

edge of the world of nature (not of experiment), the more insecurely founded they appear to be.

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THE IMPORTANCE OF DIAMETER AS A FACTOR IN MYELINATION

It is believed that the close relationship existing between diameter of the axone and whether or not it shall possess a myelin sheath has not received sufficient attention. Due to the present interest in the physiology of nerve fibers, a brief presentation of the main facts seems to be desirable.

The bearing of diameter on myelination has been stated by Vogt,¹ who says that myelination of the tracts is not related to the acquisition of conducting power, but to the number and size of the component fibers. Speidel² states that myelination is preceded by a characteristic thickening of the axone. Ranson *et al.*,³ speaking of the vagus rootlets proximal to the nodose ganglion, say that the number of fine myelinated fibers varies considerably in different animals, and further when the number of fine myelinated fibers is large the number of unmyelinated fibers is correspondingly reduced. In another part of the same paper they say that the unmyelinated fibers are always smaller than the myelinated fibers; however, the exact nature of the relationship is not emphasized.

From observations carried on in this laboratory, the author has become convinced that in mammals there exists a critical diameter, above which all axones are myelinated and below which all are unmyelinated. This diameter is tentatively stated as 1.5μ , including the myelin sheath. Myelinated axones of 1μ diameter can be seen in cross-sections of nerves containing large numbers of small fibers, but teased preparations show these to be constricted portions of slightly larger axones. These constricted regions are found principally opposite the sheath cell nuclei, but occur in other places in some of the fibers. Preliminary measurements indicate that a critical myelination diameter also occurs in birds, reptiles and amphibia, but that the value of the constant may be slightly less in birds and slightly greater in the cold-blooded animals. The relationship holds only for true neurones; *i.e.*, the neurosensory cells and protoneurones are excepted.

The above principle is based on measurements of the diameters of fibers in the dorsal and ventral roots of the cow, cat and rat. The thoracic ventral roots of the cat and rat contain two distinct groups of fibers—the somatic efferent and preganglionic efferent.

¹ O. Vogt, *Neurol. Centralbl.*, 27: 137, 1908.

² C. C. Speidel, *Jour. Exp. Zool.*, 61: 279, 1932.

³ S. W. Ranson, J. O. Foley and C. D. Alpert, *Am. Jour. Anat.*, 53: 289, 1933.

The somatic motor group is entirely myelinated and the preganglionic efferent is partially myelinated in both animals. In the cow both groups are completely myelinated, and the fibers of each group are distinctly larger in this animal. In the dorsal roots of the cat and rat three fiber groups may be distinguished. In the rat the smallest group approaches the myelination limit and is believed to be partially unmyelinated. In the cat the smallest group is distinctly beyond the myelination limit, corresponding to the preganglionic efferent group in the cow as to size. In the dorsal root of the cow a fourth group of myelinated fibers has appeared. This group is entirely below the myelination limit in the cat and rat, and gives rise to the C wave in oscillograph records. In all three animals the smallest myelinated fibers are 1.5μ , while the upper limit of size varies, the largest fibers occurring in the cow, the smallest in the rat.

Two other related principles of nerve fiber size are suggested: (1) Nerve fibers myelinate in the order of their appearance as specifically stainable axones and the first fibers to myelinate are the largest fibers in the adult; (2) the order of fiber size for the various functional groups is the same in different mammals. The two principles are known to hold true for all components of the spinal roots, for the median longitudinal bundle, the rubrospinal fasciculus and the corticospinal tracts. No exceptions to these rules are known to the author.

Given the above principles, the following are some of the known facts readily explained.

(1) The variations from animal to animal in the amount of myelination of the pre- and postganglionic visceral efferent fibers.

(2) Variations in the time of myelination of the tracts in the various species.

(3) The distal excess of myelinated fibers in the trunk over the sum of those in the spinal roots and the differences in the amount of this excess in different spinal regions and animals.

(4) Differences in the time of cessation of myelinated fiber increase in the spinal roots and nerves.

This statement is offered in advance of *in extenso* publication, because it is believed that a point of view is offered which will be valuable to many engaged in research on nerve fiber physiology and histology.

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A NEW TERM FOR THE YOUTHFUL STAGE OF FORAMINIFERAL SHELLS¹

IN the terminology of foraminifer shells no generally acceptable or appropriate name exists for the

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early stage of shell-building which precedes the adult idiomorphology and may or may not be distinct from the proloculum. Such early or youthful stages are clearly defined in certain Peneroplidae and megalospheric orbitoids and are more or less distinct in the Fusulinidae, mentioning only some outstanding examples.

The term "embryonic apparatus" is moderately favored among some specialists on the orbitoids, but it is inappropriate and misleading for several reasons. The stage represented can hardly be considered embryonic, even if, by far-fetched and loose analogy, the term "embryonic" can be applied to any phase of protozoan life history. To call the shell or a part of the shell an "apparatus" strains a point in lexicography.

"Nucleoconch" is another name that has been used for this stage by a few writers during recent years. This term is rather awkward and lacks euphony. It is appropriate only in the singular sense that the "nucleoconch" is a sort of nucleus for the adult shell structure, but in other respects the term is misleading because its literal and obvious meaning (*i.e.*, shell for the nucleus) does not harmonize with the peculiar usage which has been defined for it. A further and important objection is that the term has not generally been accepted.

It seems opportune, therefore, to propose a new term. *Juvenarium* appears to fulfil our requirements. This word, of Latin origin, is composed of the stem *JUVEN-*, *youth*, plus the suffix *-ARIUM*, *place of a thing*. It is intended that the term shall have a general or broad application to a stage of shell-building rather than a specific or precise reference to a particular stage in the life history of the animal. This caution is prompted by the fact that the very little which is known about the life history of such foraminifers as the Fusulinidae and Orbitoididae is based on analogy with the inadequately understood life history of more or less distantly related, modern forms. Furthermore, it is not at all improbable that the stages of shell-building in different families bear different relationships to the events of individual growth; accordingly, analogies of this sort are precarious.

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SOME NOTES ON NORTH AMERICAN CRAYFISH

No information apparently exists regarding the depths to which crayfish may live in lakes. A recent collection has been turned over to the writer with some interesting data pertaining to this question.

Two female crayfish of the species *Faxonius virilis* (Hagen) were obtained by Hilary J. Deason, of the U. S. Bureau of Fisheries, from nets set in Green Bay of Lake Michigan (Lat. 45° 34.2' N.—Long. 87° 2.8' W.). These nets were set in 18 fathoms (104 feet) and were lifted on May 21, 1932. Mr. Deason states that crayfish are frequently obtained in this region from nets set in deep water. From an economic standpoint the occurrence of crayfish at these depths is interesting. These animals are a potential food supply and doubtless could be reared or now occur over the entire bottoms of some of the Great Lakes.

In SCIENCE for August 30, 1929, a note appeared by Curtis L. Newcombe regarding a blue crayfish. The specimen referred to in this account was an immature, second form male, and was assigned to the species *Cambarus carolinus dubius* Faxon. I have examined this specimen, and it probably is referable to *Cambarus monongalensis* Ortmann, which is normally blue.

Several blue specimens of crayfish have come to the attention of the writer. Blue specimens have been seen of the normally brown or greenish *Faxonius immunitis* (Hagen), *Faxonius propinquus* (Girard) and *Cambarus robustus* Girard. A specimen of *F. propinquus* kept alive in an aquarium underwent several moultings with the blue color persisting. Recently red specimens of *C. robustus* have been obtained from a rearing pond near Grand Rapids. These red specimens (one of each sex) are alive and attempts are now being made to mate them. Probably the red and blue crayfish represent mutations.

In the mountains of the Carolinas, West Virginia and Pennsylvania two closely related burrowing species of crayfish are found. One, *C. monongalensis* Ortmann, is blue, the other, *C. carolinus* Erichson, is red. From morphological characters alone it is practically impossible to distinguish the two species. The suggestion arises that these colored crayfish species may have had their origin by mutation. It appears to me that mutant color characters would be best perpetuated in burrowing species. Such species would have limited mating possibilities and color would have little effect regarding survival.

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THE EXISTENCE OF A MONTHLY SEX CYCLE IN THE HUMAN MALE

In a study regarding the total daily urinary excretion of gonad-stimulating substances in normal individuals and in mental patients, two adult male subjects (one normal and one psychotic), included in this study, showed a sudden excretion of such substances