the bulk fell between 63 and 70%. A no more significant correlation than – 0.47 (due to the smaller sample size) between the percentage whole blood water and the hematocrit was obtained.

Duplicate samples of plasma were run by the oven method and the Karl Fischer method. On the whole, the two methods check within about 1%, but the oven method tended to yield higher percentages. This fact further substantiates the validity of the method. The results are as shown in Table 2, expressed as percentage of water.

The titrimetric estimation of water content of a large array of whole blood and plasma samples may be obtained with great rapidity using the Karl Fischer reagent; 10 min is the upper limit of time consumed.

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Perception by the Skin of Electrically Induced Vibrations

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If the dry skin of one's finger is moved gently over a smooth metal surface covered with a thin insulating layer, and the metal is connected to the ungrounded side of a 110-v power line, the surface has a characteristic feeling that disappears when the alternating voltage is disconnected. It is the purpose of this note to describe some observations concerning this effect and to suggest an explanation which may be of some interest, particularly to those who have experienced the effect without realizing its cause.

In the summer of 1950, E. Mallinckrodt noted that a certain shiny brass electric light socket did not feel as smooth when the light was burning as it did with the light off. It was soon discovered that when the light was turned on with the socket key, the socket was connected to the live wire (presumably because of imperfect insulation). If one reversed the plug in the floor receptacle the sensation ceased because the socket was then connected with the ground instead of the live side of the line, and there was no possibility of current flowing through one's body. The sensation was slight but definite when current (which later proved exceedingly minute) was flowing, and can best be described as a lack of smoothness or a feeling of vibration as one passes his fingers gently over the surface, such as might be caused by a small amount of resin. The sensation was considerably diminished if one changed from leather to rubber-soled shoes, and increased if one moved his stockinged foot from the high-resistance wooden floor to the brick of the fireplace which extended into the ground.

The effect was then noted in varying degrees (and confirmed by other observers) in a wide variety of objects when connected to the live wire and stroked with the fingers: for example, a lightly varnished brass door knob, an ordinary lacquered beer can, an egg in an electric egg boiler as the steam dried off. The hands of some individuals are more sensitive than others, and different parts of the hand yield different responses. Breathing upon the skin diminishes its sensitivity temporarily.

In an experiment made to investigate the effect quantitatively, an aluminum plate was connected to the ungrounded side of the 60-cycle, 110-v power supply through a variable current-limiting resistance. Half of the plate was coated with a very thin layer of an insulating varnish (Krylon). A man, standing on a Lucite insulator, touched the aluminum plate with one hand while the other was grounded through a meter by which the current passing through him could be measured. On drawing his finger lightly across the thinly varnished part of the plate, the peculiar resin-like sensation was felt. No such effect was observed when the finger was drawn in the same manner across the unvarnished part of the metal plate. With the highest current-limiting resistance used (22 megohms) the current through the man was about 1 μamp when the finger was drawn across the varnished part and the sensation was felt. It was 4 μamp on the unvarnished part, and no sensation was felt. The effect was also perceived on an insulated surface when the observer's body was completely insulated from ground, and all the alternating current that flowed (less than 10^{-7} amp) did so by way of body to ground capacitance. The effect diminished as the observer moved farther from the floor on a ladder. No effect whatever was obtained with direct current.

These data suggested that the effect was not due to direct action of current on the sense organs. If, instead of the finger, the thinner skin of the nose is touched to the uninsulated part of the plate and the series resistance made small enough, an intermittent sharp pricking can be felt. This is direct stimulation of sensory nerve endings by current and is an entirely different sensation from the resiny feeling observed when electric charges are not passing through the skin. The resiny effect can also be felt on the uninsulated surface if skin is used that is thin and very dry. In this case, the keratin outer layer of skin has a high resistance and acts as the insulating layer. If the edge of the ear is used under favorable conditions, a 120-cycle tone can be heard.

In order to show that touch or pressure receptors are sensitive enough to detect mechanical vibrations due to the attraction of charges under similar conditions, a condenser was made from two pieces of aluminum foil with slightly wrinkled tissue paper between. When the power line was connected across this condenser and the hand was placed gently on the aluminum sheet in contact with the grounded side, vibrations could be felt in places where the spacing happened to be favorable. Here, in contrast to the preceding experiments, the man was not in the circuit, so no current flowed through him, and the vibration could be felt whether or not the hand stroked the surface.

These observations lead us to this explanation of the original effect. The insulating layer, or the very dry outer skin, forms the dielectric of a condenser, of which the metal is one plate and the conducting fluids of the body the other. When an alternating voltage is applied to this condenser, there is an intermittent attractive force between the skin and the metal. If the hand remains stationary, the skin is not springy enough to allow perceptible motion around the receptors and there is no sensation. However, when the hand is moved with light pressure, friction between the skin and plate is increased as the condenser is charged, so there is an intermittent drag and release which does activate receptors and the surface feels resiny. The effect is not present when the finger is wet, because then the skin has a low resistance; the forces developed across the varnish are between the water outside the skin and the metal, and friction between finger and surface is not appreciably affected by the varying charge on this metal-water condenser. In general most of the energy for stimulating comes from the motion of the hand, and where the sensation is present this is modulated by the alternating electrical forces. Since these forces decrease as current decreases, the perceptibility of the effect when the body is completely isolated from ground is a striking demonstration of the high sensitivity of cutaneous receptors.

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The Resolution and Fungistatic Action of 1,4-Cyclohexanediol bis(bromoacetate)

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In examining organic substances so as to correlate fungicidal activity with chemical structure, it is intriguing, as in other studies of physiological activity, to note the variation in activity often caused by slight changes in molecular structure, especially optical or geometric isomers. The purpose of this report is to record some of the work done with the geometric isomers of 1,4-cyclohexanediol bis(bromoacetate).

TABLE 1

FUNGUS INHIBITION OF GROWTH OF A FUNGUS BY ISOMERS OF 1,4-CYCLOHEXANEDIOL BIS(BROMOACETATE)

Molar concentration	% retardation of growth		
	cis-trans	*cis*	*trans*
10^{-2}	100	100	60
10^{-3}	40	100	34
10^{-4}	12	31	15
10^{-5}	6	8	3

1,4-Cyclohexanediol was prepared by the method of Adkins and Cramer (*1*). This product was esterified by dissolving one-half mole (58 g) in 2000 ml of benzene and adding dropwise one mole (202 g) of bromoacetyl bromide. After the addition was completed, the mixture was maintained at gentle reflux for 5 hr (or until evolution of hydrogen bromide ceased) whereupon the benzene was removed by distillation. A brown residue weighing 152 g (84% yield) remained. This material was considered to contain equivalent quantities or nearly so, of both isomers since Olberg *et al.* (*2*) have shown that a similar preparative procedure for 1,4-cyclohexanediol yielded nearly equivalent quantities of both *cis* and *trans* forms.

The crude bromoacetate was recrystallized from hot 95% ethanol and the crystals obtained were washed with ether to remove the *cis* ester selectively, leaving on the filter the more insoluble *trans* isomer. The *trans* isomer was then repeatedly recrystallized from ethanol until a constant melting point of 137° was obtained. Ten grams of *trans* ester were refluxed with 19 g of barium hydroxide in water. The solution was evaporated to dryness, extracted with hot acetone, and this solution was concentrated and cooled. One gram of white crystals (30% yield) was obtained melting at 143.5–145°. This agrees substantially with Olberg's value (*2*) of 142° for the *trans* 1,4-diol confirming the assignment of *trans* to the bis(bromoacetate) melting at 137°.

The ether solution of impure *cis* isomer (contaminated with *trans* in the separation) was evaporated to dryness; and the brown crystalline residue was dissolved in acetone, decolorized with Nuchar, and cooled in a dry ice–isopropanol bath. The crystalline *cis* 1,4-cyclohexanediol bis(bromoacetate), remaining, melted at 114–115°. Recrystallization from acetone or benzene-ligroin solvent mixture failed to elevate the melting point above this value. In order to have sufficient compound for fungicidal assay, hydrolysis to the *cis* 1,4-diol was not carried out.

The fungistatic activity of the mixture and pure isomers was determined using the method previously used by this laboratory (*3*), in which the indices of toxicity are the radial growth rates of the test organism at the various concentration levels of toxic material.

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