can be used to hold the needle to the table. The other end of the needle is to be formed with a V-shaped point, fairly sharp. Just below the point a slot is made about one-eighth of an inch wide by half an inch long, or long enough to pass the ends of the pieces of cloth through.

To sew the pieces together, which can be done very rapidly, after a little practice, press one end of a length of cloth down upon the needle until it passes the eye. Likewise, one end of another piece is pressed down upon the first. The other end of either piece is then threaded through the eye for a short distance, as shown in Fig. 3.

The whole is then lifted up until the threaded end falls below the other two, when it is pulled all the way through.

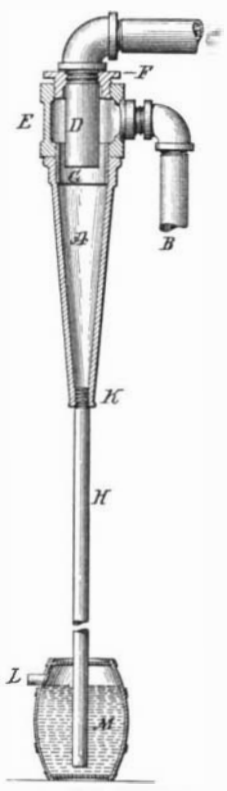
It will be found that these joinings are perfectly flat and satisfactory.

Figs. 1 and 2 show the two styles of clamps, one with a foot, to be held to the table by means of a thumb-screw clamp, and the other with a screw attachment, to be held to the edge of the table by means of an ordinary wood screw.

HOME-MADE VACUUM CLEANER.

BY W. J. C.

The installation of a vacuum cleaning system in private houses entails at present a considerable expense, as it includes the purchase and maintenance of a gasoline engine and vacuum pump. If the latter two machines were eliminated, and a simple method of obtaining the required vacuum devised, this great labor-saving device would be much more in evidence, even in homes of moderate size.



HOME-MADE VACUUM CLEANER.

This object can be realized by use of the ejector or ordinary barometric condenser used in connection with the city water supply or from a tank.

The entire arrangement can be built at the rear of the dwelling, and does not take up more room than an ordinary leader pipe.

The illustration shows the arrangement of the device. *A* is an ordinary hose nozzle 12 inches long, with thread for 3-inch iron pipe on large end and tapped for ½-inch pipe on smaller end.

By means of the nipple *G* it is connected to a 3 x ¾-inch tee, which is bushed on the opposite end to 1 inch. This bushing has a 1-inch pipe *D* extending from the inside and ending as shown in the cut just inside of nozzle. The other end of *D* protrudes through the bushing *F*, and is then run as afterward described. The smaller end of the nozzle carries a ½-inch pipe *H*, which forms the down leg of the ejector. The apparatus is placed so that the point *K* is at least 34 feet above the cellar, forming the barometric column. The pipe *B* is connected with the water supply, with a conveniently situated valve to regulate the flow.

The pipe *H* is carried down to a seal pot *M* situated in the cellar. This can be made of a barrel with an overflow to sewer, as shown at *L*.

The pipe *C* is carried to a vacuum reservoir, which can be situated either in cellar or attic, preferably the latter, as it means a saving in piping and less joints to provide chance of leaks. This pipe is connected to top of reservoir, and the service pipe to the various rooms also comes from the upper end, but extends to within 12 inches of the bottom.

The service pipe has a connection for rubber hose, with valve at each floor.

In order to obtain the required vacuum, all that is necessary is to turn on the water in the pipe *B*, when the descending column in *H* causes a partial vacuum in the reservoir and in the service pipes.

Care must be taken that all joints are made perfectly air-tight in service pipes and in *C*.

The reservoir must also be air-tight. It can be made of a kitchen boiler with a small hand-hole cut in the bottom to remove dust which collects within.

The ejector can be placed outside without danger of freezing if precaution is taken to break the vacuum when through using, thereby emptying the down leg of all water.

The down leg need not be straight if the first bend is at least 10 feet from the nozzle.

This device is not intended to supply a vacuum cleaning system for large buildings, but rather for private dwellings, and can be put up by anyone accustomed to handling pipe and competent to make good tight joints.

A STEREOSCOPE FOR SINGLE PHOTOGRAPHS.

BY PROF. GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

Some stereoscopic relief is usually perceived when a photograph is examined at a very short distance

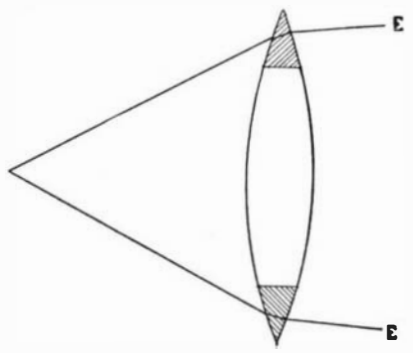


Fig. 2.—BINOCULAR VISION THROUGH A LARGE LENS.

through a pinhole. The relief is increased when the drawing or photograph shows some positive distortion, but however strong may be that relief in some cases, it always disappears at once when both eyes are used, with or without pinholes. The impossibility to get binocular stereoscopic relief in such circumstances has for probable cause the very fact which makes it possible to get stereoscopic photographs; the image of a protruding or receding object which is not far from us is not the same for each one of our two eyes. The right eye sees more of the right side of the protruding object; the left eye sees more of the left side. Whenever both images are identical, everyday experience has taught us to consider the object as perfectly flat, although it might be the faithful reproduction (so far as outlines, shades, and color are concerned) of a long rifle directly aimed at us. That the object is near, we instinctively infer from the converging effort our eyes are making; that it is flat is none the less evident, as both eyes see it alike in spite of its proximity. One eye might be deceived; two eyes cannot be as long as they are obliged to converge and, while so doing, get two different images of any *true* relief.

Would the result be the same if some artifice were used to prevent them from converging while examining simultaneously, through two diaphragms, a flat drawing or photograph? To give an answer to this question, the writer has devised an apparatus which is a very simple piece of work and requires but a minute or two for its making. It does not seem at first to deserve the name of stereoscope for single photographs, as it requires two pictures. One and the same negative, however, is used to make both of them, and the two pictures on Fig. 1 differ from ordinary stereoscopic photographs in being identical.

In a rather large piece of dark-shaded pasteboard, two circular holes are cut out. Their diameter should be about ½ of an inch, and the distance between them (this being measured from their centers) should be exactly 2½ inches. Fig. 1 is placed at a distance of about two feet from the eyes, and the piece of pasteboard with the holes at about six inches from the eyes. Through the holes the observer looks at the two pictures without making any effort to see them distinctly, his eyes being completely at rest, as if they were directed in an absent way toward some far-away object. As this is being done, the two holes seem to get nearer each other, and at last will merge into one and the same hole. So will apparently the two photographs, and relief will be manifest.

Fig. 1.—THESE PHOTOGRAPHS ARE IDENTICAL BUT SHOW STEREOSCOPIC RELIEF WHEN VIEWED THROUGH A DOUBLE DIAPHRAGM.

The experiment throws some light on the hitherto unexplained cause of the relief which appears when a photograph is examined through a lens large enough to allow binocular vision through its two opposite marginal parts. Such relief is probably the direct consequence of the decreased convergence of the eyes. The same explanation holds good for the relief obtained with two convex prisms which act exactly as the opposite segments of a large lens, the eyes being in *E E* (Fig. 2). Parallelism of the optical axis of the eyes seems again to be the only sound explanation of the relief perceived when Javal's iconoscope or Giraud Teulon's binocular ophthalmoscope is used to examine flat drawings. In all such apparatus the convergence of the optical axis is decreased or suppressed, and the eyes are thereby prevented from applying the only test by which they can readily distinguish the real object from its *facsimile* drawing or photograph.

Some people (about one in every four, if a limited number of observations is to be trusted) cannot obtain the fusion of the two images. On putting on a pair of convex spectacles, such observers generally get the desired result. The explanation of this curious fact probably lies in the difficulty we meet in dissociating the convexity of the crystalline lens from the convergence of the eyes. When we are looking at some near object, the eyes become convergent and the crystalline lens becomes more convex. When we are looking at a considerable distance, the axes of the eyes become parallel and the crystalline lenses are flattened. Thus an intimate connection is established between the convergence of the eyes and the convexity of the crystalline lens; and to exact at the same time

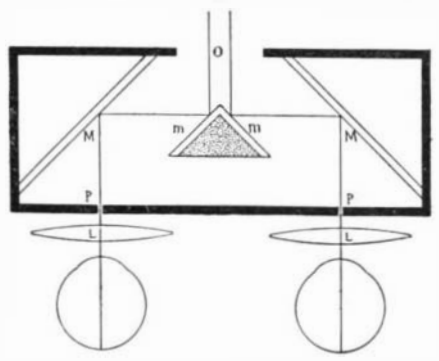


Fig. 3.—A POWERFUL STEREOSCOPE FOR SINGLE PHOTOGRAPHS.

increased convexity of the crystalline lens because the object is near, and parallelism of the eyes as if the object were far away, is for some people as difficult a task as it is for anyone to move independently the fingers of both hands during a first piano lesson. Convex lenses relieve the crystalline lens from part or from the whole of its task; this is probably the way in which they contribute to the fusion of the two images during the experiment just described.

The strongest binocular relief which can be had with *single* photographs or drawings requires the use of an easily made little apparatus, the main features of which are two pinholes, *P P* (Fig. 3), four mirrors, *M*, *M*, *m*, *m*, and two biconvex 3-diopter common spectacle lenses, *L L*. The localization of the rays in the crystalline lens and the exaggerated curvature of the focal surface are produced by the opening in *O*, far from the eyes, and by the pinholes in *P P*, which allow to bring the picture within a reduced distance from the apparatus. The parallelism of the optical axis is obtained, as in Javal's and Giraud Teulon's instruments, through two consecutive reflections of the luminous rays. The more or less complete relaxation of the crystalline lens is produced by the lenses placed between the pinholes and the eyes. If they are suppressed, the relief does not much decrease, but then a considerable number of observers fail to get the two images to coincide. As in the case of the piece of pasteboard, one must look into the apparatus as if the object to be seen were far away and without making any effort to see it.

Fig. 3 is on the scale of six inches to the foot. The inside of the box containing the mirrors must be blackened. The mirrors are kept in place with straps of black paper. Although standing below the average in manual ability, the writer made his own apparatus without meeting any greater difficulty than the exact setting of the small mirrors vertically and at a horizontal angle of 45 deg. with the sides of the box.