

of the fender chain machinery rooms; the machinery for actuating the fender chains, at all upper and lower guard gates, and at the intermediate and safety gates in Pedro Miguel Lock and upper chambers of Gatun and Miraflores Locks; the tracks and conductors for the towing locomotives; and the posts for the illumination of the locks.

Ancillary to the foregoing is an elaborate system of electrical generation and transmission to the transformer rooms in the lock walls, from which power is distributed to the various motors, and the interior and exterior lights. The opening motors number 334 at Gatun Locks, 206 at Pedro Miguel, and 252 at Miraflores; and at each set of locks their operation will be managed from a central control house.

All of this work, as well as the installation of operating machinery in the spillways for Gatun and Miraflores Lakes, controlling 22 "Stoney" gates, each 47 feet long by 19 feet high, has been carried on by the erection subdivision of the First Division of the Office of the Chief Engineer.

### SANITARY SURVEY OF RIVERS.

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**A** BULLETIN of the Illinois State Laboratory of Natural History, published last June, comprises an article by Mr. Stephen A. Forbes, Ph.D. LL.D., and Mr. R. E. Richardson, A.M., which is a compilation of scientific information on the biological and chemical analyses of the Illinois River. It is well known that Chicago constructed a huge drainage canal at a cost of \$50,000,000, including power-plant, to dispose of its sewage by dilution. This sewage discharges into the river near Lockport.

The article is comprehensive, covering over one hundred pages, and the reader who desires details that are not contained in the following review is advised to obtain a copy of the bulletin. As much attention is now being paid to the purification of rivers, the writer has deemed it of interest, and perhaps of service, to review the work done by the authors of the article, which is largely referred to, in the following paragraphs, by extracts and references:—

"The Illinois River is peculiarly characteristic of the State of Illinois, and, next to the prairies, is its leading natural feature. The level richness of the central plateau of the State is reflected in the turbid waters and the broad, sluggish current of the stream; and its wide bottom-lands, originally covered with huge trees, completely flooded when the river is highest, and holding many marshes and shallow lakes at its lowest stages, are a relic of the time, not so very far remote, when the limpid waters of the Great Lakes rolled down its valley in a mighty flood on their course to the southern gulf. It was not an accident that this river was the first great artery of transportation into and through the State, or that the first colonial settlement and the first fortified post in Illinois were established on its banks. After the railroads had deprived it of its commerce it was discredited and neglected for many years, and the second city in the country and the second city in the State have long used it as a mere convenience for the discharge of their organic wastes.

"These are temporary conditions, however, and the time seems now at hand when the people of Illinois will

learn to appreciate and develop this great gift of nature in the various directions in which it may be made to serve their interests and their pleasures. Its frequently beautiful and occasionally picturesque scenery is attracting more attention every year; and when, as is sure to happen in due time, a superior highway follows its course between Chicago and St. Louis; when the attractive building sites on its banks are relieved, as they now might generally be, from the midsummer plague of mosquitoes; when its most interesting situations are converted into parks, and its fisheries are protected and enriched by means of State reservations for the breeding and feeding of fishes; and when, as must eventually come to pass, it becomes once more an indispensable central link in a principal line of traffic between the Great Lakes and the Gulf, it will take for all time, for the State at large, the place which Lake Michigan now holds for our greatest city.

"The senior author of this work began work as a biologist, on Illinois River problems, some thirty-six years ago; and the junior author has virtually lived on the river for purposes of investigation during the last four years. The Natural History Survey of the States has published in the meantime more than 2,500 pages of contributions to its biology; and it is now rounding this work to a close, and bringing its results to bear, in practical ways, upon the economic problems most pressing and important at the present time.

"**Objects of the Investigation.**—The Illinois River work of the Natural History Survey, pursued at irregular intervals since 1877, became virtually continuous at Havana for five years, from April, 1894, to March, 1899, after which it seemed expedient first to diminish, and in 1903 to suspend, field operations in order that more important scientific results might be organized, reported, and published.

"The opening of the Chicago Drainage Canal in 1900 was a revolutionary event in the biological history of the river; and, as the most important period of our earlier work was that immediately preceding this event, an examination of its consequences to the general system of aquatic plant and animal life was an important part of our object in recommencing systematic study. As the Illinois is a rather peculiar member of the great Mississippi River system, it was also much to be desired that comparative studies should be made on the life of the more closely related companion streams; and, as the Illinois is economically one of the most productive rivers in the United States, it was evidently time to study the subject of the conservation and possible increase of its values in the light of the knowledge we had gained, and intended to gain, of its physical, chemical and biological conditions and requirements.

"The reports of the work of the earlier period were largely on the minute plant and animal life of the stream—its so-called plankton—which forms a considerable part of the food of many kinds of fishes, and nearly all the food of the young of almost every kind; and the plankton product of the waters of the Illinois under the new conditions, as compared with those prevailing before the opening of the sanitary canal, was one of the first topics to commend itself to us for careful study. Involved in this subject of food production for fishes, river mussels, and other useful aquatic animals, was the economic effect of a great increase in the flow of the stream, the rise in its levels, and the consequent expansion and longer continuance of its overflows, which, there was reason to suppose, might so increase the food supply and enlarge the breeding and feeding grounds of fishes as to increase the fisheries products of the stream. It was also a matter