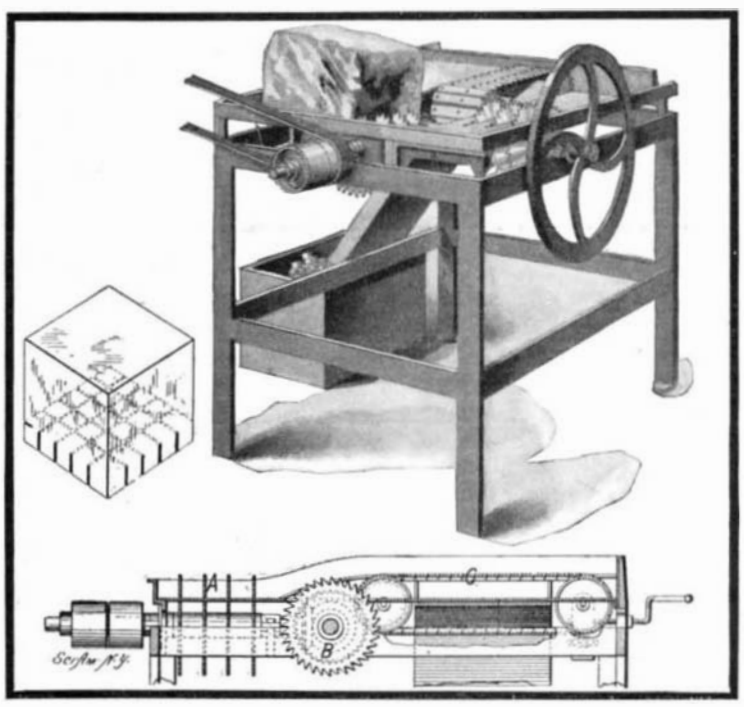
sary one can be made to accommodate as many as 120 persons. The doors are so arranged that all are opened together by one move of a lever, but are closed separately. The platforms at the stations being level with the floor of the coach, no steps are necessary, and consequently much time is saved in this way. These cars have been especially constructed for World's Fair service, but I am told it is the intention of the company to convert them into furniture cars as soon as the Exposition closes. On this account the springs first put under the coaches were made too strong, and the temporary abandonment of the use of the cars for a few days has therefore been made necessary in order to remove a couple of leaves and make them weaker.

For their shuttle-train service at St. Louis the Wabash has a double track running all the way from the Union Station to the World's Fair grounds; and, with the exception of a short distance, these tracks are provided with automatic electric block signals every 1,200 feet. Fifteen minutes is the time required for a one-way trip, and at present the trains are being run each way fifteen minutes apart. If at any time, however, the business demands it they may be run every five minutes. Each train may contain as many as ten coaches, and if thus forced to the limit it is possible for the system easily to handle 25,000 an hour. The total number of persons handled by the Wabash on the opening day of the Exposition was a little over 17,000, and consequently it will be seen that a rush is not apt to occur. The number of side-door coaches constructed for the system is 150.

ICE-CUTTING MACHINE.

Pictured in the accompanying engraving is a machine for cutting blocks of ice into small pieces for use in hotels and other establishments. The machine will be found very useful, owing to its arrangement, which permits of quick and convenient handling of the block during the cutting operation. The machine comprises a feeding table over which the block of ice is moved to successively engage the cutting devices. These consist of gangs of circular saws on shafts disposed at right angles to each other, and thus adapted to make intersecting cuts in the ice block. The ice block is first moved against the saws shown at *A* in the illustration, which make a series of parallel cuts in the block, and then against the saws shown at *B*, which make a series of parallel cuts intersecting the first series. The ice then presents the appearance shown in our detail view. The block is now moved against a horizontal band or link saw which makes a horizontal cut, cutting off the cubes formed by the previous saw cuts. These cubes drop into a chute which conveys them to a suitable receptacle. The main body of the ice block, however, slides over the band saw, ready to be moved again against the gang saws at *A*. The process is then repeated until the entire block has been cut up into small cubes. The machine is provided with fast and loose pulleys, which carry the belt that drives the cutting mechanism. The shafts which carry the gang saws are geared together and also to the pulleys of the band saw so that all the saws turn in unison. A patent on this machine has been secured by Robert Mowery, Hot Springs, Ark., and John D. Tellman, care of Hotel Jefferson, St. Louis, Mo.



ICE-CUTTING MACHINE.

The Chicago River Tunnels.

Lowering the Chicago River tunnels has been reported on by Col. O. E. Ernst, U. S. Enginers. He recommends that the Washington Street and La Salle Street tunnels be lowered to give a depth of 26 feet in the river, on the ground that such a depth would be required to carry 8,000 cubic feet of water per second without making a too rapid current. This amount of water must ultimately flow through the river to the drainage canal. The time for completing the work is to be limited to May 1, 1907, but the tunnels are to be removed so that half of the channel shall be open to navigation by April 1, 1905, says Engineering News. It will be necessary to abandon these tunnels at once, and cofferdams will have to be built to the center of the river, enabling the contractor to build half of the new tunnel while leaving the other half of the stream free to navigation. Regarding the Van Buren Street tunnel, Col. Ernst reports that no cofferdam work will be necessary and the reconstruction may be carried on without interfering with the use of the tunnel.

Death of Prof. Ratzel.

Prof. Friedrich Ratzel died on August 9. He is best known to Americans by his splendid work, "The United States of North America," in which he exhaustively studied the natural resources of the United States and their relation to its population. His work on "The Political Geography of the United States" and many other works of an ethnological and geographical character are likewise well known.

THE DIRECT PRODUCTION OF PHOTOGRAPHS IN COLORS BY A NEW METHOD.

Messrs. August and Louis Lumiere, the well-known French experimenters and manufacturers in photographic products, have recently described in a communication to Focus their latest experiments toward the attainment of direct colored images by photography, which are novel. The method is based on the following theories:

If a collection of microscopic elements, of a transparent nature and colored respectively red-orange, green, and violet, be spread on the surface of a glass plate in the form of a single thin coating, it will be found, if the intensities of coloration of these elements and their number be correct, that the coating so made does not appear colored when examined by transmitted light, and also that this coating absorbs a fraction only of the light transmitted.

The light rays in passing through the elementary screens, orange, green, and violet, reconstruct white light, if the number of surfaces or elementary screens for each color, and the depth of coloration of these, are in accordance with the relative proportions of those which are found in white light.

This thin trichromatic coating being formed is then coated with a sensitive panchromatic emulsion. If the plate so prepared is submitted to the action of a colored image, taking the precaution to expose through the back of the plate, the luminous rays pass through the elementary screens, and undergo, according to their color and the screens they encounter, a variable absorption before having any influence on the sensitive coating.

By this means a color selection should be effected by means of the microscopic elements and making it possible to obtain, after development and fixing, colored images in which the tones are complementary to those of the original.

If, for example, we take a portion of the image which is colored red, the red rays are absorbed by the green elements of the coating, while the orange and violet elements allow the passage of those rays.

The coating of panchromatic gelatino-bromide emulsion will therefore be acted on beneath the violet and orange screens, while remaining unaltered under the green screen.

Development reduces the bromide of silver sensitive coating, and so masks the orange and violet portions of the image, while the green portions appear after the plate is fixed, because the emulsion covering them has not received light action, and so is transparent after fixing; the result obtained in this case is therefore of a green color, which is complementary to the red rays dealt with. Similar phenomena are produced with other colors, as, under the action of green light the green screens are masked, and the coating would appear of a red color; with the use of yellow light the image would appear violet, and so on in like manner with other colors.

It follows that with a negative showing complementary colors obtained in this way it is possible to obtain, with plates prepared in this manner, positive prints which will be complementary to the negatives, i. e., reproducing the colors of the original.

Also, after development, and before fixing of the negative image, that image may be reversed, and, by the known processes, a positive image may be obtained, showing the colors of the object photographed.

The difficulties we have met in the application of this method are numerous and considerable, but the results obtained show that those difficulties may be overcome. It will suffice if we indicate a few of the more important conditions, showing the delicacy of the problem before us.

A coating must be prepared, formed of microscopic screens, orange, green, and violet, which coating it is necessary should adhere to its support and be extremely thin, that the coloration of these microscopic elements or screens should be exactly determined as regards intensity, quality of color, and the number of elements of each kind. It is also necessary that these colors should be stable, that they do not diffuse, and that there is no superposition of color screens or elements, nor gaps between them.

It is further essential that the photographic sensitive emulsion should be orthochromatized in a manner which shall not falsify colors, and that this orthochromatism should be in relation to the nature of the emulsion and the colors of the elementary screens. This coating of emulsion must also be of a special nature to avoid diffusion, and the manipulations, development, exposure, etc., must be of a nature suitable to these preparations. The simple enumeration of some of the conditions necessary to be filled shows how essential are care and method to the success of such processes.

This research is not entirely finished, but we indicate hereunder the practical position to which we have brought the process at the moment. We first separate in potato starch, and by the aid of apparatus made for this purpose, the grains having a diameter of from the fifteen-thousandth to the twenty-thousandth of a millimeter. These grains are divided into three parts, and colored respectively red-orange, green, and violet, by the use of special coloring matters, and by a process too prolonged to describe here.

The colored powders so obtained are mixed, after complete desiccation, in such proportions that the mixture shows no dominant tint. The resulting powder is spread by a brush on a sheet of glass covered with an adherent or sticky coating.

With suitable precautions we obtain a single coating of grains all touching and without superposition. We then stop, by the same process of powdering, the spaces which may exist between the grains, and which would allow the passage of white light. This stopping is accomplished by the use of a very fine black powder, as for example, charcoal.

We have by these methods formed a screen in which each square millimeter of surface represents two or three thousand small elementary screens of orange, green, and violet. The surface so prepared is isolated by a varnish possessing an index of refraction as near as possible that of starch. This varnish must also be as impermeable as possible, as it is coated with a thin layer of panchromatic gelatino-bromide emulsion. Exposure is made in the ordinary manner, in a photographic camera, taking the precaution always to turn the glass side of the plate to the lens, in order that the light may pass through the color particles before reaching the sensitive emulsion.

The necessity of employing emulsions of an extremely fine grain, and in consequence of a lower speed, and the superposition of a coating formed of a system of microscopic screens, render the necessary exposure longer than for ordinary photography.

Development is performed in the same manner as ordinarily, but as we have said, if the negative be fixed with hyposulphite, a negative is obtained which shows by transparence colors complementary to those of the object photographed.

If it is desired to obtain correct colors, we must, after development, but without fixing the image, proceed to reverse it by dissolving the reduced silver, and then by a second development reduce the silver which has not been primarily acted on by the light.

We see then that by simple manipulations little different from those used in ordinary photography, it is possible to obtain with these special plates, prepared as indicated, the reproduction, by means of a single plate and a single exposure, of objects in their natural colors.

A breach has been made in the Manchester Ship Canal at Runcorn, and when the tide is out water pours into the bed of the river Mersey at the rate of 70,000 to 100,000 gallons per hour. As, however, the tide sweeps into the canal twice in every twenty-four hours, no appreciable difference appears to be made in the level of the waterway. The danger lies in the possible undermining of the wall at this point. The "burst" has occurred at a point where there was experienced great difficulty in building the wall.

At the Kleinfontein shaft, in the Transvaal, 858 feet of sinking was done in the first five months of 1903. The dimensions were 21 feet by 6 feet, the rock was hard, and the maximum rate of progress in May was 7 feet 2.2 inches per hole bored, there being 4,032 holes, or 144 rounds.