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TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

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THE BROOKLYN MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The forty-third meeting of the American Association was opened on the 16th inst., at the Polytechnic Institute, Brooklyn, N. Y. There was a large attendance of scientists from all parts of the Union.

The mayor of Brooklyn was to have extended the city's welcome to its honored guests, but in his unavoidable absence the duty was gracefully performed by President Truman J. Backus. He spoke of the debt due to representative men of learning, who were truly priests of the Almighty and benefactors of mankind. He said that in the early days of Brooklyn it was hoped that here might be reared a great university. But while disappointed in that respect, this city has made significant expressions of its interest in education. Its annual appropriation for its public school system is $2,500,000. The fame of its Polytechnic Institute, Packer Institute, Adelphi Academy and other schools has gone abroad; as has also that of those spacious buildings erected for industrial education by the lavish liberality of Mr. Pratt. The Brooklyn Institute is unique, with its 26 departments of research, its many courses of lectures, and its more than 3,000 subscribers. He welcomed the Association, trusting that it might while here give an impetus to learning such as should impel men of wealth to build a fitting superstructure on the broad foundation already laid.

President Daniel G. Brinton, of Media, Penn., replied. He said that the habits of the American Association for the Advancement of Science are migratory, like those of the birds, fishes and primitive human tribes. It journeys from city to city, the nation's guest, and representing the nation. It comes with no empty hands, but makes due return for favors granted. Its aim is to increase the popular love of learning, and therefore it frames its rules so as to admit all searchers for truth. No barriers are thrown in the way of those who would enter this republic of science. There is no restriction of color, caste, nationality or sex. The industry of practical workers supplements the diligence of special students. Once a year, for nearly half a century, this association has convened the scientists of the land that they might know each other personally, compare their views, harmonize their differences, and push forward the good work by a united effort. We now number 2,000 members and embrace all prominent lines of research. Our published volumes form an epitome of what science has done for nearly half a century. Our influence is highly educational We have no inner secrets. We are no mysterious guests. Scientific truth is absolutely open to the world, free as air, visible as light. We have no favored few, no select illuminati. The spirit of true science is modest in its own claims and liberal to the claims of others.

Our first lesson is to follow the facts. New facts bring new conclusions. The opinions of to-day must be modified by the learning of to-morrow. The despair of a scientific assembly is the hobby rider, the man of a pet theory which he is bound to uphold in the face of facts. Yet so supreme is energy that error itself ardently pursued yields a better harvest than truth languidly cultivated.

The ultimate aim of all our labor, of our study of phenomena, our revision of results and rejection of errors, is to discover those absolute laws of motion, life and mind that are ubiquitous and eternal, and that reveal with sunlike distinctness the order that presides over all natural processes. This is the mission of science, noble, inspiring, consolatory, humanitarian and spiritual. We assemble here to lead you to unite with us and to share our lofty enthusiasms. And we interpret your sympathetic welcome as a sign of your participation in our purposes.

In the afternoon the vice-presidents addressed the several sections. Abstracts of some of these interesting papers are given.

PARADOXES IN RESISTANCE.

Prof. Mansfield Merriman addressed the section of mechanical science and engineering on the resistance of materials under impact. It is important to mark the effects of falling bodies in relation to machinery, bridges and buildings. Young first recognized impact as a case of energy which he called "resilience." There is elastic and ultimate resilience. In the former the elastic limit of the material is not exceeded, while in the latter there is rupture. In elastic resistance under impact a sudden force causes twice as much elongation and stress as where a force is slowly applied. The modern methods of static testing were described, culminating in the precise apparatus of Emery and the powerful machine of Phœnixville. The cold-bend test is of great value. The contraction of area is an important element in judging of the quality of material. Impact tests are now required to be made at the mill by at least three of our great railroads, a ram being used weighing 2,000 pounds and falling 20 feet. Such tests lead to conclusions as to temperature, chemical composition and methods of manufacture, and thus lead to a better, cheaper and more uniform product. The discovery of Goss, in 1892, that the driving wheels of a locomotive lift up from the rails during a part of each revolution, when running at a high speed, shows that impacts are more common than had been supposed, and that they require increased resilience. The violent impacts caused by explosion of dynamite and by projectiles striking against armor plate were discussed, with the prediction that in the contest between projectiles and plates, the former will win the supremacy. The paradoxes of resistance were shown to have their origin in a lack of clear comprehension of the laws of mechanics. Herbert Spencer's discussions regarding the persistence of force and of continuity of motion were shown to be inexact, and it was claimed that the law of the conservation of energy is the basis of all dynamic investigation.

FACULTY DETERMINED BY RACE.

Dr. Franz Boaz made the opening address in the section of anthropology. He contrasted the achievements of civilized man with those of barbarians who have not yet subdued nature. Where the civilization is higher we are wont to assume that the aptitude for it is higher too. And, as this depends on the perfection of body and mind, the inference is usually drawn that the white race represents the highest human type. Many anthropologists look for anatomical peculiarities of primitive man that would mark him as being of a lower order, while others claim that there are no such peculiarities. The error is in confounding achievement with the aptitude for it. The same error is committed in judging of social distinction. As the development of the white race is the highest, its mind is supposed to have the most subtile organization. It is asked why the white race actually developed a civilization that is sweeping the world. Have not all races had naturally the same chances? Is it not fair to conclude that those races that remained at the bottom of the scale were incapable of rising to higher levels? Dr. Boaz discussed these questions in detail, tracing the history of civilization from its earliest dawn until now. The advancement in Peru and Mexico was the same as in Asia and Europe, the only difference being one of time. One reached a certain stage some three thousand years before the other. Man has existed for a period to be measured by geological standards only. Formerly the races did not differ so widely as now. Disease also wastes regions newly opened to white men. In fact, several races have developed a civilization of a similar type to the one from which our own had its origin. Favorable conditions facilitated the rapid spread of culture in Europe. In short, historical factors have been more potent than race faculty in leading men on in civilization. Granted that the brain weight of the white race exceeds that of the negroes, does increased brain prove certainly increased faculty? There are facts looking that way, and there are also restrictions on such an assumption. No data have yet been found to prove it to be impossible for lower races to attain a high civilization. The only feasible way will be to investigate the psychical processes of a great number of individuals of different races living under equal conditions. This has not yet been so done as to warrant far-reaching conclusions. It is difficult to prove the progress of a faculty. Many changes are due to environment. It is, therefore, much less likely that advance is hereditary than that it results from education. Finally, there is no good reason to think that other races may not reach the level of civilization represented by the bulk of our own people.

POINTS IN GEOLOGICAL HISTORY.

Vice-President Calvin took for his subject before the geological section the lessons of the Niobrara chalk. These deposits are distributed over an area reaching from Iowa to the Rocky Mountains, and from Texas to Manitoba. But the characteristics now considered mark the beds exposed between the mouth of the Niobrara River and Auburn, Iowa. The typical beds have all the physical features of true chalk. The region was an area of subsidence during the Upper Cretaceous period. There were shallow seas and high contiguous shores during the previous period; but in the Niobrara stage the water deepened and the shores were low and flat. The sea bottom therefore received no mechanical sediments, and lime-secreting organisms of microscopic size flourished abundantly. These gave their skeletons to form the chalk. The hesitancy of American geologists to recognize the Niobrara deposits as chalk is remarkable, as shown by the literature on the subject from 1841 to 1894. The Niobrara chalk is made up in part of foraminifera specifically identical with those found in the chalk of Europe. These, together with the spicules of shells, are embedded in a matrix composed of the minute bodies known as coccoliths, which are the most characteristic organisms found in chalk elsewhere. Some very interesting peculiarities as to the distribution of these minute organisms were considered. The chalk of America was compared with that of Europe, and the practical identity of the two, so far as relates to physical characteristics, composition and origin, was clearly pointed out.

A STABLE MONETARY STANDARD.

A lengthy and elaborate address was made before the section of economic science and statistics, by Vice-President Farquahar, of Washington, concerning the application of scientific principles to the question of a stable monetary standard. A medium of exchange should maintain its value till a contract is completed. In deferred payments any change not contemplated by the contracting parties must be injurious to one of them. Our unit of value should be able to ride the chopping seas of an ebbing and flowing commerce. Public interest is usually with the debtor, because social progress is largely due to his hopefulness. But it should not be forgotten that the creditor class includes, besides opulent men of leisure, thousands of manual laborers whose wages are in arrears. The assumption is often made that the good of society is advanced by money's growing cheaper instead of dearer; whereas there is no essential difference in point of demerit between the two conditions. Every change in the money standard is hurtful. It can never be helpful to the public. A change in value is unmeaning, except in relation to something that does not change. But what is that something? In war times there were the widest changes in what was termed "the price of gold." And with it all other prices rose or fell. But when we came to trade with other countries, there were no such fluctuations. Yet we use today the census tables of 1860, 1870, 1880 and 1890, as if the "dollars" in those tables always meant the same thing; and to make it do so arbitrarily is not scientific.

After discussing in an exhaustive manner the comparative value of gold and silver, the two metals fixed on by the selection of many centuries as best fitted for monetary uses, and doing justice to the able pleas for a bimetallic standard, the conclusion was reached that a monetary standard may be said to be constant when the same amount of money does the same work, supplies the same want and compensates the same effort. By an ideal standard the prices of merchandise ought to have been diminishing and the wages of labor increasing within the last twenty years—a requirement more satisfactorily met by gold. An attempt to work gold and silver on equal terms is of doubtful merit or practicability. Active interference by the governing power is needless. Allowing freedom in contracts in money, construing terms by usage and enforcing them accordingly, and granting facilities for immediate decision in metallic form by marks as to weight and fineness—this is about all that the government ought to do. The usurped power of passing "legal tender acts" should be surrendered, and legal definitions of value should cover only contracts made by the government itself. Men might then treat as money anything they *so agreed to treat*; accepting the government's stamp as evidence that their agreement was kept, and not fearing or hoping for any meddlesome enactment to declare that, though one metal was agreed on, the agreement might be discharged by paying fifteen and one-half times its weight of some other metal. If contracting parties preferred silver to gold, they might make their agreement accordingly and have it so enforced; or if it were decided to give the debtor an option to pay one metal or "put" another, the law might help them there; but it should not infer the put unless the contract expressly provided for it.

The question of the ideal standard of value would then remain as now, interesting and altogether suitable for discussion by scientific bodies; but active business men would never have occasion to wait for our verdict. In a total abandonment by the government of its power to declare a legal tender for private debts is to be found the true practical solution of the problem of a stable monetary standard.

EXPANSION IN METALS BY OBSCURE HEAT.

Vice-President Rogers addressed the section of physics on "Obscure Heat as an Agent in Producing Expansion in Metals under Air Contact." Whatever advantages may be offered by liquid contacts, or by freedom from exposure to the air, it is more useful to regard the expansion and contraction of metals under the conditions in which they are daily used. Water, except at a very low temperature, never rises to the temperature of the air to which its surface is exposed. Its cooling effect increases with the extent of its evaporation. This was illustrated by a series of observations. Other disturbing causes were also mentioned. But under air contact the time required for thermometers and for bars of steel and bronze to pass from complete saturation at one temperature to complete saturation at another is nearly constant, and it is nearly independent of the range between the initial and the final temperatures; e. g., the time from 0 to 5 is nearly the same as the time from 0 to 100. It would be almost impossible to give a satisfactory report of this address without its explanatory diagrams and tabulated results of delicate experiments as to varying thermal forces which seem to govern the process of cooling. While affirming the importance of what has already been accomplished in its bearing on a correct system of measures, and in other directions, the speaker made the honest confession that he was not wholly satisfied with his investigations, but intended to continue them by methods and with instruments best adapted to the purpose, aided by the experience already gained, hoping to be able at a future time to add something more definite to our knowledge of an obscure subject. Addresses were made before other sections as follows: By Vice-President Comstock, before the section of mathematics and astronomy, on "Binary Stars;" by Vice-President Underwood, before the section of botany, on "The Evolution of the Hepaticae;" and by Vice-President Norton, before the section of chemistry, on "The Battle with Fire."

The address of the retiring president, Dr. William Harkness, of Washington, was given in the evening; which was followed by a reception given by the citizens of Brooklyn to the members of the Association in the Assembly Rooms and Art Galleries.

CAISSON WORK.

A great change has come over the complexion of engineering. In olden times the great triumphs of the engineering world were attributed to individuals, and to-day in England the old custom obtains in a greater degree than in this country. Here the change is very marked. Instead of an individual engineer being the hero of some difficult work, a firm of contractors perform the operations quietly and as a matter of business, having naturally in their employ, or as members of the firm, the best engineers that can be obtained. In the building of the Forth bridge, while Sir Benjamin Baker is credited by the public with the engineering of the operations, he, in his addresses on the subject, has not hesitated to give the contractors the highest possible credit for their ingenuity.

We illustrate and describe elsewhere the sinking of the foundations for one of the great office buildings which are now going up with such startling rapidity in this metropolis. In olden times the making of such foundations would have been well nigh impossible. The conditions were a restricted area of work, surrounded by buildings, ground of uncertain stability, and an enormous weight to be placed upon it. Yet the whole operation is intrusted to a firm of contractors, who quietly execute the operations and carry a series of immense brick piers down to bed rock, 70 feet below the street level.

In the early days of caisson work under compressed air, the lives of the workmen were sacrificed by the wholesale. The conditions for the preservation of health under the trying circumstances of caisson work and the medical treatment of the caisson diseases were little understood. But when the medical faculty took up the problem it was found possible to greatly reduce the danger, so that caisson work now has a widely different aspect from what it once had. In the first place, the men who work in compressed air are more carefully chosen on account of their physical fitness, a preference being given to men of a medium size. During the caisson work they understand very well that they must abstain from any excess in drinking. This they do from necessity of the case. Some of them who are addicted to intemperance will work in a caisson until they accumulate considerable money and will then, after the operation is over, enter into a long period of dissipation. The period of work in the caissons is also short; six hours being allowed under the lighter pressures. The custom with some of the best engineers is to have a supply of hot coffee for the men to drink and facilities for a hot bath as they leave the caisson. A physician is kept constantly accessible for instant treatment for any patient sent up from below.

In the manipulation of the caissons great ingenuity is shown. In the case we illustrate one definite object was to remove absolutely no material except that which is vertically under the caissons. This was to avoid disturbing adjacent buildings. Accordingly a very high pressure of air was kept up, so that the material that was sent up in buckets came up comparatively dry. In sinking caissons in river beds no such care has to be taken, and there the bucket can be dispensed with and the material in semi-liquid state sent up by discharge pipes. By excavating on one side the caissons are tilted in any desired direction, so as to be kept level, or what is the same thing, so as to keep the pier vertical. When bed rock is reached it has to be cut out to the level to receive the edge of the caisson, or may be cut out in steps and built up with concrete, brick, or rubble to receive evenly its load.

But as an example of the gymnastics of engineering the moving of a caisson horizontally when many feet under ground, and carrying a pier of solid masonry many feet in height, deserves notice. To do it diagonal struts bearing against the upper corner of the caisson on the side toward which it is to be moved, while their other ends press against the soil beneath, are introduced. Now if weight were allowed to come on the caisson, it is easy to see that the tendency of the struts would be to push it laterally. But the brick pier above it has also to be moved against the resistance of the soil. Accordingly a number of jets of water are distributed by means of pipes along the advancing side of the caisson, forcing the water upward from beneath its bottom or cutting edge. Corresponding jets are arranged above, forcing water down along the same side of the pier. This loosens the soil. The air pressure is now reduced, and as the weight comes on the struts, they gradually thrust the whole mass forward. By repeating the operation the pier can be moved a considerable distance, as much as seven feet having been accomplished in one instance by the firm whose operations are illustrated on our front page.

Longevity of Females.

The Medical Record says woman has the advantage of man as regards longevity; she suffers less from accidents, injuries, and many forms of disease; she is, in fact, more tenacious than man of the limited enjoyments allowed her. Dr. Brandreth Symonds has collected and studied a large number of statistics to illustrate this interesting fact (American Journal of the Medical Sciences). The comparative mortality of the sexes at different ages shows that in the first year of life the mortality of the female is much less than that of the male, being at birth 92·64 per 1,000 as against 112·80, and at the end of the year 31·87 as against 35·08. This difference continues up to the fourth year. From 5 to 12 the female mortality is greater than that of the male, being at the latter period 3·56 formales and 4·28 for females. At the age of 46 the male mortality equals that of the female, the latter having been up to this time slightly in excess. During the years 46 to 56, the period of the climacteric, the male mortality gains rapidly on the female, being 6·32 per annum for the one and only 3·47 for the other. Hence the climacteric is really a much more serious time for man than for woman. After 56 the female mortality gains on that of the male, but is always slightly below it. Woman has not only a less mortality, but a greater longevity than man. There is, also, a plurality of female births.

A Mirage at Buffalo.

The citizens of Buffalo, N. Y., were treated to a remarkable mirage between 10 and 11 o'clock on the morning of August 16. It was the city of Toronto, with its harbor and small island to the south of the city. Toronto is fifty-six miles from Buffalo, but the church spires could be counted with the greatest ease. The mirage took in the whole breadth of Lake Ontario, Charlotte, the suburb of Rochester, being recognized as a projection east of Toronto. A side-wheel steamer could be seen traveling in a line from Charlotte to Toronto Bay. Two dark objects were at last found to be the steamers of the New York Central plying between Lewiston and Toronto. A sailboat was also visible and disappeared suddenly. Slowly the mirage began to fade away, to the disappointment of thousands who crowded the roofs of houses and office buildings. A bank of clouds was the cause of the disappearance of the mirage. A close examination of the map showed that the mirage did not cause the slightest distortion, the gradual rise of the city from the water being rendered perfectly. It is estimated that at least twenty thousand spectators saw the novel spectacle.

This mirage is what is known as a mirage of the third order. That is the object looms up far above the real level and not inverted, as is the case with mirages of the first and second class, but appearing like a perfect landscape far away in the sky.

Test of Thirteen-inch Projectiles.

The excellence of our heavy projectiles was amply demonstrated, at the Indian Head proving ground near Washington, Aug. 14, when two 13-inch projectiles penetrated nearly fifteen inches of nickel-steel, passing through a forty-inch oak backing and entered the ground two hundred feet from the plate. When recovered the projectiles were practically uninjured and could, with a little treatment, be used for another round. The plate was made of oil-tempered nickel steel and measured 12 by 7 feet and was 14½ inches thick. The first projectile used weighed 1,100 pounds and the powder weighed 327 pounds. The velocity obtained was about 1,400 feet per second, which gave the projectile a striking energy of 12,000 tons. The shot passes through the plate, as has already been described. The plate was badly ruptured. The point of the projectile, which is as fine as a lead pencil point, was entirely uninjured, not being in the least blunted. The second shot was fired under the same conditions and completely demolished the plate, passing through it as easily as the other projectile, and it was not materially injured. The projectiles, which were made by the Carpenter Company, of Reading, Pa., were selected from the lot of sixty tons as being the worst of the lot. With the gratifying results noted above for projectiles selected on account of supposed faults we may reasonably expect that the remainder would prove even better.

A NEW SPIRAL NEBULA.—At a recent meeting of the Royal Astronomical Society, says Nature, Dr. Roberts exhibited a photograph of a new spiral nebula in Perseus. The convolutions of the spirals are very faint, though clearly visible on the negative. They are symmetrical and proceed from a very faint star-like nucleus.