stimulates the adjacent region. There the process is repeated, and the impulse in this way propagated along the axon. At the nerve ending, owing to the increased surface, there is less resistance and more flow of current enabling the impulse to cross the non-conducting gap. The flow of current is the transmitting agent.

The new concept is based, to a large extent, on studies of the enzyme choline esterase. Three essential features are: (*i*) the high concentration of the enzyme in nerves. The concentration is sufficiently high to make possible a rate of acetylcholine metabolism which parallels that of the electric changes. (*ii*) The localization of the enzyme at the neuronal surface where the bioelectric phenomena occur, and (*iii*) the parallelism between the enzyme activity and the voltage of the nerve action potential developed by the electric organ. In these experiments, it was assumed that the enzyme is specific, *i.e.*, that the substrate metabolized is acetylcholine, the release of which during nerve activity has been demonstrated at several instances.

Evidence has now been obtained that the enzyme present in various nerve tissues, on which the role of acetylcholine in the mechanism of nervous action has been studied, is a specific enzyme. It differs essentially from the esterases present in other tissues or serum in which, as shown by Stedman, Stedman, and Easson,[4] only a fraction is specific choline esterase. Whatever nervous tissue is used the enzyme present has the same typical properties. It is unable to split carbaminoylcholine and benzoylcholine. That the latter compound is not split by brain esterase was already observed previously.[5] It splits butyrylcholine at a much lower rate than acetylcholine. On the other hand, acetyl-β-methylcholine which is not hydrolyzed by most other tissues is split by nerve esterase, although at a rate 20 to 40 per cent. lower than acetylcholine. Table 1 gives a few examples of significant data chosen among a number of substrates and tissues tested. The results thus provide further essential support for the new concept of the role of acetylcholine in the mechanism of nervous action.

TABLE 1

RATE OF ESTERASE ACTIVITY OF DIFFERENT TISSUES COMPARED TO THAT OF ACETYLCHOLINE (= 100)

| Species | Tissue | Benzoyl = Choline | Butyryl = Choline |
|---|---|---|---|
| Rat | Brain | 0 | 20 |
| Squid | Ganglion | 0 | 24 |
| (Loligo paealii) | Fiber | 0 | 48 |
| Lobster (Homarus vulgaris) | Ab. chain | 0 | 15 |
| Electric eel (Electrophorus electricus) | Electric organ | 0 | 3 |
| Torpedo | " " | 0 | 0 |
| Rabbit | Liver | 31 | 130 |
| Guinea-pig | Pancreas | 65 | 200 |
| " " | Kidney | 200 | 350 |
| Human | Serum | 60 | 272 |

[4] E. Stedman, E. Stedman and L. H. Easson, *Biochem. Jour.*, 26: 2056, 1932.

[5] B. Mendel, D. B. Mundell and H. Rudney, *Biochem. Jour.*, 37: 473, 1943.

This concept has been criticized by Lorente de Nó[6] because he is unable to find an effect on the frog's sciatic when put into concentrated acetylcholine solution. It is extremely difficult to reproduce an *intracellular* process by adding a compound to a living cell in a test-tube (see insulin). The failure to produce such an effect is therefore meaningless and can not be considered as contrary to a concept based on an impressive body of biochemical and physiological evidence. Acetylcholine is a quaternary ammonium base. Such compounds usually do not permeate the living cell membrane. Eserine is a tertiary ammonium base which as a free base may enter the cell. With eserine, Lorente de Nó finds a depolarization of the nerve—a point quite consistent with the mechanism suggested.

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## BRAIN-WEIGHT AND BODY-WEIGHT IN THE RED SPIDER MONKEY

IN recent compilations of the brain and body weights of primates[1,2] the Cebidae are represented as having the highest brain to body weight ratio of any of the primates including man. The coefficients of cephalization computed for them are correspondingly high.

The recorded data are chiefly those of Hrdlička,[3] and the body weights which he gives for Cebus and for Ateles are very much less than the weights of adult animals for those genera with which we are familiar. Table 1 gives the weights of 19 adult red

TABLE 1

WEIGHTS OF 10 ADULT RED SPIDER MONKEYS

| Males | Females | |
|---|---|---|
| 5.19 kg | 4.27 kg | 5.36 kg |
| 6.63 | 4.82 | 5.39 |
| 6.89 | 4.85 | 5.42 |
| | 5.08 | 5.78 |
| | 5.13 | 5.81 |
| | 5.22 | 5.87 |
| | 5.22 | 5.96 |
| | 5.25 | 6.01 |

[6] R. Lorente de Nó, *Jour. Cell. Comp. Physiol.*, 24: 85, 1944.

[1] S. Zuckerman, "Functional Affinities of Man, Monkeys, and Apes." New York: Harcourt, Brace and Co., 1933.

[2] G. von Bonin, *Jour. Psychol.*, 16: 379–389, 1937.

[3] A. Hrdlička, *Amer. Jour. Phys. Anthrop.*, 8: 201–211, 1925.

spider monkeys (*Ateles geoffroyi*) at the Yerkes Laboratories. The average is 5.48 kg with a range from 4.27 kg to 6.89 kg. The average weight of the males is 6.24 kg; of the females 5.34 kg. These animals have been in captivity from 7 to 9 years and are sexually mature. They have had an adequate opportunity for exercise and do not have an excess of fat. The average of 5.48 kg is certainly more typical of the adult Ateles than the averages of 2.0 and 2.2 computed by Zuckerman and von Bonin from Hrdlička's data. It is apparent that this author was correct in stating that 4 of the animals he weighed were emaciated, but it is doubtful if any of them were adult.

The average of 10 brains of *Ateles geoffroyi,* fixed in formalin, is 91.6 with a range from 75.5 to 107 grams. Body weights and sex of these animals are not known, but most of them were used for acute experiments and were selected because of their small size. The brain weights, however, closely approach those given by Hrdlička, which average 95.6 grams, and the difference may well be due to the fixation. Computation of brain-body weight ratio from our figures gives a value of 16.7 instead of 44.9 reported by Zuckerman and a coefficient of cephalization of 0.33 instead of 0.62 computed by von Bonin.

Although we have not material at hand for measurement, we believe, from experience with adult animals, that the published figures for Cebus and some other members of the order may be as greatly in error as those for Ateles have proved to be. Certainly no attempt to correlate brain-body weight ratios with intelligence in the primates can be justified until more accurate anatomic data are available.

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# SCIENTIFIC APPARATUS AND LABORATORY METHODS

## ANTI-RETICULAR IMMUNE SERUM: ITS ACTION DEMONSTRATED BY TISSUE CULTURE TECHNIQUE[1]

A GROUP of Soviet investigators under the leadership of A. A. Bogomolets have recently emphasized the importance of anti-reticular cytotoxic serum (ACS) as a means of pathogenetic therapy.[2] It has been reported that such serum possesses stimulating effect on the reticulo-endothelial system (RES) when used in minute doses. When the same serum is employed at large doses the effect is "cytotoxic" for the RES.

To our knowledge no demonstration has been made as to the direct action of ACS on living cells *in vitro.* The following is a preliminary report on a phase of a group project dealing with this subject.

Since tissue culture technique affords a direct method of observing cellular responses this method is being utilized. The serum (ACS) was prepared by using spleen and rib marrow of guinea pigs as antigen for immunization of rabbits. Gradually increasing amounts of the tissues were given four times intravenously and orally at 4 to 5 day intervals. One hundred tissue cultures in hanging-drop were used for the first series of experiments. The medium consisted of fresh embryonic extract from chick embryos incubated seven days, combined with normal rabbit serum, the final dilution being 1:10 for control experiments. For test purposes the rabbit ACS was substituted. The clot was formed by combining these components with fresh heparinized rooster plasma. Four sets of tissues were cultivated: (1) adult guinea pig spleen in medium containing normal control rabbit serum; (2) adult guinea pig spleen in medium containing ACS; (3) spleen from 14-day chick in medium containing normal rabbit serum; (4) spleen from 14-day chick in medium containing ACS. After 48 hours cultivation at 37° C no difference in the abundant outgrowth was seen between controls and the ACS treated cultures of embryonic chick spleen.

In striking contrast adult guinea pig spleen cultures showed practically no outgrowth of cells in medium containing ACS, whereas such tissues in control cultures uniformly showed abundant migration of cellular elements.

These results indicate (1) the reality of the strong inhibitory action of ACS when a homologous cell system is used, (2) that this action is specific for guinea pig as compared with chick spleen cultivated under identical conditions. These observations demonstrate only the inhibitory phase of the potentialities of ACS, while its stimulating property on the RES will be determined by serial dilutions of this serum. We believe it will be possible to define by the behavior of cells *in vitro* the action of ACS from total inhibition to marked stimulation; the two extremes of ACS action which are apparently of practical significance.

Studies in progress will also establish cytological changes as well as serological and immunological phenomena involved.

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[2] A. A. Bogomolets, *Amer. Rev. Soviet Medicine,* I, 101–112, 1943; P. D. Marchuk, *ibid.,* p. 113–123; B. E. Linberg, *ibid.,* p. 124–129.