by means of swing lines, which are controlled by auxiliary engines devoted entirely to this purpose. All of the larger dredges are provided with individual electric light plants; so that the work can be carried on night and day if desired. On the largest excavator a crew of fifty men is employed, divided into shifts of eight hours each. This number is sufficient for all purposes requiring manual labor.

As fast as the meadow is filled in to the requisite height, the pipe lines are removed to another section. Around it is constructed a dam of earthwork, with openings or weirs left at frequent intervals through which the water escapes. On the section of the filled land nearest the ocean, the water discharged through the conduits has been carried into the sea by means of a pipe line. By employing this method, the only work required, except that performed by the excavators, has been to grade the surface with horse machinery. Fortunately, most of the material which has been taken out of the meadows consists largely of sand, from which the water escapes quickly, leaving a dry and firm formation. Already an eight-story hotel has been constructed upon this made ground without any difficulty due to settlement.

It can well be said that a new city is being created upon this worthless salt marsh, for the portion which is being filled in is of sufficient area to allow 7,500 dwellings to be erected in addition to the necessary space for streets and avenues. A sewerage system is being constructed which will drain into Delaware Bay; but owing to the slight fall, the system will be served by a pumping station having a capacity for handling 360,000 gallons an hour. At the present time, five excavators are removing the marsh to a depth of about 40 feet at the rate of ten acres a month. It is an interesting fact that the largest of these dredges, which was designed by Mr. Frank Furst, of Baltimore, was built at Orange, Texas, and towed up the Atlantic coast to Sparrows Point, where its machinery was installed. It was then taken by sea to the present scene of operations. This excavator probably has the largest capacity of any in the world for removing material by the suction method. The work is being performed under the supervision of Ellis Thompson, chief engineer, and Charles W. Tarr, resident engineer.

A CURIOUS ILLUSION.

BY GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

When we are looking at anything, the image of what we see paints itself on the retina as it would on the ground glass of a photographic camera, upside down. Through some nervous process we invert again the upset image and set it or rather see it right. In the following experiment the opposite operation is made. An image which, through some artifice, is made to paint itself right side up on the retina is turned over by the general upsetting process and appears to us to be upside down.

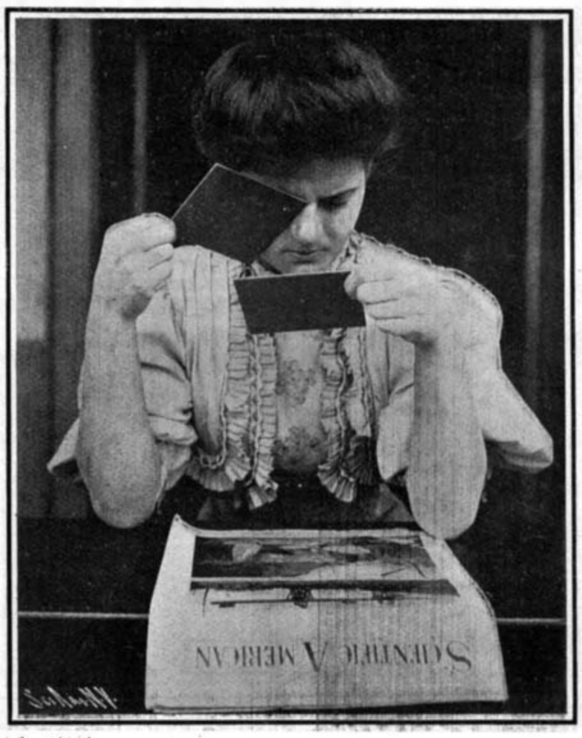
Take two pieces of dark-shaded pasteboard. In the center of one, bore a pin hole. Near a corner of the other make a cluster of three pin holes arranged about as the angles of an equilateral triangle, and at a distance of about 1-16 of an inch from one another. Lay on the table before you a well-lighted sheet of printed matter. Place the card with the three holes in contact with your eye, and through the cluster of three holes look at the center of the other card, this being placed between your eye and the printed matter at a distance of from two to four inches from your eye.

The cluster of holes through which you are looking will then seem to you to be a single aperture and the single hole in the center of the card which you hold far away from your eye will seem to you to have vanished but, instead of it, you will distinctly perceive, on the same card, three holes through each one of which you can easily read a different part of the printed text. These three holes are unlike those which you made on the card kept near your eye, for if the latter are arranged thus: $_{0}{}^{0}{}_{0}$ those on the card which you examine will be arranged in the opposite way: $^{0}{}_{0}{}^{0}$ and *vice versa*.

As the single luminous hole on the card you hold at a distance from your eye is still abnormally close to it, its image will be formed behind the retina or, in other words, the rays will strike the retina before meeting. In ordinary circumstances this fact causes the image to be blurred, but as, in this case, only thin pencils of light are admitted, the rays of which they are made may be considered as nearly parallel and a tolerably good image of the hole will be formed even at some distance of the point where the rays meet. Photographers take advantage of that property of a thin pencil of light whenever they use a small diaphragm to get "depth of focus." Moreover, as the pencils themselves strike the retina before having crossed each other, the triangle they form on the retina is arranged just as it is on the card, right side up. The nervous element, however, blindly upsets this image as it does upset ordinary inverted images, and this gives us the queer sensation of seeing upset what we know to be erect.

If the card with the central hole is now slowly drawn farther away from the eye the three luminous holes get nearer each other and finally unite into one and the same image. The position of this coincides with that of the retina.

At that stage of the experiment, if the observer is short sighted, even to a slight degree, he will find that, on withdrawing the card still farther, nearly at full arm length, the three luminous dots reappear, but, this time, right side up. Owing to an abnormal convexity of the crystalline lens the image is formed before the retina; the luminous pencils have crossed each other before striking the retina; the image is inverted; the eye inverts it again and it is therefore seen right side up.



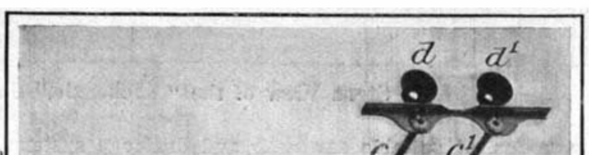
A CURIOUS OPTICAL ILLUSION ILLUSTRATING INVERSION OF IMAGES.

AN X-RAY STEREOSCOPE.

BY DR. ALFRED GRADENWITZ.

In connection with the use of X-rays for medical purposes one of the most important tasks, as is well known, is to ascertain the location of foreign objects in the human body. Now the depth of such foreign bodies can be generally found only by taking two views from points ninety degrees apart. However, this process is frequently rather troublesome, requiring as it does a placing of the patient in different positions, which is not always practicable. Moreover, the heavier bones frequently prevent the taking of such views.

Endeavors have therefore been made of late to produce stereoscopic X-ray diagrams, and to determine from the plastic picture the desired depth. In this process, however, which has been applied with more or less success, the relief is only apparent, being due to the lack of sharpness of a combined picture produced by superimposing a negative and a positive X-ray diagram. The results derived from the inspection of such pictures thus hardly justify the expenditure of time and trouble made in preparing them.



THE X-RAY STEREOSCOPE INVENTED BY DR. GILLET OF BERLIN.

Dr. J. Gillet, a military surgeon, of Berlin, has **suggested a novel method, dispensing with the pro**duction of relief effect and securing in place thereof an accurate measure of the depth in question. The "X-ray stereometer" invented by him and constructed by Heinz, Bauer & Co. is based on the well-known principle of stereoscopic vision.

If two corresponding stereoscopic picture points (that is to say, two corresponding points on photographs of the same object, obtained by displacing the objective through the distance between the eyes) be inspected in such a way that the left-hand picture is observed by the right eye, and the right-hand picture by the left eye, the convergence of the optical axes will result in the two corresponding points being combined to a stereoscopic picture suspended in space, the crossing being the point at which the picture appears. This point can be located in the following manner with the naked eye:

A pointed object, e. g., a pencil, is kept midway between the two corresponding points, immediately in front of the latter, and while the pencil is slowly approached toward the nose at right angles to the plane of the picture, both eyes should attempt simultaneously to fix the picture points and the point of the pencil, when the former will be found to approach each other more and more as the pencil point is moved away from them until they finally coincide with the latter at a single point, the crossing in question. Whenever the pencil is moved a short distance sideways, forward, or backward, the crossing is at once decomposed into two different points, thus showing the accuracy with which this point is located.

The distance of the crossing from the two corresponding picture points is dependent on the distance between the eyes and the picture and, on the other hand, on the mutual distance of the axes of the eyes, being the greater as the latter is smaller and the former greater. The distance of the eyes from the picture has, however, alone to be taken into account in ordinary practice, the mutual distance of the axes of the eyes being generally constant, viz., equal to about 65 millimeters (2.6 inches).

From the above, it will be readily understood why it is only necessary to prepare two corresponding X-ray diagrams with a lateral displacement of the X-ray bulb of some 65 millimeters, in order immediately to read (after adjusting for the crossing with the naked eye) the distance between the X-ray plate and the foreign body in question; the vertical distance between the anticathode and photographic plate (viz., the focal distance) should obviously be given.

The parallel extensible brass tubes *a a'*, *b b'*, *c c'*, consisting of three sections, correspond, when fully extended, to a focal distance of the X-ray tube of 24 inches, which, after folding *c c'*, decreases 20 inches, and after also folding *b b'* from 4 inches to the smaller focal distances of 1.6 inch and 1.2 inch respectively.

The glass plate, *s*, provided with a vertical millimeter scale, serves as searcher, and is adjusted longitudinally of the instrument and transversely of the X-ray shade of the foreign body in question, by means of two special pinions. The millimeter scale plays the same part as the pencil point in the fundamental experiment described above, allowing the depth of the stereoscopic image to be determined. By means of two pointers the foot points of the stereogram can be so adjusted with regard to the lenses *d* and *d'*, as to be traversed by the lines of vision striking the picture. These lenses, secured to the front ends of the brass tubes, *c c'*, are situated apart a distance of 2.6 inches.

Measurements are carried out by means of the apparatus in the following manner:

The X-ray stereogram, covered with a squared celluloid sheet, is so adjusted that its foot points coincide with the pointers. The tube having then been drawn out to the actual focal distance, the stereoscopic picture should be searched by means of the glass plate, *s*, until it is cut by the vertical black line on the glass scale. The distance of the glass plate from the stereogram should finally be read on the millimeter scale, whereby the distance of the foreign body will be obtained.

This process, it is true, implies the capacity of stereoscopic vision, that is, the capacity of imparting to the axes of the eyes a certain convergence toward the center. In the case of observers lacking this capacity or having no practice in this respect, the process will be a little more complicated:

The right eye having been closed, the glass scale should be so adjusted by means of the left eye that its black middle line passes through the right-hand shadow of the object in question. The left eye should next be closed and the right eye be used in the same way for adjusting the left-hand shadow. After thus finding a position of the middle line in which both requirements are complied with without any alteration, that is, simultaneously, the scale line will have been brought to the proper position, and by simply reading its distance from the plate on the scale of the pinion, the height of the foreign body above the **surface of the plate will be found.**