pletely carried through its characteristic movements and counter movements. This produces the maximum lengthening of the muscles acting upon the joint. This lengthening is permanent.

It is now only necessary to use a fluid that will not make the joint capsule rigid. This means that liquor formaldehyde (U. S. P.) can not be used, for as little as 500 cc per cadaver produces rigidity. The fluid we use in this laboratory, like the majority of those fluids used in this country, consists of varying mixtures of phenol (pure crystalline), alcohol and glycerine.

Rigor mortis when present ordinarily does not interfere with the mobilization of the joints. Very muscular cadavera may be conveniently left at room temperature over night so that the rigor may subside. The entire manipulating of the body, including the mobilization of the vertebral column and the temporomandibular joint, does not require more than ten minutes. Torn muscles have not been found in the dissection of over one hundred cadavera prepared by this method. It is of course possible to obtain similar results by using an arsenic fluid without manipulation; however, arsenic fluids are at present not in favor as preserving media for routine class material.

O. V. BATSON

DEPARTMENT OF ANATOMY,
UNIVERSITY OF CINCINNATI

SPECIAL ARTICLES

THE SURFACE EQUILIBRIUM OF COLLOIDAL SOLUTIONS. II

ANTAGONISTIC ACTION OF COLLOIDS

WHEN a trace of powdered sodium oleate is added to pure water or to a salt solution contained in a watch-glass, the surface tension decreases instantaneously and becomes very small. If the amount of sodium oleate added is smaller than (1/1,000), the drop will continue for over one hour until a certain minimum value is attained. This value will then remain practically constant.[1] But when the same amount of sodium oleate is added to the same watch-glass containing some other colloid in solution, instead of pure water or saline, the surface tension, after reaching instantaneously its bottom value, starts up immediately and in a few minutes, according to the concentrations, tends towards its original value or even reaches it. Of course, if the amount of sodium oleate (or any other strongly surface active colloid, such as sodium glycocholate) is too large, the final value will be smaller than the original value of the surface tension of the solution. The same thing will happen if the amount of the second colloid (antagonistic) is too small. Table I shows the results of one experiment.[2]

TABLE I

RISE OF SURFACE TENSION OF SERUM IN FUNCTION OF TIME AFTER A DROP DUE TO THE ADDITION OF SODIUM OLEATE

Pure Dog Serum, No. 1

Temperature 22° C.

About 1/10,000 in weight of powdered sodium oleate was used.

Time	Surface tension dynes
Before addition of sodium oleate	57.5
After addition of sodium oleate	39.0
After 15 seconds	44.0
After 30 seconds	48.0
After 1 min.	51.0
After 1.5 mins.	52.5
After 2 "	53.5
After 3 "	55.0
After 4 "	56.8
After 5 "	57.3
After 6 "	57.6
After 9 "	58.0
After 20 "	57.6

After having dropped from 57.5 dynes to 39.0 dynes (18.5 dynes drop) instantaneously, it comes back to 57.5 in less than 6 minutes. When the phenomenon is plotted in function of the time, it gives a very smooth logarithmic curve. Of course, in order to study this phenomenon, it is clear that the Tensiometer[3] previously described must be used, since measurements of the surface tension of the *same* layer of liquid are required at least every minute.

As far as we could see, this phenomenon is general for all colloids studied. In other words, the less surface-active colloid will tend to adsorb the more active colloid so as to counteract, sometimes completely according to their nature and relative concentration, the effect of the second on the surface tension of the solution. This explains why, in jaundice, relatively large amounts of sodium glycocholate and taurocholate can exist in the circulation without causing hemolysis of the whole blood.

II

ACTION OF COLLOIDS ON THE CRYSTALLIZATION OF SALTS

It has been shown in a previous paper[4] that col-

[1] du Noüy, P. L., "Surface Equilibrium of Colloidal Solutions. I.," SCIENCE, 1924, Vol. LIX, No. 1539, p. 580.

[2] *Compt. rend. Acad.*, 1922, clxxiv, 1258; *Compt. rend. Soc. biol.*, 1924, lxxxix, 1148.

[3] du Noüy, P. L., *J. Gen. Phys.*, 1919, i, 521; *La Nature*, 1920, No. 2391, p. 63. Holmes, H. N., "Manual of Colloidal Chemistry," New York, Wiley, 1922.

[4] du Noüy, P. L., *J. Exp. Med.*, 1922, xxxv, 732; *Compt. rend. Acad.*, 1922, clxxiv, 963.

loids in solution will become adsorbed in the surface layer in function of the time. When salts, NaCl, for example, are contained in the solution, the dissociated ions are adsorbed on the micellae or molecules of the colloid, and carried to the surface of adsorption, thus decreasing to a considerable extent the concentration of salts in the solution. In other words, when colloids are present with salts in a solution, the concentration of salts in the bulk of the liquid, according to Gibbs's law, does not occur. On the contrary, the salts are concentrated in the surface layers, together with the colloids. This explains the precipitation of colloids at interfaces and the formation of membranes.[4] The experimental illustration of this fact is made as follows:

Solutions of different colloids (serum, albumins, gum arabic, saponin, dyes, etc.) are prepared in saline solution (NaCl 0.9 per cent.). The following concentrations are then placed in watch-glasses, carefully cleaned: 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} and intermediate values up to 10^{-7}. Pure NaCl solution is also placed in watch-glasses as a control. After evaporation, the pure saline solution shows large, well-formed NaCl crystals at the bottom of the watch-glass, while the watch-glasses containing the colloids exhibit a large opaque white disk, with a dark area in the center. The white disk is made of minute NaCl crystals, so small as to give the impression of smooth white paint. At the bottom, instead of large crystals, a few small scattered crystals are seen, showing that the crystalloid could not concentrate in the bulk. The diameter of the white disk is almost that of the solution before evaporation, showing that, as it evaporated, the liquid abandoned progressively on the glass the colloid and the salt concentrated in the surface. The phenomenon with saponin is very clear up to a concentration of saponin of 1×10^{-7} gms per cc (1/10,000,000), and with proteins up to (1/4,000,000) (NaCl concentration of 1 per cent.).

At a given concentration (10^{-2} for serum, 10^{-3} for saponin and sodium oleate), periodic rings consisting of small crystals are observed on the watch-glass, a little over 1 mm apart. These experiments show very clearly the adsorption of crystalloids by colloids in the same solution.

P. LECOMTE DU NOÜY
THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

BREEDING HABITS AND MUTATIONS IN THE MOTH-LIKE FLY (PSYCHODA)

DURING the last eighteen months I have been engaged in studying the breeding habits and life history of a moth-like fly (Psychoda alternata) with the view of determining whether the form might not be used in studies in genetics. The effort has been attended with unusual success both in breeding the flies and in the discovery of at least one mutation.

Culture methods and life history: The adults are minute, hairy animals about two millimeters in length. They ordinarily breed in decaying vegetation, but dung from either horses or cattle has proved to be an excellent medium. Breeding takes place readily under laboratory conditions, the life cycle being completed in from twelve to sixteen days. Adult females are favorably stimulated by the culture medium, so that ovipositing takes place quickly. The eggs hatch in a little less than two days into active, eyed larvae resembling those of midges. The larvae feed for about ten days, after which they become quiescent and pupate. Adults emerge two days later and complete the life cycle.

Pedigreed strains are being maintained in test tubes and small flasks, while battery jars are being employed for large mass cultures.

A second species of moth-like fly (psychoda minuta) is being bred successfully under conditions similar to but somewhat more difficult than the first.

Mutations: Several mutations have appeared which reoccur regularly and a number of fluctuating variations have been induced by altering conditions of temperature and moisture. The most striking mutation has been studied in detail especially as to its method of inheritance, and it has been found to behave as a simple Mendelian recessive. The normal, wild fly has a reddish-brown pigment in the lens of each ommatidium, giving a reddish-brown color to the entire compound eye. The pigment is also found in the Malpighian tubules from the earliest stage in which the tubules may be distinguished and the ocelli of the larvae are also colored reddish-brown. In the mutant the pigment is lacking, so that the adults are white-eyed except for the pigment between the ommatidia and colorless Malpighian tubules appear in larvae, pupae and adults. The larvae also have colorless ocelli. This mutation breeds true and has been carried through forty-eight generations with no indication of a return to the normal condition.

Two other mutations have appeared and their methods of inheritance are being studied.

Because of the ease with which this fly is bred and handled, its short life history and its possibilities in the production of mutations it is predicted that the form will become very useful in the study of heredity.

Articles with figures and photographs are being prepared dealing with the life history and culture methods, with the white-eyed mutation and its method