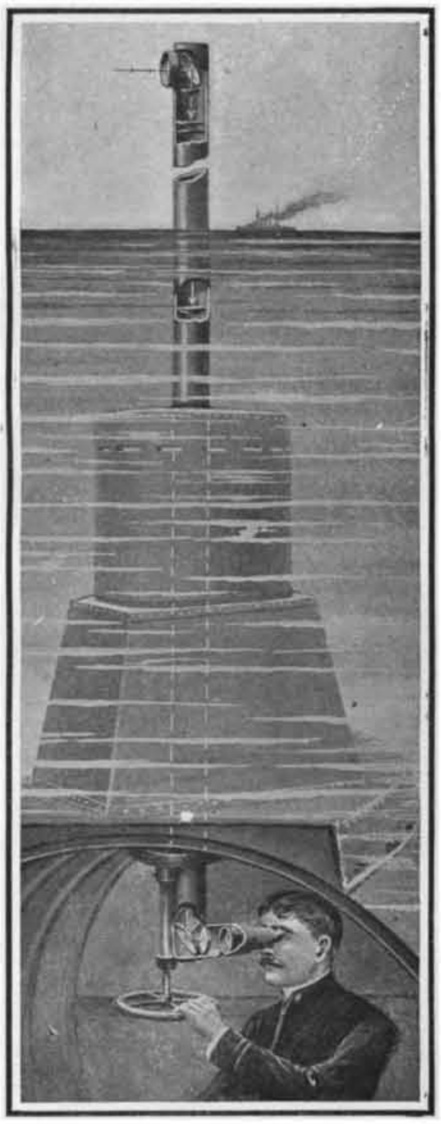
AN ALL-SEEING EYE FOR THE SUBMARINE.

Vision under water is limited to but a few yards at best, and hence a submarine boat, when submerged, would be as blind as a ship in a dense fog and would have to grope its way along guided only by chart and compass, were it not for a device known as a periscope, that reaches upward and projects out of the water, enabling the steersman to view his surroundings from the surface. Of course the height of the periscope limits the depth at which the craft may be safely sailed. Nor can the periscope tube be extended indefinitely, because the submarine must be capable of diving under a vessel when occasion demands. But when operating just under the surface, where it can see without being seen, the craft is in far greater danger of collision than vessels on the surface, because it must depend upon its own alertness and agility to keep out of the way of other boats. The latter can hardly be expected to notice the inconspicuous periscope tube projecting from the water in time to turn their great bulks out of the danger course.

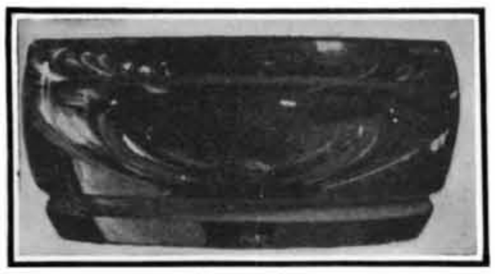
The foregoing article describes the type of periscope now in common use on submarines and one of the engravings on this page clearly illustrates the principles of the instrument. A serious defect of this type of instrument is that the field of vision is too limited. The man at the wheel is able to see under normal conditions only that which lies immediately before the boat. It is true that he can turn the periscope about so as to look in other directions, but this, of course, involves considerable inconvenience. On at least two occasions has a submarine boat been run down by a vessel coming up behind it.

As long as the submarine has but a single eye it would seem quite essential to make this eye all-seeing; and, since the two lamentable accidents just referred to, an inventor in England has devised a periscope which provides a view in all directions at the same time. This has been attempted before, but it has been found very difficult to obtain an annular lens mirror which would project the image down the periscope tube without distortion. The accompanying illustrations show how this difficulty has now been overcome. While we will not attempt to enter into a mathematical explanation of the precise form of the mirror lens, it will suffice to state that it is an annular prism. The prism is a zonal section of a sphere with a conoidal central opening and a slightly concave base. All the surfaces, however, are generated by arcs of circles owing to the mechanical inconvenience of producing truly hyperboloidal surfaces. The lens mirror is shown in section at *A* in Fig. 1. The arrows indicate roughly the course of the rays into the lens and their reflection from the surface *B*, which is preferably silvered. The tube is provided with two objectives *C* and *D* (Fig. 3) between which a condenser *E* is interposed at the image plane of the lens *C*. At the bottom of the periscope tube the rays are reflected by means of a prism *F* into the eyepiece. Two eyepieces are employed. One of low power, *G*, is a Kelner eyepiece, the purpose of which is to permit inspection of the whole image, while a high-powered eccentrically placed Huyghenian eyepiece, *H*, enables one to inspect portions of the image. The two eyepieces are mounted in a rectilinear chamber, *I*, which may be rotated about the prism at the end of the periscope, thus bringing one or other of the eyepieces into active position. The plan view, Fig. 4, shows in full lines the high-powered eyepiece in operative position, while the dotted lines indicate the parts moved about to bring the low-powered eyepiece into use. A small catch, *J*, shown in Fig. 2, serves to hold the chamber in either of these two positions. The high-powered eyepiece is mounted on a plate, *K*, which may be rotated to bring the eyepiece into position for inspecting any desired portions of the annular image. The parts are so arranged that when the eyepiece is in its uppermost position, as indicated by full lines in Fig. 2, the observer can see that which is directly in front of the submarine, and when the eyepiece is in its low position, as indicated by dotted lines, he sees objects to the rear of the submarine. With the eyepiece at the right or at the left he sees objects at the right or left, respectively, of the submarine. The high-powered eyepiece is slightly inclined, so that the image may be viewed normally and to equal advantage in all parts. Mounted above a plain unsilvered portion of the mirror is a scale of degrees which appears just outside of the annular image. A scale is also engraved on the plate *K* with a fixed pointer on the chamber, making it possible to locate the position of any object and rotate the plate *K* so as to bring the eyepiece *H* on it. The scale also makes it possible to locate the object with respect to the boat.

This improved periscope is applicable not only to submarine boats but for other purposes as well, such as photographic land surface work, in which the entire surroundings may be recorded in a single photograph. The accompanying photograph taken through a periscope of this type shows the advantages of this arrangement and gives an idea of its value to the submarine observer when using the low-powered eyepiece. Of course, by using the other eyepiece any particular part of the view may be enlarged and examined in detail.

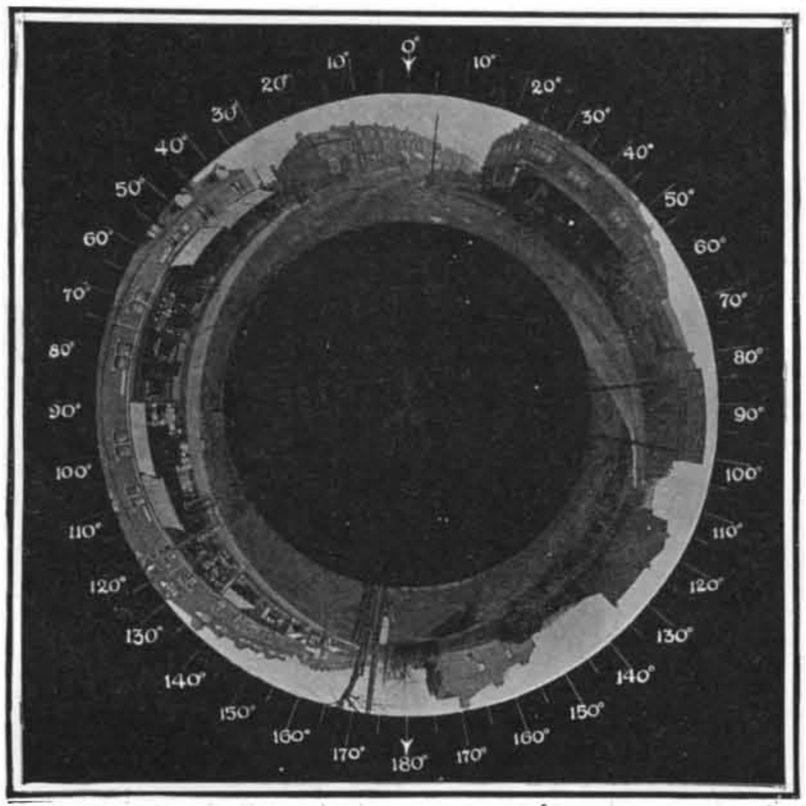


Periscope in general use.

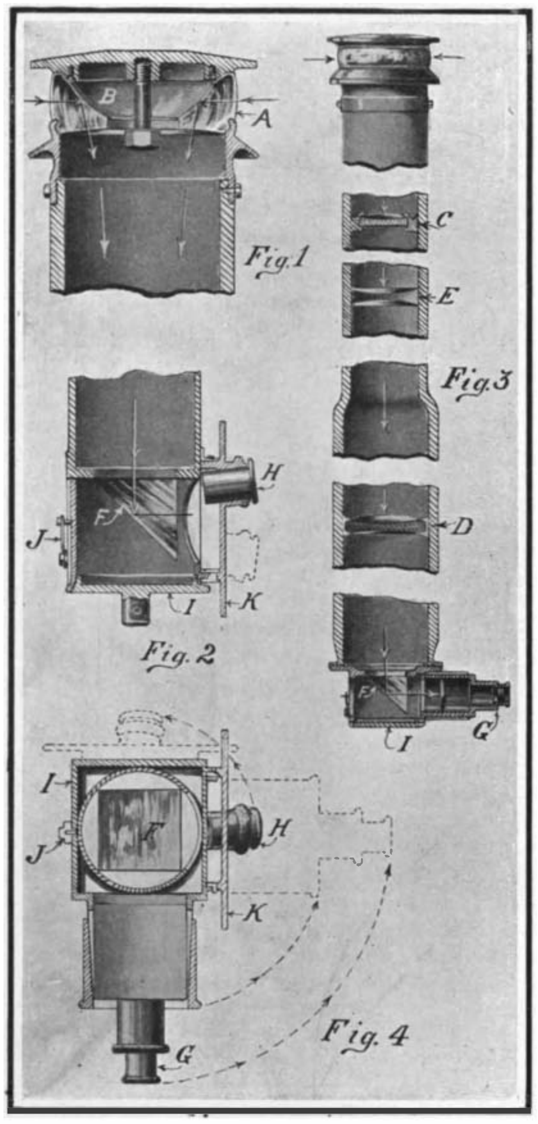


The universal observation lens.

The periscope top.



A photograph taken with the periscopic universal lens.



British periscope with universal eye.

FORMS OF PERISCOPES FOR SUBMARINES. THE EYE THAT LOOKS IN ALL DIRECTIONS AT ONCE.

Cement for Meerschaum.—Stir very fine meerschaum chips with white of egg or dissolve caseine in water glass, stir in finely powdered magnesia and use the cement at once. It hardens very quickly.

Red and White Meat.

The flesh of cattle, sheep, horses, wild hogs, deer, hares, pigeons, ducks, geese, and salmon is red or dark colored, while the flesh of calves, domestic hogs, rabbits, trout, pike, all flat fishes, lobsters, and crabs is white or pale. In fowls, white meat is found in the breast, dark meat in the legs and thighs. The contrast is most sharply marked in wild fowl. In frogs, on the contrary, the legs are white and the rest of the flesh is dark. The mackerel, the eel, and many other kinds of fish also have both white and dark flesh.

Knobloch has shown that this anatomical distinction between white and dark muscles runs parallel with the distinction between agile and sluggish muscular fibers, which has been established by physiological experiment. In general, pale muscles are more active than dark or red muscles. They contract more quickly, but they become fatigued sooner than the dark muscles, because they produce, in performing the same amount of work, a larger quantity of lactic acid, which is the fatigue product of muscles. The two classes of muscular fibers differ also in sectional dimensions. The adductor, or shell-closing, muscle of the mussel consists of a white and a gray portion, which can be clearly distinguished from each other, and the presence of both kinds of fibers is explained by the habits of this mollusk.

The mussel propels itself through the water by quickly opening and closing its shell, but in the presence of danger it keeps its shell closed for long periods. The rapid swimming movements are started by the pale and agile muscular fibers and maintained by the automatic operation of the dark, sluggish fibers, which also serve to hold the shell closed. The same biological law of division of labor appears to govern the character of the muscular structure of higher animals. The relative proportions of pale, agile fibers and dark, sluggish fibers are determined by the method of locomotion. The incessantly leaping frog possesses a much larger proportion of white muscle than the slowly creeping toad. The leg muscles of fowls are dark because the legs almost continually support the weight of the body, but the breast muscles are white because the wings are used only occasionally, and for short periods. The dove, continually on the wing, has dark-colored breast muscles. The flesh of the sportive calf and lamb is white, while that of the contemplative cow and sheep is red. The ever-active heart and respiratory muscles, and the very frequently-used muscles which move the eyes and jaws, are red. The flesh of calves and lambs and the white legs of young chickens darken with advancing age. Knobloch infers that the white muscles represent the primitive stage, through which every dark muscle has passed.—Prometheus.