and that cessation occurs with the appearance of morphological symptoms of impairment.

(2) *Amoeba proteus* shows negative phototropism toward ultra-violet light.

(3) The cell membrane of irradiated amebas is relatively inextensible.

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A CONTRIBUTION TO THE PHARMACOLOGY OF PHYSOSTIGMINE[1]

WHILE investigating the peripheral action of barbiturates, we observed that in all experimental animals where the cardiac vagus response to weak faradic stimulation had been abolished by barbiturates doses of physostigmine salicylate ranging from 0.2 to 0.35 mgm per kgm showed no detectable spontaneous effect on the heart rate. However, if two to three minutes were allowed to elapse after intravenous administration of this drug and then the peripheral vagus was stimulated with the same weak, or even weaker, faradic current as used above profound cardiac inhibition was produced. Occasionally the slowing of the heart which was produced by stimulation of the peripheral vagus persisted for several minutes after stimulation was discontinued. A similar cardiac slowing was noted following injection of acetyl choline, but it was not as marked and consistent.

This physostigmine sensitization of the vagus to stimulation lasted for about 30 minutes and was promptly antagonized by intravenous injections of further doses of barbiturates.

On the assumption that barbiturates produced their vagus-impairing effects by ganglionic depression, we employed in another series of experiments nicotine salicylate in doses varying from 2 to 4 mgm per kgm to produce ganglionic paralysis in dogs and rabbits. After sufficient nicotine salicylate had been administered intravenously to render the peripheral vagus non-responsive to even strong faradic stimulation, physostigmine (0.2 to 0.3 mgm per kgm) was injected intravenously. In every case within three minutes following the injection of physostigmine, faradic stimulation of the peripheral end of the vagus nerve produced marked cardiac inhibition. In other words, physostigmine antagonized the synaptic paralysis produced by nicotine.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PROPOSED METHOD FOR THE DIRECT MEASUREMENT OF CORRELATION

ATTENTION is called to the possibility of applying certain relations given by Yule to the development of a device for the physical determination of the correlation coefficient. The relations are:

$$\Sigma_1^2 + \Sigma_2^2 = \sigma_1^2 + \sigma_2^2$$

$$r^2 = 1 - \frac{\Sigma_1^2 \ \Sigma_2^2}{\sigma_1^2 \ \sigma_2^2}$$

where Σ_1 and Σ_2 are the maximum and minimum standard deviations of the scatter about the intersection of mean_1 and mean_2, and σ_1 and σ_2 have the usual connotations.[1]

Given the correlation surface actually constructed, the measurement of all these standard deviations in terms of moments should be feasible. The equivalence of σ^2 to the moment of inertia of the distribution about its mean is well known. It is possible that a physical method has not yet been applied to correlation because of the difficulty of obtaining cross-products. If Yule's Σ_1^2 and Σ_2^2 can be physically measured, this difficulty is eliminated by the proposed method.

A moment of inertia is measurable as $\frac{T t^2}{2 \theta}$, where T is torque applied (constant), and t is time to reach θ, which is resultant angular displacement. What would seem necessary then would be a device utilizing unit rotational force acting through unit time, whence a moment would be found in terms of distance rotated. A spark marker could be used to measure this distance. Having found the means of the constructed correlation surface by balancing, σ_1^2 would be obtained by rotation of the surface about the line through mean_1 parallel to the axis of the other variable, and correspondingly for σ_2^2. The axes of rotation for finding Σ_1^2 and Σ_2^2 would be passed diagonally through the intersection of mean_1 and mean_2 (center of gravity). The angles of these axes would be varied until the minimum or maximum rotation had been noted. Inspection of the surface would reveal the angles for these axes closely for correlations higher than .30.

For plotting the scatters there could be provided light, rigid trays having twenty cells each way and a small post in each cell. With thin but heavy metal coins having holes in the centers, the plotter could construct the surface as rapidly as one plots the usual scatter on paper. The coins should fit snugly and be thin enough to give the surface a relatively small vertical dimension. The physical measurements of the

[1] From the Department of Pharmacology and Materia Medica, Georgetown University, School of Medicine, Washington, D. C.

[1] "Introduction to the Theory of Statistics," p. 322, 1919.

surface could then be taken, applying forces which would cause rotations through acute angles only.

For recording the scatter plots before removing the coins, a device could be arranged to fit over the tray in such a way as to register automatically the number of coins in each cell. For researches in which the scatters are needed, something will have been gained in a standard machine method of recording scatters. When not needed, little will have been lost in making the scatters, because plotting often requires little more time than does organizing the material for use in other correlation methods.

In so far as the tray's weight would be uniform, correction of the moments for this factor should be possible as part of the calibration of the machine. Coefficients higher than .90 might require special attention because, while their smaller probable errors would require the greater precision, their Σ^2_{min}'s would be small and probably difficult to measure. With $\sigma_1 = \sigma_2 = 1$, an r of .96, for example, has Σ^2_{max} and Σ^2_{min} equal to $(1+r)$ and $(1-r)$ or 1.96 and .04, respectively. However, Σ^2_{min} need not be measured, since, having obtained σ_1^2, σ_2^2 and Σ^2_{max} in the machine, it is determined by Yule's first equation above. This relation should also be useful in checking and in calibrating the machine.

The method appears to warrant experimental work because, given a device adapted to these problems, the determination of a coefficient would require only that a few measurements be taken from the correlation surface. Presumably an operator provided with tables appropriate to the method should be able to report a plotted coefficient, together with means and standard deviations, in less time and with greater likelihood of accuracy than seems possible by methods of standardizing correlational arithmetic.

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DENATURIZING FORMALDEHYDE

MANY of us who work in anatomy and pathology laboratories and others who work with material preserved in formaldehyde solutions have often wished that the irritating properties of the formaldehyde could be overcome. Recently there appeared in SCIENCE (Vol. 73: 495–496; 675) two discussions covering the disagreeable effects of formalin and a method which in a measure would reduce some of these effects.

In our laboratories we have been able to counteract to a very satisfactory degree some of the objectionable effects of formaldehyde. Museum specimens preserved in formaldehyde solution (4 per cent. to 10 per cent. formalin in water) and dissection material so preserved have been removed from the preservative, washed in water, then submerged for 15 to 30 minutes in an aqueous solution containing 5 per cent urea and 1 per cent. ammonium phosphate. Before returning to the original formaldehyde preservative the specimens were again rinsed in water to remove any free urea. Many repetitions of the method have failed to show any bad effects on the tissues so treated. During a period of 3 to 4 hours dissection or demonstration subsequent to the treatment no irritating effects from formaldehyde were evident.

In applying this process to our embalming procedure, we have used as our regular embalming solution: Formalin, 12 to 20 per cent.; glycerol, 10 per cent.; potassium nitrite, 0.1 per cent.

The embalmed cadavers have been kept for various periods previous to dissection. One or two days before the cadavers are turned over to the students a cold cornstarch-red-lead mass containing 5 per cent. urea has been injected into the arterial system. One difficulty with the method is that mold growth appears to be enhanced and greater vigilance in mold control is necessary. To combat the mold growth, we have had success only with topical applications of known fungicides.

The atmosphere of the dissecting room has been remarkably free from formaldehyde following the application of the method described, and the irritating effects of formalin on the skin and mucous membranes of the students and instructors have been almost nil.

The experiments upon which these observations were based were largely financed by a grant from the Graduate College.

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