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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE ERIE CANAL MUDDLE.

The Erie Canal problem has been further complicated by the action of the Canal Association of Greater New York, which has emphatically and unanimously repudiated the $26,000,000 canal improvement bill now before the State Legislature, and has declared itself as being strongly in favor of the 12-foot 1,000-ton barge waterway costing $62,000,000, which was recommended by the expert commission of Governor Roosevelt's administration as the only solution of the problem. As the Canal Association comprises all the leading commercial organizations of this city, its resolution may be taken as indicating that the city of New York is opposed to any appropriations for the 9-foot $26,000,000 canal, or any improvement of less scope than the 12-foot waterway.

The resolution of the Canal Association produced something like consternation among the supporters of the present bill, for it looks as though this expression of opinion would prevent the passage of the bill and, therefore, prevent appropriations of any kind for canal work at this session. So far as we have been able to discern, very little, if anything, has been said of one aspect of the question—an aspect which is surely of the highest importance, seeing that it dominates the whole canal problem, irrespective of the particular merits of a 9-foot or a 12-foot reconstruction. We refer to the superior advantages, due to geographical location, offered by the powerful competitive route which exists in the system of canals and channel improvements known as the St. Lawrence River Canal system. Since the object of the Erie Canal improvement is to provide a cheap route from the Lakes to deep water, it is evident that the question of the quantity of tonnage which will seek this outlet will be determined by the question of its relative convenience compared with the northern route. As matters now stand, the least depth over the sills of the Canadian locks is 14 feet, which is 2 feet more than the least depth of the proposed 1,000-ton barge canal. Moreover, the aggregate length of the St. Lawrence canals is relatively insignificant compared to the total length of the Erie system, the canals in the former case being merely connecting links between the natural channels of the St. Lawrence River, which have been put in wherever the navigation is obstructed by rapids or waterfalls. We notice that in the report of the Green Commission to Governor Roosevelt, the approaching completion of the Canadian system was urged as one of the urgent reasons for improving the Erie canal, and in this connection it becomes a question for serious consideration as to how far the shorter length and greater capacity of the Canadian system will cause the east-bound grain to seek that outlet in preference to a canal of inferior accommodation through New York State. Probably the St. Lawrence Canal has now been in use long enough to determine what its effect will be upon the various rail and canal routes from the Great Lakes to New York. That it will divert a portion of the tonnage which has hitherto come to this city is to be expected, and upon the probability or improbability of a 1,000-ton barge canal being able to compete successfully with one that will allow of shipments direct from lake ports to Europe in deep-sea steamers, should depend very largely the question of the expediency or inexpediency of any canal improvements whatever, short of a full-sized ship canal.

The question of a ship canal is an attractive one until it is weighed in the balance of cold figures; for it must be confessed that the report of the United States engineers indicates that the total cost would be so great as to overbalance the prospective advantages to the State at large or to the city as a terminal point. At the same time, we think that a careful investigation of the results already obtained by the St. Lawrence Canal system, and a determination of its advantages of location, would render it possible to determine very closely what improvements would be necessary to place the Erie Canal at least on equal terms with its powerful northern competitor.

APPLICATION OF THE COHERER TO DETECTION OF STORMS.

M. Tommasina has recently discovered a new application of the coherer, that of detecting atmospheric electrical discharges or storms, even when these occur at great distances, and has devised an instrument for the purpose, which he calls the electro-radiophone. A description of this apparatus has been given in a paper presented to the Academie des Sciences. It is, however, to the Italian scientist, Prof. Boggio Lera, that the credit of constructing the first instrument of the kind belongs; by using a coherer in combination with a series of relays of different sensitiveness, the effect of the distant electrical discharges was recorded upon a registering apparatus. The relays acted in greater or less number according to the conductibility acquired by the coherer under the action of the discharges, and the apparatus traced a series of lines, long or short, according to the intensity of the phenomenon. M. Tommasina utilizes in his new instrument the principle of the "auto-decoherer" discovered by him, in connection with a telephone receiver. This form of coherer consists of a glass tube containing two cylindrical carbons, nearly touching in the center; between the carbons is a small quantity of carbon granules, and this combination, under the action of electric waves, forms a coherer which has the unique property of returning to its original state after the waves have ceased, without any external action. This coherer, placed in circuit with a battery and telephone receiver, is thus a very good detecter for electrical waves; and M. Tommasina has applied it with success in detecting far-off electrical disturbances of the atmosphere or distant storms.

The coherer used in this case is formed of two small arc-light carbons, of 0.16 inch diameter, fitting easily into a glass tube, and between which are placed small grains obtained by crushing a portion of the same carbon, these being well freed from dust. To the ends of the carbons are fixed platinum wires to form the outer terminals; the carbons and granules are dried by heating to redness in a flame. The space between the carbons is regulated for maximum sensitiveness, this being 0.04 inch for grains of 0.008 inch diameter; the tube is then sealed at the ends to prevent moisture from entering, as this causes variations in the sensitiveness of the coherer. The tube is placed parallel to the axis of the telephone receiver and put in series with its coil and a few cells of battery. When the receiver is held to the ear the coherer is horizontal and in the position for best action. In carrying out the experiments, this arrangement was used at the same time as the electric registering apparatus of Prof. Lera, and the experimenter states that during the time that the discharges of the distant storm were registered, he heard a corresponding series of sounds in the telephone, and the hearer has the illusion of being transported to the actual place of the storm and of listening directly to all its phases; he was thus enabled to hear and study the phenomena of storms when they were at such a distance that no trace was observed on the horizon. In one case he observed a storm twelve hours before it passed over Intra, in Italy, where he had installed his apparatus. Owing to its great simplicity and absence of regulation, there is no doubt that the "electro-radiophone" will render great service in detecting the approach of storms, especially on shipboard.

IMPROVED PROCESS OF DUPLICATING PHONOGRAPH RECORDS.

The commercial demand for phonograph records for amusement purposes amounts to several thousand records a day. It would not be practicable to supply such a demand if each record had to be made separately by singing or playing before a phonograph. For several years the practice has been to record each performance on from four to a dozen machines at once, the machines being arranged on racks or shelves with the horns converging toward the band or singer. The records thus made are called masters, and are copied in duplicating machines, which work somewhat on the principle of a pattern lathe. Two mandrels rotate side by side, one bearing the master record and the other a blank on which it is to be copied. A reproducer stylus rubbing over the master guides a recording stylus which cuts the duplicate record in the blank. By this method a number of duplicates are made from each master, but after a while the master shows signs of wear, and the duplicates produced are not of good quality. Ordinarily about twenty good duplicates can be made from one master before the latter is condemned.

As many of these masters require a whole band of music to make them, they are expensive, and it is very desirable to have a method of producing a larger number of duplicates from a single master. Two successful solutions of this problem have recently been perfected.

By the first method an electrotype mold is made by first depositing over the master an exceedingly thin coating of metal by Edison's process of vacuous deposit, electroplating, and backing up the copper plate with a stout backing of metal. Records are cast by introducing melted wax into the mold about a core. The mold is used cold, so as to chill the surface of the wax.

To remove the record from the mold advantage is taken of the facts that wax has a high coefficient of expansion, and that the record groove is very shallow, so that when the record is cooled it contracts more than the mold and is readily slipped out endways. The molds may be preserved indefinitely, and any number of duplicate records produced from them.

The other process referred to is quite different from this, and is very ingenious. The master is dipped into a solution of gelatine and bichromate of potash, which when dried and exposed for a time to the light remains as a thin, tough skin adhering closely to the record. This is coated with shellac, and afterward with a substantial backing of wax, which is turned true and pushed into a brass tube. When the master record is broken out, there remains on the interior of the composite cylinder thus produced a very faithful gelatine mold of the record. A one per cent solution of celluloid is flowed over the interior of this mold and permitted to dry, leaving a very thin skin of celluloid which is then coated with chromatized gelatine. Several alternate layers of celluloid and gelatine may be laid on in this mold until a skin of sufficient thickness is obtained, which is then strengthened by a suitable backing having in its center a hole properly tapered to fit the mandrel of the duplicating machine. The brass tube and the wax part of the mold are then removed and the gelatine matrix stripped from the celluloid, leaving a very perfect copy of the original record with a surface of celluloid.

This record is used as a master in the duplicating machine, and it shows no signs of wear even after many hundreds of wax duplicates have been made from it.

NEW PRODUCTS IN THE GLASS INDUSTRY.

M. Léon Appert has lately read an interesting paper before the Société des Ingénieurs Civils, relating to the progress of the glass industry as shown at the Paris Exposition. After describing the different processes of manufacture, he mentions several new products which have been lately brought out. One of these is called glass stone by its inventor, M. Garchey. It has been found that when certain kinds of glass are cooled, then slowly reheated, that a kind of precipitation takes place in the mass. The inventor uses a glass rich in lime, such as bottle-glass, for this purpose. The glass, cooled to a point somewhat below fusion, is submitted to a temperature of 1,200 deg. C., and the plastic mass then undergoes a strong pressure by means of powerful hydraulic presses. The piece after it comes out of the press is annealed in the usual way. This product possesses remarkable qualities of hardness, inalterability and resistance to wear. It is more elastic than ordinary glass, and is thus much less fragile. Its properties render it well adapted for paving blocks or tiling, and it may be used to advantage on the outside of buildings. The author mentions also the "strengthened glass" which has come into use, this being a flat glass plate containing a metallic network in the center which renders it far superior to ordinary glass as regards solidity and resistance. In case of fire it will stand the highest temperature without bending. This glass may be obtained in two different ways. The French process, due to M. Appert, differs from the American, in which the rigid metal network is forced into the glass sheet; in the French process, two separate sheets of glass are rolled, and the network is introduced between them, the whole being pressed together in the rolls. Another glass which may be considered as new, although known for some years past, is that known as "opaline." This glass, of a milk-white or greenish hue, has come into use of late for tile-work, and it may in a great many cases replace ordinary tiles at a less cost. The underground stations of the Paris Metropolitan are entirely lined with these "opaline" tiles, which produce an agreeable effect. The St. Gobain glass works had an important exhibit of opaline glass at the Exposition. The author mentions also the perforated glass, which facilitates the ventilation of dwellings, and thus renders great service from a hygienic point of view. Plates of glass for buildings, roofs, etc., are now being made of very large size, up to 15 and 18 feet in length, and glass tubes are made as large as 20 inches in diameter.

NEW CHEMICAL COMPOUNDS.

Two new compounds have been recently formed in M. Moissan's laboratory by M. Tarible, who combines the bromide of boron with the two chlorides of phosphorus and obtains two well-defined crystalline bodies. The experiments are described in a paper read before

the Académie des Sciences. The first of these compounds is formed by pouring bromide of boron upon the trichloride of phosphorus, PCl_3, contained in a test tube; the formation of a white crystalline compound is observed, and considerable heat is given off. The crystals were separated and dried, and upon analysis were found to correspond to the formula $PCl_3,2BoBr_3$, being a combination of the bromide of boron with the trichloride of phosphorus. This compound is colorless and crystalline, melting near 58 deg. C.; it sublimes partially at 40 deg. C. and decomposes before reaching its boiling point. It is soluble in both of the bodies which form it, and besides in carbon disulphide and chloroform; it is insoluble in vaseline oil. It fumes in the air, and water decomposes it rapidly, with production of heat and formation of hydrobromic, hydrochloric, phosphorous, and boric acids. In a current of hydrogen it sublimes near 30 deg. C., and decomposes partially beyond 50 deg.; it is attacked by oxygen at a red heat, but sulphur does not act upon it below its decomposing temperature. Ammonia gas is absorbed by it, with disengagement of heat and formation of a white crystalline compound. The organic compounds, ethers, alcohols and acids act energetically upon it. It dissolves easily in trichloride of phosphorus, and although the crystals obtained from the solution are not as fine as those from a bromide of boron solution, their formula is the same, and it is quite probable that this is the only combination formed at ordinary temperatures. The second body is formed in a similar way with the pentachloride of phosphorus, PCl_5; however, the bromide of boron and the pentachloride must be heated in a sealed tube to 150 deg. C. to give the reaction. In this case yellow crystals are seen to form, these being denser in appearance than those of the pentachloride; their composition is found to be $PCl_5,2BoBr_3$. This body, when pure, is colorless, the yellow color seen at first being probably due to the presence of chlorine. It melts near 151 deg. C., and then begins to decompose; it sublimes at about 100 deg. This compound is soluble in bromide of boron and carbon disulphide, but insoluble in vaseline oil. It fumes in moist air and water decomposes it rapidly, giving off the acids mentioned above; in a current of hydrogen it sublimes without decomposing; oxygen acts upon it at redness. Ammonia gas is absorbed by it, with great elevation of temperature, forming a white amorphous powder. The organic compounds and acids act upon this body as with the former. From a number of experiments it is probable that this compound is the only one formed under the circumstances.

LOCAL CONDITIONS FAVORABLE TO THE COTTON INDUSTRY OF THE SOUTH.

Nowhere has the development of cotton manufacturing been so rapid as in the South, and never before in the history of industries has such an increase in any one branch been recorded. In order to define the causes plainly, it is necessary to go back several decades. During the first years of the century, Virginia, the Carolinas and Georgia manufactured considerable cotton, but by degrees New England developed the industry at the expense of the South, while the civil war reduced the number of spindles in actual operation to less than 350,000 in this section. It may be said that the present industry in the Southern States had its birth in 1865 and has grown to its present proportions since that date, although but few mills were constructed until 1870. All of the machinery in use at the time of the war has long since been discarded, and for that matter much of the equipment which was running prior to 1890. Such has been the extent of the improvements made in mechanism for spinning and weaving.

It is hardly necessary to state that the water power and the extensive domestic market afforded near at hand stimulated the textile industry in New England until it assumed its present proportions. The abundant water power was also a reason for the revival of manufacturing in the South—but only one of several causes which have contributed to its growth. The climate, cheapness of fuel, proximity of the raw material, the abundance of labor as well as building material, also contributed to an important degree. The humidity of the Piedmont section of the South gives it an advantage which has caused a belt of these industries to be constructed in the Carolinas, Georgia and Alabama, although some mills are located in the lower country near the seacoast. The temperature is such that but for six or eight weeks out of the year is artificial heat needed to keep the mills at the proper degree of warmth. In fact, some of the plants are heated less than a month in the year, while the moisture in the atmosphere precludes the necessity of artificial means for supplying it, required in many other textile districts. The center of cotton production in the United States, not a few of the mills have been constructed in places where all of their supply is secured from the neighborhood, being brought to the door by wagon loads from the plantations. The purchasers are thus enabled to select the choicest lots for their purpose, and although the mill prices average from one-fourth to one-third of a cent per pound more than the amount paid by factors or agents of Northern and foreign consumers, the freight by rail and water saved on the raw material from the locality of the plant represents a percentage in its favor. The water power is abundant and capable of economical development in the Piedmont district, but while the machinery in a large number of the mills is operated by turbine plants, fuel is so cheap that auxiliary steam power comprises part of the equipment of most of the factories, to guard against the possible cessation of the water supply, temporarily or permanently. Both wood and coal are utilized, quite a few of the plants in the Carolinas still depending upon the first-named fuel, which is also purchased in the vicinity and much of it carried to the furnace doors on wagons. In Georgia and Alabama coal is more depended upon, and it is an actual fact that a part of the supply is delivered on the premises of the consumers as low as $1.50 per ton; while a company in Alabama located at Cordova controls mines from which the fuel is brought to its power house at a cost of about 90 cents per ton, including every item. It probably has the cheapest fuel supply of any textile industry in the world.

A large proportion of the population of the hill country of the South consists of white people who prior to the manufacturing era depended principally for a livelihood upon the few acres which each could till to raise food for themselves and fodder for their stock. Some gathered herbs which formed the basis for various medicines. The majority worked and lived under conditions of extreme destitution. With the building of the mills, an opportunity was offered not only the men, but the women, the boys and girls of ten years and older, to obtain steady employment, of which they have taken advantage. It is upon this class of labor that most of the manufacturers depend. Many of the large mill owners have secured the services of a superintendent and possibly two or three foremen proficient in weaving and spinning, and with the help of these experts have instructed the native whites in the work, in which they are becoming more and more adept. Compared with the English and New England spinners and weavers located where the industry is over a century old, they have not reached the standard attained by the Northern and foreign classes, but it is admitted that skill in producing finer yarns and cloths is only acquired after at least several decades of manufacturing, and the industry in the South is still in its infancy, so to speak, although the tendency has been of recent years to purchase more and more machinery adapted for spinning finer yarns and for manufacturing even such high grades of goods as cheviots, plaids, gingham, bedspreads, carpetings and damasks, in which fair success has been attained. As yet, however, the bulk of the product from the South consists of ducks, coarse cloths and heavy yarns. It might be stated here that although two or three experiments have been made with negroes as skilled laborers, thus far the results have not been successful, and in two instances mill owners have abandoned the idea. Colored labor, however, is utilized in handling the cotton, for "firing" the boilers and in other ways where purely mechanical ability is not required.

The low price of real estate in the South and its sparsely settled condition have given factory promoters an opportunity to secure sites at a very small price. In many cases land has been donated them by village or municipal corporations on account of the advantages which would accrue from the industry and the market it afforded for food, clothing and other supplies and the necessary demand for dwellings for the employes. Consequently the factories are not crowded together, and the great majority have been built on the outskirts of towns or in the open country, forming the nucleus of a community in themselves. Clay for brick making, timber for framework, even slate for roofing, can be procured throughout the cotton-manufacturing section, and most of the buildings have been erected by local mechanics under the supervision of a mill architect or engineer at a comparatively small cost, all of the material coming from near at hand with the exception of the machinery.

Some are upon navigable waters, giving them the benefit of obtaining not only supplies, but shipping their goods by vessel. The railroad companies, however, have been very liberal in constructing sidings to mills located on water powers and elsewhere at distances of from five to fifteen miles, for such sidings can be cheaply made of second-hand rails, thus enabling cars to be loaded directly at the doors of the mills without the extra expense for drayage and other transfer charges. The more important companies have found it profitable to purchase enough land to build the necessary dwellings for their employes, which they rent out at a price generally sufficient to pay for the outlay in a few years. In fact, an important item of the revenue of many of the companies comes from rental of their real estate. At the beginning of the activity in mill building, there was a tendency to use second-hand machinery exchanged by Northern mill owners for improved apparatus. This could be purchased at a much lower percentage than new equipment, and quite a number of mills constructed in the eighties were supplied with it, but several failures have been directly traced to the use of such equipment, and of late years Southern mill owners have been among the best customers of makers of standard textile machinery. In a later issue we shall treat of first cost and cost of operation of the Southern cotton mills.

SCIENCE NOTES.

Congress has appropriated the sum of $300,000 for the preservation of our forest lands. A regular force is to be established, the salary of each of whom is to be $3 per day, and $3 per diem for livery and traveling expenses. This is a practical step in the right direction.

A large hospital is being built in the Vosges Mountains for the isolation and treatment of lepers. In case whole families are attacked, small dwellings are provided for them. The treatment will be most scientific, and it is hoped that progress will be made in the cure of this terrible scourge.

An English signal operator kept an account of the various animals killed by the trains along the line where he was employed. His observation included three miles of track. He found cats, dogs, foxes, hares, rats, rabbits, a sheep, a cow, an adder, a hedgehog, a long-eared bat, hogs, rooks, besides other more familiar varieties of birds.

It is announced that on April 1 M. Curie, the chemist, separated a new gas from radium. It is intensely phosphorescent and will glow for months in the dark. It was also announced, says The New York Sun, who cabled over the news, that M. Naudon found means for producing X-rays without the aid of electricity by exposing a metal plate to the rays of the violet end of the spectrum.

The cold storage of furs, clothing, rugs, etc., is quite an industry in many of our larger cities. As the temperature is constantly kept below the freezing point, it is obvious that this is a perfect method of storing garments and furs when they are not required. They are removed from the racks free from the odor of tar, camphor, cedar, etc., and the furs are improved by hanging in the cold, dark, dry rooms. The wear and tear of frequent examination, beating, combing and brushing is avoided. The equipment of some of the plants is quite extensive.

In the majority of cases of the so-called arsenical poisoning by beer, the gravity of the symptoms has far exceeded those produced by any possible quantity of arsenic absorbed. This has been somewhat vaguely attributed to the formation of some biological organic compound of arsenic of a more intensely toxic nature than arsenic itself. It has been suggested that these symptoms indicate as a more probable cause the presence of selenium, which has been found in quite a considerable quantity, even in several forms of purified sulphuric acid. It is practically certain that any selenium in the acid would pass into glucose during the process of inversion.

Prof. W. P. Amalizki, of the Warsaw University, recently delivered a lecture at St. Petersburg relating to the discovery of his first skeleton in North Russia of an antediluvian race of giants, the Pariosaurus. The skeleton he unearthed measures nearly ten feet in length and is the largest fossil of this reptile that has ever been discovered. Hitherto the British Museum has possessed the largest specimen, found by Prof. Seeley in Cape Colony in 1889, and which measures over nine feet in length. Prof. Amalizki has been engaged in this quest for fossils for several months. He unearthed some thirty skeletons on the banks of the Northern Dwina, but they were in fragments, with the exception of this colossal specimen. The skeletons were found embedded firmly in a hard sandstone. They will be deposited in the Palæontological Museum, which is shortly to be built at St. Petersburg.

The investigation made by Prof. Beyer for the American Ornithological Association of the Louisiana Gulf Coast for the purpose of stationing wardens to protect the sea birds shows that action was not taken a moment too soon. Prof. Beyer found that nearly all the breeding places of the birds had been destroyed by killing the birds themselves and taking their eggs. Not a trace of birds was found on either Brush or Caillou Islands, at one time the home of millions of sea fowl. The same was true of Calumet and Castelle Islands, on which every living thing had been killed. A few gulls and hens were found left on Timbalier Island, and there are said to be a few on Last Island, which, however, could not be visited on account of the severe weather. Wardens were appointed wherever birds were found and the fishermen of the neighborhood promised to co-operate with the wardens in preventing the killing of the birds in the breeding season and the stealing of eggs.