

ELECTRON MICROSCOPY 1978

VOLUME I PHYSICS

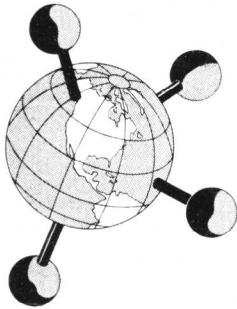
VOLUME II BIOLOGY

**VOLUME III STATE OF THE ART
SYMPOSIA**

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ELECTRON MICROSCOPY 1978

VOLUME III STATE OF THE ART SYMPOSIA



Papers presented in Symposia at the
NINTH INTERNATIONAL CONGRESS
ON ELECTRON MICROSCOPY
held in Toronto, Canada
August 1-9, 1978.

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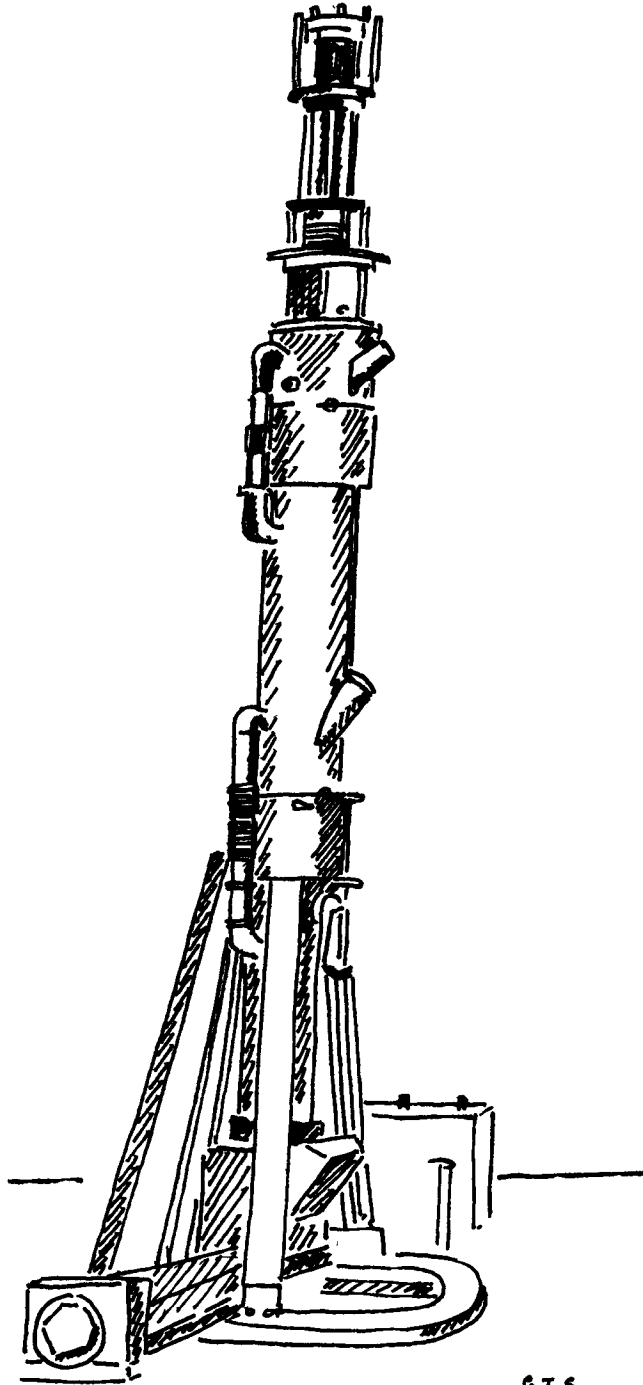
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G.T.S.

Drawing of the first North American Electron Microscope. This instrument is on display at the Ontario Science Centre, Toronto, Canada.

FOREWORD

It is our conviction that the future of scientific research and technique lies in truly interdisciplinary work and dialogue. In order to establish such interaction, one should be able to define accurately the common aims of the different scientific disciplines: physical, materials and biological sciences. The recent concept of creating an Interdisciplinary Institute for Ultrastructure Research in Canada has led Vic Kalnins, Peter Ottensmeyer, George Weatherly and me to devise a clear definition of "ultrastructure research". After many hours of work we came to the following definition:

Ultrastructural studies are concerned with morphology and internal structure and their modifications, of biological and inorganic materials, and the use of many types of *in situ* analyses thereof at resolution levels, which are beyond the resolving power of the light microscope. A non-exhaustive list of examples of such studies in the physical and material sciences includes crystal defects, surfaces and interfaces, chemical analysis *in situ*, radiation damage and the interrelationship of structures with the physical properties of metallic and non-metallic materials. In the biological sciences they range from the study of the structure and chemical analysis *in situ* of cells, through viral particles to macromolecular structure down to the atomic level. While much of the work involves the use of electron microscopes in transmission or scanning, associated techniques involving NMR, circular dichroism, spectroscopy, (light, Auger, electron loss), fluorescence microscopy, X-ray diffraction and fluorescence, optical and computer analysis, immunochemistry, etc., often form an integral part of the study. In addition, developments in electron optics, and design and construction of accessories as well as modifications of existing instruments form part and parcel of the field.

Ultrastructural studies are part of many disciplines from anatomy and anthropology through botany, biochemistry, forensic science, geology, histology, metallurgy, physics . . . to zoology, to mention only a few. The common interest is the solution of problems at the level of very fine structure, solutions and problems which are often similar in principle from one discipline to the next. In addition to this bond, the instruments utilized are identical. The best illustration of this definition is the content of this volume. The 13 papers presented in the three interdisciplinary symposia are of interest to scientists working in various fields, and much of the data presented in the physical sciences will be of great value to biologists, and biological results important for research in the physical sciences. The common aim in almost all the papers included in this volume is to visualize single molecules *in situ*. Moreover, it appears that we are beginning to see how atoms and molecules interact with each other, thus confirming a hypothesis made 2,400 years ago by Demokritos.

It is important not to forget the past, and to remember that the actual development of ultrastructure research started with those who developed the first electron microscopes in spite of the greatest difficulties. One group of these pioneers worked in Toronto in the 1930's, and it is with a feeling of gratitude that the first article of this volume relates the history of this contribution to ultrastructure research.

In this volume, our aim was to publish the most recent data, and to do so, we have had to challenge time. This performance would not have been possible without the co-operation of the authors of the 60 articles. I would like to thank them for their help and understanding, and also for the high quality of their manuscripts. Thanks to our contributors, this volume opens up to further developments, bringing us closer to the future than to the present.

G.T. Simon

PREFACE

The Microscopical Society of Canada is proud to host the Ninth International Congress on Electron Microscopy in Toronto, in 1978. Although a young Society, we have a long history of electron microscopy in Canada and this year will commemorate the 40th anniversary of the construction of the first electron microscope in North America, completed in Toronto in 1938. The Microscopical Society of Canada and its co-sponsors the Electron Microscopy Society of America, the University of Toronto with its Faculties of Medicine, Arts and Sciences, Applied Science and Engineering and School of Graduate Studies, welcome this opportunity to host the Congress and to commemorate this historic occasion.

The Proceedings of the Congress document and illustrate the significance of the modern developments in electron microscopy to our understanding of structure and function in both the biological and physical sciences. The purpose of these Proceedings is to provide a means of communication to identify scientists in their various areas of interest, to disseminate information on current topics to those scientists unable to participate in the Congress, and to provide a means for comparison and review of current trends in instrumentation and application of electron optics. These volumes provide a focus on electron microscopy and its various applications to provide an interdisciplinary review of the field.

Volumes I and II summarize the current innovations in instrumentation in the field of electron microscopy, their applications in physical sciences and in the life sciences and provide an overview of current impressions and trends for future development in these fields. The interdisciplinary nature of this Congress and its Proceedings has an extremely important goal which is to promote the interaction between physical and biological sciences to the benefit of all scientists using similar electron optical instruments in various modes.

One of the aims and innovations introduced at this Congress by the organising committee has been to select papers of high scientific quality. To achieve this aim, all the contributed papers have been reviewed by members of the Scientific Programme Committee with the assistance of a panel of reviewers in specialised topics. Each paper has been reviewed independently by two scientists without knowledge of the identity of the authors or their affiliation. The format of the previous International Congresses on Electron Microscopy for documentation and illustration of contributed papers in two-page articles has been used as the basis for these Proceedings. The articles published in Volumes I and II represent the papers selected for presentation at the Congress, in platform sessions and also in poster sessions. The latter format for presentation — the poster session — is new to the International Electron Microscopy Congress and we hope it will facilitate interaction between microscopists since this formula has received widespread acclaim at many other meetings of this size. Those communications which could not be included among the formal presentations at the Congress are nonetheless important to document and to identify current areas of research in electron microscopy. These are included as summaries, bound at the end of each volume. All papers and summaries are indexed fully according to authors' names and to subjects, based on keywords selected from each article.

Volume III of these Proceedings entitled "State of the Art" brings together the most important concepts and recent advances in electron microscopy. Each section documents the topics reviewed in symposia selected for the Congress with each article written by a leading authority and representing a landmark statement on the subject. This volume is of central significance to scientists in all disciplines;

its content will provide all up-to-date and invaluable reference to the state of the art in electron microscopy.

The publication of symposium topics as a separate volume has been an ambitious project. This volume is a tribute to the invited speakers who agreed to provide an up-to-date review of their subject only 6 weeks before the Congress and to our printers Imperial Press who, using the offset copy process, have completed the printing of this volume in time for the Congress. The first section of Volume III is devoted to an historical account of the construction of the first electron microscope in North America. This commemorative article has been carefully researched and compiled by G.C. Weatherly and U. Franklin and is illustrated by photographs taken at that time. The theme of this Congress has been to focus the modern day accomplishments in electron microscopy and this historic account adds perspective to the achievements in the past 40 years. The succeeding papers document and illustrate the accomplishments and achievements in the development of electron optical equipment and applications to our understanding of ultrastructure.

The Proceedings represent the organ for communication of the scientific programmes arranged by my colleagues F.P. Ottensmeyer (Physical Sciences), and V.I. Kalnins (Biological Sciences) under the direction of G.T. Simon, and with the support of the members, advisors, and reviewers of the Scientific Programme Committee. Dr. Simon has been responsible for the introduction of a number of innovations in the organisation of this Congress including the concern to present a scientific programme of the highest quality, to promote the inter-disciplinary nature of the Congress and to encourage the participation of young scientists at this important scientific event. The attendance of young scientists in the Congress has been possible by granting awards to selected students, nominated from member societies of the Federation. More than 180 students have received such an award, representing a major opportunity for young scientists to participate and meet with established and internationally renowned scientists.

Publication of these Proceedings would not have been possible without the dedicated work of many members of the organising committee and without the secretarial assistance of J. Rooney and E. Duh of the Congress secretariat and A. Warner as editorial secretary. To all I express our gratitude for their generous assistance in the realization of the Congress.

On this occasion the Congress is held in conjunction with the 5th annual meeting of the Microscopical Society of Canada and the 36th annual meeting of the Electron Microscopy Society of America. Members of both societies have actively participated in the organisation of this meeting and its programmes. We dedicate these volumes to members of both the Microscopical Society of Canada and the Electron Microscopy Society of America.

1 June 1978, Toronto, Canada

J.M. Sturgess

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