HISTOCHEMISTRY OF
NERVOUS TRANSMISSION

PROGRESS IN BRAIN RESEARCH VOLUME 59

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VOLUME 34

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EDITED BY

OLAVI ERÄNKÖ

Department of Anatomy,
University of Helsinki (Finland)

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P. H. HASHIMOTO, Department of Anatomy, Osaka University Medical School, Osaka (Japan).
A. HERVONEN, Department of Anatomy, University of Helsinki, Siltavuorenpenger, Helsinki (Finland).
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G. JONSSON, Department of Histology, Karolinska Institutet, Stockholm (Sweden).
L. KANERVA, Department of Anatomy, University of Helsinki, Silvatuorenpenger, Helsinki (Finland)
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E. KAWANA, Brain Research Institute, University of Tokyo (Japan).
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E. KLINGE, Department of Pharmacology, University of Helsinki, Siltavuorenpenger, Helsinki (Finland).
G. B. KOELLE, Department of Pharmacology, Medical School, University of Pennsylvania, Philadelphia, Pennsylvania (U.S.A.).
A. KOKKO, Department of Anatomy, Yale University School of Medicine, New Haven, Conn. (U.S.A.).
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L. OLSON, Department of Histology, Karolinska Institutet, Stockholm (Sweden).

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A. PALKAMA, Department of Anatomy, University of Helsinki, Siltavuorenpenger, Helsinki (Finland).

AMANDA PELLEGRINO DE IRALDI, Instituto de Anatomía y Embriología, Facultad de Medicina, Buenos Aires (Argentina).

G.-F. PLACIDI, Department of Medical Pharmacology and Therapy, University of California, Irvine, California (U.S.A.)

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MIRIAM SALPETER, Department of Applied Physics, Cornell University, Ithaca, New York (U.S.A.).

CLARA SANDRI, Brain Research Institute, University of Zürich, Zurich (Switzerland).

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ANN SILVER, Institute of Animal Physiology, Agricultural Research Council, Babraham, Cambridge (England).

ELOISE G. SMYRL, Department of Pharmacology, Medical School, University of Pennsylvania, Philadelphia, Pennsylvania (U.S.A.).

E. SOLATUNTURI, Department of Pharmacology and Electron Microscope Laboratory, University of Helsinki, Siltavuorenpenger, Helsinki (Finland).

U. STENEVI, Institute of Anatomy and Histology, University of Lund, Lund (Sweden).

L. STJÄRNE, Department of Physiology, Karolinska Institutet, Stockholm (Sweden).

ANGELA M. SUBURO, Instituto de Anatomía General y Embriología, Facultad de Medicina, Buenos Aires (Argentina).

S. TALANTI, Department of Anatomy and Embryology, Veterinary College, Helsinki (Finland).

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ANJA TISSARI, Department of Pharmacology, University of Helsinki, Siltavuorenpenger, Helsinki (Finland).

D. R. TOMLINSON, Departments of Human Biology & Anatomy and Biochemistry, University of Sheffield, Sheffield (England).

J. P. TRANZER, Department of Experimental Medicine, F. Hoffmann-La Roche & Co. Ltd., Basle (Switzerland).

R. UUSITALO, Department of Anatomy, University of Helsinki, Siltavuorenpenger, Helsinki (Finland).

MARTHE VOGT, Institute of Animal Physiology, Agricultural Research Council, Babraham, Cambridge (England).

BRENDA WEAKLEY, Department of Anatomy, University of Dundee, Dundee (England).

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Preface

Nervous transmission, which some time ago was a subject reserved mainly for neurophysiologists and pharmacologists, has recently attracted an ever-increasing number of investigators using histochemical methods. The expanding work in the field of histochemistry has, indeed, made it possible to localize at the cellular and subcellular level the transmitter substances and the enzymes synthetizing or hydrolyzing them with a precision not attainable by other means.

During the International Congress of Histochemistry in August 1968 in New York, several prominent histochemists, among them the President of the American Histochemical Society, Professor R. L. Hunter, proposed that a neurohistochemical symposium should be held in Helsinki. As a result of this encouragement and further endorsement by the Histochemical Society of Finland and the Societas Biochemica, Biophysica et Microbiologica Fenniae, an Organizing Committee was formed consisting of Liisa Eränkö, O. Eränkö (Chairman), A. Hervonen, L. Kanerva, J. Karkamo, Anneli Laitinen (Managing Secretary), A. Palkama (General Secretary), and Leena Rechardt, all members of the staff of the Department of Anatomy, University of Helsinki. The subject was limited to nervous transmission, because preliminary considerations made it clear that the field of neurohistochemistry would cover too large an area for a symposium.

The meeting was planned to include all aspects of the histochemistry of nervous transmission in such a way as to provide for a well-balanced programme. A list was then prepared of about 45 distinguished investigators, and invitations were sent to them. Almost all invited speakers responded enthusiastically and attended the meeting, which was held in the Nokkala Congress Center near Helsinki on August 11–14, 1970. The original aim was achieved better than the Organizing Committee ever dared to dream, and the present volume is composed of the 41 papers read at the Symposium and the 3 papers submitted by investigators who were not able to come. We believe that it represents a valid summary of the latest developments in the histochemistry of nervous transmission.

The organizers and members of the Symposium noted with pleasure that the President of Finland, Doctor Urho Kekkonen, agreed to function as the Patron of the Symposium. The meeting was sponsored by the International Committee of Histochemistry and Cytochemistry, whose General Secretary, Professor T. H. Schiebler, took part in the Symposium. The City of Helsinki welcomed the participants by holding a reception in the heart of the city.

Our thanks for financial support are due to the Ministry of Education of Finland, The Sigrid Jusélius Foundation, The Finnish Medical Society Duodecim, The Finnish Medical Association, Oy Astra Ab, G. W. Berg & Co., Havulinna Oy, F. Hoffmann–La Roche & Co. AG., A. Ilmonen Oy, Oy Christian Nissen Ab and Oy

Philips Ab. Thanks are also due to the many members of the medical profession who took part in the meetings as local observers and helped the Organizing Committee to entertain the foreign visitors.

OLAVI ERÄNKÖ

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Functional Aspects of the Localization of Transmitter Substances

MARTHE VOGT

Agricultural Research Council Institute of Animal Physiology, Babraham, Cambridge (England)

When substances of high biological activity are found in the brain, the question of their possible function immediately comes to mind. If, furthermore, such a compound is found to be unevenly distributed, this fact suggests that the compound may take part in some specialized function attached to those regions which are particularly rich in it. It is with this reasoning in mind that the monoamines were first mapped in the brain, noradrenaline (NA) and 5-hydroxytryptamine (5-HT) in 1954 (Vogt; Amin *et al.*) and dopamine (DA) in 1959 (Carlsson). In the course of the last 10 years, the view has been strengthened that the monoamines act as transmitters (or modulators of transmission) in the brain. This view was not difficult to accept for NA which is known to be a transmitter at adrenergic synapses in the periphery, but often doubted for 5-HT or DA since transmission by 5-HT or DA is unknown in vertebrate peripheral nerves; such transmission has, however, been demonstrated for invertebrates.

The evidence for the transmitter nature of cerebral monoamines is based (1) on fluorescence microscopy (Carlsson *et al.*, 1962), which shows the localization within the entire neurone; (2) on electron microscopy, which makes it likely that all monoamines are stored in axonal vesicles: many papers in this symposium are going to deal with this aspect; (3) on the fact that release of some of these substances can be obtained as a response of the brain to suitable stimuli. Thus DA or one of its metabolites is released from the striatum on stimulation of the substantia nigra (McLennan, 1965; Portig and Vogt, 1969), and release of 5-HT from cortex and subcortical regions is seen on stimulation of the raphe nuclei (Eccleston *et al.*, 1969; Holman and Vogt, 1970); (4) on electrophysiological evidence: York (1970) recorded potentials from cells in the cat's putamen and compared the changes produced by local application of DA with those following electrical stimulation of the substantia nigra. The changes were identical in 77% of the excited cells. In similar experiments carried out by Connor (1970) on the caudate nucleus, correlation was complete for inhibitory effects, but only about half the neurones excited by electrical stimulation were facilitated by DA.

Thus the monoamines, like acetylcholine, are formed and contained in groups of neurones which appear to transmit their impulses with the help of these amines. Therefore the question of the function of these substances becomes the question of the action of these systems of neurones, a problem which can only be attacked by a combination of physiological and anatomical methods. Histologically, the axons of

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