THE GREAT CHICAGO CANAL.

The headwaters of the Des Plaines River lie in Wisconsin near Lake Michigan. The river runs to the south approximately parallel with the western shore of the lake, and, after it has reached the parallel of Chicago, trends to the southwest, and passing through Joliet, joins its waters with those of the Kankakee River, forming the Illinois River. The combined waters run through the channel of the Illinois River to the Mississippi, emptying into it a short distance above the mouth of the Missouri River. Through the city of Chicago winds the small stream called the Chicago River, a devious creek with several branches. This enters into the lake. A distance of a little over ten miles intervenes between the lake shore and the Des Plaines River at Chicago, while between the Chicago River and Des Plaines River but two miles intervenes. At present much of the sewage of Chicago runs into the lake, threatening with contamination the water supply of the city, notwithstanding the fact that the intake of the water works is situated some miles out in the lake. Largely to avoid this contamination, the great drainage works which we describe and illustrate have been undertaken.

It will be seen that at Chicago there is a true divide, the waters on the east pouring into Lake Michigan, and on the west reaching the Gulf of Mexico, through the channels of the Des Plaines, Illinois and Mississippi Rivers. Should the divide be pierced, the waters of Lake Michigan would run into the Gulf of Mexico as well as into the Gulf of St. Lawrence, and an internal waterway from the British Provinces through the St. Lawrence and the great lakes to the Gulf of Mexico would be created. At present work is being done on this connection, and if all goes well by 1896, the city of Chicago will have internal water communications with the Gulf of Mexico—communication to be utilized for the tranportation of freight, as well as for the disposal of her sewage.

While the operation of merely effecting water communication between the Des Plaines River and the lake by the Chicago River would be comparatively a small affair, the necessities of the case are such as to involve very extensive work and the excavation of one of the great canals of the world. The Des Plaines River in some seasons runs almost dry, so that its entire flow could pass through a six inch pipe; at other times what is described as a majestic flow of water, flooding the whole of its valley and passing through it at the rate of 800,000 cubic feet per minute. In order to secure the construction of a canal through the valley of Des Plaines River, a new channel in places has been made for the river at an outlay of nearly $1,000,000. This alone involved the excavation of 13 miles of new river channel, parallel with the main drainage channel, and 19 miles of levee had to be used to keep the water of the Des Plaines watershed out of the canal. The latter has to be restricted as far as possible to the one function, the conveying of sewage of Chicago, diluted more or less with the waters of Lake Michigan, to the lower Des Plaines River, near Joliet.

The levels of the canal are referred to as what is known as the Chicago Datum, 579·61 feet above the sea level of Sandy Hook, N. J. The bottom of the canal begins 25 feet below this level, and running on a down grade, follows the Des Plaines Valley to Joliet, where it is to join the main river. From the mouth of the Chicago River to Joliet is a distance of 35 miles. This involves considerable excavation, reaching in places a depth of nearly fifty feet. The present aspect of the works is quite impressive. At places in the rock the excavation is practically completed, while elsewhere operations in earth, peat, and rock are actively in progress. The general course of the canal is slightly sinuous, and the parts under contract between Lockport and Chicago are divided into 29 sections, each section approximately one mile in length. The grade to be followed is so steep—about forty-two feet in four miles, at the steepest part—that a very strong current would be established. For reducing the flow, accordingly, controlling works are to be introduced at the western end for keeping back the flow. As it is proposed to use the canal for barges, some of which will be 500 or 1,000 tons capacity, provision will be made for passing around the dams by means of locks.

The great freshets to which the Des Plaines River is exposed brings out the question of supplying an adequate outlet for water. Accordingly, a spillway is provided at the head of the river works proper, or "river diversion," as it is called, which are to be so proportioned that when the flow exceeds 300,000 cubic feet per minute, the excess will flow over the spillway and toward Chicago, finally going into the lake.

The river diversion channel on the bottom is 200 feet wide; side slopes, 1½ to 1. Its general grade is 0·12 per 1,000 feet. The canal proper varies in width, its maximum section providing for a total flow of 600,000 cubic feet per minute, enough for the sewage of a population of 3,000,000. This is the legal capacity of the canal. In softer ground, however, where dredging at any time will be applicable, the channel is reduced to about one-half this capacity. The idea is that, as the population increases, the narrow portions can be dredged out.

The portion of the canal now being constructed is in the hands of numerous contractors, and for executing the work these contractors have selected their own plant, and the consequence is that the most varied class of machinery is employed on the works. Our illustrations give examples of the more striking and original types. Fig. 1 shows the direct application of horse power for excavation in the New Era grader. This great machine, drawn by its team of eight draught animals, cuts away the soil and delivers it one side to a spout by belt conveyor. At the end of the spout team after team draws its wagon to receive the spoil, the work going on practically without break. It has been applied for removing the upper seven feet of earth on some sections.

Fig. 2 shows one of the high power derricks, whose operations are obvious. With its long booms and rotary movement it transports the material from the center of the canal to the banks, perpetually turning about on its own axis. These have not proved as economical as anticipated.

Hydraulic dredging has its exponent in the Bates hydraulic dredge, shown in Fig. 3. used for cutting away peat and similar materials. From the booms in front of the dredge is suspended what may be called a giant milling machine—a wheel with blades rotating on a horizontal axis and cutting through the turf to right and left as the dredge is moved and fed to its work. From the vicinity of the cutting wheel a pipe runs to the dredge, connected to a rotary pump, by which the material is pumped through the long pipe seen running astern floated on pontoons, and which may deliver the soil 3,000 or more feet away. These dredges average a rate of 100,000 cubic yards per month, which, as it includes delivery as well as removal, is a most remarkable result.

Fig. 4 shows one of the most striking machines and an impressive view of the work. Here are shown two of the giant Brown cantilever machines, working in a rock section. The sides, nearly vertical, have been cut in the solid rock by a channeling machine of which 57 have been employed at one time on the canal. On the bank the cantilevers travel on rails. The sloping trusses provide an inclined track for carrying up the loaded buckets and delivering their contents far up on the bank. The great trusses are 342 feet long and each machine disposes of 600 cubic yards per day, principally of rock blasted out by dynamite. One of these machines can deliver material from the far side of the canal over a mountain of debris 90 feet high. They are considered to represent the highest degree of efficiency.

Fig. 5 shows work on a rock section executed by cable conveyors. From trestle work abutments moving on tracks, cables are carried clear across the cut and are used for conveying the material to the side. As improved since their introduction, they compare with the cantilevers. Their original cost is about one-half that of the cantilevers. In the background of this cut can be seen the channeling machine at work, to whose operations are due the great regularity of the side walls. These views present some of the principal machines used, but cannot give an idea of the grand scale of the operations. The fact that seven tons of dynamite are used in a day in the removal of 14,000 cubic yards of rock gives an idea of the unprecedented magnitude of the operations.

The cross section of the canal varies. In rock a uniform width of 162 feet to a depth of 22 feet is provided for; in earth a width of 202 feet at the bottom is provided for, of the same depth. This gives a larger cross section of prism than that of any canal in existence. The nearest approach to it among existing canals is the North Sea Canal, and of canals in existence or proposed the Nicaragua Canal comes the closest.

The work is under the charge of the Trustees of the Sanitary District of Chicago. The State of Illinois, by statute passed in 1889, provided for the incorporation of sanitary districts. The sanitary district of Chicago applies to all the city north of Eighty-seventh Street together with some 43 square miles of Cook County. A population of about 1,400,000 inhabits the district. The trustees are elected by popular vote and are quite distinct from the municipal government of Chicago. They have the right to collect taxes to definite amounts stated in the law, and they can also issue bonds for the prosecution of their work.

The estimated cost for the work is $21,799,293.82. Operations began on September 3, 1892. November 1, 1896, is set as the probable date of completion of the entire work. The cutting represents two-thirds of the cost of creating a channel from Chicago to the Mississippi. Federal work on the Illinois and Mississippi Rivers is needed to complete the waterway from Chicago to the Gulf of Mexico.

TWENTY-FIVE miles of the Congo Railroad, forming the first section between Matangé and Kengé, are now completed. The work has cost $100,000 a mile. The line will be 93 miles long in all, and will connect the immense waterways above Stanley Falls with the sea.

The Golden Number and its Use—the Approximate New Moon for Two Centuries.

The golden numbers of a year are the numbers for any year in the metonic cycle of 19 years, on which the new moon falls upon the same day of the year as it did in the same year of the last or previous cycles.

The metonic cycle had a Greek origin, and was made to commence with the year in which the new moon falls on the 1st of January; and as this happened in the year preceding the commencement of the Christian era, hence to find the golden number for any year, add 1 to the date and divide by 19. The quotient is the number of cycles elapsed, and the remainder is the year of the cycle, or the golden number. Should there be no remainder, the year will be the last of the cycle, for which 19 is the golden number.

By tabulating the golden numbers to correspond with the months and days for one cycle, they will correspond with the numbers for any cycle for one or two centuries in which there is no leap year at the beginning of a century, and will be reliable to the fraction of a day, which may, in a few cases, make the tabulated date have an apparent variation of one day, but mostly with an error not exceeding 12 hours.

In the following table the golden number, as in the computation above stated, will be found in the column of the months opposite to the day of the month, and by tracing the golden number for the year through the monthly columns, the days of new moon throughout the year will be shown approximately within the fraction of a day. For example, for

1895: $1895 + 1 = \frac{1896}{19} = 99$ cycles and 15 remainder,

which is the golden number.

In the table this falls on January 25, and tracing the number through the months, February 23, March 24, and consecutively one day later through the following months of the year.

TABLE OF APPROXIMATE NEW MOONS FROM 1801 TO 1999.

Day of month.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	9		9	17	17	6				11		19
2		17			6	14	14	3	11		19	
3	17	6	17	6			3	11		19	8	8
4	6		6	14	14	3			19	8		16
5		14			3	11	11	19	8		16	
6	14	3	14	3			19			16	5	5
7	3		3	11	11	19		8	16			13
8		11			19	8	8	16	5	5	13	
9	11	19	11	19						13		2
10			19	8	8	16	16	5	13		2	10
11	19	8					5	13	2	2	10	
12	8	16	8	16	16	5				10		18
13					5	13	13	2	10		18	7
14	16	5	16	5			2	10	18	18	7	
15	5		5	13	13	2				7		15
16		13			2	10	10	18	7		15	
17	13	2	13	2			18	7		15	4	4
18	2		2	10	10	18			15			12
19		10			18	7	7	15	4	4	12	
20	10	18	10	18			15			12	1	1
21	18		18	7	7	15		4	12			9
22		7			15	4	4	12	1	1	9	
23	7	15	7	15			12			9	17	17
24			15	4	4	12		1	9			6
25	15	4			12		1	9	17	17	6	
26	4		4	12		1				6		14
27		12		1	1	9	9	17	6		14	
28	12		12		9		17	6	14	14	3	3
29	1		1	9		17				3		11
30		×			17	6	6	14	3		11	
31	9	×	9	×		×	14	3	×	11	×	19

Historical and Traditional Accounts of the Fall of Aerolites.

Every country and every age has its historical, semi-historical, or traditional stories concerning immense stones falling from the sky, or more properly, from space. Levi tells of a whole shower of aerolites which fell on the mountains near Rome in the year 654 B. C.

The Arundel marbles (marble tables giving the events of the Grecian history from 1582 B. C. to 624 B. C. in chronological order) give an account of a great stone which "fell down from heaven" at Ægospotami about the year 467 B. C. Pliny, who died in the year 79 A. D., says that in his time the "great air stone" mentioned in the foregoing was still to be seen on the Hellespont, "and," he quaintly adds, "it is even now of the bigness of a wagon."

Since the opening of the present century there have been several well attested instances of falls of stone from the regions of space. In the year 1803 a perfect shower of litho missiles fell in the farming country adjacent to L'Aigle, France, upward of 3,000 separate stones falling upon a wedge-shaped section of country eight miles long by about four miles wide.

Aerolites, or "meteorites" as they are sometimes called, usually fall singly, sometimes in pairs, and less frequently in showers, as was the case at New Concordia, O., in 1860, when nearly 200 red-hot stones fell in a field in broad daylight.

Up to January 1, 1894, there had been between 300 and 350 instances recorded of stones falling from the unknown regions outside of our atmosphere, and in eight of these the fall was in the shape of "showers," three individual missiles numbering from 10 to 5,000 and of all sizes, from that of an orange to immense blocks of strange combinations of minerals weighing hundreds of tons.—Baltimore Herald.

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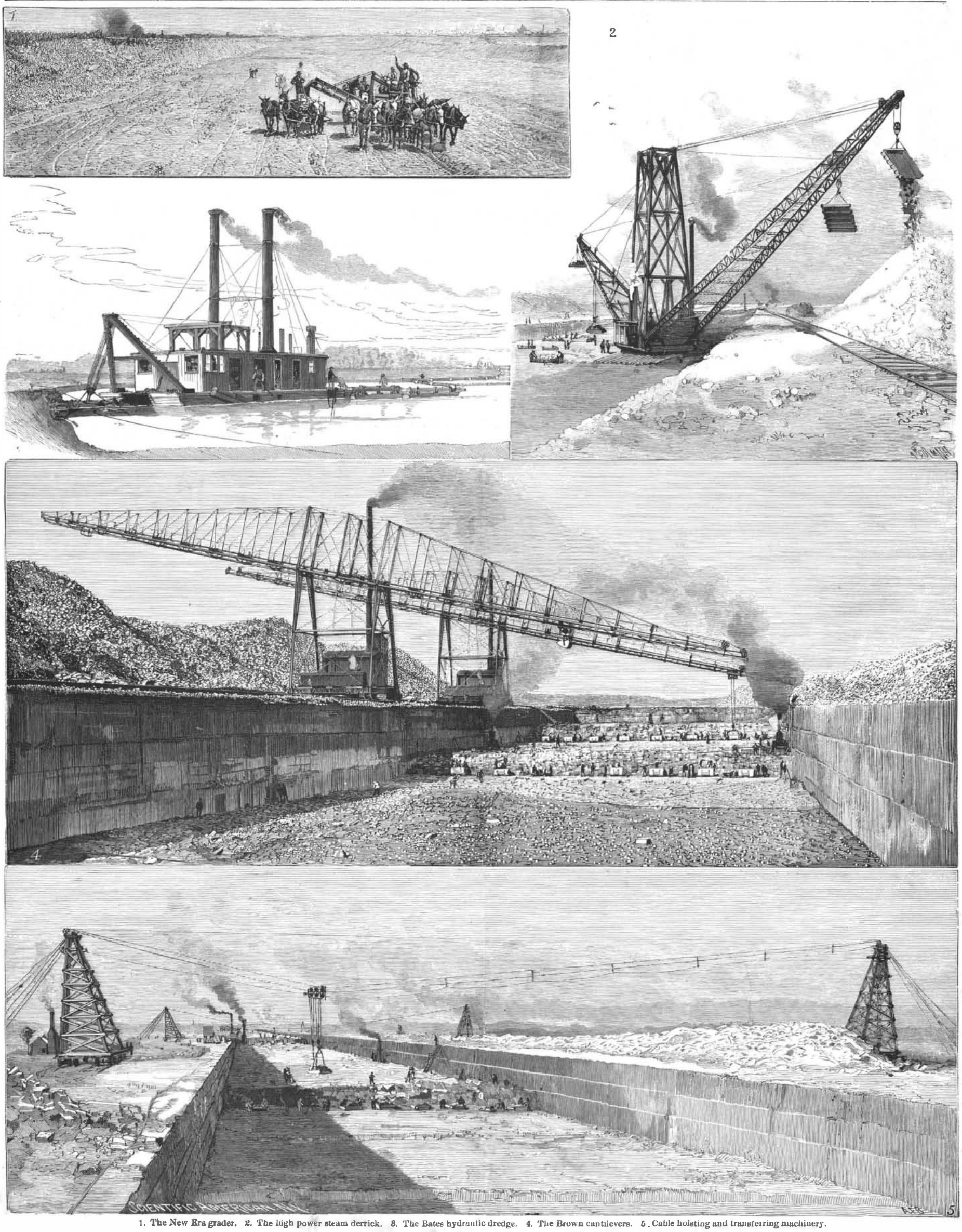

1. The New Era grader. 2. The high power steam derrick. 3. The Bates hydraulic dredge. 4. The Brown cantilevers. 5. Cable hoisting and transferring machinery.

THE GREAT CHICAGO CANAL.—[See page 247.]