reader is referred to SCIENTIFIC AMERICAN SUPPLEMENT, No. 837. It will be noticed that in these trials four projectiles from the six inch gun and one from the eight inch gun were fired at each plate. The six inch projectiles weighed 100 pounds and had a striking velocity of 2,075 feet per second. The eight inch projectiles weighed 250 pounds and had a striking velocity of 1,700 feet per second. Total amount of energy thrown at each plate, 16,940 foot tons per second.

The results of the trial of 1890 caused the navy department to abandon for the present the idea of making compound plates, and devote its energies to the development of the steel and nickel-steel plates. The trials of 1891 showed the superiority of the alloy plates of nickel-steel over the simple steel plates, and gave a strong hint of the value of surface carbonization by the Harvey or some similar process.

The manufacture and experiments with nickel-steel harveyized plates went on, every detail of the process being watched with the utmost care, and minor improvements and suggestions in the detail of manufacture were experimented with. Nothing was left undone or untried that experience and ingenuity could suggest. In all the trials the plates were of the uniform dimensions of 8 feet by 6 feet by 10½ inches. In the 1890 and 1891 trials, a total energy of about 16,940 foot tons per second was thrown at each plate. In the 1892 trials, a total energy of about 25,042 foot tons per second was thrown at each plate.

The two 1892 plates were constructed as nearly alike as possible in all particulars except one. The July 23 plate was double forged, that is, it received its final finished forging under the 125 ton hammer after being harveyized. The July 30 plate was single forged, having been forged to its final dimensions before being harveyized. These last two tests were made principally to determine which was the better of the above two methods of forging.

The test of July 23, 1892, took place at Indian Head proving ground. Five eight inch Holtzer projectiles were fired. Three of them broke into a number of pieces, and the penetration was between three and four inches. Two projectiles pierced the plate, the points reaching the rear surface. There were cracks in the upper right hand corner only. The projectiles weighed 250 pounds and had a striking velocity of 1,700 feet per second. The total energy thrown at the plate was 25,040 foot tons per second.

This plate then withstood an onslaught of 50 per cent more destructive energy than the plates of 1891, and was in a better condition by at least 20 per cent. It was by all odds the finest plate that had ever been tested in this country or in any other.

The test of July 30, 1892, took place at Redington proving grounds. Five eight inch Holtzer projectiles were fired. Each shot was broken into many fragments. The penetration of each shot was between three and four inches. The points of the projectiles remained welded in the plate. A tempering crack was opened from the upper right hand shot hole to the top of the plate. The projectiles weighed 250 pounds and had a striking velocity of 1,700 feet per second. The total energy thrown at the plate was 25,042 foot tons per second.

This trial was fully as severe as that of July 23, and the plate stood the attack better. These two trials are the most remarkable ever held, and the July 30 plate stands, to-day, as the record breaker of the armor world.

OPPORTUNITIES FOR INVENTION.

No argument is needed to show that to invention must be accorded a very high place among instrumentalities for promoting progress, but with some the question has arisen whether the climax has not been reached, with retrogression in prospect. Those who raise this question hold that, although in the past great inventions have been made, opportunities grow less as time goes on. They believe that no new principles remain to be discovered, and that there is little if any unknown material; that the greatest adaptations of materials and principles have already been made, and that from now on, inventions must be in the nature of new combinations of old materials and principles according to known laws; therefore, they say, great inventions in the future must necessarily be few. Such is the argument of the pessimist, which at first may seem rational, but seen in the light of modern progress must give way to the opposite view, which holds that every new discovery or invention is almost sure to lead to other discoveries and inventions of equal or greater importance; that we are only on the borders of the realm of invention, and that the possibilities of the future are far greater than those of the past. This is the optimist's view, which is backed by history, reason and common sense. As an example bearing out this view, the enormous development of the applications of electricity may be mentioned. Who, in 1882, thought that, in 1892, electric manufacturing would be one of the principal industries?

Now, according to the pessimistic view, dynamos and motors have neared perfection; new electric appliances and methods are not to be expected; dynamos have an efficiency of 96 per cent, and motors are correspondingly efficient; an improvement of 4 per cent in efficiency only is possible, and that is not worth trying for. The optimist says, although this may be true in regard to dynamos and motors, yet discoveries are always in order, and it is not impossible that some inventor may hit upon a new principle which will revolutionize dynamo and motor construction; what has heretofore been regarded as ultimate may prove only the beginning; but, however this may be, dynamos and motors are not prime movers. The great thing to be expected in the electrical line is an invention which will make electricity a prime mover. This is not a

new suggestion, but, nevertheless, here is a standing offer of both fortune and fame to the lucky inventor who produces the invention, either by one brilliant flash of the intellect or by years of hard work.

The thermo-electric battery, Edison's pyro-magnetic motor, and similar devices, are distant relatives of the coming electric invention. Heat energy will be put into the machine and electrical energy will be taken out. Possibly another form may be based on chemical action.

As the world grows older the gifts of nature are held in higher esteem, and thoughts of economy of material and energy become rife. Now, although our coal supply seems sufficient to outlast the race, the supply of coal to the consumer is often controlled by causes other than its scarcity, so that not only does the economization of coal afford a field for invention, but a substitute for it is to be looked for. Although water contains the required elements, the chemist tells us that to utilize water as fuel uses up more energy than can be realized from the consumption of the oxygen and hydrogen obtained by its decomposition, and while, the pessimist says, the chemist is right, and the thing is practically impossible, the other view of the subject is that it is by attempting apparently impossible things that progress is made.

If coal mining should cease, all industries need not fail for lack of power; there is power enough in the rivers and streams, in the tides and in the wind to run all the machinery in the country, if it could be properly stored and distributed. According to the optimist there are great possibilities in all these forces, and although no thoroughly practical way of utilizing these powers in a manner to compete with steam has been invented, the field is open and there is promise in it. Those differing from this view hold that while some of these powers may be used to supply a portion of the demand, others are too irregular and too unreliable to be available; and storage and distribution is too expensive to compete with steam.

There are of course two sides to these questions, but success lies in following the lines of progress. The modern inventor must be alert and must keep in mind the fact that a slight suggestion is sometimes worth thousands of dollars. How many such suggestions are overlooked it would be impossible to say, but, without doubt, for every valuable suggestion or hint or thought entertained and made use of, a score or more are allowed to pass unnoticed.

Learning a Business.

A gentleman who had induced a large publishing house to take his son, as boy, into its employ at a moderate rate of pay, not long since, was especially anxious in his request that the young man should be made to work and learn the business.

This instruction was needless, as although modern fashion has done away with much of the janitor and porterage work of old times, yet the young man found the selection of stock for orders, packing the same, entering, charging ditto, and occasional errands kept him actively employed for about ten hours a day, with an hour out for dinner.

At the end of three weeks' time he failed to put in an appearance, but the father walked in one morning with the information that John would not return to the position.

"Why not?" asked the publisher.

"Well, John has to have his breakfast at half-past seven every morning to get here, and then he is not used to carrying bundles, and sometimes he's been sent with books right up to the houses of people we know socially. My son hasn't been brought up that way, and I guess I won't have him learn this business."

He did not; and what's more, has never learned any other business.

Now let us look at another actual picture, that of the son of a wealthy mill owner desiring to become a manager of the mills.

"But that is impossible," said the father, "unless you practically learn the business."

"That is what I would like to do," said the son.

"But to become a superintendent or manager, we prefer a man who has risen from the ranks and understands the mechanical department and the ways of employes."

"Let me begin in 'the ranks,' then," replied the young man.

To this the father assented, stipulating that no favor should be shown the son, but he should actually begin and work at regular labor in the mechanical department.

Not only was this done, but the young man went and boarded in the manufacturing town at a workman's boarding house, and went in and out of the factory at bell call. In three years he was foreman in one of the departments, and a former classmate and well known society man, calling there upon him, was surprised at meeting a stalwart fellow in blue overalls, with hands so soiled with machinery oil as to prevent the conventional hand shake.

But this young man persevered, made and paid his own way himself, and his father concluded it would not injure his future prospects. Judging from the fact that he is now manager of mills (not his father's), at a salary of ten thousand a year, and with ability to command even better compensation and partnership, is evidence that "learning a business," even by a man with a good education and a rich father, pays a good return, both in money and manly independence.—*Boston Com. Bulletin.*

The World's Columbian Exposition—Official Dedicatory Ceremonies.

The programme of the dedicatory ceremonies of the World's Fair has been completed. It is subject to approval by the Council of Administration, but it is not thought many changes will be made in the arrangements.

The celebration will be inaugurated Wednesday evening, October 19, by a reception to the President of the United States, his Cabinet, and other distinguished guests at the Auditorium. The next day, Thursday, the civic celebration will occur, beginning with an imposing procession indicative of peace, contentment, and prosperity, participated in by innumerable civic organizations. The procession will be reviewed by the President, his Cabinet, Members of Congress, and other honored guests. In the evening, at Jackson Park, amid myriads of electric lights and other displays, a water pageant, "The Procession of the Centuries," will move through the waterways of the exposition grounds.

ALL THE AGES REPRESENTED.

The vessels upon which the tableaux will be presented will be modeled after those of the age represented, and the subjects are to be as follows:

1. Aboriginal age, representing the American Indians.
2. The stone age, representing the cliff dwellers.
3. The age of metal, representing the Aztecs, their religious rites, manners, and customs.
4. Columbus at the Court of Ferdinand and Isabella.
5. Departure of Columbus from Palos.
6. Discovery of America.
7. Columbus before the Court of Ferdinand and Isabella, presenting natives and the strange products of the new country.
8. English cavaliers and the settlement of Jamestown.
9. Hendrik Hudson; discovery of the Hudson River; Dutch settlement of New Amsterdam.
10. Landing of the Pilgrims and illustrations of early Puritan life.
11. Ferdinand de Soto; discovery of the Mississippi River.
12. The French explorers; Pere Marquette; Chevalier La Salle and the Northwest.
13. Washington and his Generals.
14. Signing the Declaration of Independence.
15. Union of the Colonies; the thirteen original States; the sisterhood of the great Republic; welcoming the Territories to the constellation of the States.
16. "Westward the course of empire takes it way."
17. The genius of invention; application of steam, etc.
18. Electricity and electrical appliances.
19. War, representing valor, sacrifice, power, death, devastation.
20. Peace, representing tranquillity, security, prosperity, happiness.
21. Agriculture.
22. Mining.
23. Science, art and literature.
24. The universal brotherhood of man; equal rights; law of justice; Liberty enlightening the world.

DEDICATION DAY CEREMONIES.

Friday, October 21, the national salute at sunrise will inaugurate the ceremonies of dedication day.

The President of the United States, his Cabinet, members of the Supreme Court, members of the Senate and House of Representatives, distinguished foreign guests, and Governors of the different States and Territories, with their official staffs, will be escorted by a guard of honor composed of troops of the United States Army, detachments from the various State National Guards, to the Manufactures and Liberal Arts Building, in which the dedicatory exercises will be held.

At 1 o'clock in the afternoon in this building the following dedicatory programme will be carried out under the direction of the Director General:

1. "Columbian March," written for the occasion, by Professor John K. Paine.
2. Prayer by Bishop Charles H. Fowler, D.D., LL.D., of California.
3. Dedicatory ode. Words by Miss Harriet Monroe, of Chicago; music by O. W. Chadwick, of Boston.
4. Presentation of the master artists of the exposition and their completed work, by the Chief of Construction.
5. Report of the Director General to the World's Columbian Commission.
6. Presentation of the buildings for dedication by the President of the World's Columbian Exposition to the President of the World's Columbian Commission.
7. Chorus. "The Heavens are Telling," Haydn.
8. Presentation of the buildings for dedication by the President of the World's Columbian Commission to the President of the United States.
9. Chorus, "In Praise of God," Beethoven.
10. Dedication of the buildings by the President of the United States.
11. Hallelujah Chorus from "The Messiah," Handel.
12. Dedicatory oration, the Hon. William C. P. Breckinridge, Kentucky.
13. "The Star Spangled Banner" and "Hail, Columbia," with full chorus and orchestra accompaniment.
14. Columbian oration, Chauncey M. Depew, New York.
15. National salute.

At the close of this programme a special electric and pyrotechnic display will be given, with a repetition of "The Procession of Centuries."

A series of military maneuvers and parades will constitute the main portion of the programme Saturday, Oct. 22. In the evening attractive and appropriate celebrations will be provided, followed by a magnificent display of fireworks. Pyrotechnic displays are scheduled for each of the evenings of the celebration, and they are expected far to surpass anything ever before attempted in that line.

A number of brilliant social entertainments will be given by the citizens of Chicago during the three evenings of the dedicatory ceremonies.

Drainage of the Zuyder Zee.

The commercial and technical societies of Holland have petitioned the government to advance the work upon the draining of the Zuyder Zee as fast as possible. The estimated cost of the work is $76,000,000. It requires the erection of a dike 26 feet high and 25 miles long, and involves the removal and reconstruction of the coast defenses. The plan to drain the Zuyder Zee is not new. It was proposed by Engineer Van Diggelen in 1849, before the great work of draining the Haarlem Zee was completed. It was then rejected as impracticable, but it was again proposed in 1865, and plans for the work made by Mr. Beyerinch, who had conducted the drainage of the Haarlem Zee. The result was satisfactory and the plans seemed practicable. In 1873 the Minister of the Interior appointed a committee of experts to examine into the feasibility of the plan. This committee declared it not only possible but desirable. In 1875 the Dutch Chamber voted the equivalent of $47,000,000 for the work, but nothing was then done. A solid, broad foundation has now been laid, extending from the north point of North Holland across to the island of Wieringen, and thence straight across the Zee to the nearest point of the opposite coast of Friesland, a distance of 18 miles only. It has been found that as the work advances, the sea itself assists by depositing large quantities of sand and silt at every tide, on both the outside and inside of the dam, which is being gradually, simultaneously, raised along its whole length.

When the project of draining the Zee took shape 40 years ago, the first idea was to join by dams the great islands of the Texel, Vlieland, Terschelling, and Ameland to each other and to the mainland at each end. The total length of dams required for this would have been only the same as that from Wieringen to the Friesland coast, and it would have reclaimed from the sea about half as much again as the present plan; but the tide going in and out through these openings four times daily, with tremendous strength and in enormous volume, could not be coped with. It had hollowed out deep channels between the islands, from which it was considered vain to attempt to dislodge it. It is wellestablished by history that the Zuyder Zee was once dry land, and that the sea broke over it about 1282. The water in many plaees is shallow, only 4 feet and 5 feet deep. It is practically an inland sea, which at one time covered an area of 12,000 square miles, but about 400 square miles of this have been reclaimed, and the work projected anticipates reclaiming the remainder. The drainage of the Haarlem Zee, begun in 1839 and completed in 1853, reclaimed about 70 square miles, and this now sustains over 7,000 persons.

A New Hair Dye.

Silver salts have so long held the field as a hair dye that some interest attaches to the German proposal to use paraphenyldiamine for the same purpose. The invention is protected by patent, and the details as revealed by specification are somewhat wanting in clearness. From this it appears that the hair is first well brushed with a solution of 20 grammes paraphenyldiamine and 14 grammes caustic soda in a liter of water, and then washed with a 3 per cent solution of hydrogen peroxide. In the course of a day the hair becomes very dark and, by repeating the application, of a blue-black color, but if "a 5 per cent iron oxide solution" is added to the hydrogen peroxide, the color produced is brown.