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 Monthly (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, New York.

NEW YORK, SATURDAY, DECEMBER 17, 1904.

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.

PANAMA CANAL PROBLEMS.

One by one the various fictions that lingered around the Panama Canal have given way before the thorough investigation of the subject which is now being carried on by the United States government. Most of these errors related to the engineering problems, and they were due to the persistent efforts of the advocates of the rival scheme at Nicaragua to prove that to build a canal at Panama was an engineering impossibility. It took much time and patience to refute these errors and present the true facts to the American public. Now that the work of education is done, and the country is committed to this splendid enterprise, it is a matter of no small satisfaction to this journal to reflect that the SCIENTIFIC AMERICAN took an early stand in favor of the Panama route and contributed largely by its text and illustrations to the desired result. To-day, it is well understood that a canal at the Isthmus is not only perfectly feasible, but that its cost, and the period of time in which it can be completed, may be accurately stated. There was one popular misconception, however, containing just enough of truth to make it formidable, which seems to die very hard. We refer to the widespread belief that the climate of Panama is so fatal, that the construction of the canal can only be accomplished at an enormous sacrifice of human life. Popular ideas on this subject are based upon the percentage of deaths that occurred, or are supposed to have occurred, during the construction of the Panama Railroad, and during work on the canal when it was under French control. There can be no doubt that tropical diseases did make serious inroads upon the army of laborers employed at the Isthmus, in the period referred to; for there seems never to have been any serious attempt at sanitation, either in the construction camps or in the towns along the route of the canal and the railroad; but that the mortality was as frightful as stated has always been open to doubt.

One of the first active steps taken when the canal question passed over to American control was to make a thorough investigation of the climate, the diseases, and the local conditions affecting health in the zone of the canal, and to apply the latest ideas both for the prevention and cure of tropical diseases. The work already done has given most excellent results. Both malaria and yellow fever may be said to be to-day practically under control, and these are the two diseases which are most to be dreaded when the great construction camps are assembled and work is in full swing throughout the whole length of the canal. According to Gen. Abbott, whose various articles, published during the past few years, have been a powerful agency in breaking down the tissue of falsehoods that have grown up around Panama, the records of the hospital of the old Panama Canal Company show that the total death rate among the laborers was far less than is commonly supposed, being, in fact, from 44 to 67 per 1,000. This is much below the exaggerated estimates, which have obtained common credence, one of which told of the death of 600 imported Chinamen within a single year, out of one single force of 1,000 that was landed at the Isthmus. It seems, moreover, that the rainfall has been the subject of as gross exaggeration as the diseases. It varies from about 130 inches on the Atlantic to 65 inches on the Pacific, a record that can be duplicated in the United States, where the average rainfall on the Atlantic coast is about 50 inches and the fall on portions of the Pacific coast compares in total precipitation with that at the Atlantic terminus of the canal. Furthermore, it will be news to many residents of our more northerly latitude to learn that the temperature ranges at Panama from 70 deg. to 85 deg. F., and that it is very rarely that the thermometer reaches the high temperature which is experienced when a hot wave passes over the United States. Temperatures of from 90 to 100 degrees are not uncommon during an ordinary summer on our Atlantic seaboard, and consequently it is not surprising to learn that there are natives of the United States in Central America and Panama who have lived in those localities from ten to eighteen years in good health and with complete immunity from local diseases.

BLONDLOT AND PROF. WOOD ON THE N-RAYS.

Those who have followed the controversy which has been waged over the existence and non-existence of the N-rays, will read with interest two articles which, for lack of space, we have been compelled to publish in the current issue of the SUPPLEMENT. In one article, reprinted from Nature, Prof. Wood advances what are probably the most telling arguments thus far published on the non-existence of the N-rays. In the other article, written at the Editor's request, Prof. Blondlot replies to Prof. Wood, and demonstrates with convincing scientific evidence that the emanations of which he is the discoverer do exist.

Prof. Wood, after a searching investigation of the rays in an unnamed laboratory which is evidently that of Prof. Blondlot, says that he was "not only unable to report a single observation which appeared to indicate the existence of the rays;" but also that he left "with a very firm conviction that the experimenters who have obtained the positive results have been in some way deluded." Passing over Prof. Wood's criticisms of direct visual observation, in which the element of personal skill enters too largely, the most formidable objection which he has raised is the fact that the method of photographing the N-rays was not conducted with the scientific accuracy demanded in a discovery of so problematic a character. A number of photographs were displayed to him which showed the brightening of the image under certain conditions. A plate was exposed in his presence; but the exposures, as Prof. Wood rightly maintains, were made under conditions which admitted of too many sources of error. The brilliancy of the spark throughout the time fluctuated by an amount roughly estimated as 25 per cent, and this alone rendered accurate work impossible. Furthermore, the two images (with N-rays and without) were built of "installment exposures" of five seconds each, the plate-holder being shifted back and forth by hand every five seconds. It was possible that the difference in the brilliancy of the images was due to a cumulative favoring of the exposure of one of the images, quite unconscious, to be sure, but still sufficient to frustrate the purpose in hand.

Since Prof. Wood's visit to the Nancy laboratory, Prof. Blondlot assures the editor of the SCIENTIFIC AMERICAN that he has measured the times of exposure with the utmost accuracy by means of an automatic apparatus. To remove all uncertainty, Prof. Blondlot caused the spark, in the absence of N-rays, to act for a somewhat longer period on the plate, so that the exposure under these conditions was one half a second to one and one-half seconds longer than when the N-rays were allowed to exert their influence. The N-rays were produced by a Nernst lamp, between which and the spark 50 centimeters distant were inserted three sheets of aluminium, a sheet of zinc, a spruce plank 2 centimeters thick, a sheet of cardboard, a sheet of paper, and lastly a plano-convex aluminium lens 5 millimeters thick. Despite these obstructions, the N-rays caused a pronounced increase in the photographic effect of the spark. The photographs thus obtained seem to have been made with such scientific care that they may be considered strong evidence of the existence of the N-rays.

Readers are referred to the SUPPLEMENT for a more detailed account of the investigation conducted by Prof. Wood and the reply of Prof. Blondlot. We have confined this brief *résumé* to the photographic process because upon photography alone can any scientific confirmation of Blondlot's reputed N-rays be based.

THE ELECTRIC SMELTING OF IRON ORE.

In an age like the present, when the electric current is being applied to such a variety of uses in the industrial arts, there is, at the first mention of it, something decidedly attractive in the proposal to use the electric current in the smelting of iron ore. The wide range of industries covered by the electrical furnace, and the vast scale upon which their operations are conducted, lead very naturally to the presumption that the electric furnace may some day displace the huge blast furnace, costly to erect, and costly to operate because of the enormous tonnage of materials that must be handled to produce a given output of pig iron. The persistency with which the problem is attacked by men who are well qualified for the investigation, proves that the end sought after is no mere dream of the enthusiast. Indeed, electric smelting of iron ore is a perfectly feasible process, if we are willing to leave out of consideration the all-important element of cost. In the present state of the art, however, it must be admitted that for the majority of cases the cost is altogether prohibitive.

The subject has recently been made the subject of investigation by an expert commission appointed by the Canadian government, whose study of the subject was directed particularly to the question as it affected the iron-ore deposits of Canada. The commission made a tour of the best-known electric iron-smelting furnaces in Europe, and its findings have been embodied in a report which has recently been issued by the Canadian Department of Mines. Its conclusions are summed up in the statement that pig iron can be produced on a commercial scale, at a price to compete with the blast furnace, only when electric energy is very cheap and fuel very dear. It was found that on the basis assumed in the report, with electrical energy at $10 per electric horse-power year, and with coke at $7 per ton, the cost of production is the same as the cost of producing pig iron in a modern blast furnace. Under ordinary conditions, where blast furnaces are an established industry, electric smelting cannot compete; but in special cases, where ample water power is available and blast-furnace coke cannot be readily obtained, electric smelting may be commercially successful. On the other hand, although the cost of electric ore reduction prevents it from competing with either the Bessemer or the Siemens open-hearth process in the production of the common grades of commercial steel, the process was found to be in successful commercial use in the production of high-grade crucible steel.

Now the report of this commission, outside of having fulfilled the immediate purpose for which it was presented, should serve as a safeguard to the general public against being led into hasty and undigested schemes for the electric smelting of iron ore. The figure of $10 per electric horse-power year can only be realized under very exceptional circumstances, where water is abundant, readily available, and contiguous to large deposits of iron ore. We believe that the lowest figures obtainable at Niagara are from $15 to $20 per horse-power, and here, because of the size of the plant, and the unlimited volume and great head of water available, the conditions are ideal for cheap production. It may be that some of the large plants which, during the past few years, have been hurriedly erected on a scale far beyond the immediate local demand for power, are making contracts at prices that give very little, if any, return on the investment; and great care should be exercised in using such low figures as a basis of indiscriminate estimate of the cost of electric iron-ore reduction.

LAUNCH OF THE ARMORED CRUISER "TENNESSEE."

The armored cruiser "Tennessee," which was successfully launched on December 3 at the Cramps' yard, Philadelphia, is an armored cruiser which, in the great power of its batteries and its very extensive protection by armor, brings the armored cruiser type one step nearer to the battleship. The "Tennessee" is an improved "Pennsylvania"; but the improvements are of such a nature as to render her a far more formidable ship than her prototype. She has the same speed and coal capacity, but her displacement is 1,100 tons greater, and her armament far more powerful. Her main battery consists of four 40-caliber 10-inch guns of the latest naval pattern, these pieces taking the place of the four 8-inch guns in the "Pennsylvania." The 8-inch gun, when firing capped armor-piercing shells, can penetrate 7¼ inches of steel at 5,000 yards; but the 10-inch piece of the "Tennessee" can penetrate 11¾ inches at the same range. The respective weights of the shells are 250 pounds and 500 pounds, and the muzzle velocity is the same; but, whereas the muzzle energy of the 8-inch piece is 13,602 tons, the 10-inch has a muzzle energy of 27,204 foot-tons. The "Tennessee" carries two more 6-inch guns, or sixteen as against fourteen, and five more 3-inch guns than the "Pennsylvania." Another improvement is in the distribution of the armor. The thickness of armor on the main gun turrets has been increased from 6 inches to 9 inches, with 7-inch bases to the turrets, and the side armor above the water-line belt has been extended until it overlaps the barbettes of the main turrets, thus materially strengthening the protection of this important element. The weak point, if it may be called so, in the design, is that the side armor at the water-line has been reduced from 6 to 5 inches. We could wish that the difference of one inch had been on the *plus* rather than on the *minus* side.

With the exception, perhaps, of the new armored cruisers of the "Warrior" class, designed for the British navy, this is the most powerful armored cruiser in existence. The "Warrior," on the same displacement, is to carry six 9.2-inch guns and ten 7.5-inch guns, the side armor being 6 inches in thickness as against 5 inches in the "Tennessee" and the speed 23 knots as against 22 knots. On the other hand, the protection of the main battery in the new English cruiser is inferior, consisting of only 6-inch, as against 9-inch armor.

NEWS ABOUT THE SUBMERGED COAL EXPERIMENTS.

Some time ago we drew attention to the experiments that were being carried out by the British Admiralty with submerged coal. In May, 1903, five crates of coal, each holding two tons, were sunk in a basin at Portsmouth, and a similar quantity was placed at the coal-