THE NILE IRRIGATION WORKS.

One of the most beneficial effects of the English occupation of Egypt has been the attempt to restore the country to something approaching its former fruitfulness. Egypt is the Nile, and the Nile is Egypt. For several centuries this country, which during the reign of the Pharaohs was the most prosperous in the world, has remained over the greater part of its area a desert waste. When at the zenith of its power, the country was intersected in all directions with canals which irrigated the land; but in course of time the canals were filled up with the drifting sand from the desert and the country was abandoned.

The river Nile during its progress through lower Egypt gathers a vast quantity of rich sediment, which hitherto has been allowed to flow into the Mediterranean. It is estimated that billions of tons of this silt are thus wasted every year. The value of this alluvial soil alone may be estimated from the richness of the country at the Nile Delta. When Egypt was in the height of its prosperity, the Nile waters and silt were distributed over the desert, converting the sandy wastes into fertile fields.

The British government is endeavoring to resuscitate the country by storing the flood waters of the Nile and irrigating, once more, the desert lands. By this means Egypt will not only be in a position to produce sufficient cereals, cotton, etc., for her own exigencies, but will be able to supply the various markets of the world, since it will be possible to produce three crops in one season.

This conversion is being attained by the construction of large dams at different points on the river. Already two of these enormous structures are practically completed—one at Assouan and the other at Assiut. The idea is by no means modern, since a similar scheme was projected several years ago, and a tentative effort to realize it was made by some French engineers, by the construction of a dam near Cairo. This latter achievement, however, owing to the lack of care displayed in the erection of the barrier, and its instability, was practically a failure, and would have collapsed, flooding miles of the country, had it not been for the timely appearance of British engineers, who succeeded in strengthening the structure.

Egypt, however, although desperately requiring such a scheme to restore her country, owing to the lack of funds in the imperial exchequer would never have been in a position to have carried it out herself. The execution of the scheme originated with a syndicate of gentlemen in London, who propounded the idea to Sir Benjamin Baker, the well-known civil engineer, and Sir John Aird, the head of a large firm of contractors. The syndicate then approached Mr. Ernest Cassel, the well-known London financier, and he, together with Sir John Aird and Sir Benjamin Baker, hurried to Egypt, and laid their plans before the Egyptian government. After a short consultation the government approved the scheme and awarded the contract.

Surveys were then made of the river, to select the best spots at which to erect the dams. The river had previously been thoroughly surveyed by Major Willcocks, a well-known authority upon irrigation, so that the engineers were enabled to profit by the results of his work. Finally Assouan and Assiut were decided upon. Work was immediately commenced and has been continued day and night ever since. It was imperative that the work should be hurried forward with all possible speed, since when the Nile rose labor had to be stopped for several weeks, owing to the works being submerged.

The river at Assouan is over a mile in width, so that a fair estimate of the magnitude of the task may be made. The dam consists of a huge wall of granite, 60 feet in width at the top, 90 feet above low water, and a mile and a quarter in length, stretching across the river, from bank to bank. A roadway is to be constructed upon the top of the dam, which will afford a means of communication between both banks of the river. The dam is pierced by 180 huge steel sluices.

The erection of this barrier will impound over 1,000,000,000 tons of water, forming a lake which will extend up the valley of the Nile. When the sluice doors are opened while the Nile is at high water, something like 900,000 tons of water will rush through them every minute.

One effect of the construction of this dam will be the partial submersion of the historic temples of Philæ. When the scheme was originally projected, these ruins were to be entirely submerged, but an influential body of Egyptologists, headed by the late president of the British Academy, were successful in obtaining their partial preservation, so that now the ruins themselves will still be visible above high water.

The stone with which the dam has been built has been obtained from the same quarries which furnished the stone for the temples of Philæ and Cleopatra's Needle. Indeed, many of the granite blocks that have been excavated bear the marks of the Egyptian wedges that were utilized over thirty centuries ago. The work is being carried out under the supervision of English engineers, and some 25,000 natives are engaged upon the task, working in day and night shifts of 12,500 men each. During the night the work is carried on under electric light. The laborers receive about a dollar a week for their labor, together with board accommodations, which, although it may appear a ridiculously small wage, is yet about twice as much as is generally paid.

According to the terms of the contract no money is to be paid by the Egyptian government to the contractors until the task is completed. It is estimated that the undertaking will cost $25,000,000, and the settlement of the bill is to be spread over thirty years. The completion of the scheme will add 2,500 square miles to the crop-bearing area of Egypt, which, it is estimated, will be worth $400,000,000 to the country.

THE HEAVENS IN MAY.

BY HENRY NORRIS RUSSELL, PH.D.

The season of eclipses has once more come round, and two of them occur in the present month, being its most remarkable astronomical events.

The first is of little account, being indeed termed not a lunar eclipse, but a lunar appulse, for the reason that the moon does not pass into the earth's shadow at all, though it grazes it closely, and its nothern limb is considerably dimmed by the penumbra of the shadow. It takes place on the third and is invisible in America, but may be seen in Europe.

The second—the total solar eclipse of May 17—is a very notable one, and would doubtless be the most important one for many years, were it not for the unfortunate situation of the shadow-track, which crosses land for only a small fraction of its length, and that in rather inaccessible situations. Beginning in the Indian Ocean near the South African coast, it touches the southern end of Madagascar, passes over Mauritius, and after crossing several thousand miles of sea, falls on Sumatra and Borneo, crossing them almost exactly on the line of the equator, and moves eastward over Celebes, the Spice Islands and New Guinea, into the Pacific, where it leaves the earth.

The most favorable situations from which to observe the eclipse are on the coast of Sumatra, but unfortunately the weather conditions are bad, the chances being somewhat against clear skies at noon at this season—a poor showing compared with the ratio of six clear days to one bad one which held good for some American stations a year ago.

But the most remarkable feature of this eclipse, and the one which will cause astronomers to travel half way round the globe to see it, is its extraordinary long duration. While last year's eclipse, and the Indian eclipse of 1898, lasted at most about two minutes, the duration of totality on the present occasion is at maximum no less than 6 minutes and 26 seconds, which is longer than any that has ever been observed with modern instruments. This will add little to the importance of the phenomenon in the study of the lower layers of the sun's atmosphere, but will be of immense value for investigation of the corona, and also in the hunt for possible intra-Mercurial planets, since it enables photographic exposures of much greater length than usual to be made.

Since Americans who stay at home cannot see the eclipse, its interest for them must be chiefly theoretical; and in this connection, the question presents itself at once, "Why should this eclipse last so much longer than usual?" The principal reason is the moon's greater nearness to the earth, as we shall proceed to study in detail.

The orbit of the moon, like those of many other heavenly bodies, is decidedly eccentric, so that her distance from the earth varies by about 7 per cent on each side of the average value. Her apparent diameter is of course subject to corresponding variations, being greatest when she is nearest us. On the average it is 31′ 7″, but it may appear as great as 33′ 32″ or as small as 29′ 28″. The sun's apparent diameter is subject to similar changes due to the eccentricity of the earth's orbit about him. Its mean value is 32′ 4″, its greatest 32′ 36″ and its least 31′ 32″.

A clear understanding of the character of the different kinds of solar eclipses follows easily from the consideration of these figures. Suppose the observer to be so situated that the center of the moon appears exactly in front of that of the sun. If the moon is at her nearest she will appear larger in diameter than the sun, and will hide him completely, producing a total eclipse, while if she is at her farthest she will seem smaller than he does, so that a bright ring of uneclipsed sun will appear all round her, forming an annular eclipse. Since the average diameter of the moon is less than that of the sun, annular eclipses will evidently be more frequent in the long run than total ones.

The diameters of the sun and moon given above are those of these bodies as seen from the earth's center. But as a matter of fact they are observed from its surface, which must introduce certain modifications into our reasoning. If the observer is directly under the body he is 4,000 miles nearer it than he would be if at the earth's center, or if on any part of the earth where the body is just rising or setting. This makes no perceptible difference in the apparent size of the sun, since 4,000 miles is less than 1/20,000 part of his distance. But the case is not the same with the moon. When she is nearest she is but 220,000 miles away, and 4,000 miles is 1/55 part of this. Since she is 1/55 part nearer to the observer than to the earth's center she must look 1/55 part larger.

Referring to the above figures we find that her diameter will be increased by 36″, becoming 34′ 8″ as against 33′ 32″ as seen from the earth's center.

This augmentation of the moon's diameter increases the duration of a total eclipse, since the moon appears larger and extends farther beyond the sun's limb. It decreases the length of annular eclipses, because, since the moon seems larger, the width of the projecting rim of the sun is less. Its most remarkable result, however, is that the same eclipse may be total in one part of the earth and annular in another. Suppose, for example, that an eclipse occurs when the sun's diameter is 32′ 4″ and the moon's, as seen from the earth's center, is 31′ 50″. To an observer so situated that the moon is rising or setting, its apparent diameter will have this same value; and since the sun's is greater, he will see an annular eclipse, provided, of course, he is in the line of central eclipse. If, on the other hand, another observer, still on the line of central eclipse, has the sun—and moon—in his zenith, the moon will appear larger to him by 36″ than to the first observer, on account of the augmentation, and will have an apparent diameter of 32′ 26″, which is 22″ bigger than that of the sun, so that the eclipse for him will be total. On the 17th the sun's apparent diameter is 31′ 37″ and the moon's 33′12″. While the first is not quite at its minimum nor the second at its maximum this is much more nearly the case than usual, and to this circumstance the unusually long duration of totality is due.

THE HEAVENS.

We have nearly lost the winter constellations by this time. Only Auriga, the Twins and the lesser Dog-star remain, and they are so low in the west that we cannot hope to see them much longer.

Cassiopeia swings low beneath the pole, while the Great Bear is far up in the zenith above us. Draco is coming up on the eastward, almost surrounding the Little Bear with his starry coils. Cygnus is rising in the northeast, and Lyra is well up. Ophiuchus and Serpens occupy the eastern horizon, and Hercules, Corona, and Boötes extend upward nearly to the zenith, with the brilliant and ruddy Arcturus near the highest point. Of the zodiacal constellations, Leo and Virgo are conspicuous in the southwest and south. Cancer and Libra are visible on either side and Scorpio is rising in the southeast. Hydra occupies the lower southwestern sky, and low in the southeast and south are some moderately bright stars, which are all that we can ever see of the brilliant southern constellation Centaurus.

THE PLANETS.

Mercury is morning star till the 14th, when he passes behind the sun and becomes an evening star again. He can only be seen during the last few days of the month, when he sets nearly one and one-half hours later than the sun. At the time of the eclipse he will be visible close to the sun on the east, in a position singularly like that in which he was so conspicuous last May, but on the opposite side of the sun. Venus will be very close indeed to him. She is now an evening star, but will not be clearly visible in the twilight till the latter part of May. Mars is evening star, moving slowly eastward through Leo. He is in quadrature on the 28th, southing at 6 P.M. Jupiter rises about 1 A.M., Saturn about 1.15, and Uranus at about 11 P.M. in the middle of the month. The last named is in Scorpio, the other two in Sagittarius. Neptune is evening star in Taurus.

THE MOON.

Full moon occurs at the time of the lunar appulse on the afternoon of the 3d, last quarter on the forenoon of the 11th, new moon during the solar eclipse of the 17th, and so about midnight of our time, and first quarter at midnight on the 24th.

The moon is farthest from the earth on the 2d and again on the 29th, and is nearest early in the morning of the 17th, less than a day before the great eclipse. She is in conjunction with Uranus on the morning of the 6th, with Jupiter and Saturn on the afternoon of the 8th, with Mercury and Venus on the 17th, within a few minutes of each other and three hours after the eclipse, with Neptune on the morning of the 20th and with Mars on that of the 25th.

Armored Cruiser Discussion.

We are in receipt of another lengthy communication on the subject of our new armored cruisers, which will be found in the current issue of the SUPPLEMENT. Hereafter all correspondence on this subject will be transferred to the last-named publication.—Ed.

SCIENTIFIC AMERICAN

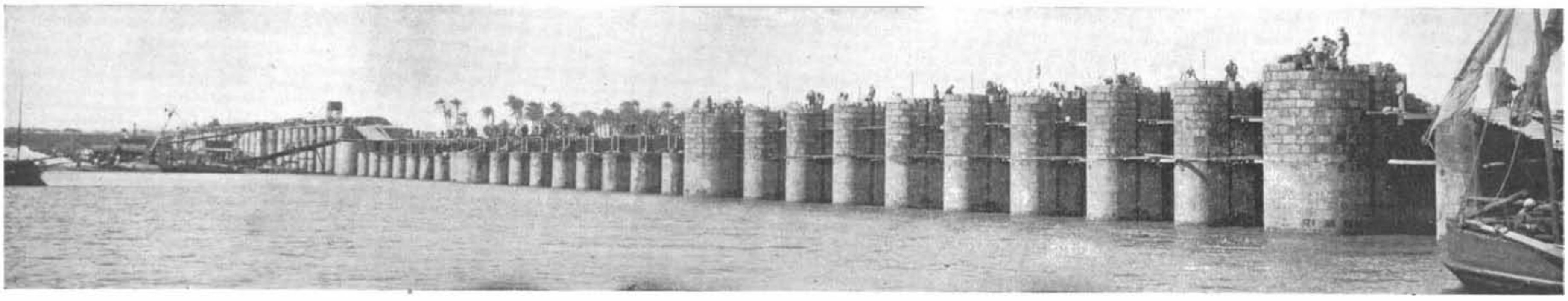
[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1901, by Munn & Co.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

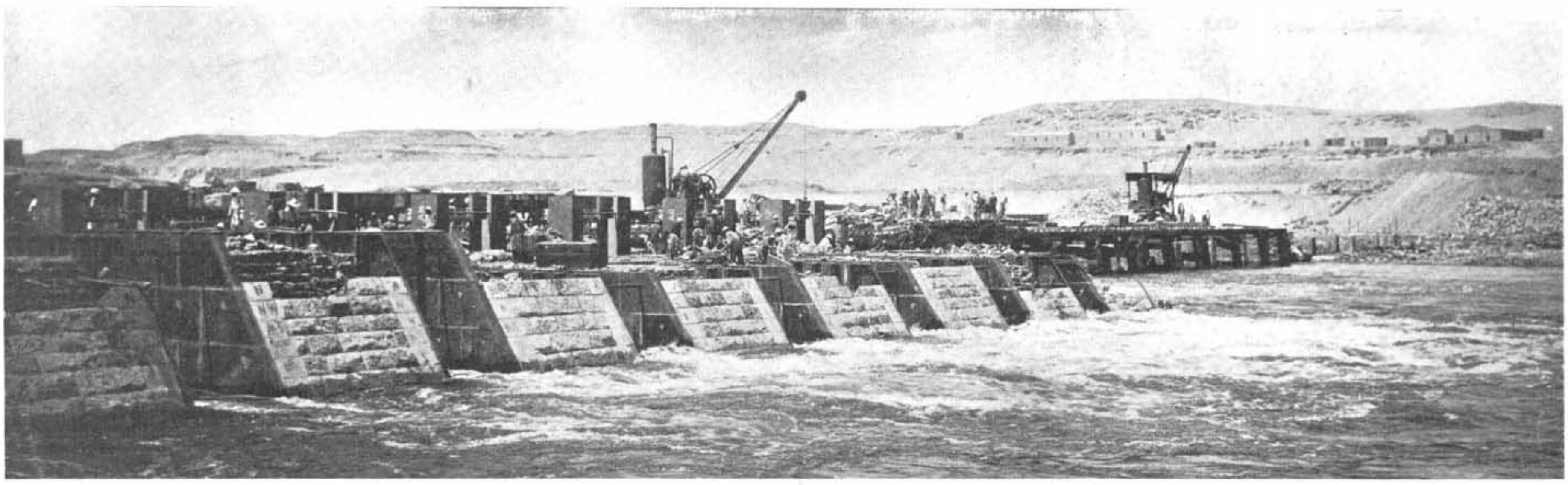
Vol. LXXXIV.—No. 18.
ESTABLISHED 1845.

NEW YORK, MAY 4, 1901.

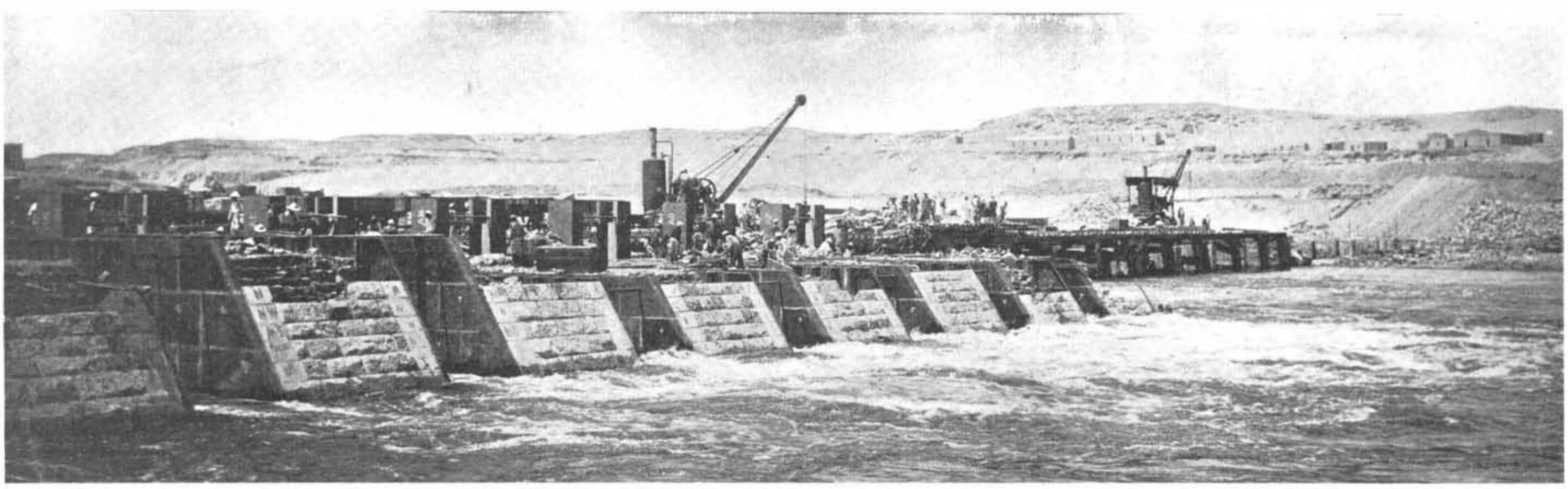
$3.00 A YEAR.
8 CENTS A COPY.



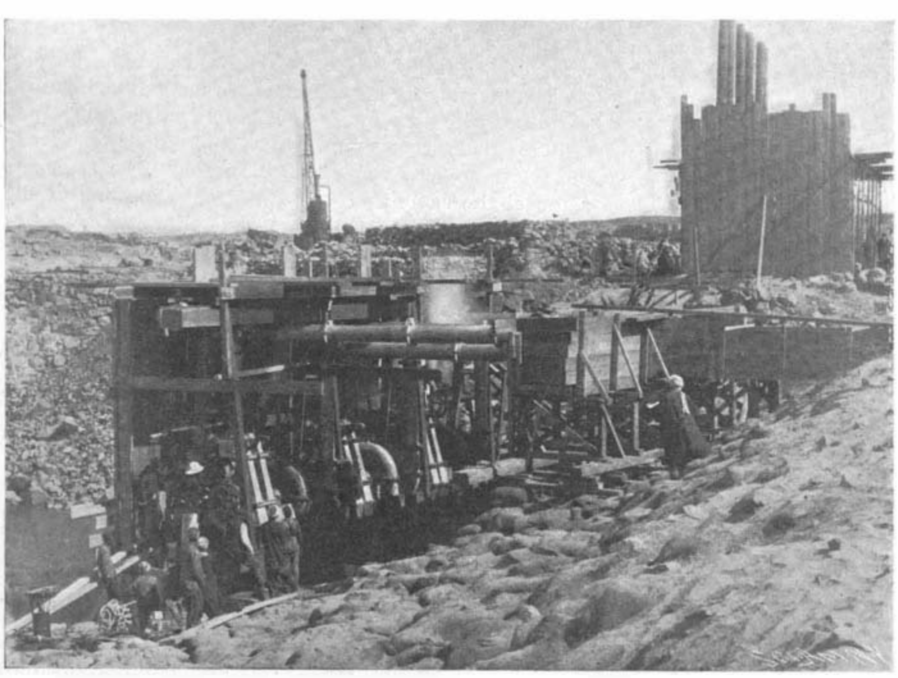
Nile Reservoir Works, Assiut—Upstream Side of Piers, Looking West.



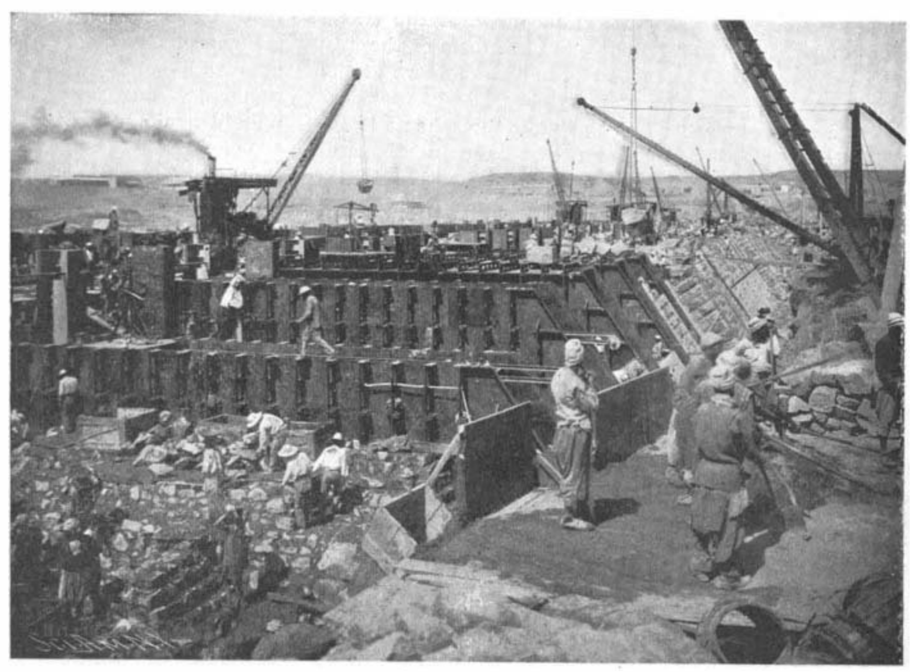
Assouan Dam—Water Rushing Through Central Sluices.



Work at the West Bank, Assiut.



Centrifugal Pumps at the Foundation Excavations.



Composite Metal and Masonry Construction, Assouan.

CONSTRUCTION OF THE GREAT NILE RESERVOIR.—[See page 279.]