some representative pesticides (*12*) when the LD_{50} for *Drosophila* was used as the base dose. The vertical extension of each percentage of mortality represents the 95-percent confidence interval under our test conditions. It is obvious from this example that even closely related pesticides can be distinguished. For instance, with the *Drosophila* base dose, aldrin can be readily distinguished from dieldrin by its effect on the mite *Tyrophagus*. Allethrin can be confused with these two toxicants when tested on the basis of this single criterion, but clarification occurs in the effect of these toxicants on *Artemia* and *Cryptolestes*. Needless to say, there are instances where careful cross-checking of the effectiveness in all organisms is necessary to separate the 31 compounds tested; this can be done by selecting a different organism to establish a base dose.

Certain toxicants tend to separate out as groups; this indicates a chemical relationship or suggests similarity in mode of action. Chlordane and related cyclodiene derivatives form similar mortality patterns, as do several organophosphorus compounds. In like manner, all the specific acaricides affect only *Artemia* and *Tyrophagus*.

It will usually be necessary to remove waxes and other interfering substances from plant extracts before using this method. It is hoped that this procedure can be used for identification of an unknown toxicant, subject to confirmation by chemical procedures.

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Temperature Fluctuations Accompanying Water Movement through Porous Media

Abstract. Temperature measurements were made at localized sites in bentonite, kaolinite, and small glass beads during infiltration. The temperature of the medium was observed to rise gradually and then to drop sharply as the infiltrating water approached and reached the measurement site. Temperature fluctuations were observed to be about 9°C for bentonite, 4°C for kaolinite, and 0.1°C for the glass beads.

The detection of water movement at localized sites in porous media, though frequently difficult, is usually possible. Determining whether the water arrives as a vapor or as a liquid is much more difficult, and often may be impossible. Velocity measurements which distinguish between liquid flow and vapor flow are even more complicated, but these measurements are precisely what is needed to investigate the kinetics of water movement in unsaturated porous media.

This is an old problem and one which received the early attention of soil physicists, although a satisfactory solution is still lacking. Apparently, Bouyoucos (*1*) was the first to place an air gap in the medium to distinguish liquid and vapor movement of water in soils. He arranged the apparatus containing the soil so that water vapor could diffuse unimpeded across a small air gap which completely interrupted liquid flow. This method was also used, with some modification, by Lebedeff (*2*) and by Taylor and Cavassa (*3*). By measuring the change in the distribution of a small amount of salt added to the medium, Gurr *et al.* (*4*) distinguished vapor flow from liquid water flow. More recently, Rollins *et al.* (*5*) used an external capillary on a closed soil-water system to measure vapor movement induced by temperature gradients. Measurements were taken at the steady state when the liquid flow through the capillary was presumed to equal the vapor flow through the unsaturated soils. In an excellent review of the whole problem of water and heat flow through unsaturated media, Philip and deVries (*6*) have discussed the experimental procedures and results of these investigations. They concluded that experimental methods have not satisfactorily distinguished between liquid and vapor transfer because of various complications inherent in each of the methods.

The measurement of temperature fluctuations due to the heat effects accompanying phase changes offers a means of differentiation and measurement of vapor and liquid flow. Let us visualize a liquid front advancing through a porous medium. Water molecules continually evaporate from the liquid and diffuse into the voids ahead, colliding with and being sorbed by the medium. Thus, one may predict that the advancing liquid front will be cooled, and that the medium ahead of the liquid front will be warmed. Hence, a temperature sensor located ahead of an advancing liquid front should show a gradual temperature rise due to sorption and condensation of water vapor followed by an abrupt temperature drop due to the arrival of the cooled liquid front.

To check the validity of this prediction, a series of experiments was performed. Ultrasmall thermistors and a potentiometer of high sensitivity made the experiments possible. Bentonite, kaolinite, and glass beads (*7*) were used as the porous media. Several small, cylindrical, Plexiglas sample holders were fabricated with provisions for embedding the thermistors in the medium during the preparation of an experiment and for controlling the introduction of water. Thermistor circuits which generated self-heating effects of less than 0.01°C were used in all the experiments. During the course of an experiment, voltage drops across the thermistors were continuously monitored by a two-pen Bristol recording

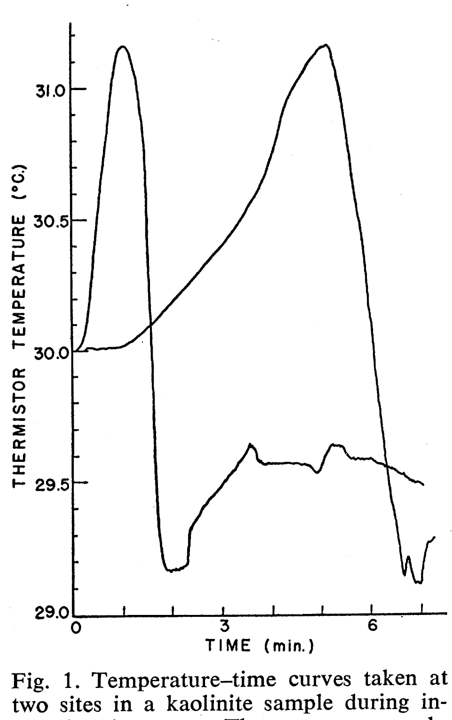

Fig. 1. Temperature–time curves taken at two sites in a kaolinite sample during infiltration by water. The curves were obtained by means of two thermistors embedded in the kaolinite sample. The temperature sensed by the thermistors is the ordinate and the time required for each thermistor to respond after the introduction of the water is the abcissa. The thermistor nearest the source of the infiltrating water gave the first response.

potentiometer. The experiments were done in an air bath at constant temperature; all materials were brought to constant temperature before each trial.

The result of an experiment with kaolinite, which is typical of all the experiments so far conducted, is shown in Fig. 1. The kaolinite was contained in a vertical, plastic cylinder (1.5 cm inside diameter and 6 cm long); it was supported in the cylinder by a porous glass wool plug. At the time the cylinder was filled, two thermistors were embedded in the kaolinite, one 5 mm and the other 10 mm from the sample top. The clay was gently packed into the sample holder and around the thermistors by means of a small mechanical vibrator held against the walls of the holder. So far, there has been no attempt to achieve truly uniform compaction in the several experiments. Deionized water under a 5 mm falling head was introduced at the top of the sample and allowed to percolate downward. The temperature of the water, sample, and sample holder was brought to 30°C at the beginning of the experiment in a thermostated chamber which was maintained constant ± 0.01°C throughout the experiment.

The temperature-time curves, shown in Fig. 1, substantiate the prediction made above, and can be interpreted in terms of the physical processes postulated. The erratic behavior of the thermistors after the abrupt temperature drop is due possibly to imperfect insulation of the thermistor leads.

Experience has shown that the magnitude of the temperature fluctuations can be correlated, at least qualitatively, with the kind of medium and its specific surface. The velocity of movement seems to be determined largely by the kind of porous medium and its degree of compaction. On wetting, some media shrink and some swell, causing either cracking or heaving which markedly affects the results. However, for the three porous media studied, every trial resulted in a curve having the same characteristics. Temperature fluctuations ranged from about 0.1°C for the glass beads and about 4°C for kaolinite to about 9°C for Arizona bentonite.

Since the color of all the porous media darkened on wetting, the visually observed arrival of the liquid front could be correlated directly with the abrupt drop in temperature. But, in order to verify this observation, a series of trials was made in which the infiltrating liquid was a solution of sodium chloride instead of deionized water. At various stages of the process, 2- or 3-mg samples of the medium were taken by a microspatula at different distances from the liquid source and analyzed for water content and for the presence of the chloride ion (*8*). It was shown conclusively that (i) the water content at the thermistor site increased during the initial temperature rise, (ii) the chloride ion was not present at the thermistor site until the temperature began to level off just before the sharp drop, and (iii) practically complete saturation of the medium at the thermistor site had occurred by the time the temperature began to drop sharply.

If chloride ion is transported only in the liquid phase, the evidence seems conclusive that the initial temperature rise is due to water vapor sorption. The arrival of chloride ion at the thermistor site when the temperature decrease first becomes apparent may be regarded as proof that the temperature drop is due to the arrival of the liquid front. The results of these experiments and careful visual inspection have indicated, however, that the liquid front does not have a clearly defined boundary. Apparently, films and fingerlike extensions race ahead of the nearly saturated zone.

Our principal conclusions are: (i) The movement of water through an unsaturated porous medium is not an isothermal process as is generally assumed. (ii) The movement of water—and likely other fluids—through unsaturated porous media can be studied to advantage by observing the heat effects accompanying the fluid phase changes. It appears that the theoretical treatment of infiltration and similar processes should consider the energy transfer implied by these experiments. The energy transfer ahead of the fluid by the diffusing vapor and heat flow due to temperature gradients appear to be important considerations (*9*).

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Tympanic Muscles and Control of Auditory Input during Arousal

Abstract. A reticular stimulation producing a powerful arousal reaction decreases the potential in the cochlear nucleus evoked by a click. This reduction results from the contraction of the middle ear muscles, which lessens the pressure transmitted to the cochlea, and is not due to a direct neural inhibitory effect at the level of the first synapse of the auditory pathway.

Three years ago, Hernandez-Peon, Scherrer, and Jouvet published a note showing that the electrical responses evoked by clicks in the dorsal cochlear

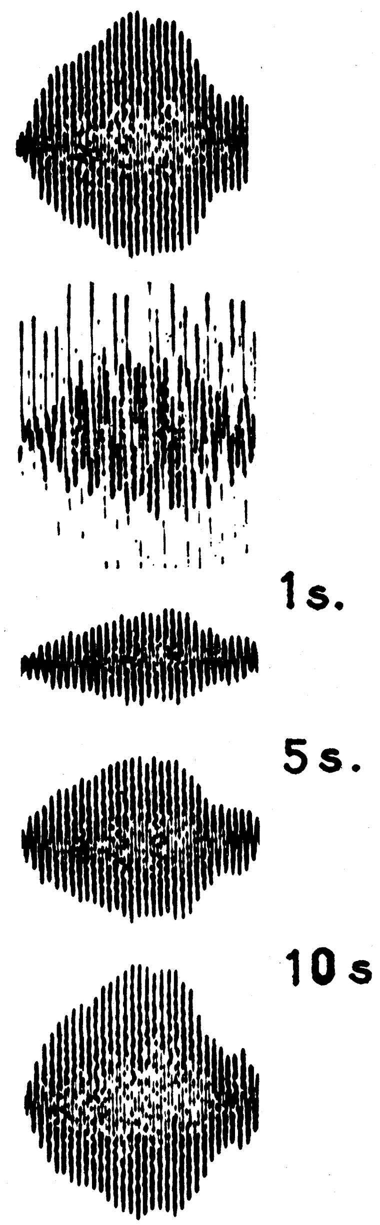

Fig. 1. Microphonic potential recorded on the round window in response to pips (0.25 kcy/sec) before, during, and 1, 5, and 10 seconds after a supramaximal mesencephalic reticular stimulation (150 pulses per second, 6 volts).