dried residues of sprayed material. The slides were incubated for 18 to 20 hours and then counts were made of the percentage inhibition of spore germination.

TABLE 2

EFFECT OF ADDING ZINC OXIDE TO TETRAMETHYLTHIURAM DISULFIDE ON THEIR ABILITY TO INHIBIT THE GERMINATION OF FUNGOUS SPORES

Dosage of toxicant (γ per sq. cm)		Percentage inhibition
Tetramethylthiuram disulfide*		
34.3		53
24.4		54
17.1		75
12.3		74
8.5		23
6.1		10
Tetramethylthiuram disulfide + zinc oxide		
8.6	69	99
6.1	49	50
4.3	34	24
3.1	25	15
2.2	17	6
Zinc oxide		
137		100
98		99
68		67
49		32

* The dosage-inhibition relation shown for tetramethylthiuram disulfide is characteristic. See Albert E. Dimond, James G. Horsfall, J. W. Heuberger and E. M. Stoddard, *Conn. Agr. Exp. Sta. Bul.* 451, pp. 649–652, 1941.

These tests indicate that in compounding with zinc oxide, mercaptobenzothiazole becomes inactivated as a fungicide, whereas tetramethylthiuram disulfide does not. Since the presence of zinc oxide is absolutely essential to the successful compounding of rubber, it is evident that when mercaptobenzothiazole is used as an accelerator in rubber, it will be rendered wholly innocuous as an inhibitor of microorganisms, and that the resulting rubber will be susceptible to attack by microorganisms under the conditions noted by ZoBell and Grant.

On the other hand, it is evident that tetramethylthiuram disulfide retains a large part of its activity against microorganisms in the presence of zinc oxide.

That mercaptobenzothiazole, tetramethylthiuram disulfide and zinc oxide as such remain in vulcanized rubber is implied by the fact that their presence in rubber can be estimated quantitatively.[7] We may therefore conclude that accelerators incorporated into rubber in vulcanization at least partly remain in the manufactured product. Any anti-microbial properties possessed by an accelerator would be a decided factor in preventing bacterial oxidation of rubber.

In view of these results, it is clear that, when rubber is to be used under conditions where it is likely to be in contact with water over long periods or even intermittently (as in the tropics), tetramethylthiuram disulfide be used as an accelerator in preference to mercaptobenzothiazole, provided that other desirable properties of the resulting rubber are not sacrificed by this procedure.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD FOR CONVERTING A LINE-RECORD INTO A SHADOWGRAM[1]

LINE-RECORDS are easy to obtain and entirely satisfactory for visual inspection, but they are difficult to deal with photoelectrically. Where it is desired to change the record into electrical energy, a shadowgram, *i.e.*, a record in which the signal appears as a black and white profile, has obvious advantages.

In electroencephalography, for various practical reasons,[2] records are made in ink on a moving paper tape. Such records can not be analyzed with the Grass frequency analyzer,[3] for it requires that the electroencephalogram be projected electrically through a continuously varying filter. A way out of this difficulty was discovered, and because the essential problem involved is more or less general, it was believed that the solution might interest workers in other fields.

A line-record can be converted into a shadowgram by the following procedure: A high contrast negative is made of the record and this negative is placed in an enlarger, preparatory to printing on film of the type used for sound recording. While the film is exposed, it is not held in a fixed position but moved at right angles to the axis of the line-record, and the movement continued until the image of the line no longer falls on the film. One of the many ways in which this can be accomplished is to place the film in a holder mounted on the carriage of a typewriter. The carriage can be set in motion by pressing the tabulation key and the motion can be slowed by keeping the carriage in contact with the plunger of an oil-filled hypodermic syringe, which is clamped to the body of the typewriter.

[1] From the Department of Neurology, Harvard Medical School, and the Neurological Unit, Boston City Hospital, Boston, Mass.

[2] F. A. Gibbs and E. L. Gibbs, "Atlas of Electroencephalography." Lew A. Cummings Co., Cambridge, Mass., 1941, pp. 221.

[3] A. M. Grass and F. A. Gibbs, *Jour. Neurophysiol.*, 1: 521–526, November, 1938.

[7] K. Shimada, Jour. Soc. Rubber Ind. Japan, 10: 431, 533, 1937; *ibid.*, 11: 1, 1938. E. Slipushkina, Caoutchouc and Rubber (USSR) 1937: 48, 51, 1937.

The speed of movement during exposure need not be absolutely constant, for changes in speed will merely produce longitudinal stripes. Some vertical banding will occur because of differences in the slope of the line. A little consideration will make it apparent that the line is widest, so far as the direction of movement is concerned, where the slope is steepest, the time of exposure is a function of the "width" of the line. Differences in slope are closely related to frequency and wave-form, however, and experience has shown that this type of banding is not ordinarily a serious source of error. It can be almost entirely eliminated if a high contrast print is made from the shadowgram.

The theory on which the procedure is based is exceedingly simple. When a point of light is moved on a photographic film, it forms a line. When a line is moved, it forms an area. When the image of a wavy line is moved at right angles to its long axis, it will widen, and, if moved far enough, it will become so wide that half the line can be disregarded and its characteristics will be correctly represented by its margin.

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A METHOD FOR THE STUDY OF INVERTEBRATE BLOOD IN VITRO

THE blood elements of many invertebrates disintegrate very rapidly when exposed to air and their study in the hanging drop is extremely difficult. This is particularly the case with the various types of trephocytes, but the amebocytes of some species present similar obstacles.

The following method was found suitable for this kind of observation. A capillary about 3 to 4 cm long and not over 0.25 mm thick is drawn out from a glass tube of 3 to 4 mm external diameter. About 5 cm of the glass tube are left for handling and a

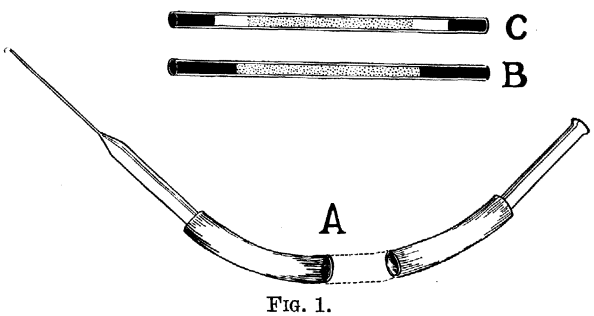

FIG. 1.

rubber tube attached to it (Fig. 1A) through which suction is applied when necessary.

When used, first the end of the capillary is dipped into pure mineral oil till a column of a few millimeters is drawn up by capillary attraction. The oil adhering to the outer surface of the capillary is wiped off and the latter carefully inserted into the body cavity or blood vessel like a syringe needle. Capillarity will draw the body fluid up whilst pushing the paraffin column ahead; if this for some reason is insufficient, suction is applied through the rubber tube.

After a column of 1 to 2 cm of blood has been drawn up, the capillary is removed from the body and is instantly dipped again into mineral oil drawing up another 2 to 3 mm of it. Thus the capillary contains a column of body fluid enclosed between two columns of mineral oil (Fig. 1B).

Now the capillary is broken off just above the liquid, placed in a drop of mineral oil on a slide, and covered. For observation with immersion it is advisable to use mineral oil instead of cedar oil.

If necessary, the method can be applied without exclusion of air either by omitting the use of mineral oil or by drawing in small columns of air before and after drawing the blood. In the last case the blood column is separated on both ends by air from the mineral oil (Fig. 1C).

This method has some other advantages over that of the hanging drop. The corpuscles adhering all around the capillary wall are seen from above, below and in profile. By slightly moving the cover glass the capillary is made to turn, thus enabling observation of a single element from various angles. The method is also useful for the study of blood in very small forms, where its quantity is so minute as to make the preparation of a hanging drop rather difficult.

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