fraction of the corresponding mean frequency. For the different individuals the amount of deviation is about the same.

The critical termal increment, μ, is in this case 12,200 calories. This agrees quantitatively with the increment for a number of other activities among arthropods[1] in which "nerve center" activity may be presumed to be the determining phenomenon.

Our purpose now, however, is not to dwell upon the meaning of the specific increment for heart rhythm, but to present the fact that when sources of variation are reduced to a reasonable minimum the velocities of biological phenomena are found to obey with exactitude the law of temperature influence upon irreversible chemical processes. The nature of the residual variations in velocity (frequently), as disclosed in this and other instances,[2] makes it important for precise analysis to secure numerous observations at close intervals of temperature.[5] Careful analysis of this type applied to representative cases makes it possible to interpret instances unavoidably involving more influential sources of variation.

A detailed discussion of the experiments, and a comparative account of thermal control of heart rhythm in various animals, will appear in *The Journal of General Physiology*.

[1] Crozier, W. J., *J. Gen. Physiol.*, **7** (123, 189); these PROCEEDINGS, **10** (461).

[2] Crozier, W. J., and Federighi, H., *J. Gen. Physiol.*, **7** (151); Crozier, W. J., and Pilz, G. F., *Ibid.* **6** (711).

[3] We are glad to thank Mr. L. R. Campbell for his assistance in caring for the larvae.

[4] Crozier, W. J., and Federighi, H., *Proc. Soc. Exp. Biol. Med.*, **21** (56); *J. Gen. Physiol.*, **7** (151); Glaser, O., *Ibid.*; *J. Gen. Physiol.*, **7** (177).

[5] The reasoning underlying the biological use of the Arrhenius equation for reaction velocities as function of temperature should warn against "averaging" observations from different individuals. Failure to avoid this practice has resulted in some curious errors in the literature of "temperature coefficients."

MICROCHEMICAL COLOR REACTIONS AS AN AID TO THE IDENTIFICATION AND CLASSIFICATION OF BRAIN TUMORS

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Cellular differentiation during embryological development in the last analysis is probably the result of chemical differentiation in the protoplasm of the cells. The nature of these differences is very obscure. We know in a general way that synthetic processes in the cells are condensations with dehydration, but the reasons for these processes resulting in a certain product in one cell, an entirely different product in another, and the steps through which the different results are achieved are but dimly surmised.

But certain it is that cells elaborate very different substances by means of which they may be recognized under the microscope. Sometimes these substances are retained within the cell, as in the case of the Nissl bodies of the nerve cells. Sometimes they are discharged to the exterior, as in the case of the externally secreting cells of the stomach and other glands. Again, these substances may be expelled into the intercellular spaces, as is the case with the collagen and mucin formed by the connective tissue cells.

The chemical constitution of these substances elaborated by the various cells is often unknown, but they may be made to give certain chemical or physicochemical reactions resulting in color changes. If such a color change is produced by but one substance, elaborated by a certain cell, this color change is of the greatest value in identifying that substance even though its chemical constitution is unknown, and secondarily is of value for the identification of the cell which elaborates it. The search for such specific color reactions constitutes a large body of microscopic research, for such a change renders the substance visible under the microscope, making it stand out in contrast to the surrounding tissue elements.

The application of these microchemical color reactions to the study of tumors lies in the fact that the terminology of tumors is based on that of the normal cells from which the tumor cells arise, or on that of the normal cells which they most resemble in their differentiation. An attempt is therefore made to identify the tumor cells by means of the substances which they elaborate, such as collagenic fibrils, neuroglia fibrils, etc., and the tumor is named accordingly.

There are, however, tumor cells which elaborate no special substances by which they may be recognized. Consequently, the identity of these cells is often most obscure. There is, however, another possible and promising method of identification. If different cells elaborate substances of very different character, it is reasonable to suppose that there may also be a difference in the chemical constitution of the protoplasm of the various cells from which these various substances are elaborated. It would doubtless be a smaller difference than that between the specialized elaboration products, but nevertheless possibly sufficient to give differential reactions similar to those obtained with the products of elaboration themselves.

Such, in fact, is the case with the various types of cells in the central nervous system. It has long been known that such a specific reaction may be obtained with the cytoplasm of the nerve cells, but it remained for Ramon y Cajal and his pupils to show that three other distinct types of cells giving similar specific reactions existed in the interstitial or supporting tissues. These types are known as the neuroglia, the microglia and the oligodendroglia.

Practically all of the true tumors of the central nervous system are com-

posed of these supporting elements rather than of the nervous tissue itself. The neuroglia cells have long been recognized in these tumors by means of the fibrillae which they usually elaborate, known as neuroglia fibrillae, but many tumors are encountered in which no neuroglia fibrillae can be found and the nature of their cells has long been disputed.

The origin of many at least of these doubtful tumors may be established by means of specific physico-chemical reactions of the cytoplasm of their cells. This is particularly true of the common tumors of the neuroglia in which the tumor cells have not elaborated fibrillae (spongioblastomas). Some evidence has also been obtained to show that the microglia and the oligodendroglia form cerebral tumors as well.

VIRUS ENCEPHALITIS IN THE RABBIT

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Under the designation of virus encephalitis may be grouped a form of inflammation of the brain in the rabbit induced by the inoculation of the contents of febrile herpes esicles and certain other but allied substances derived from man.

Among the substances which have been successfully employed for producing virus encephalitis in the rabbit are certain materials, of diverse origin, taken from cases of epidemic (lethargic) encephalitis. These materials include the secretions of the nose and throat, filtered through earthenware filters to remove ordinary bacteria, extracts of the nasopharyngeal mucosa, removed at autopsy and freed from bacteria in the same manner, fragments of the brain, taken at autopsy, and cerebrospinal fluid, collected by lumbar puncture during life.

At the outset and for several years, until recently, the condition which we propose to call "virus encephalitis in the rabbit" was believed to differ etiologically, according as it was incited by the hypothetical virus of epidemic encephalitis, or the recognized virus of herpes. The virus encephalitis of the rabbit arising from epidemic encephalitis in man was first studied extensively. It was not until the corresponding condition of febrile herpes was equally minutely studied that the similarity of the two processes became evident. This resemblance is so exact and complete that, with few exceptions, students of the subject have come to believe the two processes as identical.

The confusion which persisted over a period of several years arose not