it also poses the question concerning the indiscriminate use of the nonionics as solubilizing, wetting, or detergent agents in various germicide and drug formulations without preliminary biological compatibility data.

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A Rapid Titrimetric Method for Determining the Water Content of Human Blood[1]

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The use of the Karl Fischer reagent to determine blood and tissue water *in vivo* and *in vitro* in rats has been reported by Cook, Cramer, and Kenyon (*1*). Such a method, if applied to human beings, may have physiological, diagnostic, and therapeutic applications, since a determination can be made in a matter of 10 min. The most convenient tissue to use is the blood, which is relatively sensitive to changes in body water.

References to the literature have given rather diverse and incomplete figures for human plasma water and whole blood water. The accompanying chart shows this diversity.

TABLE 1

Reference	Total H_2O whole blood %	Plasma water %	Cellular water %
U.S.A.F. (*2*)	83(81–86)	94(93–95)	72(70–75)
Cushny (*3*)		90–93	
Best & Taylor (*4*) (Modified after Cushny)		92	
Everett (*5*)		92	65
Davis, Kenyon, Kirk	80.5(79–82)	92.4(91–93)	66(63–70)

To obtain values of blood water in normal humans by the Karl Fischer method, we obtained an unselected group of blood donors at the Los Angeles County Hospital. Our procedure is as follows. A small amount of venous blood is drawn into a medicine dropper. Capillary blood from a finger puncture can also be used (*1*). The medicine dropper is weighed and one drop of blood (more would obscure the end point) is discharged into a flask containing 20 ml of anhydrous methanol previously brought to an orange-red end point with Fischer reagent. The medicine dropper is again weighed and the flask is brought to the same orange-red end point by titrating a measured volume of Fischer reagent. The Fischer reagent is dispensed from an anhydrously maintained all-glass buret assembly.

[1] Support for this study from Harold V. Kirk and Edward Pollard is gratefully acknowledged.

TABLE 2

Substance	Percentage water found by: Oven drying	Titration (Av. of duplicate samples)
Whole blood	80.2	80.2
	80.5	80.0
	80.2	79.9
Plasma	92.3	91.5
	92.6	91.6
	92.0	91.6
	90.8	90.4
	91.3	90.5

By using a special double necked flask containing a twin platinum electrode and attached to an aquameter, an electrometric end point can also be used. Up to 8 drops of blood can be used in this instance, hence greater accuracy can be obtained. However, we found that both methods gave the same values on the same blood. All of the work reported in this paper was done using the electrometric end point method.

Mitchell and Smith (*6*) have written the only book on the subject at the present time, but we found the methods and formulae for the Fischer reagent used by Shell Development Company, Emeryville, California, to be superior in producing a more stable end point. We strongly advise against using the commercially available material as the end point is extremely unstable.

Hematocrit values by the Wintrobe method and specific gravity values by the copper sulfate method were routinely done on the same samples.

In all, 100 whole blood samples were used including 23 females and 77 males. The female extremes were 78 and 84%. The average was 80.8% and the bulk of the samples fell in the range 80–82%. The male extremes were 74 and 84%. The average was 80.4% and the bulk of the samples fell in the range 79–82%. The combined average was 80.5%.

We found a nonsignificant correlation of − 0.17 between the percentage whole blood water and the hematocrit. We found a significant correlation of − 0.49 between the specific gravity and the percentage whole blood water. There was no correlation between age and percentage whole blood water.

A smaller group of 15 additional samples was obtained in the same manner. The whole blood water was obtained and the samples were then centrifuged. The plasma water content was obtained and the cellular water content calculated. Extremes of whole blood were 76–84% with an average of 80.5%, the bulk falling between 79 and 83%. Plasma water extremes were 90 and 94%. The average was 92.5%, the bulk falling between 91 and 93%. The cellular water extremes were 56 and 74%, the average was 66% and 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.