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CAPPED PROJECTILES AND PANIC LEGISLATION.

Several years ago during some armor-plate trials in Russia, in which the plate had thoroughly beaten the projectile, it occurred to some one to cover the hard face of the armor with a thin plate of soft steel. The result was magical, a shell which splintered hopelessly on the hard face now boring its way through both plates with impunity. It was evident that the soft plate served to embrace and hold together the point of the projectile during the critical moment when it was breaking its way through the intensely hard surface of the armor. Once through the surface, penetration through the softer body of the plate was easy.

Projectiles, however, could not carry soft plates around with them, nor was it necessary. A small cap of soft steel, attached to and covering the point of the shell would serve equally well; and so the capped projectile took its place as one of the most effective inventions in the development of guns and armor. The invention was taken up and perfected by the Johnson firm of Spuyten Duyvil, New York, and their fluid-compressed, steel-capped projectile secured a world-wide reputation when a 12-inch shell penetrated 18 inches of Harveyized steel, although striking the plate obliquely at an angle of 21° from the normal, and with the customary velocity of 2,000 feet per second.

But all this is ancient history, and was duly recorded in the SCIENTIFIC AMERICAN, of December 5, 1896, when illustrations were given of a 6-inch projectile which, after penetrating 10 inches of Harveyized plate, had sufficient energy left to carry it 8 feet into the sand embankment at the rear—a total energy equal to the penetration of 12 to 14 inches of plate. The perforation of Harvey plate and of Krupp plate of lesser thickness, has subsequently been accomplished with capped projectiles, probably at every armor-proving ground in the world.

It seems that on a recent occasion our own navy officials, by giving it a high velocity, put a 6-inch capped shell cleanly through a 6-inch Krupp plate, and drove a shell of the same caliber through 14 inches of Harveyized steel. Both were remarkable performances, though if we bear in mind the experiments of 1896 above referred to are in no sense phenomenal. Nothing would have been heard of the matter outside of military circles had not the item found its way to the awestruck ear of a member of the Senate, who, communicating the secret to others, produced such consternation that the Senate forthwith closed its doors, and in secret session debated what emergency measures must be taken in view of the profound revolution in the relative efficiency of guns and armor which had just taken place, and had only now fortuitously come to the knowledge of Congress.

By some occult process of reasoning, this routine proving-ground test was taken to imply that the vaunted superiority of face-hardened armor being now shown to be a myth, there was herein clear proof of the fraud (long suspected) which the armor plate makers were perpetrating upon the government; for who would now think of paying $450, to say nothing of $545, per ton for plate that had just been shown to be little short of worthless?

The incident has an obvious moral; for surely it is not asking too much to suggest that the gentlemen upon whom devolves the grave responsibility of saying the last word as to what shall and what shall not be done in matters naval and military, should keep themselves so far informed on these technical questions as to be able to debate them with intelligence, dignity, and deliberation.

THE SHRINKAGE OF LAKE NICARAGUA.

In the current issue of the SUPPLEMENT will be found an article by Prof. Heilprin, entitled "The Shrinkage of Lake Nicaragua," which is certainly the most significant, we had almost said dramatic, contribution to the literature of the Nicaraguan region that has yet appeared.

In our issue of February 24, the same author, whose geographical and geological attainments give him eminent authority, showed that there is abundant evidence, drawn from the inconsistency of early recorded levels with those of later surveys, and from other phenomena, that there has been a gradual falling of the lake level. A reply to this article by Mr. C. Willard Hayes, geologist of the Walker Canal Commission, was published in the SUPPLEMENT of April 28, and in the present article, while replying to Mr. Hayes, Prof. Heliprin fortifies the position taken in his former article, by proving from the records of rainfall, evaporation and outflow of the lake, furnished in the report of the Walker Commission of 1897–99, that there has been a shrinkage in the waters of the lake during the past twenty years.

It is evident that, if any doubt exists as to the permanence of the lake, a similar doubt exists as to the permanence of the canal; for not only is Nicaragua, with the canalized San Juan River, to form the major portion of the canal, but it is upon the maintenance of the lake at or above a certain specified minimum level that the very existence of the whole system depends. Should the waters of the lake in time fall below a level which would afford less than 30 feet (the proposed depth of the canal) at the points where the canal enters and leaves the lake, there would be absolutely no remedy for the disaster.

Does such a danger exist? Is there any evidence that the average losses by evaporation and outflow are in excess of the average gains by rainfall in the Nicaragua watershed? The question can be answered by gathering all the recorded data on the subject, and by a simple process of addition and subtraction, determining whether the volume of the lake is increasing, stationary or undergoing a steady shrinkage. The necessary data are furnished by careful records taken at Rivas, on the Pacific side of the lake, during the years 1880 to 1898 inclusive, and it is from these data that Prof. Heilprin has arrived at the discouraging conclusion "that the lake—unless, indeed, the official reports are inaccurate—has been steadily and progressively undergoing shrinkage, and that it must continue to do so in the future."

The determinations of altitude of the lake made by Galisteo, in 1871, and by Baily, in 1838, show that it formerly stood at a much higher level than that established by recent surveys, a fact which is confirmed by the report of Collinson to the Royal Geographical Society, in 1867, who states that "even the least observant native, dwelling on the lake, will tell how its banks are rising year by year visibly before his eyes." The most comprehensive record of rainfall, evaporation, etc., is that contained in the report of the Nicaragua Canal Commission of 1897–99, which, although it makes no specific analysis of its own figures to determine the question of net gain or loss in the volume of the lake, does actually afford confirmation of the statements of the early engineers, as Prof. Heilprin shows in his article.

It is made plain from the report that the intake of Lake Nicaragua—rainfall and drainage from its drainage basin—is apparently for almost every year less than the output—the loss due to evaporation and outflow; while in exceptionally dry years the evaporation alone is greater than the entire intake.

From November 1, 1889, to June 1, 1891, the total rainfall would have raised the level of the lake 45·75 inches. The evaporation alone would have lowered it 95 inches, a loss, outside of what would have run off through the San Juan River, of over 4 feet. The aggregate loss during three dry spells, not taking count of outflow through the San Juan, was 10 feet 10 inches.

The compensations for such losses must be found in periods of extraordinarily heavy rainfall; but despite the fact that immediately after excessive rains the lake has been known to rise two feet in six weeks, the greatest net accession to the lake for any entire year, during a period of 20 years, was considerably less than 2 feet.

In the year 1898, when the rainfall was 108 inches, the net rise of the lake was only 18 inches, and a comparison of the records show that during 19 years of successive observations (1880 to 1898) there were not more than four periods, the years 1893, 1897, 1898 and possibly 1886, when the lake held its own, and during these years combined the actual gains were less than 5 feet. On the other hand, in the single year 1890, when the rainfall at Rivas was only 31·81 inches, the loss was as great as the gains for the entire 19 years!

In calculating the net result of all the causes of supply and loss affecting the lake level, the average recorded evaporation is taken as 55 inches, and the outflow through the San Juan as 42 inches, or one-half the amount in the extremely wet season of 1898. On this basis there is a total loss of 363 inches as against a total gain of 114 inches, or a net loss of 20 feet 9 inches. From this result the author of the paper concludes that for a long period of years Nicaragua has undergone a very marked and progressive shrinkage.

It is true that the outflow through the San Juan may be controlled and water may be stored in wet seasons against the deficiencies due to drought; but although the evil day may be thus postponed it is only a question of time, if the lake be steadily shrinking, when the surplus storage will be inadequate to meet the ever-growing deficiency.

We agree with the author of this paper that "it is hardly less than amazing that these reports should not have been analyzed before, and their bearing given full consideration;" and, we trust, that Congress will recognize, in the grave considerations thus presented, a further inducement to await the results of the searching investigation which is now being made by the President's commission.

ELECTRICITY IN THE FIELD OF TRANSPORTATION.—A FORECAST.

In no branch of science has the century now fast nearing its end witnessed more rapid advances or remarkable applications than in electricity, which, in a brief space of one hundred years, has developed from a scientific curiosity to one of the most potent forces that enter into our industrial life. It is still but ill-understood, and not even adequately definable. So vast have been the changes which it has already wrought in chemistry and manufactures, and so powerful may be the influence which it is destined to exert over the arts, that one involuntarily looks into the future for a glimpse of its possibilities in the twentieth century.

Present developments give no reason to expect that electricity will ever completely supersede steam as a motive power of great railway systems. In the transportation of heavy loads through long distances, the use of electricity is accompanied with many inconveniences and disadvantages. The steam-locomotive, on the other hand, ever remarkable for its great tractive power and high speed, has, in late years, been so considerably improved that it will undoubtedly hold its own in the economical, long-distance haulage of freight. Improvements in smoke-consuming devices, in constructions for lessening vibration, and in arrangements for increasing the heating surface and boiler capacity, follow one another so rapidly that the merits of concentrated power, cleanliness and compactness are almost as characteristic of the locomotive as they are of the electric motor. But, although electricity may never be exclusively used as the motive power of our large railroads, there are certain conditions under which it may be far more satisfactorily employed than steam. Scarcity of coal and a superabundance of water-power, for example, may favor the construction of electric rather than steam roads. In Switzerland and the Alpine regions of Italy, short trains of moderate speed, running at frequent intervals and carrying but few passengers, are chiefly employed, electric power being used for reasons of economy; while there is every indication that electricity will be exclusively used in the subway systems of the future.

For suburban travel and the street railways of large cities, we find that electricity is admirably adapted to meet the requirements of punctuality, security, and speed. Electric power is eminently suited to the needs of the small road; the cars are small, the trains short, the superstructure light, and the system cleanly. Whether the over or the underground trolley or the storage battery will be the prevailing system, it cannot be doubted that for city and suburban service electricity will remain the best form of motive power. So widely is it now employed on tramways, that it practically monopolizes the field; and further advancement must be looked for only in intensive improvement, in increased efficiency and safety.

That electricity will actually supplant steam on short, industrial roads, such as those that connect mines with foundries, and factories with shipping wharves, is as certain as that it will be generally employed in city and suburban traffic. The small electric locomotive of great tractive power, easily controlled, ever ready for service, has proven itself of untold value, and, to a certain extent, has already taken the place of the steam-locomotive. The field which is here opened to electricity is not so limited as one might be inclined to imagine. The centralization noticeable in all branches of commerce, the combination of small factories to form giant industries, is becoming more pronounced with each succeeding year. Industrial plants, which cover acres of ground and which swarm with workmen, require a quick means of transporting material from building to building, and for this purpose electricity is the most convenient and, under many conditions, the cheapest form of energy that could possibly be employed. In many of these establishments large generating plants have been already built to drive the many motors, cranes, machine-tools, and labor-saving appliances, and the utilization of the same current employed in driving these machines, to operate short railways would be both practicable and economical.

Transportation by water will be affected by electricity less markedly than transportation by rail. The electric appliances which are now largely used on European canals have contributed much to increase the efficiency of these and other waterways. Electrically-operated cranes, elevating apparatus, and gates are multiplying; and the mule that now reigns supreme over the towpath is gradually giving way to the small, powerful, electric locomotive, capable of towing several barges at a time. On ocean-going steamers, electricity will occupy a minor place. At present it is employed