Progress in NEUROLOGY and PSYCHIATRY

An Annual Review

VOLUME XII

Edited by

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1957

GRUNE & STRATTON

NEW YORK LONDON

Library of Congress catalog card number: SG 46-279

GRUNE & STRATTON, INC.
381 Fourth Avenue
New York 16, New York

Printed in U.S.A. for GRUNE & STRATTON

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NEUROLOGY and PSYCHIATRY

Preface

AS IN OTHER BRANCHES of medicine, the literary output in our field is characterized less by ingenious discoveries than by an enormous production of details as tested by the some four thousand papers reviewed in this volume. If one tries to discover main trends of interest, he may perhaps mention electrophysiologic and biochemical research in the basic sciences; prevention and treatment of diseases of infectious and vascular origin in clinical neurology; refinement in technique, as for instance by means of stereotaxic methods in neurosurgery, and experimentation with drugs in clinical psychiatry. The enthusiasm for the shock therapies seems to have passed its peak. We have therefore added shock therapy to the biennially reviewed subjects. The chapter on neuro-ophthalmology deals this year with cortical innervation of ocular movements and that on psychology with the experimental approach to the analysis of behavior.

We moan the passing of Dr. Albert Kuntz whose outstanding survey of the autonomic system the readers of this series have enjoyed since its initiation.

The editor feels it his pleasant duty to express sincere thanks and appreciation to all contributors for their endurance and patience and to Drs. G. L. Alexander, M. Marks, B. Rovine and H. T. Wycis for their valuable help in reading the proofs.

E. A. S.

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I. BASIC SCIENCES

CHAPTER 1

Neuroanatomy

By ELIZABETH C. CROSBY, PH.D. AND
EDWARD W. LAUER, PH.D.

A RECENT and beautifully written book on *The Evolution of Human Nature* by C. Judson Herrick[50] is a worthy product of a long and fruitful scientific career. The first part of the book is concerned with the general biological principles underlying successful living for animal life in general as revealed by evolutionary history. The second part of the book deals with the evolution and structure of the human nervous system as these form the bases for man's preeminent position in the animal scale. This volume will be enjoyed especially by those interested in the philosophical aspects of human nervous system activity and in its evolution. A recent atlas by Ludwig and Klingler,[72] consisting primarily of photographs of casts of dissected human brains, with accompanying key drawings, shows beautifully various paths of the brain which can be demonstrated by gross dissection. The relationships of the internal capsule are particularly well illustrated.

In chickens and in several mammals, Bergquist[8] found three distinct bands in the neural tube during development: the proneuromeres, the generally recognized neuromeres, and the postneuromeres. He believed that these bands represent regions of increased metabolic activity and of different metabolic patterns, but have no metameric significance. The relations of the cranial venous supply in the developing and adult brain in man, and to the cranial arterial system were described by Padget.[83] Strong[107] considered the development of the vascular supply of the fourth ventricle in the rabbit.

LaVelle[65] described the development of the nucleoli and the Nissl substance in various nerve cells, as seen in preparations of guinea pig brain stem and cord. Vraa-Jensen[115] studied rather extensively the *embryonic development,* the migration and the functions of various cranial nerve nuclei in the chicken. He noted variations in size of the Nissl granules and differences in length of the axons, and emphasized particularly the correlation between the structure and the function of such cells. Kiss and Sattler[62] found nerves of interoceptive type supplying the human pacchionian bodies. These nerves were considered to measure the pressure of the cerebrospinal fluid. The granulations are said to serve as internally secreting organs. In no other form studied were the Pacchionian bodies structurally similar to those in man. Recently, studies of the finer structure of the choroid plexuses of the rat (Maxwell and Pease[75]) and of the rabbit (Millen and Rogers[77]) have been presented.

Histology

Deitch and Murray[25] grew spinal ganglia cells in vitro. With the phase-contrast microscope, they obtained evidence for the presence of Nissl bodies and neurofibrils in living nerve cells. The electron microscope has been used by various other observers to reveal the finer structure of nervous and supporting elements of the central nervous system. Hess[51] studied the finer structure of the spinal ganglion cells in young and old guinea pigs. He found no evidence of neurofibrils but did recognize a smaller ganglion cell with highly osmophilic cytoplasm and evenly distributed Nissl substance, and a larger cell with a low osmophilic cytoplasm and the Nissl substance arranged in scattered clumps. The Nissl substance appeared to consist of tubular filaments surrounded by fine granules. Other details of the structure of the nucleus, nucleolus and Golgi body, and the structure and arrangement of the satellite cells are described. All senile cells had pigment. Chapter 6 in *Neurochemistry* by Korey and Nurnberger contains an account by Palay[84] of the finer structure of the neuron. Using tissue from the brains of various small mammals and from tumors from human brains, Luse[73] attempted to establish suitable criteria for differentiating between neurons and glial cells. His paper contains a description of the finer structure of the various elements. Uzman,[111] on the basis of her study of myelinization of the sciatic nerve in chick embryos and young mice, interpreted the lamellar structure of the myelin as a result of infolding and spiral wrapping by the Schwann cell. Roizin and Dmochowski[92] demonstrated the osmophilic structure of the myelin sheath and its multiple concentric lamellae in preparations of guinea pig spinal cord. Numerous neurofilaments were present in the axoplasm. Causey and Hoffman[20] confirmed the presence of a mesaxon attaching the surface of the Schwann cell to the nerve fiber. They found that the inner lamella of the Schwann cell formed the outer lamella of the nerve fiber.

Kulenkampff,[63] using the light microscope, studied the nuclei of the Schwann cells in the nervus ischiadicus of the white mouse; they were significantly larger in the recovery period after heavy physical work than during the working period.

Palay[85] described synapses as seen in preparations of the rat brain. There was a close approximation of the limiting membranes of the presynaptic and postsynaptic neurons but they were separated by a cleft of about 200 A in width. He suggested that the vesicles and mitochondria in the presynaptic fibers are concerned in the neurohumoral activity and the electrical discharges, respectively, which occur at the synapse. De Robertis[27] described the degenerative changes in the synapses of the ventral acoustic ganglia (ventral cochlear nucleus) of the guinea pig, 22, 44 and 48 hours after the destruction of the ipsilateral cochlea.

Technique

Smith and his associates[99-101] have published several papers on the Marchi technique. These contain many useful suggestions.

Fearnhead and Lindner[35] reported on various factors effecting the staining of the nerve fibers to the teeth by the silver impregnation method. Nassar and Shanklin[79] described a technique for staining Müller fibers which employed silver nitrate, silver diamino hydroxide and pyridine. A detailed account of the use of a new silver proteinate (Roques) for staining nervous tissue was given by Polley.[87] Brown and Vogelaar[12] employed an amino-silver stain for nervous tissue. The use of ferrocyanide in silver staining for histologic localization of microelectrodes placed in the central nervous system has been described in some detail by Scheibel and Scheibel.[96] The Glees and the Nauta methods for demonstrating terminal degeneration of fibers in the central system were compared by Evans and Hamlyn[34]. The exact site of termination of degenerating fibers was thought to show best with the Glees method; the Nauta method was more effective when the degeneration was scanty. Using the Glees method, Cowan and Powell[24] found degeneration of fibers in the hypothalamus of supposedly normal monkey and human brains and of monkey brains in which lesions had been placed. They concluded that, for hypothalamic areas, this technique does not provide a reliable method for determining terminal degenerations resulting from lesions.

Barnard et al.[4] described lesions produced in the central nervous system of the cat by high intensity ultrasound. The universal stereoencephalotome (model V) devised by Spiegel, Wycis and Goode[102] for localization of points in the human brain can be modified very slightly for use with experimental animals.

Peripheral Nerves

The innervation of the dental pulp, the alveolar periosteum, the peridontal membrane and the gingival tissue were described by Bernick.[9] He found no specialized nerve endings. According to Cauna,[18, 19] the capsules of human Meissner tactile corpuscles arise after birth from tissue of the dermal papilla and continue to develop for several years. After the nerve has degenerated, the capsule remains. The corpuscle receives from 2 to 9 heavy medullated fibers—and some corpuscles also fine medullated fibers—from the deep corial plexus. Nerve fibers within the corpuscle ramify in planes parallel to the skin surface. The final terminations are of several types.

Weddell, Palmer and Pallie[117] evaluated the histologic evidence for specific nerve terminations in the skin concerned with the reception of the four primary modalities (tactile, cold, warmth and pain) of cutaneous sensibility. They concluded that convincing histologic evidence is lacking for the existence of morphologically specific terminations related to these modalities.

Using both the light and the electron microscopes, Engström and Rytzner[32, 33] studied the structure of the taste buds in several mammals (particularly rabbit) and in man. The supporting tissue of the taste bud is derived from epithelial cells of various types. The nerve fibers lose their myelin sheaths on entrance to the bud and terminate in clublike endings of various sizes. A detailed study of the structure and innervation of the cristae ampullares of the guinea pig was made by Wersäll[118] using light, phase-contrast and electron microscopes.

Schulze[97] determined the absolute number and the relative percentage (according to weight of the muscle) of muscle spindles in the human thumb muscles. The adductor pollicis brevis had the greatest number (80) and the greatest relative per cent (29.3 per cent). Voss [114] found an area of numerous, regularly arranged muscle spindles in the middle part of the human muscle, pronator quadratus. Each end of the muscle was poorly supplied with muscle spindles. Bowden and Mahran[11] described a few neuromuscular spindles in gold chloride preparations of the muscle, quadratus labii superioris, of the rabbit. Cooper, Daniel and Whitteridge[23] found, in man, higher apes and some artiodactyls, typical muscle spindles, in eye muscles, some of which act as stretch receptors of low threshold. At the periphery of the eye muscles in many mammals is a layer of muscle fibers of small diameter. Muscle spindles, when present, almost always lie close to or among the smaller fibers. The authors concluded that the degree of sensibility of the extrinsic eye muscles in man "bears comparison with that in those limb muscles with the greatest sensory innervation (e.g.: the lumbricals of the human hand)."

The ultrastructure of the myoneural junction in reptiles (Anolis) was studied by Robertson.[91] He found that small branches from the terminal axons of the motor nerve lie in troughs on the surface of the muscle fibers, not beneath the sarcolemma. In the region of the ending, the sarcolemma shows complex branching and anastomosing folds. The axoplasm of the nerve fibers is separated from the sarcoplasm by a five-layered compound membrane (500 A to 700 A thick).

Wolman[121] studied the early degenerative changes in the myelin after section of the sciatic nerve and following lesions in the brain. He believed that a carbohydrate (possibly acidic) is liberated in early stages of demyelination. Hoen and Brackett[53] investigated various methods for peripheral nerve lengthening following nerve injury with loss of substance in the dog. Their most satisfactory results were across joint stretch after neuroma formation.

Tomasch and Britton[109] found a greater proportion of small fibers in the cutaneous than in the muscular branches of the human sciatic nerve but emphasized the great variability in its fiber composition in various individuals. In a series of 10 human embryos (from 19 mm. to term), the angulation of the spinal nerves with respect to the spinal cord was determined by Barry.[6] Variations in course, in the newborn infant, of the phrenic and lingual nerves, have been studied by Frank,[40, 41] and of the median and musculocutaneous nerves in man by Buch-Hansen.[14]

Spinal Cord

Windle et al.[119] performed laminectomies between T12 and L2 on two groups of monkeys. In one group the cord was transected; in the other the dorsal spinal vessels were ligated or coagulated. Very careful postoperative care was instituted and piromen given to some of each group. After autopsy suitable microscopic sections were made. Scar tissue was present in all animals but varied in density, increased with time and was thinnest where the cut regions were closest to each other and the principal arteries were spared. Scars were less discrete and blended better with the cord parenchyma in animals to which piromen had been given. The most severe damage appeared in cords where hemorrhage had occurred during the operation. Regenerating, extramedullary spinal nerve roots were present around the cord and between the two stumps in animals which had lived more than 90 postoperative days. Only two monkeys had any appreciable number of regenerating fibers within the cord parenchyma. No functional restitution was obtained.