pastures new, maybe far from its parents' home.

When excavating their burrows they make pellets of earth in their jaws, which they bring up to the mouth of the tube and kick away with their feet. From the first they make their burrows larger than they seem to require, so as to allow of their growing, so doing away with the necessity of building larger from time to time as they increase in size. The burrows are of considerable depth, often extending to over a foot. They change their skin from time to time, the first taking place within the cocoon, and the second moult often while on their mother's back. Before their span of life is over they change their coat some nine or ten times, living as long as three years if fortunate enough to escape the pursuit of scorpions, their inveterate enemy. During the winter they hibernate, and when the cold nights come round many die in their burrows, those which escape being the fortunate ones which have chosen as a site for their nest some sunny slope facing the south, maybe under a bush, protected from the cold north wind. One of the greatest enemies spiders have to contend with is a species of hymenopterous (wasp-like) insect, which

lays its eggs in the cocoons, and whose grubs when they hatch feed on the eggs of the spider. It is probably for this reason that the female so religiously guards her treasure and clings to the cocoon night and day. With some few species, however, the female, after having deposited the eggs, just before the time has arrived for the young to hatch out, forms a silken dome-shaped nest, in which she resides for a time with her numerous family, helping them in their early days to get their own living. Some carry the cocoon in their jaws held by their palpi, small leg-like feelers attached to their lower jaw, while others hold it between the abdomen and sternum, having to straighten out their legs as far as possible to carry their body high. Some species are found in abundance in marshy places and in the neighborhood of water, being able to run on its surface and dive down into its depths in search of prey, remaining under for nearly an hour. Many lead a vagabond sort of existence, and, like wandering gipsies, roam from place to place, with no permanent home or hiding-place, miniature tramps in the lanes and byways, some days rolling in luxury, on others knowing not

where to get a meal. Others are as skillful in making an abode as the trap-door spiders, forming nesting burrows very similar in character to those of the last named. The turret spider (*L. arenicola*), found in many parts of America, builds a turret of sticks and stones at the mouth of its tube, while another American species (*L. carolinensis*) builds a funnel-shaped tube at its entrance, concealed in the grasses around. One interesting species found in Russia (*Tarantula opifex*) builds a trap door to its tube; the lid, composed of layers of silk and dirt, being made thin toward the hinge and thicker in front, falls to its own weight. As with the nests of the trap-door or tunnel-weaving spiders, they vary in form between a single tube and the exquisitely-constructed silk-lined burrow having a hinged lid. At the commencement of winter the Lycosids often seal up their burrows with silk, keeping them closed until the spring, when they emerge with renewed life and energy after a long hibernation. The well-known *Lycosa tarantula* of Southern Italy, around which so many fables and yarns have been spun, is an allied species to the Lycosid, whose life history I have attempted to describe.

TWO REMARKABLE SENSE ORGANS.

A HEAT-FEELING EYE AND A SEARCHLIGHT EYE.

BY DR. WILHELM ROTH.

EVEN more remarkable than the gradual evolution of so important an organ as the eye from a very rudimentary form to the perfection which it attains in the human species is the fact that certain lower animals possess very elaborate organs which closely resemble the eyes in anatomical structure but perform functions that are yet little understood. These organs, which are of two distinct types, are found in certain cuttle fishes that live in the depths of the Mediterranean Sea.

One of these organs, which has been called a thermoscopic eye, is shown in section in Fig. 1. It is a globular body, covered by a protuberance of the epidermis *E*, and consists of a mass of large transparent cells *T*, a bundle of nerves, and a lens-shaped body *L*. This lens, however, is not transparent. On the contrary, it is so filled with black pigment that it is evidently quite opaque to luminous rays. Hence this organ cannot be an organ of vision but, as black substances possess great power of absorbing radiant heat, Joubin has expressed the opinion that it is an organ of heat per-

FIG. 1.—THERMOSCOPIC EYE OF A CUTTLE FISH (*CHROTEUTHIS BOMFLANDI*).

ception. Indeed, the layers of flat cells behind the lens bear suggestive resemblance to the elements of the thermo-electric pile, which is exceedingly sensitive to radiant heat. But we are quite "in dark" concerning the possible use of such an organ to a creature living in the ice-cold depths of the sea in almost total darkness and also possessing two highly developed eyes of the usual type.

We know a little more of the function of the second eye-like organ (Fig. 2), the structure of which indicates that it is a lantern designed for the generation and projection of light. Here, as in an eye, we see a lens (*L*), a transparent mass (*K*), corresponding to the vitreous humor, a layer of cells (*Ph*), corresponding to the retina, and a bundle of nerves (*N*), but the recent researches of Joubin prove that the function of the organ is the production and projection, not the perception, of light. It is true that no human eye has beheld the light produced by these organs which are imbedded in the skin of certain cephalopods, but they are almost identical in structure with the known luminiferous or phosphorescent organs found in some species of crustacea. When regarded from this point of view the organ may be described as follows: The nerve bundle (*N*, Fig. 2) pierces the pigment screen (*P*), which protects the adjacent tissues from the light produced in the organ, then traverses a layer of tissue (*R*), the inner surface of which is smooth and

glistening and acts as a reflector, and terminates in the layer of nerve cells (*Ph*). This layer of nerve cells, which is called the photogenous layer, is the source of the light, which is projected outward by means of the concave mirror (*R*), the vitreous cone (*K*), the biconvex inner lens (*B*), and the concavo-convex outer lens.

Now the axis of this remarkable animal lantern is not perpendicular to the surface of the body, like the axes of thermoscopic and ordinary eyes, but is almost parallel to that surface. The rays emerge parallel to the bottom of a shallow depression in the skin and it has been discovered that this depression serves as a second reflector for the luminous rays which penetrate the transparent epidermis (*O*) and are bent nearly at right angles by reflection from the broad concave mirror (*Sp*), as is indicated by the arrows in the illustration. The organ has never been observed in a state of activity and I do not know that any but a conjectural explanation of this peculiar arrangement has been found. The effect of the arrangement would be to prevent the phosphorescent organs, which are distributed over the tentacles and the mantle, from showing as separate luminous points (as they would appear if their axes were normal to the surface) and to surround the predatory cuttle fish with a mild radiance which may at once attract its prey and prevent the latter from seeing it distinctly.—Umschau.

THE COLOR OF RED GRAPES.

THE coloring matter of red grapes appears to be an oxidation product of a tannin derivative present in the green grapes of either red or white vines. Thus it has been shown by M. Laborde that on heating the solid matter from either kind of green grapes for thirty minutes under pressure with two per cent of hydrochloric acid, an intense wine-red solution is obtained. A similar chromogenic property is possessed by the tannins of cherries, plums, and other fruits, but not by the tannin of oak-bark. A bright wine-red color is also obtained when the solution of one of these fruit-tannins is boiled with a little caustic alkali, and the color is permanent so long as air is excluded. If, however, the liquid be exposed to atmospheric oxidation for some hours the color slowly changes to pale yellow.

From the results of M. Malvezin's experiments, it appears that the formation of color from the chromogenic substances depends upon the simultaneous action of air and heat, and possibly of light as well. Thus when green grapes from a red vine were sealed in a tube containing water but from which all air had been removed, no red coloration was produced on heating, whereas the same kind of grapes became strongly red when placed in water and exposed for twenty-four hours to the air at a temperature of about 85 deg. C. Green grapes from a white vine were also changed to a red color when placed under the same conditions, which shows that they, too, contain the chromogenic substance. In the change that occurs naturally in the grape upon the vine, an important part is probably played by the presence of a specific enzyme (ferment), which acts as a conveyor of oxygen from the atmosphere to the chromogenic substance, and the non-occurrence of the change of color in white grapes must be attributed to their lacking this enzyme. Similar specific oxidizing enzymes, termed *oxydases*, are present

in numerous plants, and are a main cause in the discolorations that take place when a cut apple or potato is exposed to the air, and of the bright blue coloration which rapidly appears when certain kinds of *boletus* are broken.—Knowledge and Scientific News.

Recent tests by naval officers of "man-lifting kites" proved, it is reported, that observations taken at a height of 2,000 feet to 3,000 feet will be of great ser-

FIG. 2.—LUMINOUS ORGAN OF A CUTTLE FISH (*HISTIOTEUTHIS RUPPELLI*).

vice in discovering shoals, wrecks, submarines, and sunken mines. Balloonists have noticed that at a high altitude objects under water can be distinguished quite clearly, and these tests were to verify these claims. These "kites" have been the subject of so much experimenting in this country that they are now placed ahead of captive balloons for naval purposes, and have a not unpromising future before them. The kites possess an advantage over the balloons in their less resistance to the wind, their ability to stand practically any wind of less force than a hurricane, and in their being far less cumbersome than an inflated gas bag. Observations were taken in perfect comfort recently from a basket supported by three kites, and towed by a destroyer at a speed of 26 knots dead in the teeth of an 18-mile wind.