A LONG DISTANCE TRANSMISSION PLANT BETWEEN TIVOLI AND ROME.

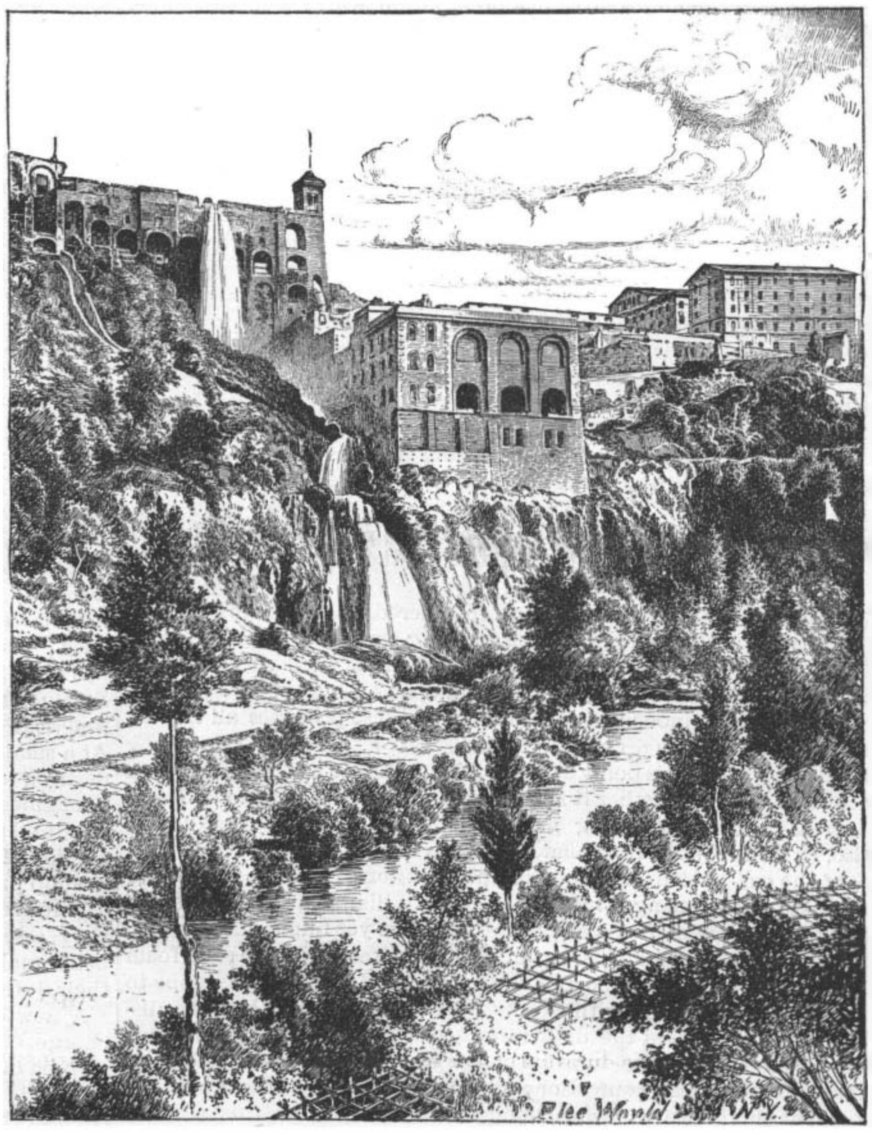
AN interesting plant for the transmission of electricity for lighting and power is that recently opened at Tivoli, where the electric current, generated by water power, is used for arc and incandescent lighting in the city of Rome, some 17 miles distant. This plant was erected by the Roman Gas Company as a supplementary source of electricity to the central station at Rome. This company has been operating its station at Rome for six years, the source of power being steam engines having a total capacity of 2,700 horse power. This plant, together with the new station now in operation at Tivoli, is expected to supply the city of Rome with electric lights for public and private use, and with electric power wherever it is demanded for industrial purposes.

Tivoli abounds in cataracts as beautiful as they are useful, which have served for centuries as a source of power for various industrial enterprises. In 1887 an electric plant was established at Tivoli which is still in operation, but this is only of small size. It was constructed by the firm of Gaulard & Gibbs for supplying Tivoli with electric lights, the system used being the alternate current with transformers in series. Some years ago a company was organized for the purpose of utilizing the water power of the falls at Tivoli for the generation of electricity to be transmitted to Rome, but for various reasons the project was never completed. In 1888 the director of the Roman Gas Works, Mr. C. Panchain, took the matter in hand, and to him belongs the credit for having carried the enterprise to its present successful completion. The old and incomplete plant was purchased and the construction of the new station undertaken. This station is erected on the site of the old villa Mecenate, where a waterfall of 3¾ cubic meters per second, 110 meters in height, furnishes the necessary power. The water is carried through a canal on an old Roman viaduct to the wheel house. The canal terminates in a tower in which there is a stand pipe of sheet iron, 125 feet high and 50 feet in diameter. From the bottom end of the stand pipe a sheet iron pipe of the same width projects 150 feet further on and carries water to the level of the ceiling of the wheel house.

The station stands half way up the side of a mountain, as shown in one of our illustrations. The main room in which the dynamos and turbines are placed is 80 by 50 feet. The main pipe for conveying the water into the machine room is divided into three cross pipes, from each of which three vertical pipes lead out. These nine vertical pipes conduct the water to the nine turbines. A complete system of valves, which can be regulated by hydraulic pressure from the machine room, makes it possible to close each of the three cross pipes whenever necessary within a very few seconds. Corresponding with the three sets of pipes nine turbines form three groups, each group consisting of two 300 horse power turbines and one 50 horse power turbine. Each turbine is coupled direct to its corresponding dynamo. The turbines are of the Giraud type, the 300 horse power wheels having six inlets and valves, and the 50 horse power wheel having one inlet and a throttle valve. The former are constructed for 170 and the latter for 370 revolutions per minute. Each turbine is provided with a self-acting regulator of the Ganz system, which, by regulating the water supply, keeps the speed as accurately constant as is the case with the best types of steam engines. The turbines are completely inclosed in protecting cases, the water outlet being subterranean. In our illustrations one of the wheels is shown with the protecting cover removed. Every precaution has been taken to keep the machine room dry.

Each of the larger turbines drives an alternating current machine, which at 170 revolutions per minute supplies a current of 42 amperes, at a potential of 5,100 volts. The armature of each of these machines is 2·2 meters in diameter, and each generator has 30 poles. Each of the smaller turbines is coupled direct to a four-pole exciter, running at 375 revolutions per minute, and furnishing a current of 150 amperes at 180 volts electromotive force. Both the exciters and the large alternators are arranged in parallel. The exciters have hand rheostats. The regulation is effected by two automatic rheostats of the Blathy type in the field circuit of the exciting machines. These are so arranged that the electromotive force of the alternating currents is kept constant at the distributing station in Rome. The breaking of the circuit is effected by means of a dead resistance of iron wire.

The conductors from Tivoli to Rome are carried through the deserted and forlorn Campagna Romana for a distance of nearly 17 miles. The leads consist of four copper cables, of 19 wires each, the entire system of conductors containing 100 tons of copper. These cables are so arranged that they can be exchanged at will in case of accidents or when repairs are necessary. Of the existing four cables, three are sufficient for running the entire plant, while two are sufficient for two-thirds of the load. The loss in transmission amounts to 20 per cent of the total pressure, that is 1,020 volts, the initial pressure being 5,100 volts. The cables are attached to very strong oil insulators placed upon poles or iron columns set from 115 to 130 feet apart. These poles consist of two parallel T-irons connected together by bolts, at the upper end of which are wooden uprights 10 feet in length, to which the oil insulators are fastened. The same line of poles carries silicon bronze wires for telegraph and telephone purposes, the lowest wire being 25 feet above the ground.



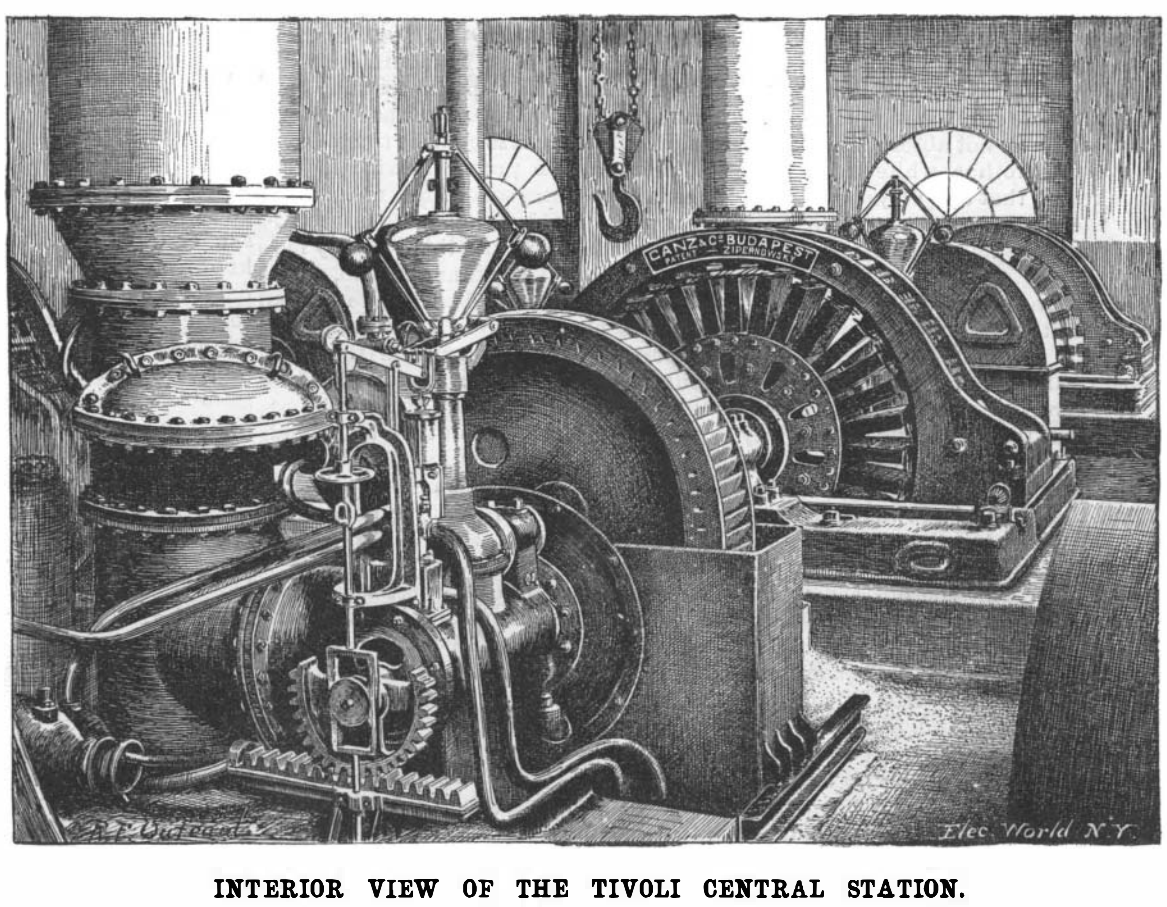
EXTERIOR VIEW OF THE TIVOLI CENTRAL STATION.

The conductors from Tivoli terminate at the old Roman wall, near the Porta Pia, in a small building, where the necessary transformers and other apparatus are placed. As the central station in Rome is operated at a pressure of 2,000 volts, and as the Tivoli plant, as stated above, is intended as a supplementary station for the plant in Rome, the current from the Tivoli station must necessarily be reduced from 4,000 to 2,000 volts. For this purpose 32 transformers, each of 25,000 watts capacity, are placed in the transformer building. Of these 32 transformers, 16 arranged in parallel form a group which transforms the 4,000 volt current into a current at 2,000 volts, and transfers the current from the Tivoli aerial conductors to the underground network of concentric cables that distribute it over the streets of Rome. In the summer, when the demand is at a minimum, and also during the daytime at other seasons of the year, it is intended to operate entirely from the Tivoli plant, and to make use of the Rome central station only when greater demand makes it necessary.

At present 250 arc lights are in use, but this number can be increased at any time to 600. These lights are in series of 45 each, and have aerial lines of copper wire 4 millimeters in diameter. The use of aerial lines was necessary, from the fact that the lamps are widely distributed over the city, quite a number being at a considerable distance from the underground network of cables.

Each of the large transformers in the transformer house is able to furnish 14 amperes at 2,000 volts for supplying 45 arc lamps; 14 such transformers are able to feed the 14 arc light circuits, or over 600 lamps, the other two transformers being kept in reserve. In each of these circuits an automatic rheostat keeps the intensity of the current constant at 14 amperes.

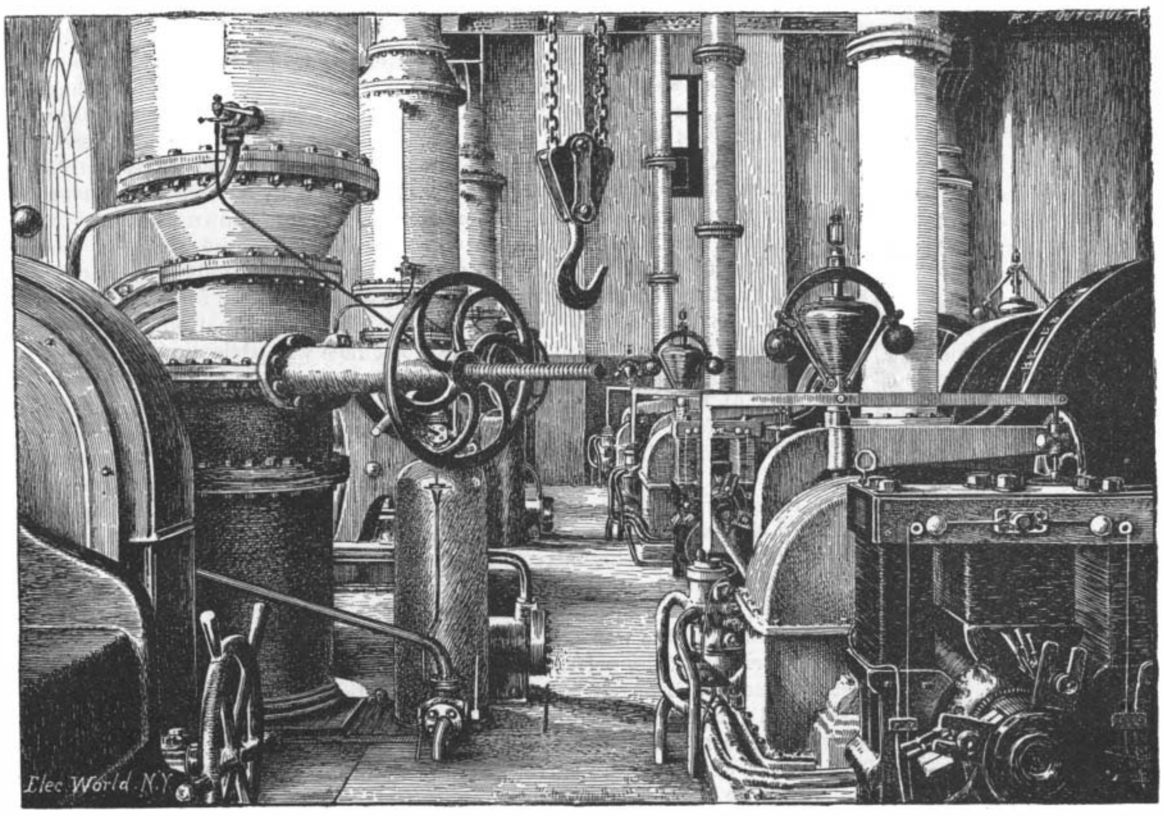
The entire outfit of the central station and of the transformer house, as well as the arc lamps, was furnished by Ganz & Co., of Budapest. The conductors and their supports were furnished by the Society Anglo-Romana, according to the specifications furnished under the direction of Ganz & Co. The entire plant is modeled on the Zipernowsky-Deri-Blathy system, and represents one of the most advanced types of European practice in the distribution of alternating currents over long distances for lighting and power purposes. It is interesting to know that this plant was planned as far back as 1888, a time when the application of a 5,000 volt current for any purpose was considered very remarkable.—*Electrical World.*



INTERIOR VIEW OF THE TIVOLI CENTRAL STATION.

Glycerine in Wine.

The usual method of determining glycerine in wine is that officially recognized by the Berlin committee of 1884, although it is far from ideal. The residue which is obtained by evaporating the wine together with quartz sand and milk of lime nearly to dryness is difficult to remove from the dish in which the evaporation has been performed, and a certain quantity of glycerine is apt to be left in the residue after extraction. The following are the modifications proposed by the author: 10 c. c. of the wine are well mixed with 0·1 of a gramme of powdered calcium hydrate, 10 grammes of quartz sand added, and the whole evaporated almost to dryness on the water bath. The residue is extracted four or five times with hot absolute alcohol, and the extract, amounting to 40–50 c. c., is filtered into a flask holding about 100 c. c., then evaporated on the water bath, sirupy residue dissolved in 5 c. c. of alcohol, 7·5 c. c. of ether added, the flask well corked, allowed to stand some hours, and the clear solution poured into a weighed flask (previously filtering if necessary), the alcoholic liquid evaporated off, and the residue dried for one hour in the water oven and weighed. This method, when tried on seven samples of Servian wine, containing from 0·7 to 1·0 per cent of glycerine, gave results ranging from 0·1 to 0·36 per cent higher than the old method; while, at the same time, closely concordant results were obtained by repetitions of the new method, and also when it was carried out on a scale ten times as great as that prescribed above. In order to ascertain whether the compound formed of lime and glycerine by evaporation to complete dryness resisted the solvent action of the alcohol, further experiments were made in which this condition obtained, with the result that the percentage of glycerine found was not diminished, but slightly increased. Should this observation be confirmed, the need for special precaution in the evaporation will be obviated. The author also states that he has obtained good results by evaporating an aliquot portion of the alcoholic extract, by which means previous filtration and washing necessary to the original process are avoided. He has yet to prove the purity of the glycerine thus isolated.—*M. T. Lecco, in Chem. Zeit.*



INTERIOR VIEW OF THE TIVOLI CENTRAL STATION.

REYNAUD'S OPTICAL THEATER.

We have several times spoken of the apparatus constructed by Mr. Reynaud with the object of improving the methods of projections and that permit of obtaining the illusion of movement and life through optical processes.

The apparatus that produce the synthesis of the successive phases of an action have, up to the present, all (from Plateau's phenakistiscope to Reynaud's praxinoscope) been limited by their very nature to the reproduction of a motion or, at the most, of a very simple action, every rotation of the apparatus evidently being capable only of repeating the effect produced by the preceding rotation.

The object of the optical theater is to extend the illusion to the reproduction of a large series of actions, and of thus realizing the reconstruction of an entire scene through optical synthesis.

To this effect a band of great length carrying a large number of poses replaces the crown of the old apparatus. In order to present the animated scenic illusion to a great number of spectators, it was necessary to give it large dimensions, which is something that can be done only by projection upon a screen.

But, in order to obtain such illusion under good conditions for the operators, it is necessary that the postures shall succeed each other on the screen without a break; in other words, that there shall be no extinction or eclipse between two successive postures.

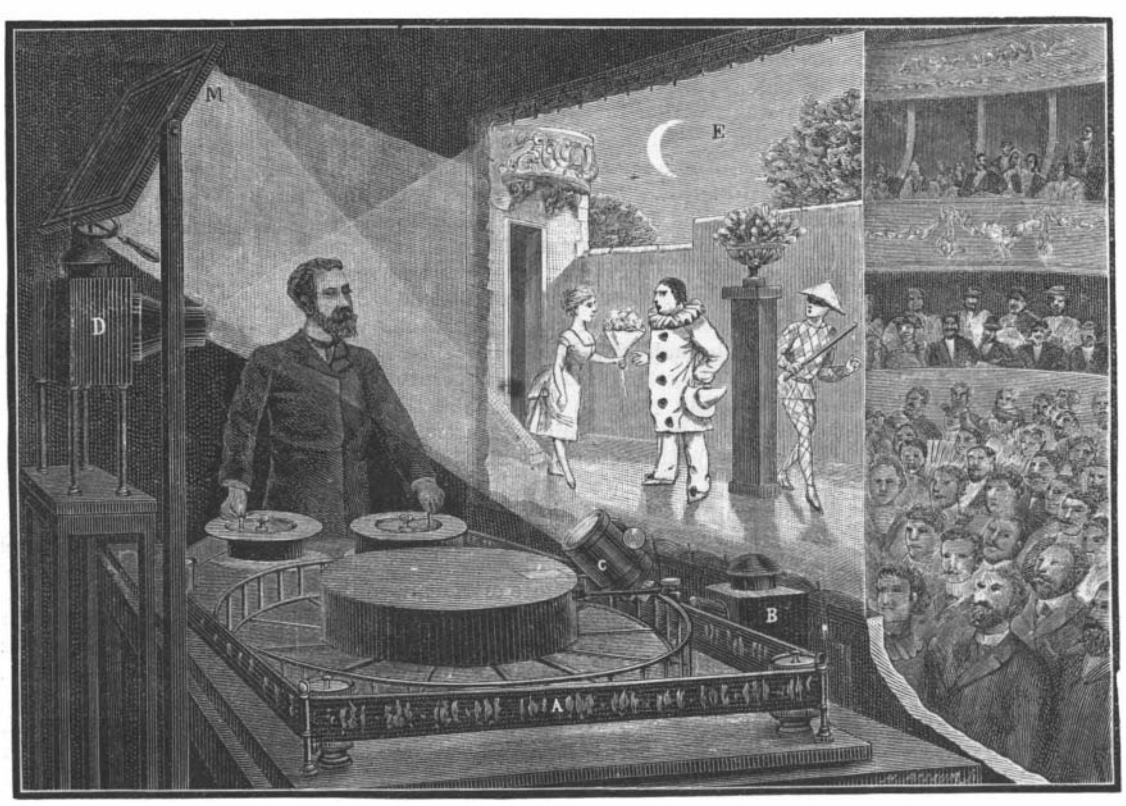
This continuity of the image, obtained already by the praxinoscope, invented in 1877 by Mr. Reynaud, has not, up to the present, been realized by any projecting apparatus.

The optical theater, by its very construction, realizes it in such a way that the succession of the postures may be interrupted at every instant without the image ceasing to be illuminated and visible upon the screen. This property permits, in the representation of the animated stage, of reposes and repetitions which, at the same time, increase the truthfulness of the effect and the duration of the scene represented. The optical theater thus allows spectators to witness complete scenes (pantomimes, interludes, etc.), lasting from 15 to 20 minutes, with a number of postures and a length of band that remain within practical limits. It thus produces a spectacle both interesting and amusing.

Moreover, the optical theater seems as if it will hereafter constitute the typical apparatus for the synthesis of the photographic series of successive postures, and it is doubtless in this direction that it will in the future find its principal application, when the improvements in instantaneous apparatus and the reduction in the cost price of photogenic films will have permitted of easily and cheaply obtaining very numerous series of such postures.

Our illustration represents the arrangement of Mr. Reynaud's new optical theater. The crystalloid band upon which the images are painted is represented at A. The operator can revolve it in one direction or the other by means of two handles. The images, reproduced by a special process of reproduction in colors, pass before the lantern, B, and are projected through the intermedium of a lens, C, upon an inclined mirror, M, which projects them upon the transparent screen, E. Another projection lantern, D, causes the appearance upon the stage of the scenery amid which appear the characters changing postures painted upon the band, A.

Mr. Reynaud has got up some very amusing scenes, especially the three-character pantomime entitled "*Pauvre Pierrot*."—*La Nature.*



REYNAUD'S OPTICAL THEATER.

The New York State Canal Convention.

It is proposed to hold a convention this fall for the purpose of promoting the improvement of the canals of the State of New York. In paralleling the through railroad routes from Lake Erie to tidewater the Erie Canal figures as the connecting link in a complete water service, covering all the great lakes. In this connection its enormous importance as a competitor for freights with the railroads cannot well be overestimated. The other canals perform similar service, and their value in keeping down the freight charges on railroads is of the utmost importance also. This is a service directly affecting the producer. Anything done to promote the efficiency of the canals is a service to the farmer and lumberman, as well as to the consumer of their products. It is even claimed that New York would have never attained her relative importance among the States but for the canals.

From 1871 to 1891 the total tonnage of the New York canals was 106,844,759 tons, whose value is estimated at over three thousand millions of dollars. During the year 1891, one-third of all the grain brought to this port came through the canals.

It should be enough to remember that railroad rates are pool rates; that in 1891, on the opening of the Erie Canal, in May, the railroad rate for grain was $7\frac{4}{5}$ cents per bushel, when the canal at once offered transportation for less than one-half this figure, $2\frac{5}{8}$ to 3 cents a bushel. These figures show the value of the Erie Canal.

Again, when the canals are opened, New York receives nearly double the quantity of grain that Philadelphia, Baltimore and Boston combined can show. When the canals close, the New York receipts drop off to about the same as those of the three ports mentioned. Canal navigation is closed for five months. During their seven months of operation their value to the port of New York is immeasurable.

What is needed now is the improvement of the canals. They need to be deepened, the locks should be enlarged, and everything possible done to increase their efficiency. The present tendency seems to be to let them alone. This policy will be a very bad one for the port of New York.

The affairs of the convention are in the hands of the Union for the Improvement of the Canals of the State of New York, 55 Liberty Street, New York, N. Y. It is to be hoped that the ends in view will be speedily attained.

Laxative Lemonade.

The *Pharmaceutical Record* says that a preparation known as laxative lemonade is prepared in Germany by dissolving 30 to 50 grammes tartrate of soda in 500 grammes of hot water, allowing the solution to cool, and adding to it 50 to 100 grammes of flavored simple sirup. This mixture is then transferred to strong glass bottles and charged with the weight of several atmospheres of carbonic acid gas. This is said to furnish a cheap and effective substitute for citrate of magnesia.