Inactivation of 2,4-D by Adsorption on Charcoal[1]

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A method has been found which will inactivate some preparations of 2,4-D by adsorption on activated charcoal. This method is important because of its simplicity and its thoroughness of action. Substances and equipment which have been in contact with 2,4-D frequently carry small residues which are injurious to plants. Inhibition and injury of succulent plant tissues such as bean and tomato have been observed to be caused by dilutions as low as ½ ppm, and hence it has been almost impossible to clean adequately equipment which has been used to hold herbicidal preparations. Also, instances may occur where the separation of 2,4-D from other materials is desired.

Experiments have shown that a solution of the water-soluble powder (sodium salt of 2,4-D, as prepared by the Dow Chemical Company) containing 1,000 ppm of the active principle can be safely sprayed on all but very young bean plants after being mixed and shaken with 1 per cent activated charcoal (Norit A). Bean plants sprayed with this material shortly after emergence indicate by a very slight nastic response that the adsorption on the carbon is not complete. However, the amount of active substance not adsorbed is so small that it can be disregarded for all practical purposes. The addition of a larger percentage of charcoal results in complete inactivation.

TABLE 1

QUANTITATIVE ADSORPTION OF 2,4-D ON NORIT A AS ESTIMATED BY RESPONSE OF 10-DAY-OLD BEAN PLANTS

Concentration of 2,4-D (ppm)	Norit A in suspension (%)	Effect of application by	
		Drop method	Spraying
1,000	1	0	0
5,000	3	0	++
5,000	5	0	+
10,000	5	0	++
10,000	10	0	+

0 = no visible effect; + = very slight effect; ++ = slight effect.

A hand sprayer which had been used to apply 2,4-D solution at the excessive concentration of 10,000 ppm was freed from injurious traces by rinsing with a 1 per cent Norit A suspension for 2 minutes. Young bean plants were uninjured by applications of inert solutions made with this same hand sprayer immediately after rinsing as described.

Tests carried out to determine the degree of inactivation have given positive results, as shown in Table 1. These were made by the drop method developed by Mitchell and Hamner (*2*) as well as by spraying entire plants.

It should be emphasized that the carbon treatment inactivated the water-soluble powder. Tests indicate that certain oil preparations, though somewhat affected, are inactivated much less readily. Further tests are being conducted to establish the behavior of other types and grades of carbon preparations.

It appears that the findings here reported may offer an explanation for variable results with soil treatments of 2,4-D (*1*). It had been found that weed seeds were not as readily destroyed in certain muck soils as in sandy soils. Perhaps some muck soils adsorb 2,4-D in the same manner as does charcoal.

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Pilometric Measurements and the Rheological Properties of Hair

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In man, various clinical conditions involving the loss of hair are known. Successful therapy, both locally or systemically, to counteract the loss of hair must be based on controlled experimentation. This calls for a clinical test which permits careful measurement of the firmness with which a single hair is attached to the skin and the determination of certain rheological properties (*5*) of the hair, such as its yield value, elasticity, and tensile strength.

An instrument was devised for a study of the effect of a systemic treatment on the firmness of attachment of hair to the scalp in certain clinical conditions.[1] Since then, a second instrument with significant improvements, termed "pilometer," was developed in collaboration with the Friend Laboratories, New York City.

The first device was of simple construction and consisted of a small clamp, a hook, and a ball-bearing pulley fastened to a vertical stand. The clamp was designed to hold the hair and was fastened to a silk cord which went over the pulley. A light-weight tube (Lusteroid) of 100-cc. capacity was hung on the hook attached to the other end of the cord. Clamp, cord, and tube had a total weight of 8 grams. The tube served as a container for weights in grams or water.

[1] The author wishes to thank Dr. Frank Co Tui, of New York University, for suggesting the problem of devising such an instrument.

The improved device (Fig. 1) is based on the same principle but has a balance in place of the tube. It is also equipped to permit the measurement of the elasticity of a hair and the degree of deformity on stretching.

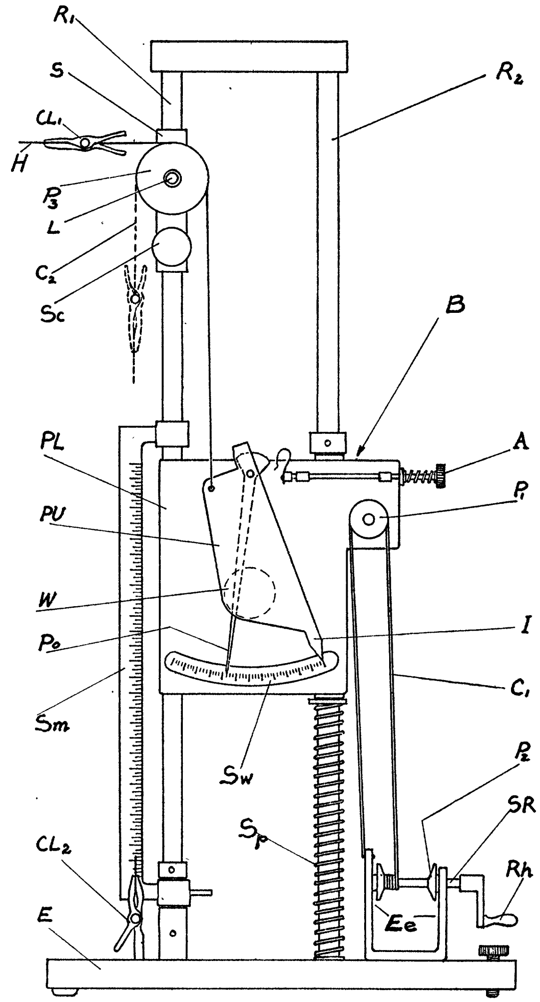

FIG. 1. Pilometer.

The balance, B, moves on two parallel, vertical rods, R_1, R_2, mounted on a base, E. A spring, Sp, to control the movement of the balance, is placed on rod R_2 between the base and the balance. The balance consists of the pendulum, PU, swinging on a plate, PL. The pendulum carries any given weight, at W, and has a projection which serves as the indicator, I. Two pulleys, P_1, P_2, are provided to lower the balance, one being fastened to the balance, and the other to an elevation, Ee, on the base. One end of a cord, C_1, is attached on the elevation, passes up and over pulley P_1, and returns to pulley P_2, which rotates on its axis, a small rod, SR. A third pulley, P_3, on ball bearings, L, is vertically movable on rod R_1 by means of slide S, which can be affixed by a head screw, Sc, to any desired height. The balance, B, is pulled slowly downward without vibrations by means of the rotating handle, Rh. One end of another cord, C_2, is attached to the pendulum of the balance and the other end to the clamp, CL_1, which holds the hair, H, while attached to the skin or after its detachment.

For measurements of properties of an isolated strand of hair, clamp CL_1 serves to hold one end, and clamp CL_2, at the base of the instrument, the other. A vertical scale, Sm, is used to measure the length of the strand of hair.

The instrument is operated as follows: A strand of hair still attached to the skin is clamped in CL_1, and the rotating handle is turned slowly until the hair becomes detached. The stress applied to the hair increases while the indicator moves along the scale, Sw, simultaneously with a pointer, Po, which is mounted behind the indicator and which remains at the maximum position after the hair becomes detached. Thereupon the indicator returns to zero. By pushing a button, A, the pointer can be brought back to zero.

The detached end of the hair is now put into clamp CL_2, and the rotating handle is again operated, but now for the purpose of measuring elasticity, yield value, and tensile strength.

For obtaining comparative values, hair was selected from an area located on the midline between the vertex and the linea nuchae. In a group of 42 healthy, white, male and female adults, the firmness of attachment ranged between 22 and 60 grams, averaging 34 grams; the tensile strength, between 65 and 120 grams, averaging 95 grams. Of interest are the findings in a small group of 4 male adult Chinese, the firmness of attachment being 64–88 grams, and the tensile strength 141–165 grams. These values definitely exceeded those obtained in the group of Whites. The individuals of the Chinese group may be exceptional, but the values obtained indicate the possibility of racial differences. The tensile strength measurements of Leftwich (*4*) were made with a comparatively crude method and gave an average of 7 ounces, or more than 200 grams. His subjects were presumably Whites.

It must be realized that the values should be amplified by a much larger number of observations in different male and female, racial and age groups on healthy subjects and on hair from various parts of the scalp as well as other regions of the body. In our experiments the tensile strength was measured immediately after the hair was pulled. Such tests should be made on several samples from the same area. It would also seem necessary to know how the hair has been treated prior to the tests. We found wide variations in comparing values obtained from different parts of the scalp or the body of the same individual.

The attachment of the hair to the skin may be supposed to be the firmness with which the cuticle of the hair is attached to the cuticle of the internal root sheath. Lower values of firmness of attachment or of "cuticle firmness" which occasionally are obtained upon several pullings may be due to progressive separation of the cuticles when the single hair is about to fall out. It is not yet known what brings about this process and what makes for firmness of hair attachment.

The pilometer permits clinical studies. Such investigations should be amplified and correlated with the analysis of X-ray diffraction patterns. Such patterns have been investigated recently by Astbury and his associates (*2, 3*). Their studies of the elastic properties and molecular structure of unstretched and stretched hair resulted in a number of practical implications. Astbury (*1*) observed that if a hair is considerably stretched and steamed for several hours while stretched, the external scale sheath of the hair often breaks up into loose, short, cylindrical sections. He points out that certain procedures to secure "permanent waves" are "inseparable from irreversible changes in the keratin molecule, changes that must be described, however reluctantly, as damage." We obtained from different subjects values of tensile strength which, in some cases, did not differ appreciably after several times of stretching, while in others the tensile strength decreased markedly.

Pilometric measurements may prove to be useful in testing both local and systemic treatments of any given substance in experimental subjects. The pilometer promises to be a tool by which the experimental biologist and dermatologist may test certain locally or systemically applied treatments for hair in health and disease.

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A New Method for the Direct Recording of Prolonged Time-dependent Processes[1]

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Loop and cathode-ray oscillographs at the present time have superseded all other methods of recording processes with temporal variations, although for some purposes they have certain deficiencies.

In medicine, for instance, it is regarded as a disadvantage that the process of photographic developing intervenes between recording and evaluation. Also, the standard recording scale requires excessive quantities of paper and film if a long record is to be made without changing the cassette. Thus, not only are there development difficulties, but analysis of the process as a whole is difficult. For these reasons some primitive, direct methods of recording (e.g. the soot kymograph) are still in use, although they do not meet present requirements as far as their frequency characteristics are concerned.

Medical research requires an efficient method of direct and continuous recording. A method of this type would serve essentially to correlate the experimental phenomena with the recording, to control the experiment according to the changes in the oscillogram, or to enable observation of certain functions (e.g. electrocardiogram) during an operation. It would also be useful for teaching and demonstration in schools. In many cases the greatest advantages of the loop and cathode-ray oscillographs, their frequency characteristics, are not exploited. In medicine, for example, while frequencies below 200–300 cycles often are recorded with the cathode-ray oscillograph, it is possible to develop devices for direct recording. It is of no importance that the recordings are not as large as usual. If the thickness of the record curves is sufficiently small compared with the maximum amplitude, the recording may easily be magnified suitably by projection on a screen. Moreover, a small recording has the advantage that a substantially longer period of registration is placed on the same amount of material. Generally speaking, this is the only method possible for making actual continuous study.

Such a method[2] has been developed on an electromechanical basis and is described below.

The cutting of a phonograph record may serve as an example in which maximum amplitudes of 0.08 are recorded. The resonant frequency of the phonograph recording system is about 5,000 cycles. Since an upper cutoff frequency of 500 cycles is sufficient for the present problem, the maximum amplitude required may be brought to the necessary magnitude by a small elastic force coupled to a lever transmission. For an electromagnetic recording system with a frequency range up to 500 cycles and an electrical input of 3 watts, this amplitude is 0.5 mm. (length of stroke, 1 mm.).

Such a magnitude may be seen directly, as may be, therefore, the total recording. On the other hand, for accurate evaluation of individual parts of the recording, they may be magnified optically to a maximum of 4–10 cm. by ordinary means and with normal space requirements. With suitable optics a much larger magnification is possible and may be used for lecturing and similar purposes.

The oscillographic method developed on this basis works as follows (Fig. 1):

The processes to be recorded (electrocardiogram, cerebral potential variations, blood pressure, etc.) are converted into electric quantities and conducted to an amplifier; this operates the recorder (S) which carries a stylus to cut the lacquer coat of the glass disc (G). While the disc is rotating, the recorder is moved radially by foot gears (V); thus, as on phonograph records, the groove forms a spiral. An illuminating device (B, below disc), placed close to the stylus, is coupled to and moves with the recorder. The optical system (A, above disc) magnifies the process recorded by means of an angular mirror (W) and projects it onto a screen (P). At a moderate disc velocity (about 20–30 cm./second on the screen for electrocardiograms) it is easy to observe the process while it is being re-

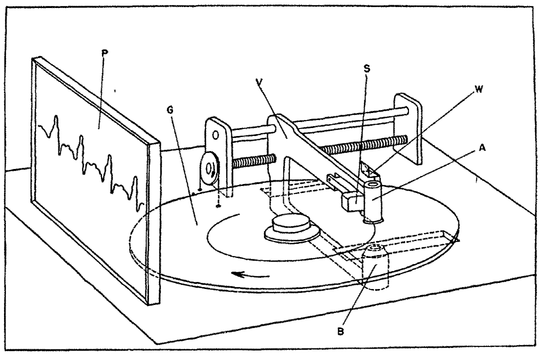

Fig. 1. Schematic representation of the recording method.

[1] Technical Report No. 11 of the AAF Aero Medical Center, Helmholtz Institute, Branch Nussdorf/Inn, Germany, March 23, 1946.

[2] The measurements were carried out by A. Habermann.