

mountain blocks and erupted molten masses. These marginal features are evidences of pressure exerted around the margin, pressure seemingly due to expansion of the disk.

The primary causation of all crustal movement, Willis thinks, is heat. The earth is "a heat engine, but I do not know how it works." Heat is the "tricky sprite that is forever playing with the established order of things," while the "great, primal, all-pervading force is the attraction of gravity" (p. 10). It appears, then, that the heat engine is at work when the deep-seated molten magmas rise into the thick crust or lithosphere and elevate large blocks into plateaus, while the subsequent crystallizing forces of the cooling intrusions plus gravity bring about horizontal pressure, rifting, and differential block movements.

Willis does not believe that there ever was a Gondwana continent, which foundered into oceanic depths in late Mesozoic time, making the Indian Ocean. He may be correct, but the reviewer prefers to continue

his belief in theoretic Gondwana, and all the more so after reading "Radioactivity and Earth Movements" by Arthur Holmes (Trans. Geol. Soc. Glasgow, vol. 18, pt. 3, 1928-1929, pp. 559-606). Here also is to be found another hypothesis explaining rift valleys (see pp. 595-598).

The reviewer heartily recommends the reading of "Living Africa" to all geologists and graduate students in geology. The narrative illustrates how a master geologist works in the field, what he thinks about the phenomena seen, and how his conclusions change from time to time as observations increase. Students of structural geology are especially advised to study the first and last chapters in the book, so that they may learn more of the rise of certain geological theories, of the earth's primary internal forces, and of the "heat engine" of Willis. All in all, "Living Africa" is an interesting book, which stimulates thought along the line of multiple hypotheses.

CHARLES SCHUCHERT

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD OF STAINING THE OOCYSTS OF COCCIDIA

ALL who have worked with the coccidia are familiar with the difficulties involved in studying the internal structure of the spores inside the mature oocysts. The refractive character of these bodies is often so pronounced that it is often next to impossible to observe for a certainty the number, size and shape of the sporozoites and the nature and size of the sporocystic residual body, if one is present. A study of the internal structures of the sporozite (nucleus, refractile bodies, granules) is often out of the question—a statement attested to by the frequency with which recent authors have omitted these structures from their figures. We have stumbled onto a technique which has proved extremely useful to us in some of our researches upon the coccidia.

The fecal material from the culture is strained through a double layer of cheesecloth. The filtrate is centrifuged in ordinary pointed centrifuge tubes, the supernatant liquid drawn off, more water added, and the mixture thoroughly shaken. This process is repeated three times in order to remove as much debris as possible. After the last centrifuging, concentrated salt solution is added to the sediment in the tubes, and the mixture is again shaken and centrifuged. The oocysts come to be present in the surface film and are transferred onto a glass slide by means of a platinum loop. The drop is covered with a No. 1 cover-glass.

A few drops of glacial acetic acid are placed on

one end of the slide and barely in contact with one edge of the coverslip. The salt solution is withdrawn by absorbing it with a blotter at the other edge of the cover, and the acid follows the solution through the narrow space beneath the cover. Most of the oocysts are held in place by contact with the glass above and below when the proper care is taken in applying the cover. When it is certain that all the salt solution has been replaced by the acid, the slide is warmed gently over a light bulb for five or ten minutes. The acid is not permitted to evaporate, however.

At the end of this time the glacial acetic acid beneath the cover is replaced by a fresh Janus green solution made up in the proportion of one part of the dye to a thousand parts of distilled water. The dye solution is drawn beneath the cover by means of a blotter as explained above. The dye remains for ten minutes, and at the end of this time the oocysts are thoroughly washed by drawing distilled water beneath the cover-glass. The water is replaced by a concentrated solution of eosin in water, and this dye is left for five minutes.

Then follows a washing with distilled water as before. The entire process of staining may be followed under the low power of the microscope. If all the excess water at the margins of the cover-glass is removed by blotting, the edges may be sealed with amber vaseline or glycerine jelly. The stained oocysts should be studied under the oil immersion lens.

The oocyst jelly stains red, and sometimes the

sporocyst wall assumes a reddish tint. We can not agree between ourselves whether or not the sporozoites are stained a very light blue. At any rate the structures within the sporocyst are rendered visible. We suspect that the improved optical properties are the result of reducing the glare by staining the material about the sporocysts.

The foregoing procedure may be variously modified. The technique may be adapted to oocysts in a test tube instead of under a cover-glass. Also, we have found that if the fresh, non-sporulated cysts are used instead of those in the sporulated condition, development will occur beneath the cover-glass if heat is not applied while the preparation is flooded with acetic acid.

H. B. CROUCH
E. R. BECKER

IOWA STATE COLLEGE

THE LIGATION OF EARTHWORMS TO REMOVE THE ANTERIOR OR POSTERIOR END

DURING experiments conducted on the regeneration of blood vessels in earthworms, it was desired to remove the anterior thirteen somites. To effect this removal of tissue the following method was found to be superior to the usual method of cutting with a scalpel.

This method consists of tying the worm tightly enough to cause the end to slough off. In a six- to eight-inch piece of number 00 silk thread, a single knot is tied and drawn to a quarter-inch loop through which the worm is caused to crawl. The number of somites can be counted as the worm crawls through the loop and at the desired point the knot is drawn tight enough to constrict the worm to the smallest diameter without cutting the body wall. A little practice will determine how much pressure can be applied to the silk to obtain the desired result. This knot should be tied quickly and drawn against the

finger with the ends of the silk on each side of the finger to prevent the worm from twisting into the thread. A second and third knot is then tied and the surplus silk clipped off.

The anterior end remains attached to the posterior for from two to four days; if it remains attached longer than this it is probable that the first knot was not tied tightly enough and a second tying is necessary.

This method is far more successful than that of cutting for several reasons. When the silk is tied around the worm a large quantity of mucus is secreted protecting the region. When the anterior end sloughs off the surface left exposed is very small, averaging about one millimeter in diameter. Around this end at the time of separation there is already a protecting fringe of proliferated epithelium. Extrusion of the digestive tract is very rare, allowing more rapid recovery. When worms are cut with the scalpel the contractions of the body wall often force the digestive tract out, and at best leaves a large surface exposed for bacterial infection, causing high mortality.

A point of great importance, in the work on blood vessels, is the retention of all the blood in the vessels. When the worms are severed by the scalpel much blood is lost. By tying, all the blood is kept in the vessels, leaving the worm in better condition.

In summing up the advantages of this method it may be said that it is far superior to cutting, allowing the animal to readjust itself more gradually to the loss of tissue. While the shock of tying the worm so tightly may be as great as the shock of cutting, certainly the post-operative effects are not so great. Regeneration starts more quickly and proceeds more rapidly. Worms severed in this manner showed signs of feeding activities in about one to one and one half months.

L. S. ROWELL

UNIVERSITY OF VERMONT

SPECIAL ARTICLES

ON A RELEASE-PHENOMENON IN ELECTRICAL STIMULATION OF THE "MOTOR" CEREBRAL CORTEX

THE starting-point for this investigation was the question as to how the excitability of a motor point of the cerebral cortex and eventually the reactions obtained by its stimulation would be influenced, if changes occurred at all, when the surrounding parts of the cortex were put out of function. To avoid as far as possible shock-producing effects on the cortex, we decided to produce a functional block of the cortex

round the motor point under investigation by local anesthesia with novocaine.

The general course of these experiments was as follows: general anesthesia of the animal by intraperitoneal injection of Dial (0.4–0.6 cc Dial Ciba per kg bodyweight), which leaves, as Fulton, Liddell and Rioch recently have shown, the cortex rather well excitable for electrical stimulation. After 1 to 2 hours, or even longer, when an even stage of narcosis is reached, the threshold of a point of the so-called motor cortex was determined for faradic bipolar or