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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-