forcement of a code of ethics among all engineers entitled to rank as such. United action on the part of engineering societies in taking up and discussing these subjects should result beneficially to the whole profession, and we should be very glad to see this effort made. We cannot, however, agree with all the statements of our correspondent, and especially deny that the name of engineer is shunned by members of that profession. It is the individual and his professional merit and reputation that command despect; and if the engineer possesses all the requisites he will glory in his professional title, and this title will command the respect due to the bearer of it.—Ed.)

NOTES ON WIND PRESSURE AND SUCTION.

Sir: Mr. O. J. Marstrand, who has communicated to your journal of Feb. 14 an abstract of my experiments on wind pressure, has written me that it would be of interest to have also some later experiments which I have made. I am very well satisfied with Mr. Marstrand's translation of my paper. The more recent experiments have been published in the "'Abstracts of Foreign Papers" of the Institution of Civil Engineers, but some errors occur.

The experiments recorded in Table II., page 110, of

	Total pressure in direction of wind.	Percentage of total pressure. Windward side.	Leeward side.
Ellipsoid with axis parallel to wind, ends sharpened and symmetrical, and length twice the diameter.	0.08 of total pressure on disk, with area equal to cross-section.	7	93
Cube of side S (wind parallel to edge).	0.80 of total pressure on disk, equal to face.	78	22
Cube of side S (wind parallel to diagonal of face).	0.66 of total pressure on disk, equal to face.	45	55
Cylinder of height equal to diameter (wind perpendicular to axis).	0.47 of total pressure on square disk, equal to section through axis.	50	50
Pyramid, square base of side S, height S (wind parallel to side of base).	0.78 of total pressure on disk equal to maximum section perpendicular to wind.	63	37
Pyramid, square base of side S, height S (wind parallel to diagonal of base).	0.55 of total pressure on disk equals the above section.	45	55
Cone, height = diameter of base = S (wind parallel to base).	0.38 of total pressure on disk, equal to maximum section perpendicular to wind.	50	50

the current volume of your journal (Feb. 14) refer to bodies long in proportion to the diameter S. The new experiments refer to bodies short in this proportion. This new table I now send you, and trust that it can be used as an appendix to the article of Feb. 14, 1895.

Yours respectfully, Irminger.

Copenhagen, March 18, 1895.

GIANTS AND GIANTISM IN STEAM SHOVEL WORK.

Sir: After the publication of such an article as that in your issue of March 21 concerning a "special contractor's shovel," with its claims of novelty, there are doubtless many of your readers who would marvel if a rejoinder were not made by some of those who have been manufacturers of steam shovels for many years. One hundred and seventy thousand miles of railway has not been built in the United States without a good many civil engineers acquiring a considerable knowledge of steam-shovel work and what the machines are capable of. Without a more definite description of the material excavated than that given in the article referred to—"indurated clay," "cemented gravel"—these people would see nothing remarkable in such an average as "594 cu. yds." for a 62½-ton machine, unless established in some different way. To say, for example, that this amount is loaded in shale rock without explosives would be to show that the machine is in advance of what they have done with other shovels for years. Unless it is established in some such way, many of them must feel about the "special contractor's shovel" somewhat as Charles L. Dana, M. D., does about "Giants and Giantism" in his paper on that subject in a recent popular magazine. I quote from it as follows:

> The most efficient work can be got from a medium-sized human machine, as physics and physiology show. . . . . It follows from my view of the case that giantism is not a desirable thing, and may be considered even unsanitary and a legitimate object of attack on the part of students of preventive medicine.

Perhaps the outcome will also be the same; Dr. Dana says: "'The giant, I am sure, dies young." If the description given in the article above referred to will enable any comparison to be made, we beg to submit a generous number of figures of the output of our own shovels of ordinary size, weighing 26 tons. Messrs. Ryan & McDonald, who are far from unknown, say they have used them in the "hardest of indurated clay," and also: "But it must be extremely tough hard-pan which will prevent us handling from 16,000 to 18,000 yds. per month."

More exact figures can possibly be obtained by quoting the following letter from J. C. Hutchins, of the L., N. O. & T. Ry. Co., Memphis: "Beginning April 1 and closing Sept. 15, we loaded with it 83,030 cu. yds. of concrete gravel ballast; and the next year, between corresponding dates, 85,589 cu. yds. of the same material." This would give an average on the last figures of 590 cu. yds. per day. "Concrete gravel ballast" may not be similar material to their "indurated clay and cemented gravel"; but, to substantiate these figures, Dowling & Kennedy, contractors on the D., L. & W. R. R. at Buffalo, wrote us that they loaded in "a stiff clay with considerable small boulders that go through bucket, loaded on flat cars, average monthly record a little over 20,000 cu. yds." The Union Cement & Lime Co., Sellersburg, Ind., wrote: "Have been using an Otis shovel 21 years. We use it to strip a very hard yellow clay—so hard that a very sharp pick makes very little impression on it—from 6 to 12 ft. thick, also 2 ft. of soft shale that is under the clay. Our cement rock is under this. We move on an average 500 cu. yds. per day."

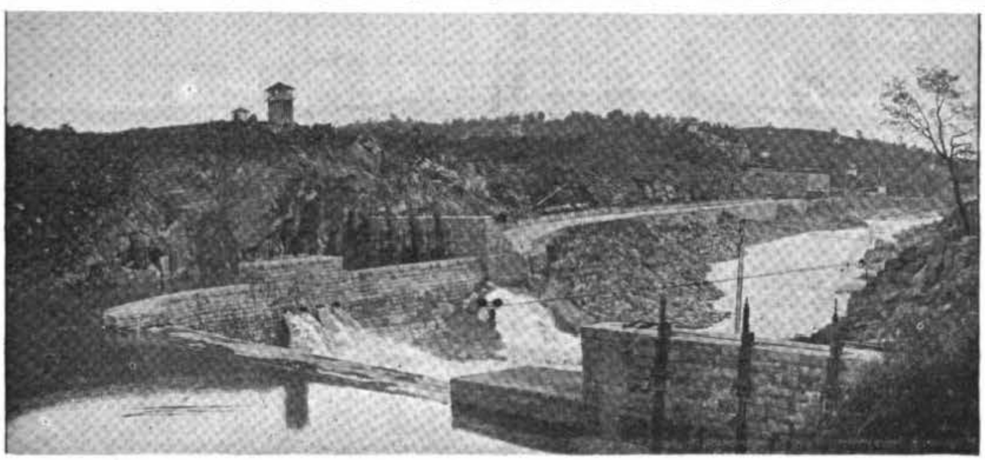
If we may be allowed to encroach on your patience and space a little further, we would like to show what is done in rock work: Chas. McFadden, of Philadelphia, wrote us: "Near Hamburg, Pa., the material was solid rock, requiring the use of steam drills and heavy blasting. The shovel did in that material what I considered admirable work, loading 8,000 to 12,000 yds. per month." Dowling & Kennedy also say: "We have used your machines since 1868, generally in hard digging; some points we note as exceptionally hard. Near Boonton, for D., L. & W. R. R., red sand rock and shale; at Bound Brook, for L. V. R. R., red shale rock; at Factoryville, for D., L. & W. R. R., red clay, with 4 and 5-yd. boulders, and detached ledges of lime rock; Danbury (Rock Hill cut of N. Y. & N. E. R. R.), very bad hard-pan, with boulders up to 5 yds.; near Batavia, for D., L. & W. R. R., blue slate and shale rock, saved and used in masonry. In all these, of course, we used powder, and in some cases high explosives, ahead of the machines." Col. T. H. Rickert, writing from Ovid, N. Y., says: "Have handled as much as 14,000 yds. of solid rock and 10,000 yds. of the hardest kind of hard pan per month of 10 hours per day." J. M. Floesch, Chief Engineer Clearfield & Mahoning Ry. Co.: "Had one of your shovels on our work in a cut 22 to 25 ft. high. The material was from 5 ft. earth, the remainder a shale rock, growing harder as you went to the bottom of the cut. When shook up well with powder, the rock was broken up in small pieces, so dipper picked up same very readily. The shovel took out from 300 to 375 cu. yds. per 10 hours. Capt. John Shields also worked one of your shovels in a 70,000-yd. cut in somewhat harder material, but it was all shale, and not over 6 ins. thick in layers, and was well broken up. It took a large amount of powder to do this, as high as 75 kegs and 200 lbs. dynamite being used for a shot; three holes abreast, 30 ft. back of face. They took out 600 dump-cars per day, working day and night, or about 700 yds. Your shovel will do good work in shale rock when thoroughly broken up."

The Bucyrus machine described weighs 62½ tons. A comparison of figures of the cost of operation would probably show that one of them will easily cost $100 per month more to operate than our ordinary shovel. There are people who have great faith that we could build a machine for the hard digging on the Chicago Canal that would dig something. Respectfully,

Jno. Souther & Co.

Boston, Mass., April 3, 1895.

WATER-POWER DEVELOPMENT WITH ELECTRIC TRANSMISSION, FOLSOM, CAL.



WATER-POWER PLANT AT FOLSOM, CAL. VIEW ABOVE THE DAM LOOKING DOWN THE RIVER.

The high price of coal and the resulting high cost of steam power on the Pacific Coast have given a great stimulus to enterprises involving the development of water-power and its distribution by electricity in that section, and some of these plants are the most notable examples of electric-power transmission in existence. The latest great work of this class on the Pacific Coast is that which has been in progress for many years at Folsom, Cal., and is now nearing completion. The work was begun in 1866, when the foundation of the dam was laid, but little more was done. Some years later the state of California granted the Power company certain water-power privileges and lands, and agreed to supply convict labor in the construction of the dam. The work at first involved merely a dam across the American River, near Folsom, and the utilization of the water for power purposes primarily, and secondly, for irrigating the surrounding country. The development of electricity, however, changed all the plans, and these now embrace the utilization of about 5,000 HP. for transmission purposes and the use of 1,200 HP. in the state prison, located alongside a special state power house.

Under the new contract of 1888, the work upon which is rapidly nearing completion, the dimensions of the dam are as follows: The dam, built of granite, laid in Portland cement, is 650 ft. long, 89 ft. high in the center, 87 ft. wide at the base, 25 ft. wide at the crest, and it contains about 48,590 cu. yds. of masonry. It is provided with a heavy wooden flashboard, 6 ft. high, which can be lowered into an opening in the crest at high stages of water. Normally the dam forms a storage basin 3½ miles long. At each side of the dam is a heavy granite bulkhead, each containing three 16-ft. gates operated by hydraulic machinery.

Two canals will leave the dam, one on each side of the river. The one on the west side, intended mainly for irrigation purposes, is not yet complete; but it is designed to be 40 ft. wide on top, 30 ft. wide on the bottom, and 6 ft. deep. The east side canal is finished to the power house, a distance of about 2 miles. It is 50 ft. wide on top, 40 ft. wide on the bottom and 8 ft. deep, with a capacity of 87,600 cu. ft. of water per minute. This canal follows the river-bank, and is partly in rock cut, partly in masonry and partly in earth cuts and fills. Just before it reaches the power house of the Sacramento Electric Light & Power Co. the canal widens into a large basin for holding the logs of the American River Land & Lumber Co., which is about to erect here a large saw-mill. This mill will be operated entirely by electricity.

At the power house there is an available fall of 55 ft. at high water. The water is led to the power house through a rock cut 60 ft. deep by 100 ft. wide, and 150 ft. long. The canal here turns at right angles and widens into a fore-bay 150 × 100 ft. and 12 ft. deep, divided by a central wall into two distinct sections, to admit of cleaning.

The entire mechanical and electric equipment is being put in by the General Electric Co., and the S. Morgan Smith Water-Wheel Co. will put in the hydraulic apparatus. This latter will consist of four pairs of McCormick horizontal-shaft turbine wheels, enclosed in steel cases, with 8-ft. steel inlet pipes, and double discharge tubes. Each pair of wheels will have a capacity of 1,260 HP. at 300 revolutions per minute operating under a head of 55 ft. After passing the turbines the water will be used for irrigating purposes.

The four generators will be of the three-phase alternating current type, furnishing current at 800 volts potential. Each generator will have a capacity of 1,000 HP. and will weigh about 30 tons. In the second-story of the power house, above the dynamos, substation step-up transformers will be installed in which the E. M. F. will be raised to 11,000 volts, and connections will be made to the line through marble switchboards equipped with the necessary switches and fuses.

The pole line will be in duplicate from the Folsom power-house to the Sacramento transformer substation. Each circuit will consist of three bare copper wires supported on specially-designed double-petticoat porcelain insulators. Each insulator is tested, before shipment, with not less than 25,000 volts, alternating current. Each three-wire circuit will carry the output of one dynamo, and any dynamo can be thrown on the line, though they will all be normally operated in multiple.

The substation at the end of the transmission line will contain, in separate compartments, the step-down transformers, delivering current at the secondaries at 125, 250, 500, 1,000 and 2,000 volts, for incandescent lighting and motor service, and three 300-HP. three-phase synchronous motors, connected to a line shaft which will drive several 500-volt continuous-current railway generators and a number of arc dynamos.

GROWTH OF TRAFFIC THROUGH THE ST. MARY'S FALLS CANAL.

The traffic through the St. Mary's Falls Canal in 1894 shows a large increase over that of any previous year, according to the official statistics of the Government officials in charge. In that year over 30% more freight and twice as many vessels passed the canal as were entered from and cleared for foreign countries at the Customs District of New York during the fiscal year of 1893. The general character of the freight, the cost of transportation, size of vessels and other items of interest connected with this immense traffic, with some comparisons with the cost of railway transportation and the traffic through the Suez Canal, are shown in the accompanying diagrams, compiled by Mr. L. C. Sabin, Assoc. M. Am. Soc. C. E., U. S. Asst. Engr., Sault Ste. Marie, Mich.

In explanation of the reliability of the figures upon which these diagrams are based, it may be said that no vessel is allowed to pass the St. Mary's Falls Canal until it has reported on blanks furnished for the purpose, such details as the ports of hail and destination, the kind and amount of freight, the number of passengers carried, etc. At the end of the year these figures are reduced and classified. The rates for transportation are obtained at the end of each season by correspondence with shippers and carriers. For 1893 the replies received probably represented over 75% of the total freight. An average rate for each kind of freight is obtained by careful inspection of the rates given by the shippers. The dates given in the diagrams concerning the traffic through the Suez Canal have been obtained from the official publication of the Suez Canal Co.,* while the other statistics have been gathered from the "Statistical Abstract of the United States, 1893;" "Commerce and Navigation of the United States, 1893;" "Internal Commerce of the United States;" "Report of the Director of the Mint for 1893."

Diagram 1 shows the growth in traffic of the five principal classes of freight through the St. Mary's Falls Canal and the comparative growth of the total freight traffic on the St. Mary's Falls Canal and the Suez Canal. This diagram explains itself pretty clearly. The traffic of the St. Mary's Falls Canal began to exceed that of the Suez Canal in 1889—if we except the years 1870 and 1871, the first two years after the opening of the Suez Canal—fell slightly below it in 1891, and again largely exceeded it in 1892 and 1893. The comparative size of the vessels carrying this traffic is shown in Diagram 2. It will be noticed that on the Suez Canal there has been very little increase in the number of vessels passing the canal, but that the size of the vessels has rapidly increased during that time, and, indeed, since the opening of the canal; while at St. Mary's Falls the number of vessels passing the canal has increased more rapidly than the size of these vessels. In considering this diagram, it should be borne in mind that at St. Mary's Falls the harbor tugs used in assisting vessels into and out of the lock, and the tugs used in towing on the river, are included in the figures. This, of course, reduces the mean net tonnage of the vessels very much. In addition to this the present lock limits navigation to vessels of less than 16 ft. draft. It may be noted that in 1893 only 4.1% of the freight passing the canal was carried by Canadian craft.

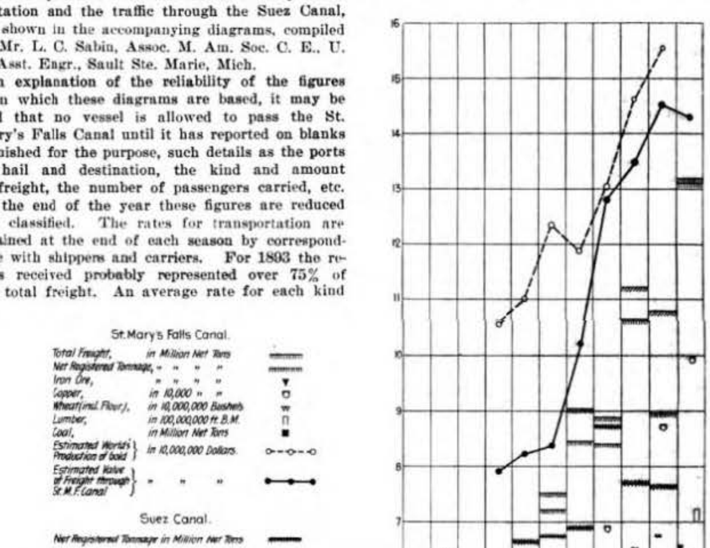


FIG. 1. DIAGRAM SHOWING THE INCREASE IN THE PRINCIPAL CLASSES OF FREIGHT PASSING THE ST. MARY'S FALLS CANAL AND THE TOTAL FREIGHT TRAFFIC AS COMPARED WITH THE TOTAL FREIGHT TRAFFIC OF THE SUEZ CANAL FROM 1870 TO 1894, INCLUSIVE.

In Diagram 3 the comparative cost of transportation on the Great Lakes and on 18 trunk-line railways is shown. The railways considered include such lines as the New York Central & Hudson River; the Pennsylvania; Chicago, Burlington & Quincy; Illinois Central; Boston & Albany, and Chicago & Alton. In comparing these curves of freight rates by rail and by lake, caution must be taken in drawing any far-reaching conclusions. The freight carried by the 18 trunk lines, of course,

* Le Canal de Suez Bulletin Decadaire de la Compagnie Universelle du Canal Maritime de Suez.