NERVE IMPULSE

Transactions of the First Conference
March 2-3, 1950, New York, N. Y.

Editor
DAVID NACHMANSOHN

NERVE IMPULSE

Transactions of the First Conference, March 2-3, 1950, New York, N. Y.

Editor

DAVID NACHMANSOHN

DEPARTMENT OF NEUROLOGY

COLLEGE OF PHYSICIANS AND SURGEONS, COLUMBIA UNIVERSITY

JOSIAH MACY, JR. FOUNDATION

565 PARK AVENUE, NEW YORK, N. Y.

Price: $3.00

Printed in the United States of America
by Progress Associates, Inc., Caldwell, N. J.

PARTICIPANTS

First Conference on Problems of Nerve Impulse

March 2-3, 1950

MEMBERS

H. HOUSTON MERRITT, *Chairman*
Department of Neurology, College of Physicians and Surgeons, Columbia University
New York, N. Y.

DAVID NACHMANSOHN, *Secretary*
Department of Neurology, College of Physicians and Surgeons, Columbia University
New York, N. Y.

DAVID BODIAN
Department of Epidemiology, School of Hygiene and Public Health,
Johns Hopkins University
Baltimore, Md.

FRANK BRINK
Department of Biophysics, School of Medicine, Johns Hopkins University
Baltimore, Md.

HOWARD J. CURTIS
Department of Physiology, School of Medicine, Vanderbilt University
Nashville, Tenn.

JOHN F. FULTON*
Department of Physiology, School of Medicine, Yale University
New Haven, Conn.

HARRY GRUNDFEST
Department of Neurology, College of Physicians and Surgeons, Columbia University
New York, N. Y.

HALDEN K. HARTLINE
Department of Biophysics, School of Medicine, Johns Hopkins University
Baltimore, Md.

HUDSON HOAGLAND
The Worcester Foundation for Experimental Biology
Shrewsbury, Mass.

* Absent

WILDER PENFIELD
Department of Neurology, Montreal Neurological Institute
Montreal, Canada

C. LADD PROSSER
Department of Physiology, College of Liberal Arts and Sciences, University of Illinois
Urbana, Ill.

J. H. QUASTEL
Department of Biochemistry, Research Institute, Montreal General Hospital
Montreal, Canada

FRANCIS O. SCHMITT
Department of Biology, Massachusetts Institute of Technology
Cambridge, Mass.

HENRY B. STEINBACH
Department of Zoology, University of Minnesota
Minneapolis, Minn.

GEORGE WALD
Department of Biology, Harvard University
Cambridge, Mass.

Josiah Macy, Jr. Foundation

FRANK FREMONT-SMITH, MEDICAL DIRECTOR

JANET FREED, ASSISTANT FOR THE CONFERENCE PROGRAM

TABLE OF CONTENTS

NERVE IMPULSE

Transactions of the First Conference, March 2-3, 1950, New York, N. Y.

Editor

DAVID NACHMANSOHN

DEPARTMENT OF NEUROLOGY

COLLEGE OF PHYSICIANS AND SURGEONS, COLUMBIA UNIVERSITY

JOSIAH MACY, JR. FOUNDATION

565 PARK AVENUE, NEW YORK, N. Y.

Price: $3.00

Printed in the United States of America
by Progress Associates, Inc., Caldwell, N. J.

PARTICIPANTS

First Conference on Problems of Nerve Impulse

March 2-3, 1950

MEMBERS

H. HOUSTON MERRITT, *Chairman*
Department of Neurology, College of Physicians and Surgeons, Columbia University
New York, N. Y.

DAVID NACHMANSOHN, *Secretary*
Department of Neurology, College of Physicians and Surgeons, Columbia University
New York, N. Y.

DAVID BODIAN
Department of Epidemiology, School of Hygiene and Public Health,
Johns Hopkins University
Baltimore, Md.

FRANK BRINK
Department of Biophysics, School of Medicine, Johns Hopkins University
Baltimore, Md.

HOWARD J. CURTIS
Department of Physiology, School of Medicine, Vanderbilt University
Nashville, Tenn.

JOHN F. FULTON*
Department of Physiology, School of Medicine, Yale University
New Haven, Conn.

HARRY GRUNDFEST
Department of Neurology, College of Physicians and Surgeons, Columbia University
New York, N. Y.

HALDEN K. HARTLINE
Department of Biophysics, School of Medicine, Johns Hopkins University
Baltimore, Md.

HUDSON HOAGLAND
The Worcester Foundation for Experimental Biology
Shrewsbury, Mass.

* Absent

WILDER PENFIELD
Department of Neurology, Montreal Neurological Institute
Montreal, Canada

C. LADD PROSSER
Department of Physiology, College of Liberal Arts and Sciences, University of Illinois
Urbana, Ill.

J. H. QUASTEL
Department of Biochemistry, Research Institute, Montreal General Hospital
Montreal, Canada

FRANCIS O. SCHMITT
Department of Biology, Massachusetts Institute of Technology
Cambridge, Mass.

HENRY B. STEINBACH
Department of Zoology, University of Minnesota
Minneapolis, Minn.

GEORGE WALD
Department of Biology, Harvard University
Cambridge, Mass.

Josiah Macy, Jr. Foundation

FRANK FREMONT-SMITH, MEDICAL DIRECTOR

JANET FREED, ASSISTANT FOR THE CONFERENCE PROGRAM

TABLE OF CONTENTS

JOSIAH MACY, JR. CONFERENCE PROGRAM

FRANK FREMONT-SMITH
Medical Director

I WANT TO tell you how happy we are to welcome you to this first meeting of the Conference on Nerve Impulse. The Foundation has brought you together to exchange ideas and experiences in an effort to further knowledge in this field.

May I explain the nature and goals of the Josiah Macy, Jr. Foundation's Conference Program which now includes thirteen groups. These cover a wide range of medical knowledge as follows: aging, adrenal cortex, biological antioxidants, blood clotting and allied problems, connective tissues, cybernetics, factors regulating blood pressure, infancy and childhood, liver injury, metabolic interrelations, nerve impulse, problems of consciousness, and renal function. Each group holds annual two-day meetings for a period of five years.

When a new conference is planned fifteen scientists are selected by the Chairman, in consultation with the Foundation, to be the original members. In this selection every effort is made to include representatives from all pertinent disciplines. For the purpose of promoting full participation of each member and guest, attendance at any meeting is limited to a total of twenty-five.

The Foundation is interested not only in furthering knowledge concerning the nerve impulse, but also in investigating the broad aspects of the problem of communication and of integration. The experience gained from the many research projects presented for consideration has led to the conviction that one of the greatest needs today is a reintegration of science, now artificially fragmented by the isolation of the several disciplines or specialties. We feel that the setting up of physiological and — what is more important — psychological barriers between the several branches of science is seriously interfering with scientific progress and that we need to make a constant effort to promote communication across these artificial barriers. Although the fertility of the multiprofessional approach is recognized, universities, scientific societies and journals have not yet made adequate provision for channels of interprofessional communication.

The Josiah Macy, Jr. Foundation's Conference Program hopes to encourage this reintegration. We are happy to say that as a result of our conferences, we have seen research plans and ideas modified, conclusions more clearly specified or placed in broader perspective, and we have watched spontaneous collaboration take place between investigators working in different departments in the same or different universities.

In contradistinction to the usual scientific meetings we place the emphasis upon discussion and not upon the presentation of formal papers. The introductory presentations at our conferences are merely the launching of the ship — the voyage is the important thing! The person opening a discussion is similar to the person who breaks the bottle of champagne over the bow of a new vessel. In other words we feel that the heart of these meetings is the discussions. We want you to speak freely and comfortably in the knowledge that even though everything said is being taken by the stenotypist you will have ample opportunity to edit, modify or delete any of your remarks which you do not want to appear in the published transactions.

From our experience with conferences we have learned that if one desires to successfully communicate with another person one cannot limit oneself merely to making statement *at* him, and increasing the power of one's transmitting set when he does not understand; some consideration of the receiving set is important. If the receiving set has filters which block out certain wave lengths, one must try another wave length. The reports of scientific work in recent years have been forced into a mold of logical sequence leading to inevitable conclusions. The processes of scientific inquiry take place in a much more flexible and unpredictable way. I do not for a moment mean to say that logic is not a most important component of scientific investigation; logic is often brought to bear upon the illogical or adventitious situations which arise. If you have read Walter B. Cannon's chapter on *Serendipity* in *The Way of an Investigator** you will know what I am talking about.

We are trying in our published transactions to maintain the informal nature of the conferences themselves, and to reproduce as nearly as possible the manner in which scientists think and work.

The Conference Program is an experiment and you are part of an experiment. The success of the undertaking is measured entirely upon what each participant gains from such an experience. We encourage your critique of this experiment and hope continuously to improve our techniques.

---

* New York: W. W. Norton and Co., Inc. 1945 (pp 68-78)

INTRODUCTORY REMARKS

H. HOUSTON MERRITT,
Chairman

WHEN DR. Fremont-Smith brought up the subject matter of this conference group I thought it was a very excellent idea, but when he asked me to be Chairman I thought it was a little strange. I came to one of the meetings of another discussion group and I think I found out why he asked me. The Chairman of this other meeting knew so much about the subject and was so interested in it that he did not give the other members a chance to talk. I think Dr. Fremont-Smith had a great deal of method in his madness because he knows I will give you all the chance to talk.

Dr. David Nachmansohn has kindly consented to be the Editor for the transactions of this group. He will send you as soon as possible your discussions to edit and he will try to put them out in a form comparable to that of the books that have been demonstrated to you.

It seems to me that one of the most important functions of discussion groups such as this is to iron out differences of opinion; to see how your work differs from others, how you have perhaps made some mistakes, and how you can correct them.

I have given a great deal of thought as to whether the directors of the Macy Foundation are spending their money wisely in conducting conference groups like this, whether it would not be better for them to subsidize individual pieces of research. However, on thinking it over and talking with other people, I came to the conclusion that this is a very fruitful way for them to utilize funds because it gets men together who are working on a problem and gives them ideas of how they could better pursue their work.

Although we have scheduled official discussers, these men are not going to give papers. As Dr. Fremont-Smith has pointed out they are merely going to throw the subject open to you for discussion. They are going to give you some of their ideas so that you can take up the ball and carry it from there. The whole success of a conference group like this depends upon how much each one of you will participate. I don't know how many talkers we have here. I hope you won't feel like Dr. Fred Gibbs, who, when I sent him his discussion of various papers presented at a recent meeting

of the American Neurological Association to edit wrote back and said, "Why can't I learn to keep my big mouth shut."

When one is interested in a subject it is hard to keep from talking. We want you all to actively participate in the discussion and in order to give the man who has the floor a chance, we shall appreciate it if you do not interrupt him; give me a signal that you want to talk next and I shall try to see that the meeting proceeds in an orderly manner.

If there are no further questions we will have Dr. Grundfest start right off on "Potentialities and Limitations of Electrophysiology." We are discussing the nerve impulse but I am sure we are going to go far afield in our discussions because there are a great many things that bear on this subject.

POTENTIALITIES AND LIMITATIONS OF ELECTROPHYSIOLOGY

HARRY GRUNDFEST
Department of Neurology,
College of Physicians and Surgeons, Columbia University

I WOULD like to open the discussion by implementing the informality suggested by Dr. Frank Fremont-Smith. I hereby put down a bet of one dollar that the first idea relating the action current and the brain, particularly in reference to psychiatry, was presented in 1603. Are there any takers?

All of you should know the name of this great scientist because I am sure you have all seen Hamlet and remember when he asks the question "To be or not to be" with its discussions of revolution, suicide, psychiatry, and so on. He ends up with:

> "And thus the native hue of resolution
> Is sicklied o'er with the pale cast of thought,
> And enterprises of great pith and moment
> With this regard their currents turn awry,
> And lose the name of action."

The potentialities of electrophysiology — being an electrophysiologist, I will accentuate the positive first, or should I say the negative — are the ease and precision of measuring time or durations. The sequences of different potential components, for example, can be easily determined and I need not tell you that one can measure times within microseconds. The precision of measuring amplitudes, it can be computed, detects with a surface electrode one single nerve fiber in a population of 10,000. With microelectrodes in the spinal cord, one can also measure the potential of activity of a single nerve fiber or cell and that is one in millions. Then, of course, by various methods one can determine quite precisely various derivatives of these, like velocities, form. I want to start off with three figures which emphasize some electrophysiological studies in the central nervous system. Although they are somewhat far afield from the nerve impulse itself, I am using them to emphasize the relations between structure and function in electrophysiology.