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IRRIGATION IN THE EASTERN STATES.

An important part of the work of the United States Department of Agriculture is the irrigation of arid lands, an undertaking which is being carried out by the Office of Experiment Stations in various regions of the United States. Owing to the great importance of the subject to the farmers of the Western States, for whose success irrigation is a positive necessity, the greater part of the experimental work of this office is being done on the arid lands which were formerly known as the Great American Desert, but which under the influence of irrigation have proved to be remarkably productive. It must not be supposed, however, that the need for irrigation exists only in the region west of the Mississippi River; for the many crop failures which have occurred in the Eastern States have drawn attention to the necessity in this region also for storing the flood waters of the rainy season, or if that be not practicable, of erecting pumping plants to make good the shortage in seasons of drought.

Although the losses due to drought are not anything like so serious in the East as in the West, they are still sufficiently large to justify the installation of irrigation plants. Prof. E. B. Vorrhees, of the New Jersey Experiment Station, estimates that as the result of his observations and experiments in 1899 he found the loss to the hay crop of New Jersey from drought during May and early June of last year to be $1,500,000, while vegetables and small fruits suffered even more seriously. That damaging droughts are not infrequent is shown by the rainfall records in Philadelphia during the seventy years from 1825 to 1895, which prove that in eighty-eight per cent of these years there was a deficiency of more than one inch for one month; that is to say, in sixty-two years out of seventy, there was one month in the growing season in which there was so marked a decrease of rainfall that a serious shortage of crops resulted. For the same period there were thirty-nine years in which the deficiency extended throughout two months, while in twenty-one years the deficiency extended throughout three months, the average rainfall during this growing period being deficient by one inch or more.

The investigation by Prof. Voorhees was made for the purpose of determining whether the increased yield resulting from irrigation during these three months would be sufficient to pay for the necessary storage or pumping plants. Careful records were kept of the yields of plots of ground which received the same cultivation, except that some of these were irrigated and others depended upon natural supplies of moisture. The increase in the yield of the irrigated plots over the others varied from 339 quarts of raspberries per acre, worth $22.90, to 1,030 quarts of blackberries per acre, worth $93.42.

The cost of plants of the size necessary to supply ten acres of small fruits and garden crops has varied in the different experiments from $230 to $500. While returns have not been made from all of the plants which were under observation, the owners are in every case satisfied that their outlay has been returned with considerable profit; while in nearly every case they state that they have paid for the plant with the receipts of increased crops during the first year it was in operation.

The results obtained by Prof. Voorhees are of unquestionable value; for the climatic conditions of New Jersey are fairly typical of the United States east of the Mississippi River. The report has greater practical value to-day than it would have had twenty years ago, for there are now upon the market many exceedingly economical forms of motive power, such as improved windmills and highly economical internal combustion motors, which do not cost much to install, and the running expenses of which are light; the windmills indeed costing practically nothing after erection.

A 40-KNOT STEAM YACHT.

Quite apart from its spectacular features, the phenomenal development which is just now taking place in the art of building extremely high-speed craft of the pleasure-yacht or torpedo-boat type is of the most vital interest to the builders of large, high-speed, ocean-going vessels, whether in the navy or merchant marine. When Mr. Parsons with the "Viper" and Mr. Mosher with the "Ellide" succeed in attaining speeds of 37 knots and 34·73 knots with their respective craft, they are "blazing the way," as it were, in a comparatively untried field of investigation, for the production of ocean steamships which as the years go by will undoubtedly approach the same speeds.

The incredulity with which the mere suggestion of such speeds in ocean steamers is received is due to the recognition of the fact that the present system of steam boilers and steam engines involves such an enormous increase of weight for a relatively small increase of speed that the limit of speed with Scotch boilers and engines of slow revolution has been very nearly reached. But to state that higher speeds can never be attained is to assert that finality in marine engine and boiler design has been reached.

For obvious reasons it was impossible to take any indicator cards of the turbine engines of the "Viper;" but as the engines of the "Ellide" are of the reciprocating type, it has been possible carefully to tabulate the results of the trial on which she achieved her record speed. The results showed that by the use of water tube boilers, carrying a pressure of 390 pounds to the square inch, and engines of extremely light construction running at 822 revolutions per minute, an indication of 910 horse power can be obtained in a craft whose displacement is only 13 tons. This represents 70 horse power per ton. There is now under construction by the same designer a twin-screw steam yacht, which is to be of 60 tons displacement, and whose engines are designed to indicate 4,000 horse power and drive the craft at a maximum speed of 40 knots per hour. The success of the "Ellide," and the fact that the new yacht is an enlargement and improvement of the principles of design embodied in the earlier boat, render it probable that this speed will be attained.

In the current issue of the SUPPLEMENT will be found a lengthy article which gives a full description and drawings of the new craft, and all who are interested in the development of steam navigation, whether for pleasure, war, or profit, will find the article of extreme interest. Of course, there is an enormous step from a 60-ton river craft to a 20,000 or 30,000-ton ocean liner, but the fact that 4,000 horse power is to be developed from two boilers whose combined weight is only 12 86 tons may well demand the serious attention of marine architects who are now engaged in designing, or getting ready to design, the latest express ocean steamers. Horse power is the product of pressure and velocity. By the use of water tube boilers pressures may be enormously increased and weights reduced, while in the engines the speed of revolution may be quadrupled, with a corresponding reduction in weights.

Doubtless the fast-running engine and the water tube boiler would have been given a trial in one of the liners recently built or now building, had there been any successful application of these to a high-speed vessel say of 1,500 to 2,000 tons displacement; but the steamship companies naturally hesitate to make radical experiments on a vessel which represents an investof $3,000,000 more or less. We hear that 30-knot Channel steamers are under consideration by one or more of the English companies, and if such a craft be built and successfully run, we may see the speed of ocean liners make a jump of three or four knots within the next decade.

THE NATIONAL MEMORIAL BRIDGE AT WASHINGTON.

It will be remembered that as the result of a competition for a National Memorial Bridge to cross the Potomac River at Washington, the first prize was awarded to Prof. W. H. Burr, of Columbia University, N. Y., who was assisted, as to the architectural features of the designs, by Mr. Edward P. Casey. Prof. Burr presented two designs for this bridge, and the committee in awarding him the first prize decided to accept in general the engineering features of one design and the architectural features of the other. One of these designs was illustrated in the SCIENTIFIC AMERICAN of May 19. In the modified design the accepted features of the two plans are combined, and the result is an extremely dignified and beautiful structure.

The bridge may be broadly divided into the bridge proper, which consists of six 192-foot concrete and steel arches, with a bascule span of 159 feet in the center, the bascule serving to span the navigable waterway, and the three spans on either side serving to reach across the river proper. The Washington approach to the main bridge consists of twelve 60-foot semicircular concrete-steel arches and 550 feet of embankment; while on the Virginia side the approach is made up of fifteen semicircular arches of the same system of construction and 1,450 feet of embankment, the total length of the bridge including the embankments being 3,440 feet. The architectural features shown in our illustrated article above referred to have been incorporated in the new design. In the original plan, the bascule piers were surmounted by massive Roman arches, which, while they were intrinsically admirable in design, were not nearly so well adapted to the site or to the structure as the piers which are incorporated in the amended design.

The judges have decided that it would be better to provide for street car lines on the main deck of the bridge, which instead of embodying an upper and lower roadway, will be constructed with a roadway 60 feet in width, which will permit of the use of car tracks and two 12-foot sidewalks on either side of the roadway. An important modification, which greatly adds to the architectural appearance of the bridge, is the substitution of curved for straight lower chords in the bascule leaves. Good taste has been shown in adopting a flatter curve for the bascules than that employed in the three concrete spans on either side, the difference in curvature serving to emphasize the fact that the channel span is a bascule and not a permanent arch. The great arch towers at the center, and the ornamental towers at the shore abutments, will be enriched with emblematic groups of statuary and heavy bas-reliefs, which will commemorate men distinguished in the foundation and development of the Republic, the memorial bridge being intended to serve as a tribute to "American patriotism." The completion of this magnificent structure will form a notable addition to the great national monuments not merely of this country, but of the whole world, ancient and modern. The memorial will be a fitting example of the best work of the American bridge engineer in the beginning of the twentieth century, and in architectural effect it will be a worthy companion to the Congressional Library.

OUR RAILROADS AT THE CLOSE OF THE CENTURY.

In respect of its size and phenomenal growth, the stupendous railroad system of the United States is to this country what the equally stupendous British merchant marine is to the mother country. In the case of both the wonderful growth has been confined to the last three generations, and each is by far the largest in the world. We have at hand the annual statistics which are published as a part of Poor's Manual, from which it is seen that there has been a healthy growth during the past year, which, while it is far below the records of some of the years of undue expansion, is still without a contemporaneous parallel in any of the world's great railroad centers. The length of the railroads completed on December 31, 1899, was 190,833 miles, and the net increase in mileage of all railroads in the United States for the last year is given as 3,981 miles. The length of the railroads reporting traffic statistics, earnings, etc., was 186,590 miles. Upon this vast trackage there were carried about 538,000,000 passengers, and the total tons of freight transported totaled about 978,000,000 tons. The total traffic revenue was $1,336,000,000. The operating expenses were about $888,000,000, leaving net earnings of about $448,000,000, which, with $66,000,000 of "other receipts," brings up the total revenue to $513,879,443. The total payments for valuable revenue was about $411,000,000, leaving a surplus over fixed charges and miscellaneous payments of $103,000,000.

Under the head of statistics of track mileage and rolling stock equipment, some interesting figures are given regarding the percentage of steel rails in the tracks of the United States from the year 1880 to the year 1899. Thus, in 1880, when there was 116,000 miles of track, twenty-nine per cent of it was laid with steel rails. In 1885 there was 160,000 miles of track, sixty-one per cent of which was laid with steel. In 1890, when there was 208,000 miles of track (these totals including sidings and yard trackage), 80·4 per cent consisted of steel rail. In 1895 the total had risen to 235,000 miles, and the percentage of steel track to 87·8 per cent, while at close of last year, out of 250,000 miles of track, only 8·3 per cent was laid with iron rails.

The total number of locomotives has risen from 18,000 in 1880 to 37,245 at the close of 1899; the passenger and baggage cars from 17,000 to 34,000; the freight cars from 539,000 to 1,328,000. In considering these figures of increase, we must remember that the locomotives and cars themselves have increased enormously in carrying capacity, the heaviest passenger locomotive having risen in the past twenty years from 45 tons to 90 tons in weight, the freight locomotive from 60 tons to 115 tons, while the largest freight cars, from carrying a maximum load of 15 tons in 1880, have now a total capacity of 55 tons.

SODA WATER FOUNTAIN IN GREAT BRITAIN.

It would be difficult to find a more peculiarly American institution than the soda-water fountain, or one which would act as a more immediate and powerful reminder of the scenes with which he is familiar in his native land than the marble-faced, many-fauceted and nickel-resplendent structure which is one of the numerous devices by which the American citizen tempers the fierceness of the periodical "hot wave." Hence the introduction of the soda water fountain into Great Britain, as referred to in a recent report by the American consul at Birmingham, may be regarded as a notable instance of the interchange of ideas and customs between this country and Great Britain which is grow-

ing more marked every year. It seems that in a window of a "chemist shop" in Birmingham there was exhibited during the summer months a sign advertising various sodas and phosphates. The proprietor, who is quoted as "an enterprising man who is ready to try new things," has proved his fountain to be a striking success. On a hot day he sold as many as a thousand glasses of various flavors, and on other days as many as six or seven hundred glasses, and this in spite of the fact that the "doctors called and denounced the use of soda water, fearing harmful effects from the dangerous ice-cold liquid, and then took it themselves, just as they do at home." It seems that an American soda fountain syndicate has taken up the matter of these hot weather necessities in England, and a number of cities now have fountains in successful operation.

THE HEAVENS IN NOVEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

The most important astronomical events of November are the annular eclipse of the sun on the 21st and the meteoric shower of the 14th.

The first of these phenomena is of little interest to Americans, since it takes place when our side of the earth is turned away from the sun. The path of annular eclipse lies chiefly in the Indian Ocean, but crosses South Africa at one end and Western Australia at the other. The duration of the annular phase is quite long, varying from five to nearly seven minutes.

There is more hope that we may see a great shower of the Leonid meteors this year; but those who, like the writer, watched in vain for them a year ago, are disposed to follow Hosea Biglow's advice, and not to prophesy unless they know. And there are several causes, any one of which, if fully operative, would prevent our seeing a conspicuous display.

In the first place, it has been shown that the orbit of that part of the meteor swarm which gave rise to the shower of 1867 has been so changed by the attraction of Jupiter and Saturn that it no longer exactly intersects that of the earth. If this change is great enough to keep even the outer parts of the meteor swarm away from the earth's orbit, there will be no more Leonid showers, unless at some future time their orbit is changed back again by some favorable planetary action. But it is by no means certain that the actual change in the orbit is as great as this.

Secondly.—The great showers of Leonids recorded in recent times were in 1799, 1833, and 1866, 1867 and 1868. Taking the middle of the last three as the main shower, the interval between showers comes out 34 years, instead of the previously supposed 33¼, and the next great shower is due in 1901, with perhaps smaller ones in 1900 and 1902.

This theory, which is due to Professor W. H. Pickering, seems to the writer of the present note to be the most probable explanation of the failure of the expected shower in 1899.

Thirdly.—Even if the shower occurs, it may be that the impressive part of it, which lasts but a few hours, may be visible only in the Eastern Hemisphere, and that we may thus miss it.

In spite of all this uncertainty, it will be well worth while to watch the sky on the nights of the 14th and 15th. For the great shower, if it does appear, will be one of the grandest of all natural phenomena, and at the same time one of sufficient rarity to make it doubly important not to lose a chance to see it.

It will be hardly worth while to start the watch before midnight, as at that hour Leo has barely risen. Unfortunately, the waning moon is in this part of the sky, and only the brighter meteors will be visible. But even so, should many of them appear, the divergence of these paths in all directions from the "radiant point" inside the sickle of Leo will be conspicuous, and will afford one of the finest natural examples of a perspective effect.

At 9 P.M. on November 15 the most brilliant part of the sky is near the eastern horizon. Just south of east is Orion. The line of his belt is almost vertical, and the still brighter stars Betelgeux (on the left) and Rigel (on the right) afford a striking contrast in color, the former being a strong red, and the latter pure white.

North of east, and also low down, is Gemini, marked by the twin stars Castor and Pollux, of nearly the first magnitude, south from which extend two lines of stars in which a little imagination sees the Twins themselves. Above Orion, Aldebaran and the Pleiades mark the position of Taurus, and to the north, over Gemini, is Capella, the brightest star of Auriga.

The great square of Pegasus is a little past the meridian. A conspicuous row of bright stars extends from its northeast corner through Andromeda and Perseus toward Auriga. The huge extent of Cetus fills most of the southeastern sky, and Aries is higher up. In the southwest the only conspicuous star is Fomalhaut. Vega and Altair are well down in the west, and Cygnus is higher up. Cassiopeia is almost above the pole, and the Dipper is opposite, skirting the northern horizon. To the right of Vega is the head of Draco, whose curving body extends for a long distance between the Great and Little Bears.

THE PLANETS.

Mercury is evening star until the 19th, when he passes inferior conjunction and becomes morning star. At this time he is very nearly in line between the earth and sun. In fact, if the conjunction took place but one day earlier, he would transit the sun's disk. He will be too near the sun throughout the month to be well seen with the naked eye.

Venus is morning star in Virgo, rising at about 3:30 A. M. on the 1st and 4:30 on the 30th. She is receding from the earth and growing fainter, but is still much the brightest object in the morning sky.

Mars is in Leo, not very far from the meteor radiant, and rises about midnight in the middle of the month, and is steadily brightening toward his opposition next February.

Jupiter is evening star in Scorpio, but is so low in the west at sunset that he will not be easy to see after the middle of the month.

Saturn is also evening star in Sagittarius, setting about an hour and a half later than Jupiter.

Uranus is in Scorpio near Jupiter, but too near the sun to be visible.

Neptune is in Taurus, invisible to the naked eye.

THE MOON.

Full moon occurs on the afternoon of the 6th, last quarter on that of the 13th, new moon at the time of the eclipse on the 21st, and first quarter near noon on the 29th. The moon is nearest the earth on the 5th and most remote on the 17th. She passes Neptune on the evening of the 8th, Mars at noon on the 14th, Venus on the evening of the 18th, Mercury on that of the 21st, Uranus on the night of the 22d, Jupiter near noon of the 23d, and Saturn on the afternoon of the 24th.

Princeton, October 19, 1900.

CONGRESS OF TRAMWAYS AT PARIS.

The International Congress of Tramways was held at Paris the 10th and 13th of September. It was organized under the auspices of the International Union of Tramways. A list of questions relating to the most important points, most of them to electric traction, had been previously sent to the members, and from the replies obtained, eleven papers or reports were prepared by leading specialists. These papers, with the discussions to which they gave rise, are of great value. The first paper, read by M. H. Géron, relates to the question of tariffs; the second, by M. de Pirch, shows the advantages of electric traction, being confined mainly to the subject of overhead systems. The results obtained have been an increase of traffic, lines and passengers; facility of extension; diminution of expenses and increase of profits, lowering of rates, etc. A paper read by M. Gunderloch shows the advantages and disadvantages of broad and narrow gages. The composition of central stations was an instructive paper by Messrs. Thonet and d'Hoop, treating of the installation of dynamos, engines and boilers. Compound engine, accumulators, and in some cases gas engines are recommended. Systems of current distribution is a paper read by M. Van Vloten, in which the usual direct current system is recommended for shorter lines, while for long lines accumulators may be used at the station. Accumulator traction may be used for lines of 9 to 12 miles. The polyphase system seems only adapted to railroads. M. Fischer-Dick read a paper upon the Falk rail-joint, and traction by accumulators was considered by Messrs. Broca and Jahannet, of the Paris traction companies, giving their experience and the deductions to be drawn for or against the system. The heating of cars was treated by M. de Burlet, who considered stoves, hot air, steam and electric heating, etc. Secondary railroad lines were considered by M. Ziffer. The methods of rating the power of dynamos and electric motors were treated by M. Macloskie. The question of brakes for tramways was considered by M. Monmerque, including the various forms of hand and mechanical brakes.

THE UNITED STATES NATIONAL MUSEUM.

The annual report of the condition and progress of the National Museum for the year ending June 30, 1898, is made by Charles D. Walcott, who has charge of the United States National Museum, and shows that the institution is in an excellent condition. During the fiscal year there were 441 accessions containing upward of 450,000 specimens. The total number of specimens recorded up to July 1, 1898, exceeds 4,000,000. The attendance during the year under consideration was less than during the previous year, owing probably to the war and the presidential inauguration, which caused a large influx of visitors. Since 1881, 3,972,987 persons have visited the museum. Prof. Walcott is of the opinion that the National Museum should be enlarged at once. The present building was erected with a view to giving the largest amount of space with the least outlay of money, and in this respect it may be considered a success. It is, in fact, scarcely more than a shadow of such a massive, dignified and well-finished building as should be the home of the great national collection. There is needed at once a spacious, absolutely fireproof building, of several stories, constructed of durable materials, well lighted, modern in equipment and on such a plan that it may be added to as occasion demands in the future. A site for such a building is already owned by the government, and only the new structure needs to be provided. The galleries just completed have added 16,000 square feet of floor space, which will help to a certain extent to relieve the crowded condition of the exhibition halls and courts below. As an illustration of the present conditions, and the necessity for more room, the anthropological collection may be cited. If the material now in possession of the government in this department should be properly placed on exhibition, it would occupy the entire space of the present museum building.

In the present structure there is a great deficiency in laboratory facilities. Curators and assistants are hampered for want of room in which to lay out, arrange, classify, mount, and label specimens. There should also be rooms in which students could bring together and compare various series of objects, and have at hand books and scientific apparatus. The quarters for storage in the present museum building are also entirely inadequate. What is needed is a series of spacious fireproof basements for the less perishable objects and equally spacious dry lofts and rooms for those collections and stores which require protection from dampness. The present museum building was built with the cheapest materials and under the cheapest system of construction, so that it gives the appearance of a temporary structure and tends to cheapen the effect of really good cases and the very valuable collections which they contain.

The head curators, curators, assistant curators and aids constituting the scientific staff of the National Museum number in all sixty-three persons and of these only twenty-six are compensated, the remainder serving gratuitously, being for the most part connected with other Bureaus of the Government. Mr. Walcott says truly that the system of honorary curatorship, while admirable within restricted limits, is a disadvantage when carried to the present extent. Such a system has a disintegrating effect upon the organization, as the men are not entirely at the command of administrative officers, and are not obliged to serve at definite hours or under the ordinary restrictions of paid curators. The number of honorary officers should be reduced by the substitution of a larger number of salaried officers.

The National Museum has at present no regular fund for the acquisition of collections, and can only make purchases from a contingent fund, which rarely exceeds $3,000 or $4,000. For this reason, every year valuable collections which should be in the hands of the government are sold abroad or to municipal museums, or pass into the hands of private citizens. The American Museum of Natural History annually expends $60,000 for the increase of its collections, and the Field Columbian Museum, in Chicago, has spent for collections during the last five years $419,000.

The floor space is far less than the American Museum of Natural History. The space on the ground floor is 140,625 square feet, and that in the gallery 16,000 square feet, and the exhibition space is 96,000 square feet. The total cost of the building was $315,400. The American Museum of Natural History, on the other hand, has 294,000 square feet of floor space, of which 196,000 is given up to exhibition space. The total cost of the American Museum to date, including the completion of the new wings, is $3,559,470, and the income for the present year is approximately $185,000. The National Museum requires buildings which will give at least 300,000 square feet of increased accommodation at once, which with the present museum space, which could be devoted to the Department of Anthropology, would make in all 400,000 square feet. With suitable buildings provided, the immediate development of the National Museum into one of the great museums of the world may be looked for.

HOW RUSSIA CORNERS SUGAR.

In an interesting article on this subject a writer in a recent Fortnightly Review says that each year the Minister of Finance fixes the amount of sugar which shall be produced in the empire and sets the price at which it shall be sold. The average domestic consumption is about 1,000,000,000 pounds. This is announced as the legal limit of production which shall be put upon the market during the year. In addition to this, it is allowed to manufacture 180,000,000 pounds more, which is placed in storage. The 1,000,000,000 pounds, as it is sold, pays an excise tax of 2½ cents a pound. If at any time through increased demand sugar becomes worth more than the price fixed by the government, the 180,000,000 pounds in reserve are allowed to reach the market free of excise duty. If this does not supply the market at the legal price, the government itself will buy from foreign countries enough sugar to supply the need for a bear influence upon the price. This has been done by Russia twice during the past ten years. This system, of course, precludes any export business in sugar, but the Russian government does not believe that the exporting of sugar from Russia can be made profitable or advisable, so it does not encourage it.