twin being absent, and five units being held in common.) However, such a model casts shadows that are in poorer agreement with the virus pictures than does the icosahedron. It would seem necessary to conclude that the subunits are either much larger in number than 12 or are shaped properly to contribute to the icosahedral appearance. Caspar's x-ray data on bushy stunt virus suggest that the most likely number of subunits is 60. His results would be consistent with the electron micrographs if, for example, each of the icosahedral vertices consisted of a cluster of five subunits.

PAUL KAESBERG
Department of Biochemistry, University of Wisconsin, Madison

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Histochemical Evidence of Protein-Bound SH Groups in Plant Tissues with 4-Iodoacetamido-1-naphthol

Dickens (*1*) and Rapkine (*2*) studied inhibition of glycolysis by iodoacetate and iodoacetamide and reported that inhibition was a result of an alkylation reaction with sulfhydryl (SH) groups of reduced glutathione. Young and Conn (*3*) obtained almost complete inhibition of wheat-germ glutathione reductase with iodoacetic acid ($10^{-2}M$) and iodoacetamide ($10^{-3}M$). Barrnett and Seligman (*4*) found complete inhibition of SH staining with 2,2′-dihydroxy-6,6′-dinaphthyl disulfide (DDD) in tissues pretreated with iodoacetate ($0.1M$). However, Barron (*5*) stated that iodoacetate is not SH specific and will react with amino groups of amino acids at a physiological *p*H. Barrnett, Tsou, and Seligman (*6*) reported the results of preliminary histochemical experiments with 4-iodoacetamido-1-naphthol (IAN).

Experiments were conducted with IAN to determine the SH specificity of this reagent in a diazo-coupled reaction in plant tissues. *Zea mays* L. embryos were excised in early stages of germination, when the coleorhiza had initially split the pericarp of the grain. The specimens were fixed for 24 hours in a 2-percent solution of trichloroacetic acid in 80-percent ethyl alcohol. The specimens were dehydrated, imbedded in paraffin, and sectioned at 15 μ. The sections, mounted on slides with albumin, were stained by a modification of the diazo-coupling method of Barrnett and Seligman (*4*) for DDD. In this method, the slides were incubated 2 hours at 60°C in a mixture consisting of 35 ml of Michaelis barbital buffer (*p*H 8.55) plus 15 ml of absolute ethyl alcohol containing 35 mg of 4-iodoacetamido-1-naphthol (*7*). In the coupling reaction the slides were stained in 3 to 5 minutes with tetrazotized diorthoanisidine. Inhibition was achieved by pretreatment of controls for 24 hours in an aqueous solution of N-ethyl maleimide ($0.1M$).

The highest concentration of protein-bound SH was observed in the promeristem of the radicle, and the staining diminished rapidly back from the apex. A high concentration was also observed in the promeristems of the paired adventitious roots located above the level of the scutellar node. Moderate-to-strong staining was observed in the procambial strands throughout the embryo. The embryonic vascular bundles of the epicotyl and coleoptile are similarly stained in cross section. Although the entire embryo is diffusely stained, those areas indicating the least SH include scutellum, coleorhiza, coleoptile, and scutellar node.

The results obtained with IAN are in complete agreement with results that I reported previously (*8*) for TCA-pretreated specimens stained with nitroprusside reagent and Bennett RSR reagent, respectively. Furthermore, I have obtained an identical staining pattern for these tissues with DDD (*9*). We can therefore conclude that the results obtained with this new SH reagent are valid, inasmuch as these findings correspond with results obtained by different types of histochemical reactions (mercaptan, disulfide, and alkylation reactions).

There is, however, the possibility that this reagent may couple with amino groups. Danielli (*10*) has suggested the use of a specific and readily removable NH_2-blocking agent to achieve SH specificity. The Danielli dinitrofluorobenzene method for tyrosine, SH, and NH_2 is based on a series of specific blocking agents. This line of approach has not, in general, been successful (*11*), and I have not used any NH_2-blocking agents with IAN.

LORIN W. ROBERTS
Department of Biology, Agnes Scott College, Decatur, Georgia

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1 June 1956

Odostomia impressa Parasitizing Southern Oysters

Recently Loosanoff (*1*) has reported observations on the pyramidellid snail *Odostomia (Menestho) bisuturalis* Say as an "obscure oyster enemy" in New England waters. According to Abbott (*2*) and Miner (*3*), *O. bisuturalis* has its southern limit at Delaware Bay. It should now be recorded that *Odostomia (Menestho) impressa* Say, which ranges from Massachusetts Bay to the Gulf of Mexico, has similar habits. A hundred or more of these snails may be found holding to the extreme margins of an oyster's shell, each inserting its proboscis between the valves whenever the oyster opens to feed. G. Robert Lunz, director of the Bears Bluff Laboratories, demonstrated this to P. Korringa of Holland and myself when we visited South Carolina in 1948. On the very day that Loosanoff's article appeared in *Science*, I arrived at Bears Bluff to begin a long-planned study of this interesting parasite.

Observations and experiments on *Odostomia impressa* to date indicate that its behavior differs somewhat from that of *O. bisuturalis* as described by Loosanoff. Rather than attacking young oysters, like the northern species, *O. impressa* works mostly on large oysters. When numerous snails are placed in the middle of aquaria containing adult oysters at one end and shells covered with spat (3 to 19 mm long) at the other end, the majority of the snails go to the large oysters, and this majority gradually increases as snails desert the spat and collect on the large oysters. Snails placed in an aquarium with single oysters of graded sizes, 26 to 76 mm long, assemble in the largest numbers on the largest oysters and in proportionately smaller numbers on the smaller oysters. Rough surfaces, such as the outside surfaces of oyster shells, attract or retain more snails than smooth surfaces, such as the inside surfaces of oyster shells. Shells of living oysters, bearing many attached snails, lose these snails when the oyster is carefully opened to remove the meat and then returned to the aquarium, and do not attract any replacements if living oysters are near. Clams (*Mercenaria*) and mussels (*Volsella*), placed in aquaria with *O. impressa* and oysters, do not attract snails; the few that crawl on them do not stay long.

Specimens and records of the Charleston Museum indicate that *O. impressa* is the commonest *Odostomia* in South Carolina; it has been taken from a number of localities by many collectors, starting with Edmund Ravenel prior to 1870. Miner (*3*) and various shell collectors' guides mention that *O. impressa* often occurs on oyster beds. At Bears Bluff, most of the population is found between 1 ft above and 1 ft below mean low-water level. At the beginning of July 1956, the individuals collected ranged from 3.3 to 5.2 mm in height and averaged 4.2 mm. These older snails soon disappeared, and at the end of July they were replaced by a younger group of snails 0.7 to 3.3 mm high, with a mode at 1.5 mm.

SEWELL H. HOPKINS

Bears Bluff Laboratories, Wadmalaw Island, South Carolina, and A. & M. College of Texas, College Station

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10 August 1956.

Geothermal Survey of Hot Ground Near Lordsburg, New Mexico

In the late fall of 1954, newspapers reported live steam and boiling water issuing from shallow wells being drilled in an area between the Pyramid and the Peloncillo Mountains, 15 miles south-southwest of Lordsburg, N.M. Marx Brook, of the research and development division of the New Mexico Institute of Mining and Technology, made a preliminary examination of the area in December 1954, at which time water samples were collected for analysis. Shortly thereafter it was recommended that a geothermal survey of the area be made.

The locations of three principal wells in the area are shown by solid circles in Fig. 1. These wells penetrate approximately 50 ft of sand and claylike soil underlain by 20 ft of warm-water-bearing gravel. The water-bearing gravel rests on a relatively impervious layer of clay that is approximately 8 ft thick, which in turn covers a hot rhyolite rock. As the drilling operation proceeds through the clay, higher temperatures are encountered, and the water becomes superheated as contact is established with the hot rhyolite.

Two of the three wells were completed at 5 to 10 ft into the rhyolite. One of these behaved like a geyser when it was disturbed by the drilling tools. The third well, which was completed at the upper surface of the rhyolite, can be pumped at the rate of 200 to 300 gal of boiling water per minute.

A geothermal survey was made using resistance thermometers, with the elements installed 1 m below the ground surface. The thermometers were made by installing a thermistor element at the end of a thin (0.25-in. diameter) Bakelite tube, which was subsequently filled with insulating material. Two fine copper wires connect the thermistor to extended leads at the upper end of the tube, where resistance measurements were made with a portable impedance bridge. The thermistor elements at 20°C had a resistance of 18,000 ohm and a sensitivity of approximately 550 ohm per degree centigrade. A hole for receiving the thermometer tube was made by driving a stake 4 ft in length into the ground, and the excess space around the tube was filled with dry sand. This arrangement gave steady-state resistance measurements 30 minutes after installation.

The temperature anomaly is mapped on Fig. 1 with a contour interval of 2°C. Points of temperature observation are indicated by open circles.

The maximum observed temperature at 1 m below the surface was 23°C, approximately 12°C higher than the corresponding readings outside the anomalous region. At one station, a thermistor remained in the ground for 5 days, during which time the air temperature changed from -5°C to $+22$°C. However, no change in temperature at the 1-m depth was noted during this interval, and in general, during the time of the study, no changes of temperature at this depth were observed. One thermistor has been installed permanently at a depth of 6 m for the purpose of detecting possible changes in ground temperatures at that depth throughout an extended period.

Temperature readings were taken at both 1- and 2-m depths at three locations in the warmest area, and a mean vertical gradient of 10°C/m was determined. Calculations based on a reasonable value of the heat conductivity of the earth material and the observed temperature gradient indicate a power flow of approximately 7500 kw for the area enclosed by the 18°C contour line.

Ranchers of the neighborhood have noticed that the winter snows melt almost immediately over an area approximately 0.5 mile in diameter in the neighborhood of the wells. Distinct changes occur in vegetation at the edges of the thermal anomaly. This is especially striking toward the south end of the area, where the temperature contour lines are close together. On the southeast, creosote bushes begin to grow where the anomaly ends. On the southwest, the hot area cuts through a cotton field. Over the hot area, the cotton stalks grow only 6 in. tall, whereas off the anomaly they attain a height of about 2 ft. Aerial photographs show the outline of the hot region as revealed by changes in vegetation at the edges.

Three hypotheses might explain the origin of the heat: (i) Hot steam and vapors, ascending from great depth along faults and fractures, are the source of heat. (ii) A postrhyolite and relatively recent intrusive has been emplaced beneath the rhyolite and is the source of heat. (iii) The rhyolite is itself the heat source. Since, however, the rhyolite, if correlated with similar rhyolites in adjacent areas, is probably of mid- to late-Tertiary age, it is highly improbable that its original heat could be retained.

It is possible that further study will indicate the true heat source. In the meantime, it would appear desirable to employ modern core-drilling methods, using compressed air, for the purpose of drilling deeper into the rhyolite mass for more significant temperature measurements.

Because of the high thermal gradient, an attempt was made to detect possible potential differences generated by the differential movement of ions in an electrolyte subject to a temperature gradient (Soret effect). Ground potentials owing

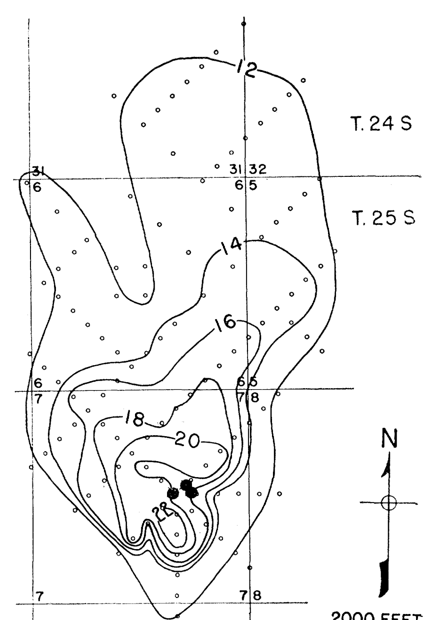

Fig. 1. Geothermal map. Temperature 1 m below surface; contour interval 2°C.