This arrangement will make it possible to obtain measurements of surface tension under conditions never realized thus far, and to record variations occurring over long periods of time, during the process of biological reactions (fermentations, growth of bacteria, etc.) in an incubator, for instance.

We applied it first to the study of the properties of lubricating oils. A new technique had to be developed, inasmuch as the surface tension of pure oils fails to supply information concerning the presence of the polar groups to which the lubricating properties are due. An oil devoid of polar, adsorbable molecules, such as paraffin oil, does not become adsorbed on the metallic surfaces, and therefore constitutes a very bad lubricating oil. It has been shown by measurements of interfacial tension against water, by means of du Noüy interfacial tensiometer[1] that the addition of highly polar molecules, such as oleic or stearic acid, in small quantity, is sufficient to transform paraffin oil into a good lubricating oil.

In order to observe such changes which up to now could be detected only by variations in the interfacial tension, we experimented no longer on pure oils, but on a small quantity of water polluted by a trace of oil.

Records of the surface tension show that while the surface tension of paraffin oil is somewhat lower than that of the average motor oil, the surface tension of water polluted by oil is decreased (by a few dynes: 5 to 12) by the presence of motor oil, while it is unchanged by the presence of non-spreading paraffin oil.

If the surface of the polluted water is then touched with a thin glass rod previously dipped in oleic acid, the surface tension falls abruptly, no matter what oil is floating on the water. But thereafter, the records are quite different: in the case of paraffin oil, over a period of four or five hours, there is no rise in the surface tension, or, when the amount of oleic acid was extremely small, a slight and progressive increase, which may attain 3 to 8 dynes, is observed. In the case of a good lubricating oil, however, we observe a rise, which may attain 15 to 20 dynes within one or two hours; this rise follows a beautiful geometric curve (see Fig. 1).

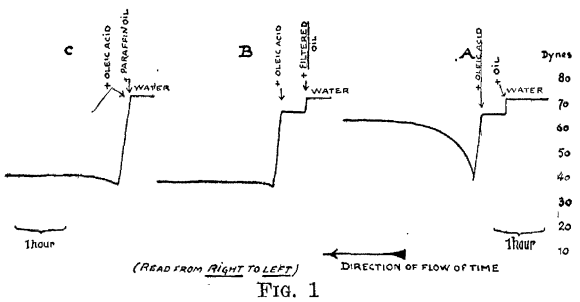

FIG. 1

[1] See J. J. Trillat, International Congress of Chemistry, Rome, 1938.

This phenomenon is apparently due to the adsorption of the polar molecules of oleic acid by the polar molecules of the oil. Should this be true, any process which would deprive a lubricating oil of its polar molecules, thereby decreasing its lubricating properties—such as filtration, for instance—should result in yielding an oil which would react to our test in the same way as paraffin oil. Fig. 1 shows that such is the case: Curve A is a record obtained with a good motor oil, unfiltered, while curve B is a record obtained with the same oil *after filtration* over four layers of filter paper. Curve C is obtained with paraffin oil.

This experiment shows definitely that filtration of lubricating oils is a dangerous process when the lubricating properties must be preserved. By means of interfacial measurements, J. J. Trillat had arrived at the same conclusions.

It seems safe to admit, tentatively, that this new phenomenon is very closely related to that which we described first in 1922 under the name of "antagonistic phenomenon."[2]

Of course, it would be possible, by means of an ordinary, non-recording tensiometer to perform the same experiments. But in order to obtain a perfect curve, it would require a large number of measurements of surface tension, over a period of hours, and this is a rather trying procedure.

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AUTOPHAGIA IN RATS TRAUMATIZED DURING INANITION[1]

IN an inanition experiment with male adult albino rats, during which the rats were wounded, 50 per cent. of the traumatized rats ate their bodies at the wounded areas. In none of the inanition experiments performed by the author in which the rats were not wounded has there been any evidence of autophagia.

Thirty male adult albino rats were placed in adjoining individual cages with wire screen walls of a mesh large enough for the penetration of the fore paws or the tip of the tail into the adjoining cage. All the rats were placed on a complete starvation diet, and one half of them were given an ample sufficiency of water at all times. Fourteen, or approximately one half, of the rats received wounds on their fore paws or tails, which occasionally penetrated the mesh of the wire screen between the cages and were bitten by their

[1] The investigation was initiated in the Department of Zoology of the University of Maryland, College Park, Maryland.

[2] Lecomte du Noüy, *Jour. Exp. Med.*, 36: 115, 1922, and "Surface Equilibria of Biological and Organic Colloids," (A. C. S. Monograph) New York, 1926, p. 155.

neighbor. Of the wounded rats, six were in the group which received neither food nor water, and eight were in the group which received water alone.

Fifty per cent. of the injured rats in both of the groups continued their own destruction by eating either their fore paws or their tails, depending upon which had been wounded. If the tail was eaten, the fore paws were left unmolested, whereas, if the fore paws were eaten, they were attacked simultaneously and removed somewhat symmetrically, while the tail was left undisturbed. In extreme cases of autophagia almost two inches of the tail was eaten and the forelimbs were completely removed up to the elbows. The eaten parts were removed evenly leaving clean wounds which presented no evidences of infection. The autophagia was not completed in one meal but was continued over a period of several days, the rats apparently finally being halted in the autophagia by their extreme weakness, which was evidently due to their inability to secure sufficient nourishment from this source.

Since an equal proportion of injured starved rats in the group to which water was available and in the group which lacked a water supply, namely, 50 per cent., ate portions of their bodies, it appears that the availability of water did not affect the incidence of autophagia.

A control group of 15 male adult albino rats traumatized in the same manner while on a supermaintenance diet exhibited a tendency to mouth their wounds, but there were absolutely no evidences of autophagia. Since neither unwounded starved rats nor wounded well-fed rats eat themselves, and since 50 per cent. of the wounded starved rats practiced autophagia, it is evident that neither the hunger drive nor the desire to mouth the wounded areas is strong enough alone to produce autophagia, but that in combination the two drives were strong enough in 50 per cent. of the cases to cause the rat to eat the wounded member.

Evidently the starved traumatized rat is originally attracted to its wound by its desire to mouth it, and, when this occurs, the already existing hunger drive causes the rat, in 50 per cent. of the cases, to begin an actual eating process of the wounded member. Apparently the mouthing of the wounded area is a necessary stimulus to set off this process. It is possible that the 50 per cent. of the injured starved rats which failed to practice autophagia were wounded before the hunger drive was strong enough to induce autophagia, and that by the time the strength of the hunger drive had reached such a proportion, the desire to mouth the wounds had ceased to exist due to the lack of irritation at these places.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

SOME USES OF VACUUM IN MICROLOGY

AT the Columbus meetings of the American Association for the Advancement of Science we demonstrated some of the advantages that obtained through the carrying out of various micrological procedures under partial vacuum. The apparatus required is simple and can be put together from materials available in any biological laboratory. An ordinary filter pump is adequate for lowering the pressure. A motor-driven vacuum pump has been tried, but it must be closely watched to prevent the production of too high vacuum. The rather low partial vacuum that we have used has not been injurious to delicate tissues.

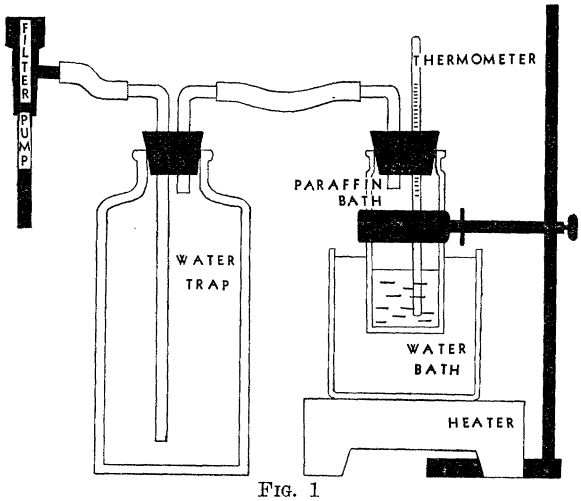

FIG. 1

The construction of the apparatus can be understood by referring to the diagrammatic figure.

The time required in the various solutions will vary with the size and density of the tissue. In general 15 to 30 minutes under vacuum will help the penetration of the killing agent, although the tissue should remain in this solution for several hours to complete fixation; 30 minutes will dehydrate the tissue when "Cellosolve" is used (tissue should be changed to fresh "Cellosolve" once during this time); 15 minutes in chloroform; 15 to 120 minutes in melted rubber-beeswax-paraffin.[1]

Of particular value is the marked reduction of the time required for the infiltration of the tissue with the paraffin mixture and the automatic indication of the completion of this process. The chloroform used for clearing leaves the tissue in a stream of bubbles when

[1] R. T. Hance, SCIENCE, 77: 353, 1933.