Integral Photography

A New Discovery by Professor Lippmann

By the French Correspondent of the Scientific American

PROF. LIPPMANN of Paris is working on a very remarkable new photographic method which he has termed "integral photography." The nature of this is best explained by reference to the accompanying diagram. It should be remarked in the first place that the process is designed to work without a camera. The sensitized plate is coated with a large number of very small globules of glass or other transparent material. In use each of these acts as a miniature eye, with a sensitive plate for its retina. The globules are very small, less than one-hundredth of an inch in diameter. In front each has a little blob which acts as the lens of the miniature eye. Suppose an object to be situated at M M^1, as indicated in the diagram. Consider any globule. Rays from the points M M^1 will pass through the minute lens, and an image will be formed at the back of the globule upon the sensitized plate at M M^1. Thus each globule will contain a minute picture of the objects placed in front of the plate. This picture is brought out by developing the plate and fixing it in the usual way. This of course yields a negative, which must be reversed by the use of a suitable reversing bath. The result is a transparency, in which all the minute pictures in the individual globules are combined into one image of the original object. To view it, a good light is placed behind the plate, so as to send light through all the globules. Suppose the eye viewing the transparency to be placed at O, the point which when the picture was taken, lay on a line joining one globule with the point M of the object. The process which now occurs will be the opposite of what happened when the picture was taken. In other words, the eye will receive from the globule a view of the image m of the point M. Other globules will send images of the point M^1, etc., at the same time, so that the eye will see the different portions of the image coming from all the different globules. In this way a complete image of the object originally presented to the plate is seen. If the eye is placed at some other point O^1, or if O^1 represents the position of the other eye, the object will also be seen, but the light received at the eye will come from somewhat different portions of the globules, and the appearance presented will differ accordingly from that seen at O. The difference is of precisely the same kind as that which distinguished the appearance of the same object when seen from two different points. In other words, when passing from O to O^1, the observer will receive the same impression, in looking at the transparency, that he would if he were to move in this way while looking at the original object. For example, in one position a certain object might be hidden behind a tree, in the second position this object might become visible. Again, if O and O^1 should represent the positions of the two eyes, each will receive a slightly different impression, with the result that a stereoscopic effect is secured. This is explained by the fact that certain portions of the landscape appear in certain of the globules, but not in others. The image which the eye sees is made up of points coming from different globules, and as the eye moves, and different parts of each globule are viewed, the contribution which each sends to the eye is changed in accordance with the direction in which the eye is looking at the globule.

After working out this remarkable principle, Prof. Lippmann presented it before the French Academy of Sciences and other scientific societies, where it awakened great interest. The realization of the process presents considerable technical difficulties. Owing to their small size, it was out of the question to shape each one of the globules separately. Prof. Lippmann tried using minute glass beads, such as are found in commerce and used for covering ornamental surfaces, such as picture post cards. He found, however, that these were too irregular in shape and size. Another idea which suggested itself was to stamp out a transparent sheet of collodion and gelatine, giving the surface the requisite shape. But the dies required were found to be too difficult to make in the laboratory, so that Prof. Lippmann has been forced to abandon his attempts in this direction for the time being. The fact is that the working out of a process of this kind is a technical

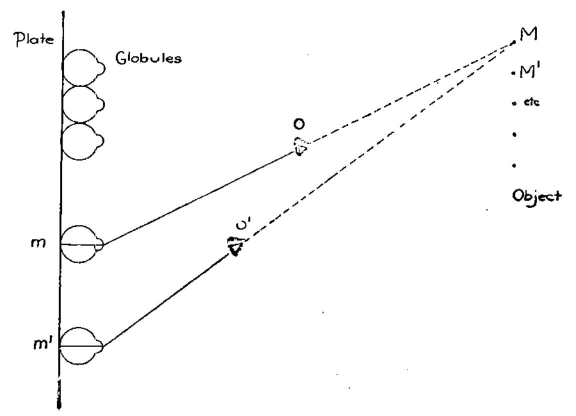


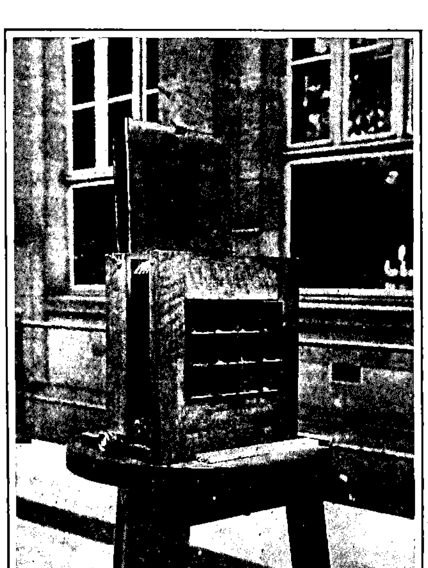
Diagram to illustrate the principle of Lippmann's integral photography.

rather than a scientific problem. There is a good field here for inventors to exercise their ingenuity, for if a Lippmann photographic plate could be made it would be of great value, inasmuch as in order to take a photograph the plate is simply exposed to a landscape or other object, without any camera at all, and the picture obtained possesses the remarkable properties explained above.

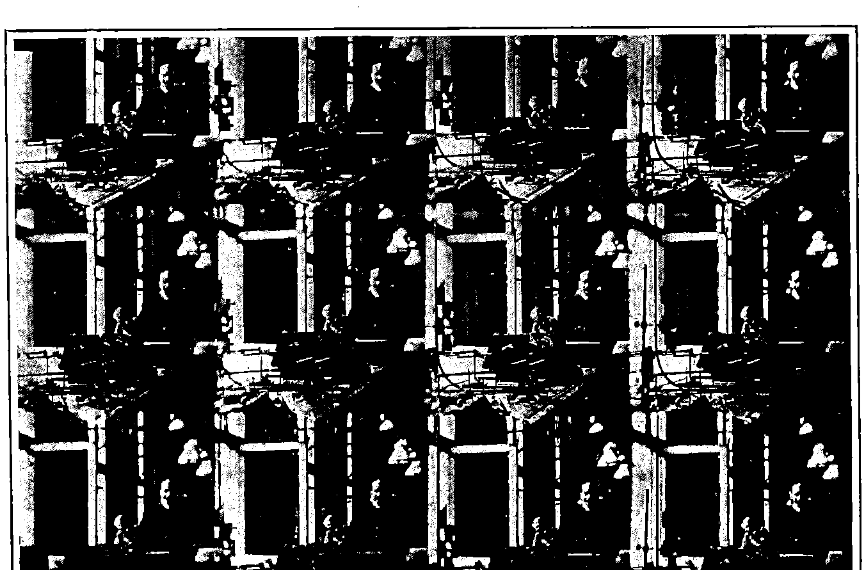
In the meantime Prof. Lippmann has been making some interesting experiments with an apparatus which is intended to show some practical results of the principle expounded, and without use of such minute globules he has succeeded in producing some very striking effects. A number of ordinary lenses (even spectacle lenses may be used) are cut into square shape, so that they can be fitted together into a continuous surface. A number of such lenses are put in the front wall of a camera, as shown in our illustration. The more lenses are used, the better is the result obtained, but twelve is found to be a sufficient number. These lenses correspond to the globules spoken of above, each image being formed on a separate portion of the photographic plate at the back of the camera. Each lens makes a picture on the plate, the portions of the plate illuminated by the several lenses being kept separate by an arrangement of black cardboard cells or partitions. One of our views represents the front of the camera with a set of twelve lenses, while the rear view shows the cells in the plate-holder. This latter carries a large plate of such size as to receive all the twelve pictures, and is placed in the camera as usual. The plate-holder, however, is made with a slide in the back as well as in the front, for a purpose which will appear presently. After the picture is taken, the negative is developed as usual, and is reversed either by means of a reversing bath, or by copying it, so that a transparent positive is obtained. The twelve pictures are not quite alike, for each lens forms its image from a somewhat different point of view. The transparency is put back in the holder, both slides of which are now opened, while light is sent through from behind. The observer looks in through the lenses with both eyes, when he sees a single view in relief of the object photographed. On moving the head from side to side, or up and down, the same effect is observed as would be under similar circumstances when looking at the real object, that is to say, objects which cover one another when looked at from one point, are seen to separate when viewed from another. Even with this simple apparatus the effect is very pleasing.

Proposed Aeronautic Map

AT a recent meeting of the Academie des Sciences, M. Lallemand, chief of the French Government Survey Department, presented the project which the Aeronautic Commission intends to carry out establishing an aeronautic map. The proposed map is of 1:200,000 size, and is drawn up after a provisory model made by the Aero Club. Each plate of the aeronautic map will be a sheet taking in one degree in latitude and longitude and there will be twenty-four such sheets included in one sheet of the world's map. This latter sheet occupies 6 degrees longitude by 4 degrees latitude. The longitude will be counted from 0 degrees to 360 degrees toward the east starting from the meridian lying exactly opposite to Greenwich, and the latitudes, or rather the distances from the South Pole, will be numbered from 0 to 180 degrees toward the north. Each sheet will carry a number which designates it. On the other hand, on the ground or the roof of a building will be traced a large square, and the position of that particular locality on the map is shown by a large circle or disk. To the left will be placed a large number showing the units of the latitude and to the right the figure for the longitude, but using only the unit figures in each case, as an error of 10 degrees, or from 400 to 700 miles, could hardly be made by a pilot as to his position, so that such figures will be enough to guide him. Thus he finds what leaf of the map he is to use for this locality. In order to make a trial of the new plan, it was decided that three specimen sheets of the map should be made by the Aero Club, and these will be put in the hands of the army pilots during the next annual maneuvers.



Prof. Lippmann's camera, showing the front with its twelve lenses.



View in Prof. Lippmann's laboratory. A twelve-fold image formed by as many lenses.

The rear of the camera, showing the cells and plate-holder.

APPARATUS AND RESULTS OF THE NEW LIPPMANN METHOD OF PHOTOGRAPHY