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NEW YORK, SATURDAY, JANUARY 27, 1906.

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.

FINAL COMPLETION OF THE CROTON RESERVOIR.

Although the gates of the Croton reservoir were closed for the first time in the spring of last year, and that event was generally taken as marking the completion of the great work, as a matter of fact the crest of the dam had not at that time been carried up to its full height, nor had anything been done on the erection of the fine arched span, which now forms a connection between the crest of the main dam and the rocky bluffs which form one wall of the spillway. During the intervening months, the great mass of masonry which constitutes the dam proper has been carried up to its full height, and the broad roadway has been completed across its crest from the northerly to the southerly abutment. The crest of the spillway was the last portion of the stonework to be completed to its full height, and on January 17 of this year the Comptroller of the city of New York, as representative of the Mayor, laid the last stone, thus putting the great wall of masonry in position to hold the waters of the impounded lake up to the high-level mark which represents the reservoir's capacity of about 30 billion gallons of water. In our issue of April 15, 1905, we gave a complete series of views of this noble work, including some of the steel bridges which carry the new driveway over various arms of the lake, and form important elements of the splendid driveway which runs entirely around the reservoir.

Quite apart from its priceless value as forming the most important element in the water supply of the capital city of the New World, the Croton reservoir is destined to become, in future years, one of the most picturesque sections of the magnificent system of boulevards and driveways which extends from Riverside Drive and Lafayette Boulevard up the easterly bank of the Hudson River. With the construction of the Hudson Memorial Bridge, and the improvements in grading and in surface which are bound to take place on the Albany Post Road, there will be no finer automobile trip in the State, both for the picturesque beauty of the country and the wide variety of interest, than a run to the Croton reservoir by way of the Hudson, and a trip over the splendid roads around the lower portion of this lovely artificial lake.

SHIPBUILDING IN THE UNITED STATES.

Were it not for the orders obtained by our shipbuilding yards for the construction of United States warships, and other government vessels such as revenue cutters and lighthouse tenders, it would be difficult for many of these establishments to keep their costly plants in operation. This is particularly true of the larger plants located on the Atlantic and Pacific seaboard. Thus we find that during the fiscal year ending July 1, 1905, there were under construction or under contract in the shipyards of the United States seventy-six steel merchant vessels, of 190,903 tons, and thirty-nine steel government vessels, of 308,702 tons; so that the amount of work being done for the government (most of it for the United States navy) was over sixty per cent greater than the work being done for private shipping concerns. Even more remarkable were the conditions in 1904, when the merchant tonnage was only 94,988 tons, as against 331,435 tons that were under construction for the government. In the presence of these figures, it would be well for those people who are bitterly opposed to the upbuilding of our navy to bear in mind that our warships not only serve as guardians of the peace (for which they are just as essential as the police of our cities) but the very act of their creation has served to keep alive the important shipbuilding interests of this country. Indeed, the absolute cessation of new naval construction would involve the closing down of several of our building yards.

The merchant marine of the United States, including all kinds of documented shipping, comprised on July 1, 1905, 24,681 vessels, of 6,456,543 tons. About one-half of this amount was afloat on the Atlantic and Gulf coasts, one-third of it on the Great Lakes, while on the Pacific coast the total amounted to 793,088 tons, the small remainder being found at the Hawaiian Islands and on the western rivers of the United States. During the year, 1,102 vessels of all kinds, great and small, were built, the total tonnage amounting to 330,316 tons. Of this total, 40,000 tons consisted of steel steamers, including the big "Dakota" of over 20,000 tons; 14,149 tons consisted of steel ferry, river, and bay steamers; and 29,104 tons of wooden schooners; while the importance of the Great Lakes shipbuilding interests is shown by the fact that the total tonnage of new steel steamers built there during the same year was 101,521 tons. Comparing the total gross tonnage of the American merchant marine, as given above, with that of our most formidable competitors, we find that for 1905 the total tonnage of the German Empire amounted to 3,517,673 gross tons, of which 2,888,693 tons represent steamship tonnage; while the total shipping of the United Kingdom and British Colonies for the same year is 17,900,720 gross tons, of which all but 1,600,182 tons represents steamship tonnage. In many of our readers the decline of the American schooner will arouse some sentimental interest. The far-famed New England schooner, with its generous beam, lofty spars, and perfectly fitting canvas, was unquestionably the pioneer of the foreign trade of the United States. To-day, however, in spite of its stanchness, speed, and carrying capacity, the schooner, with the exception of a few ports in Africa and Australia, is being steadily driven out by the small steam-propelled trading vessel.

ARMY TRANSPORT AND THE MERCHANT MARINE.

Speaking of the shipbuilding of the United States, we are reminded that the great importance of the possession by the United States of an adequate merchant marine, because of its bearing on the question of army transportation over seas, was strongly brought out in a report which has just been compiled by the General Staff, and forwarded through Secretary Taft to the chairman of the Joint Committee on Merchant Marine. The General Staff is remarkably frank in its discussion of the transport service in the Spanish war. We are told, regarding the Santiago expedition of 1898, that the Quartermaster's Department chartered every American vessel that could be obtained in the Atlantic ports in the twenty days following the declaration of war, and that as the grand result of its efforts it obtained only thirty-six vessels of an average size of 2,500 gross tons, and that of these, only two were more than 4,000 tons. The report proceeds to say (we trust that Congress will lay the words to heart): "The official records afford ample evidence that the safe arrival was due to the good fortune of continued fine weather. A severe storm would have scattered the fleet, probably with great loss of life, and would have defeated the object of the expedition. This fleet of ships could not have embarked, under reasonable conditions, a force of more than 8,000 or 10,000 men, and when so embarked, the expedition could have been dispatched on a long voyage only at great jeopardy of the welfare of the men, and of the success of the enterprise."

It will be remembered that following the close of the Spanish war a considerable increase was made in our enlisted army; yet because of the smallness of our merchant marine, we are not to-day in a position to utilize this increased force in any adequate degree, at a distance from our own shores. According to the General Staff, it is a fact that now, and for some time to come, the force for which our military establishment is maintained cannot be exerted over seas. The first quick blow, so increasingly important, cannot be struck at all, nor can an expedition of any great size be embarked without delay, except by the use of foreign vessels. This condition of things cannot improve until the American seagoing merchant marine has increased in tonnage to approximately two and a half times its present volume. Moreover, the ships should be adapted in size and in design to quick conversion into suitable transports, and should be built under conditions which make their voluntary surrender to the United States, on demand, a foregone conclusion. We are informed that a single army unit such as a division with nine infantry regiments, one cavalry regiment, three artillery battalions, one engineer battalion, and one company signal corps, with the necessary hospital, ammunition, and supply wagons, would require for its transportation ten 6,500-ton ships and nine 5,500-ton ships. Two such divisions, representing, say, 25,000 men, could be provided with transportation in fifteen days, and they would require twenty of the larger and eighteen of the smaller ships.

But owing to the fact that these merchant ships, built under transport requirements, might at the occurrence of a crisis be more or less widely scattered, and because of other delays, such as extensive dock-yard repairs, it is not possible to reckon that more than one-third of the vessels required could be made available in fifteen days. Hence, for every ship for which there is likely to be a call, there must be three afloat. That is to say, to be certain of transporting our little army of 25,000 men, there should be afloat in our merchant marine sixty of the 6,500-ton ships and fifty-four of those of 5,500 tons. Furthermore, since the crisis might arise either on the Pacific or the Atlantic, it would be necessary to have this number of ships, suitable for transport, afloat on each ocean, or a total of 228 vessels of a gross tonnage of 1,368,000 tons.

Now, in 1904, in the whole American steam merchant marine, there were only fifty-seven seagoing vessels of 4,000 tons and upward, with a total of 400,000 gross tons. It is not necessary to follow the argument of the General Staff any further to be convinced that in case of a crisis occurring, say, in Honolulu, the Philippines, Porto Rico, or Panama, requiring the instant dispatch of the very moderate force of 25,000 men, the army, because of lack of transportation, would find itself unable to give immediate response. Herein lies one of the most powerful arguments for the encouragement by the United States government of the efforts to upbuild our merchant marine.

TWO CENTURIES AFTER FRANKLIN.

On the 17th of this month occurred the bicentenary of Benjamin Franklin. Not only has posterity assigned to him his rightful position among the greatest and ablest of Americans, but foreigners as well early recognized those qualities of his masterly intellect which placed him among the foremost statesmen and men of science and letters. Undoubtedly his fame rests chiefly upon his public career, his services to his country as a statesman, diplomat, and patriot. An historical figure of international fame, his scientific attainments are overshadowed by his political eminence. And yet, the results of his scientific researches and investigations easily place him in the very front rank of scientific men of the world.

Few, indeed, of us have a proper appreciation of Franklin's work in natural philosophy and electricity. It is true that his classic experiment to prove the identity of lightning and electricity is known the world over; but so general is the ignorance of his other scientific labors, that this great discovery is often regarded merely as a fortuitous and chance occurrence. The utter absurdity of this belief needs no further proof than even slight acquaintance with his painstaking and unremitting study in this as well as other directions; and it is unquestionably true that this experiment was not the origin of a theory, but that it was the culminating test of a line of theoretical reasoning and investigation. Franklin's interest in things scientific was limited in range only by the limits of the knowledge of his time. His splendid versatility and intense interest in all phases of human endeavor led him into branches of knowledge where his remarkably practical mind and sound judgment produced contributions to science of undisputed value. So, his early investigations of chimney drafts were soon followed by the invention of a stove, which embodied the principles of the modern hot-air furnace and other devices of like character.

A subject which at this time possessed a peculiar fascination for him was meteorological investigation, and his knowledge and understanding of the general physics of the atmosphere were far in advance of his period. Franklin was probably the first to institute our present methods of tracing and recording storms from point to point, and his investigations of the Gulf Stream, for the first time using thermometric means of verification, were of great value to navigators. No strange occurrence or natural phenomenon was allowed to pass without investigation by the best means at his command. Thus his friend Priestley, in making public the account of his discovery of oxygen, at the same time published a letter from Franklin telling of an inflammable gas found in certain American rivers, known to-day as marsh gas.

Franklin's studies in electricity were, however, carried out farther and more thoroughly than his various activities permitted him to do with other branches of knowledge, and upon his electrical investigations rest his great claims to fame as a scientist. His introduction to this branch of science, then beginning actively to engage the attention of men of learning in Europe, was through a Dr. Spence of Boston, who possessed some crude apparatus and was acquainted with the work that had been done abroad. Franklin's interest was at once aroused, and his natural inclination to philosophic study of this character soon induced him to make electrical research one of the prime objects of his life, and a hobby which he did not relinquish until his death. Collinson, the English agent of the Library Company of Philadelphia, and the personal friend of Franklin, supplied him with existing English literature on the subject, and soon sent him Dr. Watson's book, as well as one of the tubes used in the experiments. Franklin eagerly took up the closer study of electrical phenomena, and in 1747, with three others, Kinnersley, Hopkinson, and Sing, conducted the famous "Philadelphian experiments," showing the "effect of pointed bodies both in drawing off and throwing off electrical fire." It is almost certain that in these investigations Franklin copied very little from the European investigators; in fact, his scientific surroundings in America almost precluded this possibility. In all probability, he at this time reinvented the static electrical machine for his own use. His splendid fertility of resource and unflagging energy are demonstrated in no better way than in these experiments, crude, hampered by insufficient apparatus and ignorance of what had already been done, but even so, outstripping the work of the best continental scientists.

Franklin evolved the electric fluid theory acceptable to the non-mathematical mind almost to our day. His work with the Leyden jar was classic, and with his experiments begins the forging of the link between this and the voltaic cells.

In 1748 he decided to retire from public life and business, to devote his entire time to electrical study and research. With this purpose in view he sold his newspaper, almanac, and printing house, and the result of this sale, with the fortune he had previously amassed, enabled him to settle down to conduct his experiments unhampered by lack of time, until again called into public activity a few years later. The work on the Leyden jar was continued with marked success, and at this time Franklin was undoubtedly in advance of most foreign electricians. He conceived and used the arrangement of electrical sources in series, a method hitherto unknown. Further, he made the important discovery, and proved it, that the charge of the jar lies near the surface of the glass itself and not in the metal as had been believed.

Unquestionably, his greatest success was in proving that lightning is an electrical phenomenon. As early as 1746, John Freke, a Scotchman, followed by other scientists, formulated this hypothesis, and unsuccessfully attempted its proof. In all probability, Franklin did not know much about these other theories, and his conception of the identity appears to have come to him early in his investigations, during certain of which he painstakingly observed and noted all the characteristics apparently common to a flash of lightning and an electric spark. In 1749 he sent to Collinson his two famous communications, making known his belief in this identity. Outlined in these letters was a theory of the causes of atmospheric electricity, ingenious though incorrect, which he soon abandoned. He continued his experiments through the summer, and in July of the following year he again sent a long communication to Collinson, giving an account of the experiments in which the invention of the lightning rod is set forth, and outlining a plan for proving that lightning and electricity are of the same character. Collinson recognized the value of the account, and attempted to secure its publication in the Journal of the Royal Society. The Society was not well disposed toward Franklin, and refused to entertain the idea. Cave, the great London publisher, denied the letter space in his Gentleman's Magazine, but consented to print it in book form. This was done, and the publication in 1751 was soon followed by a French translation. The importance of the experiments was recognized in France; and while Franklin, continuing his investigations, was pondering on how to conduct his projected lightning-rod test himself, he learned that it had been successfully carried out by French savants. How this had been done he did not know. He was only acquainted with the bare fact of the accomplishment. Nevertheless, he set to work and soon evolved the kite experiment, which made him famous the world over, and which was followed by his election as honorary member to most of the learned societies of Europe, including the Royal Society of England.

It has been held that had Franklin been able to devote his entire time to science, had his studies been pursued in an environment more suited to work of this kind, and had his opportunities for acquiring scientific erudition been more favorable, his fame today would rival that of the greatest natural philosophers the world has seen. He was essentially the practical man, of politics, of letters, of science, and this characteristic, coupled with sound common-sense and judgment, led him constantly to attempt the realization of scientific principles for purposes of practical utility. His mental attitude was one of unselfishness, of insensibility to ridicule, and carelessness of praise, as witnessed by the characteristic indifference with which he regarded the early shortsighted attitude of the Royal Society. The recognition of Benjamin Franklin's worth and eminence as a patriot, as a statesman, and as a writer cannot be too great, nor can it be too general, but in our appreciation we must not forget what Franklin's work as thinker and investigator has meant to science, the abstract, and to science as applied to the utilities of ordinary life.

THE HEAVENS IN FEBRUARY.

BY HENRY NORRIS RUSSELL, PH.D.

The astronomical news of the past month deals chiefly with comets and nebulæ.

Giacobini's comet, discovered in December, is still visible, but about the first of February it gets so near the sun that it will be invisible (although it will actually be many times brighter than at the time of discovery) since it will only be above the horizon during daylight. Later on, after its perihelion passage, it may be seen again, though the conditions are not favorable.

The discovery of two other comets has been announced from the Lowell Observatory, both being found on the same plate, taken by Mr. Slipher. Unfortunately, moonlight prevented further observations, and now the comets are "lost," and it is impossible to say whether they will be observed again.

The nebula to which we refer surrounds the new star which appeared in Aquila last August. The history of this star is very much like that of other objects of the kind. It was discovered by Mrs. Fleming on a Harvard photograph, on which it showed the characteristic bright-line spectrum. It rose from invisibility to the seventh magnitude between the 15th and 18th of August, and then gradually faded, so that it was never visible to the naked eye.

Now the announcement comes, quite independently, from Heidelberg and from Arequipa, that plates taken in October, two months after the outburst, show a faint nebulosity around the star, about a minute of arc in diameter, which was not present on photographs taken previously. It seems likely that this nebula is intimately connected with the star, as was the case with the similar nebulosity which appeared round Nova Persei in the winter of 1901-2, and that, as in the earlier case, it is spreading out from the star in all directions.

This could be explained in the same way, by assuming that the new star was surrounded by a nebula which was really dark and at rest, shining only by reflected light. As the light of the outburst moves farther from the star, it lights up more and more of the nebula, which therefore appears to expand.

On this hypothesis we may make a rough estimate of the distance of the Nova. If the outer part of the nebulosity is at the same distance from us as the star is, its distance from the star on October 18 must have been about 1/7,000 of its distance from us. But, according to one theory, this is the distance that the star's light had traveled in the two months since the outburst, and it follows by a simple proportion that its light must take nearly 1,200 years to reach the earth.

This distance is much greater than that which a similar calculation gives for Nova Persei—about 250 light years—but it is not at all incredible in itself, for astronomers have long been convinced that the more distant stars are so remote that their light must take thousands of years to reach us.

It would follow that Nova Aquilæ at its brightest sent out about three hundred times as much light as the sun. Large as this amount is, it is small compared with the light of Nova Persei, which at its best was six or eight thousand times as bright as the sun.

It should be remembered that these figures rest upon certain assumptions, which, though pretty well established in the case of Nova Persei, are not yet proved for the star in Aquila. If they are true, the most remarkable of their consequences is the thought that we are now observing and discussing as a new thing an event which really happened in the days of Charlemagne or of Alfred the Great.

Turning from the remote past to the near future, we have to note, as the most interesting astronomical event of the month, a total eclipse of the moon, which takes place on the morning of the 9th. The moon begins to enter the earth's shadow at 12:57 A. M., is totally immersed in it at 1:58, and continues so until 3:30, when her eastern limb begins to come out of the shadow, which she leaves finally at 4:37. All these dates are given in Eastern standard time, and must be corrected by one or more hours if an observer uses one of the other standard times which are current in the central or western parts of the country. This is an unusually long eclipse, as the moon passes almost centrally through the earth's shadow.

There is also an eclipse of the sun on the 23d, but it is only visible in the southern parts of Australia and New Zealand, and the south polar regions, and so is of little concern to us.

The starry heavens afford the finest spectacle they present during the year on these winter nights. If we stand on a clear February night, at about nine o'clock in the evening, and look due south, the first thing we will see is Sirius, the brightest of all the stars. Below it and a little to the left is an irregular cross of brightish stars, which mark the rest of the constellation of the Great Dog. Higher up, and a little more to the left, is the bright star Procyon, the only prominent member of the constellation of the Little Dog. Above this again are two nearly equal stars, Castor and Pollux, in Gemini.

Looking upward and to the right from Sirius we find Orion, and beyond it Taurus, to which Jupiter—now near the Pleiades—adds a greater luster. Still higher, northwest of the zenith, is Auriga with the very bright star Capella.

The constellations in the eastern and western skies are less brilliant. Leo and Ursa Major are the most prominent ones in the east, and Hydra is in the very dull southeastern sky. The southwest, which is occupied by Eridanus and Cetus, is equally uninteresting, and the only other conspicuous constellations are in the northwest, where Perseus, Cassiopeia, and Andromeda lie, and the north, where Draco and Ursa Minor are below the Pole.

Observers in latitudes south of 36 deg.—that is, south of Virginia and Missouri—may at this season see Canopus, which next to Sirius, is the brightest star in the heavens. It comes to the meridian about twenty minutes earlier than Sirius, and can just be seen, low on the southern horizon.

THE PLANETS.

Mercury is nominally a morning star until the 20th, when he passes behind the sun and becomes an evening star; but as a matter of fact, he is too near the sun to be seen with the naked eye this month.

Venus is in a similar situation, passing conjunction on the 14th. On the 22d she is in conjunction with Mercury, and both with Saturn, but all the planets are very near the sun, and hopelessly invisible.

Mars is evening star in Pisces, and sets at about 9 P. M. in the middle of the month.

Jupiter is in Taurus, near the Pleiades. On the 17th he is in quadrature with the sun—that is, 90 deg. east of him—so that he is due south at 6 P. M.

Saturn is in conjunction with the sun on the 24th, and is only visible during the first few days of the month, just after dark.

Uranus is in Sagittarius, and rises at about 4 A. M. Neptune is in Gemini, and sets at about the same hour.

THE MOON.

First quarter occurs at 7 A. M. on the 1st, full moon at 3 A. M. on the 9th (during the eclipse), last quarter at 11 P. M. on the 15th, and new moon at 3 A. M. on the 23d (at the time of the solar eclipse). The moon is nearest the earth on the 13th, and most remote on the 1st. She is in conjunction with Jupiter on the 2d, Saturn, Mercury, and Venus on the 23d, and Mars on the 26th.

Princeton Observatory.

IMPROVEMENTS NOTED AT THE AUTOMOBILE SHOWS.

This year for the first time two of the largest exhibition buildings in New York were required for the display of American and foreign machines and accessories. At the two shows in Madison Square Garden and the 69th Regiment Armory, nearly 200,000 visitors passed through the gates during the week. The machines exhibited were the product of some 94 domestic and 28 foreign makers. Most of the machines on view were high grade 4-cylinder touring cars or closed limousines of about 24 horse-power. Next in numbers were the light touring cars and runabouts with double-opposed-cylinder motors, while the single-cylinder cars were few. The friction disk transmission seems to be coming into vogue, as no less than three distinct forms of this type of transmission were noted in the armory. A peculiar type of pin transmission somewhat on this order was also exhibited. The greatest improvement in motors lies in the bringing out of a six-cylinder engine by a half-dozen different firms, and the introduction of a four-cylinder two-cycle engine by another. Practically all the gasoline motors have all their valves mechanically operated and are fitted with jump-spark ignition, although a few high-grade machines have low-tension magneto ignition. The high-tension magneto is also a favorite means of current supply with the jump-spark system. In almost every instance, the magneto, as well as the water pump, is driven by inclosed gears running in oil. A low-tension make-and-break magnetic spark plug in which the movable pin is operated electrically was a French invention of interest. A magneto was used to supply the current, which amounted to six amperes with a voltage of 20. Although decidedly inefficient, this plug produced an exceedingly hot spark and was claimed to be oil proof. The electric vehicles shown were larger and more luxurious than ever. Eighty miles on a charge at a speed of 15 miles an hour is guaranteed by several makers. The improvements in the Edison battery noted on another page will perhaps make it possible to do even better than this, although a two-passenger speed machine shown, fitted with the present type Edison cells, had a mileage of only 60 on a charge. This mileage was guaranteed, however, at a speed of 25 miles an hour. The weight of this machine—1,650 pounds—was slightly greater than that of an electric stanhope having a capacity of 85 miles on a charge at 15 miles an hour; and 60 Edison cells weighing 780 pounds were used in the former as against 24 lead cells weighing 625 pounds in the latter machine.

An elaborate display of trucks and commercial vehicles was made in the basement of the Garden. Most of these were electrically operated, although several gasoline trucks were shown. A novelty among the latter was a truck with electro-magnetic clutches for obtaining the different speeds. Three-ton trucks are about the largest that are at present manufactured. Several electric trucks of this capacity were shown. Solid rubber tires (and in some instances twin tires) are used on these vehicles.