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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.

SAFETY OF THE GREAT ASSOUAN DAM.

The great success that has attended the operation of the Assouan dam, in extending the area of cultivable land in Egypt, recently led to the consideration of the question of raising the height of the dam by about 18 feet—an addition which would greatly increase the capacity of the reservoir. At the request of the government, Sir Benjamin Baker, who is responsible for the design of the Assouan structure, was requested to make an investigation, in the course of which the fact developed that the rush of water, passing under great head and high velocity through the sluice gates, had worn out a series of cavities in the bed of the river below the dam. The structure is built in places upon a rock of a somewhat friable character, and in order to secure a perfectly broad and solid foundation platform, a broad table or bench of concrete was laid in the river bottom, upon which the masonry of the dam was built up. At the time of its construction, it was realized that the scour due to the rush of water through the sluice gates must be provided against, and the concrete platform was extended for a certain distance, forward of the downstream face of the dam. Acting upon Sir Benjamin Baker's recommendation, the concrete platform will now be carried a further distance downstream, so as to make sure that the effects of scour can never work back toward the dam and endanger its stability.

Simultaneously with the investigation of the dam, there appeared in England an academic discussion by two college professors of the question of the stability of dams in general. They advanced a rather fanciful theory as to the probable line of failure of dams, which was quite at variance with accepted and well-proved engineering theory on this subject. The proposal to increase the height of the dam; the chief engineer's investigation of the structure; and the curious theories of dam failure, above referred to, offered an attractive coincidence for the reportorial sensation monger, who seems to be getting wonderfully well acclimatized in the field of London journalism; and the British public has been treated to whole columns of matter tending to prove that this costly engineering improvement is doomed to short life, if indeed it is not liable to be swept down the Nile Valley without a moment's warning.

As a matter of fact, the Assouan dam, so far from being in any danger of failure, has a margin of stability so great as to render it possible to add the 18 feet of height suggested, and still leave the structure proof against overturning, or rupture, for all time to come.

THE MANHATTAN BRIDGE SCANDAL.

When the present Bridge Commissioner of this city took office some eighteen months ago, he found confronting him what is perhaps the most urgent problem pressing for solution in this great city of New York; namely, the construction of a new bridge across the East River for the relief of the present overcrowded Brooklyn Bridge. The Bridge Commissioner makes no pretension to knowledge of bridge construction; but he called to his assistance, as chief engineer, a former employe of the Bridge Department, who was known to be bitterly opposed to all the work that had been planned for the construction of the bridge—work which had involved two whole years of careful preparation. The commissioner clearly understood that the appointment of this man meant the undoing of everything that had been done by his predecessor, and the subjecting of the city of New York to at least two years more of the disgraceful conditions due to the overcrowded condition of the Brooklyn Bridge. When the new chief entered once more the offices of the Bridge Department, he found on file a complete set of working plans for the new bridge—plans, by the way, which had been passed upon and unanimously indorsed by a commission composed of the most eminent bridge engineers in the United States. These plans had been drawn up in accordance with the most up-to-date design and practice for long-span bridges, and in their preparation special forms of construction had been adopted with a view to insuring speedy erection. The plans and specifications were in a complete condition, ready for the contractors to bid upon. Had bids been invited, contracts let, and the work pushed through with the zeal that the urgent need for the bridge demanded, the structure would, at the present writing, have been one-half completed, and the opening would have taken place within about eighteen months from the present date.

The obvious duty of the commissioner and his chief engineer was to push the bridge through to completion with all possible dispatch. It was a duty that they owed to the people of this city. Did they meet it? Not in the least particular. On the contrary, they deliberately subjected the city to a delay, which they knew positively would amount to not less than from eighteen months to two years, and which, as the event has proved, is likely to amount to not less than four years. Had the commissioner and his chief engineer followed the course which was dictated by the most elementary sense of fidelity to a great public trust, the Manhattan Bridge would have been opened in the autumn of 1906. As it is, New York will be fortunate if it is open by the year 1910.

The plans for the new structure were unceremoniously thrown aside. Why? To many of us the reason is not far to seek, when we remember that the rejected plans had been formulated under a previous administration, and that they had been designed by a former commissioner who had promptly discharged the present chief engineer for leaving his desk to criticise those plans in a public meeting. Of course, it would never have done to have alleged political or personal motives for the blocking of a great public utility such as this; and, consequently, the commissioner and his chief engineer had recourse to the ridiculous statement that the bridge, as designed, was faulty. In other words, the present chief engineer, whose knowledge of the science and practice of New York city bridge engineering has been confined to such work as has fallen to him in subordinate positions, and who has not a single engineering work to his credit that approaches this bridge in importance, undertook to set his judgment against that of an expert commission which included the acknowledged leading authorities on bridge engineering in this country. It would have been presumption of the most extreme kind had this single individual pitted his solitary and limited reputation against that of the acknowledged leaders in this great branch of civil engineering. But when he does this, as he has done, at the cost of an enormous amount of inconvenience and damage to the leading city of the United States, the presumption, we had almost said the cool impertinence, of the thing is beyond adequate expression.

What have the present commissioner and his chief to show for their eighteen months' work in the department? When they came into office the stone piers for the towers of this bridge were completed. Had the contract been let at once, these towers would to-day be finished to their full height; as it is, not a pound of steel has been built upon the piers, and their top surface is as barren of steel-work as it was on the day the commissioner took office. Not only have the towers not been commenced, but the new plans, if you please, are not even yet completed. So also with the superstructure, that is, the cables and the suspended roadway. Had the commissioner called for bids at once, the cables would by now have been partially erected; the steel for the roadway gotten out; and, indeed, the whole structure would have been in such a forward condition as to guarantee its opening by the autumn of next year. So again with the anchorages. Had property been at once condemned, the buildings removed, and contracts for construction let, these anchorages would, to-day, have been completed, or nearly so. As it is, no construction whatever has been done; and, by the way, thereby hangs a tale that tells so graphically the whole story of the attitude of the commissioner toward this bridge, and the full appreciation of that attitude by the contractors, that it is worthy of repetition. As soon as the contract for these two anchorages was let, it was the duty of the contractors to commence at once to pull down the houses that cover the site of the anchorages, in order to make a clear space for the excavators and the masons, and for the storage of materials. Did they do this? In the case of one of the anchorages, nothing of the kind was done. Instead, the contractor promptly rented all of the buildings covering the site, and forthwith sat down to play the rôle of landlord, knowing perfectly well that time was a minor consideration in the affairs of the present Bridge Department.

Surely in all the long history of maladministration of New York city's affairs, it would be impossible to find a parallel to this exquisite comedy.

In view of the fact that not even the plans are yet completed, and that a preliminary investigation of these plans renders it pretty certain that the bridge will cost some two million dollars more than one built on the rejected plans would have cost; in view of the further fact that the spirit of indifference pervading the Bridge Commissioner's office is so perfectly realized by the contractors, we do not hesitate to say, here and now, in answer to the many questions that reach us as to the probable time of opening of the Manhattan Bridge, that, if the construction be carried on under the present methods, it will not be opened to the public until the year 1910.

In view of the dangerous and disgraceful overcrowding on the Brooklyn Bridge, which the new bridge designed to relieve, it must be confessed that the apathy of the Bridge Department has reached a point where it calls loudly for action on the part of the mayor. Mr. McClellan has the confidence of the New York public; for he has shown that he is solicitous for its best interests. We believe there is no direction in which he could further those interests so materially as by a searching investigation into the causes of the inexcusable delay in building the Manhattan Bridge.

TEXTILE FABRICS OF PAPER.

Garments made of paper have long been used in eastern Asia, but only in default of other clothing or on special occasions. In western countries the only articles of dress made of paper, until recently, were collars, cuffs, and shirt bosoms, that is to say, articles which are usually starched. Now, however, numerous inventors are endeavoring to introduce woven paper fabrics.

Some time ago an Italian, Prof. Zanetti, devised a method of making fine and strong yarns by twisting very thin silk paper, cut into strips about one-tenth of an inch wide. As yet these yarns are used only for wicks of wax candles and in the manufacture of incandescent gas mantles.

A greater advance has been made in Saxony. Here also narrow strips of paper are spun, by a process patented by Claviez & Co. Paper and cotton are also spun together, so that in the finished yarn the paper envelops the cotton. These yarns are used as fillers, in conjunction with cotton warp, in weaving drillings suitable for toweling and summer waistcoats, trousers, and skirts.

Heavier and warmer cloth is made by combining paper and woolen yarns. The fabric is cream colored, and may be washed repeatedly without injuring the surface. It is well adapted for tennis and lounging suits. Sufficient cloth for a jacket, waistcoat, and trousers costs only ten marks, or $2.50, and still cheaper garments are made for laborers. This new product is named xylolin.

For such use, however, raw materials even cheaper than finished paper are sought. Spinning mill refuse, consisting of very short smooth fibers that cannot be spun, goes, as a rule, to the paper mills. Many attempts to utilize this material have been made in spinning mills, and experiments in spinning it wet suggested the idea of further comminuting the short fibers in paper machines. In this way a thin fibrous paste was produced. This, when poured on sieves, yielded a thin soft paper which, partially dried and cut into narrow strips, could be spun into yarn. Other cheap paper stock, including wood pulp, can be converted into yarn by a similar process, and so spinning and paper making meet.

One brand of these cellulose, or wood pulp, yarns is called silvalin. During the last ten years many similar processes have been patented. The manufacture is still in the experimental stage, but definite progress has been made, and the industry has a promising future before it.

Prof. Pfuhl, of Riga, recently published a technical treatise on processes and results thus far attained.

The first practical requirement of yarn is tensile strength, which is indicated by the maximum length that will support its own weight. Cotton yarn has an average breaking strength of from 43,000 to 47,000 feet, that is, it will just break with the weight of a skein of that length. For dry-spun flax the figures are 39,000 to 41,000; for wet-spun flax, 41,000 to 49,000; for ramie, 37,000 to 40,000; for jute, 32,000. Wood-pulp yarn is much weaker than any of these. The greatest strength yet attained is 28,000, the average from 18,000 to 23,000. The strength, however, may possibly be increased by improvements in manufacture and admixtures of other material.

Resistance to the action of water is another important quality in which fabrics differ greatly. Prof. Pfuhl gives an example from experience. A lighter laden with grain in jute and canvas bags sank in the Volga. Thirty-six hours afterward the canvas (flax) bags were raised with their contents, but the jute bags had disintegrated so that the grain which they had contained was lost. Jute yarns, however, withstand several hours' immersion, but wood-pulp yarns fall apart after very brief soaking.

In a test of density and porosity, it was found that raw sugar could be sifted readily through wood-pulp cloth weighing 462 grammes to the square meter, while lighter jute cloth allowed only traces of sugar to pass.

No very fine yarn has yet been spun of wood pulp. The thickness of yarn is indicated by the number of units of length contained in the unit of weight. The metric number, designated by the symbol N^{mt}, represents the number of meters in a gramme; the English number, N^{B}, gives the number of skeins of 840 yards in a pound. The finest pulp yarn made is N^{mt} 13, or N^{B} 7.68.

From all this it appears that pulp yarns, at present, have a limited field of usefulness, and compete with other yarns only where great strength and compactness are not necessary and the action of water is excluded. In combination with jute, flax, or cotton yarns, however, they yield reasonably strong fabrics which can be washed repeatedly.

In this way are made towels and wash cloths for every purpose, mattress coverings, and bed and table "linen." The finest wood-pulp yarns are combined with wool and cotton in furniture coverings, carpets, curtains, tapestry, canvas, and clothing. These fabrics, which are very cheap, may be dyed or printed. New uses will probably be found even for cloth made entirely of pulp after further experiment and acquaintance.

As yet all these fabrics bear the stamp of inferiority, but who can foretell how greatly they may be improved?

"Wood pulp," Prof Pfuhl observes, "may advance in textile manufactures as it has in paper making, which some prophets said it would ruin. Now eighty per cent of our paper is made of wood pulp."

THE NATIONAL ACADEMY OF SCIENCES.

BY MARCUS BENJAMIN, PH.D.

The annual or stated meeting of the National Academy of Sciences was held in Washington city on April 18, 19, and 20, 1905, in the United States National Museum, under the presidency of Dr. Alexander Agassiz. The morning sessions were devoted to the business of the Academy, while the afternoons were occupied in the reading of papers.

These papers, seven in number, were all highly technical, and of them the first, "The Mechanical Equivalent of Light," by Edward L. Nichols; the second, "The Effects of Alcohol upon the Circulation," by Dr. H. C. Wood and Dr. Daniel M. Hoyt; and the fifth, "The Geographical Cycle in an Arid Climate," by William M. Davis, were read on the afternoon of April 18. The remaining papers were presented on the afternoon of the twentieth; they included "Resequent Valleys," by William M. Davis; "A Catalogue of Spectroscopic Binary Stars," by W. W. Campbell; and "Discovery of the Sixth and Seventh Satellites of Jupiter and Their Preliminary Orbits," by C. D. Perrine, which were read by title only, while "The Expedition of the U. S. Fish Commission Steamer 'Albatross,' in Charge of Alexander Agassiz, in the Eastern Pacific, Lieut. Commander L. M. Garrett Commanding," by President Agassiz, was read, and was of unusual interest. It will be remembered that on a previous occasion the scientific world has been fortunate in securing the results of a similar expedition in the Pacific Ocean, made under the direction of Mr. Agassiz. At this meeting he described that portion of the eastern Pacific Ocean lying west of northern South America, and which, from the dredgings, seemed to be largely of volcanic origin, as was apparent from the many nodules of manganese which were dredged. These peculiar nodules are more common in that part of the Pacific than elsewhere, and it may be said in passing that they are seldom found in the Atlantic Ocean. He described with much detail the depths at which the various dredgings were made, and outlined the contour of the ocean bed, which is known to geographers as the Albatross Plateau. Of considerable interest was the announcement of his finding numerous so-called "deeps," or hollows, which were found along the west coast of South America. The fauna of this territory was described in general terms and he found a tendency on the part of the animal life of the southern world to penetrate as far north as the Galapagos Islands. The fauna from the Panamic region extends down as far south as this same region. The paper was listened to with considerable interest. While only an outline of the work accomplished was presented, still much remains to be done in the way of working up the material obtained from the dredgings, which, of course, will be referred to the various specialists by the authorities of the Bureau of Fisheries.

The afternoon of April 19 was devoted to a visit to the buildings and plant of the National Bureau of Standards of the Department of Commerce and Labor, which, under Prof. Samuel W. Stratton, is doing some excellent scientific work in the way of securing instruments of all kinds of standard value. The business sessions were, for the most part, secret and of a routine character. The principal element was naturally the election of new members, and, as is the custom, five scientists were added to the group of the great men of science who constitute the official scientific advisers of the government. The new members chosen were: Michael Idvorski Pupin, who holds the chair of Electro-Mechanics in Columbia University, New York; Arthur Amos Noyes, Professor of Theoretical Chemistry in the Massachusetts Institute of Technology; John Casper Branner, who is Vice-President and Professor of Geology in Stanford University, California; William Henry Holmes, Director of the Bureau of American Ethnology in Washington city; and William Henry Howell, Dean of the Johns Hopkins Medical School, Baltimore, Maryland. The Academy also agreed upon the award of the Barnard medal, but the name is withheld from the public until it shall be announced at the Commencement of Columbia University in June.

OUR HERITAGE OF THE MECHANICAL ARTS.—III.

BY ALEX. DEL MAR, M.E.

Archimedes discovered the means of determining the specific gravity of ponderous substances; he constructed a crane so powerful that it could lift a loaded ship entirely out of water; he invented the screw-pump which bears his name; he erected great polished mirrors, which, by concentrating the rays of the sun, could set a ship on fire at the distance of a bow-shot. The knowledge of this phenomenon, coupled with the manufacture of glass, mentioned below, the use of silvered and gilded glass mirrors, and of globular glasses used for kindling a fire, all of which are described by Pliny, could scarcely have failed to suggest the reflecting telescope; and notwithstanding Beckmann's objections, this invention, either with or without lenses, must be added to the achievements of the Alexandrian age. The fact that an entire poem was engraved upon a grain of rice, and that artificial objects were made so small that their parts could not be observed with the naked eye, is almost conclusive with regard to lenses.

Eratosthenes invented the armillary sphere; Ctesibius invented pneumatic and hydraulic machines; and Hero of Alexandria constructed a steam engine, which was employed to open and shut the ponderous doors of a temple. Ptolemy Philadelphus planned a canal 62 miles long, 100 feet wide, and 40 feet deep, to unite the waters of the Nile and the Red Sea, and actually completed 37½ miles of it; Nicator Seleucus planned a canal to connect the Euxine and Caspian Seas; and Demetrius Poliorcetes still another one to make an island of the Morea; while Posidonius was bold enough to assert that the coast of India could be reached by sailing due west from Gaul. To this opinion Pliny responded: "I do not suppose that the land is actually wanting, or that the earth has not the form of a globe; but that on each side (of the known lands) the uninhabitable parts have not been discovered." Yet seventeen centuries elapsed before the voyage was actually made. Dicæarchus, who was a pupil of Aristotle, had long before held a similar opinion, and Pliny only repeats it where he says: "We maintain that there are men dispersed over every part of the earth; that they stand with their feet turned toward each other; and that the vault of the heavens appears alike to all of them." That the center of the earth is the center of terrestial gravity, was the natural corollary of these views, and, as such, it was thus explicitly laid down: "Hence it follows that all the water from every part tends toward the center, and because it has this tendency, it does not fall." And "It is to the glory of the Greeks that they were the first to teach us this, by their subtle geometry." (Pliny ii, 48, 65, 67, 112; iv, 5; vi, 12, 21, 33, 34; vii, 38.)

The loadstone was another discovery of the Alexandrian age. Its power to attract iron became notorious and even the distinction between the opposite poles of a magnet, though not commonly known, was evidently observed and utilized. Pliny cites several instances of the attraction and repulsion thus exerted. Timochares of Alexandria erected a vaulted roof of loadstone in the temple of Arsinoë, from which he designed to suspend an iron statue of the princess of that name, when the death of the king interrupted the work. Petroleum was also discovered at Samosata, in Commagene, near the source of the Euphrates. It was employed by the mountaineers to defend their city against Lucullus, whose soldiers by its agency were burnt in their iron armor. This was the origin of the dreaded Greek fire which in after ages became so famous. The manufacture of glass was carried to great perfection at Sidon, whence it spread to Venice, and thence deposited some of its most beautiful and delicate remains in the Glastonbury fens of Britain, whence they have recently been exhumed. Flexible glass belongs to the age of Tiberius, and should be mentioned among the inventions of the Romans.

The diamond drill is another product of the Alexandrian age. The adamas, or diamond, was first brought from India, but without the knowledge of cutting or polishing it. This art, so far as the West is concerned, appears to have originated in Damascus, whence, in spite of some ingenious but erroneous verbalisms suggested to account for its name, the latter undoubtedly derived its origin. This art is plainly alluded to where Pliny says: "In all cases precious stones may be cut and polished by the aid of adamas." And the diamond drill is suggested where he says: "The particles of adamas are held in great request by lapidaries, who inclose them in iron, and are enabled thereby, with the greatest facility, to cut the very hardest known substances." To corroborate this inference, an actual diamond drill, together with the porphyritic core cut by it, was, only a few years ago, found in one of the Egyptian quarries, and has been assigned by the finder to the Ptolemaic or Alexandrian age. (Pliny ii, 98, 108; xxxiv, 42; xxxvii, 15, 76.)

The manufactories of military weapons at Athens furnished numerous states with their supplies. Iron had now become common, while steel was scarce and dear. Among the odd commodities cited is an iron sideboard, costing less than $7.50 in weight of silver, that is, counting the drachma as equal to about 25 cents. This seems to prove that the sideboard must have been of cast iron and somewhat light of weight. Among the other prices quoted are $170 for a suit of steel mail and $1.80 per dozen for sailors' needles. The organization of commerce took its rise in this age. Banks and other credit institutions arose; money was lent on bottomry and other security; foreign consuls (proxenoi) were appointed; a public mart or exchange and a bonded warehouse were established in the Piræus; a trade in scriptures and tracts was organized; and books were even hawked in the theaters; the imports and exports were regulated; and trade corporations authorized, with liberty to make by-laws.

Although the scientific attainments of this era do not strictly come within our present scope, yet they are so intimately connected with the mechanical arts, and are themselves of such great interest, that at least the most prominent of them deserve some mention. The precession of the equinoxes, which had been noticed by Heraclitus, was confirmed by the numerous observations of Timocharis and Aristyllus, and popularized by Hipparchus; the celestial sphere was constructed and described by Eudoxus; and the Julian year of 365¼ days, though not established by law until the Roman imperial era, was determined by the Greeks of the Alexandrian age. Meton had computed it at 365d. 6h. 18m. 57s.; Callipus reduced this to 365d. 6h.; while Hipparchus, with increased precision, fixed it at 365d. 5h. 55m. 12s.—the nearest approach to the fact until a very recent age. To attain so exact a result, the clepsydra, or water-clock, of Babylon, was indispensable.

Our heritage of the mechanical arts from Rome is so ample that it cannot be compressed within the limits of the present article. It may be claimed with some truth that had Pliny's work been lost, the Renaissance would have been strangled at its birth and the Elizabethan age robbed of its splendor. Almost every art that sprang up after the discovery of America owes its origin to the ancient world, and to that knowledge of it which was preserved in the classical works, but especially in Pliny's "Natural History." The intervening period of fifteen centuries added but two important arts to the mechanical resources of the world—gunpowder and printing; and both of these were borrowed from the Orient. Felted paper, in default of which printing could scarcely have attained more than a stunted growth, was brought into the West in the eighth century by the Arabs of Samarcand. Gunpowder and firearms, without which Cortes and Pizarro could not have subdued, enslaved, and plundered America, had a similar origin; they were brought into Europe by the Arabs. Almost everything else that contributed toward the civilization of the sixteenth century came from classical antiquity. So far as the mechanical arts are concerned, the dark and middle ages produced substantially nothing.

SCIENCE NOTES.

The Soil of the Shari and Lake Chad Territory.—Samples of soil procured by the Chevalier scientific mission have been analyzed by Hébert and found to be rich in nitrogenous matters, but almost completely lacking in phosphates, lime, and magnesia. Although the soil is in general poor, coffee and cotton can be raised. A rich iron ore is found, which is exploited by the natives by crude methods, but with a production of iron in good quantity.

The earthquake which recently occurred in India was duly recorded upon the instruments at the various seismic stations throughout Europe, but only those at the French station at Val Joyeux, near St. Cyr, are identified with one particular shock. On April 4, between 1:10, 1:19 A. M. and 1:37 A. M., these instruments were violently affected. It was precisely at this time, which represents 6:20 A. M. Lahore time, that Lady Curzon was awakened by falling masonry. This interesting fact and identity was reported to the French Academy of Sciences by M. Mescart.