ohms and is heated by four dry cells. A series resistance of about 50 ohms is necessary to cut down the current to the desired level.

Since the microcauter tip expands on heating, the instrument is placed far enough away from the cells to be operated upon that this expansion does not unduly injure them. The loop should never be allowed to touch the cells, but merely to heat them by radiation. The duration of the heating may be limited to a fraction of a second, for the circuit is made and broken as quickly as possible, and since this fine filament-wire cools almost instantaneously, a consecutive series of identical exposures may follow each other rapidly.

Several preliminary series of experiments were made on the posterior cluster of cells in the embryo of *Drosophila melanogaster* from which the germ cells of the adults are known to be derived.[2] Eggs of *Drosophila melanogaster* were collected by allowing well-fed females to lay on strips of blotting paper saturated with yeast-water and spread with a layer of fermented banana. The freshly laid eggs were immediately dechorionated by hand and placed in sea water diluted with tap water to 33 per cent.[3] so that the stage of development could be determined.[4] For this study eggs were used which had begun to form pole cells, that is, they were approximately two hours old. The eggs (20 or more at a time) were aligned along the edge of a small block of moist agar with the posterior ends projecting slightly. Excessive desiccation was prevented by the use of the agar block, no moist chamber being necessary.

After cautery, the eggs were returned to the diluted sea water, where their development was followed through a compound microscope. No portion of any egg was seen to be coagulated. In one series of 20 eggs, 19 were found in which the pole cells were not folded into the embryo normally. Many of these embryos continued to develop but did not hatch as larvae. Four of the eggs hatched as larvae, pupated and eventually emerged as phenotypically normal imagoes. Three of these were fertile, but one female, which (on repeated testing) was sterile, was found on dissection to have no ovaries. A male which was fertile had only one testis.

Similar experiments were carried out by Hegner,[5] who burned the posterior pole of the eggs and early embryos of chrysomelid beetles with a hot needle. These burns were so drastic that the entire posterior regions of the late embryos showed structural deficiencies. Reith,[6] using the Péterfi electromicrocauter, burned large areas in the eggs of *Musca domestica*, the house fly, with similar results. It is of particular interest, therefore, that the heat radiations inflicted in our experiments were so localized and controlled as to limit the injury to the germ cells themselves. The formation of the posterior segments and of the external genitalia of the adults hatched from the operated embryos was normal. The sole effect was the production of partial or entire sterility.

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A CLOCK DEVICE FOR TEACHING SOIL TEXTURE

THE average student of soil texture fails to obtain an adequate concept of the variability of the percentage composition by weight which is permitted for a given soil texture, as defined in standard works on soils. A clock device, which is illustrated herewith,

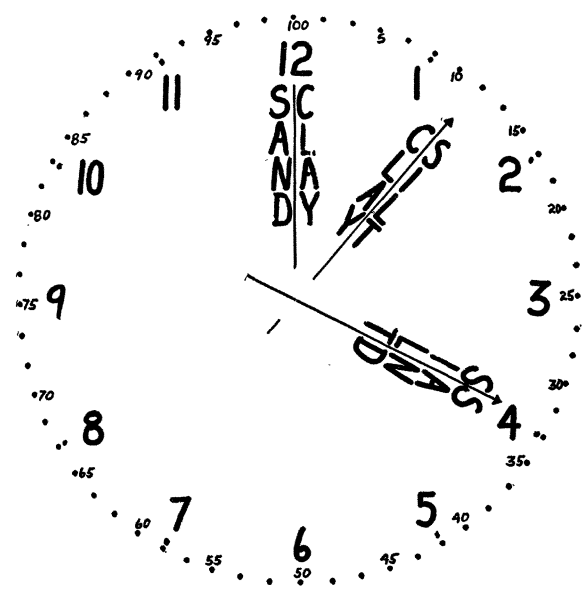

FIG. 1.

makes it possible to make a visual presentation of the limiting percentages of sand, silt and clay present in a given soil texture. The soil clock is set for sandy loam. The clay hand is at 12 minutes and the silt hand at approximately 20 minutes. This represents 12 per cent. clay, 20 per cent. silt and 68 per cent. sand. Sandy loam may contain from 20 to 50 per cent. silt and clay. The clock demonstrates this quickly and easily.

This clock device has proved so highly satisfactory

[2] A. F. Huettner, *Jour. Morph.*, 37: 385, 1923.

[3] We have found in our laboratory that Drosophila eggs develop normally when immersed in this concentration of sea water for the entire embryonic period.

[4] R. B. Howland and G. P. Child, SCIENCE, 77: 624, 1933.

[5] R. W. Hegner, *Biol. Bull.*, 16: 19, 1908.

[6] F. Reith, *Z. wiss. Zool.*, Bd. 126, S. 181, 1925.

as a teaching aid for soil texture that its use is suggested for demonstrating other systems composed of two or more variables. For instance, the addition of more hands and a change of labels will allow the demonstration of the various percentages of protein, fat, carbohydrates, ash and water which distinguish our foods. The proximate analysis of coals showing the percentages of moisture, volatile matter, fixed carbon and ash makes classification of coals a very concrete matter when seen on the clock face. Thus visualizing the nutrient values of feeds becomes simple, and so forth.

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SPECIAL ARTICLES

COUPLING OF RESPIRATION AND SYNTHESIS OF PHOSPHATE ESTERS IN HEMOLYZED BLOOD

MAMMALIAN erythrocytes are not able to oxidize carbohydrates but exhibit only glycolysis, the end product being lactic acid. On addition of methylene blue or some other reversibly reducible dye stuff they acquire the property of oxidizing sugar by molecular oxygen as Harrop and Barron have first shown.

On hemolysis, both the faculty of glycolysis and of respiration are lost. Warburg,[1] however, showed that though the hemolyzed blood has no action on glucose or glycogen, it does react with hexose-monophosphate-ester (Robison ester). This carbohydrate ester is oxidized in the air by hemolyzed blood on addition of methylene blue.

It is characteristic of normal respiration that its energy is not entirely liberated as heat but in part utilized for work or chemical synthesis. In the system, hemolyzed blood + Robison ester + methylene blue, however, respiration is not accompanied by any chemical synthesis or work. Runnström, Lennerstrand and Borei[2] found that addition of cozymase from yeast cells to the system mentioned brings about a synthesis of organic phosphate esters coupled with the respiration. We can, now, add the following observation. When pyocyanine is used instead of methylene blue, such a synthesis of phosphate esters takes place without cozymase being necessary.

Though no full insight into the mechanism of this coupled reaction can be obtained as yet, it seems likely that this faculty is correlated with the exceptional property of pyocyanine of accepting either one or two electrons,[3,4] whereas in general dye stuffs can accept only two electrons at once. To be sure, no causal connection between these two properties can be recognized as yet. However, since the reversible two-step oxidation has been recently encountered in other physiologically occurring dye stuffs,[5] especially in Warburg's yellow respiration enzyme, and the flavines or lyochromes, or at least in their prosthetic colored component, according to Kuhn and Wagner-Jauregg,[6] and to Barron and Hastings,[7] the particular behavior of pyocyanine with respect to oxidation and reduction can no longer be considered as a fortuitous property of one special bacterial pigment but as a property of some physiological significance.

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THE EFFECT OF THALLIUM ON PLANT GROWTH

THALLIUM compounds have proven useful in the control of particularly intelligent rodents, such as the rat (*Rattus rattus rattus*), the Zuni prairie dog (*Citellus gunnisoni zuniensis*), and the California ground squirrel (*Citellus beecheyi beecheyi*). The normal occurrence of thallium in the vegetable kingdom has been reported and possibility suggested that plants may take up thallium from the soil.[1,2] Articles have appeared[3,4] suggesting, apparently without any experimental foundation, that "thallium sulfate has potential destructive effects on vegetation which have not received adequate attention from those advocating its use in vermin control," and predicting "enduring sterility of the soil." McMurtrey[5] suggests that thallium produces symptoms similar to "frenching disease" of tobacco and McCool[6] has conducted some

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