

FOREWORD

Rook McCulloch

Nothing conveys the lively independent mind, the mischievous playfulness of spirit or the earnestness of Warren McCulloch better than do his own writings. His papers were written with great care. Some are not easy to read, for often he used an economy of words, choosing those that said as precisely as possible what he intended. McCulloch's writings reflect such a rich background of humanism, thoughtfulness and labor that the reader matching effort with effort in the cause of understanding is well rewarded.

As an idealistic young boy McCulloch longed to emulate the brave missionaries who ventured into the wilds of Africa. Somewhat later, still with a strong desire to be of service to mankind, he thought of joining the ministry. Then, after graduating from high school in Orange, N.J., where he was born and brought up, he entered Haverford College in Pennsylvania and his world commenced to widen. Here he was introduced to mathematics and philosophy and was most fortunate to have exceptionally knowledgeable and enthusiastic teachers.

Because the first World War was under way, McCulloch transferred to Yale University in order to be able to join the Naval Reserve's program for students, which, as a Quaker college, Haverford did not have.

From the earliest days of the United States, the McCulloch family had contributed with their various abilities to what they vividly felt was "their country". Patriotic enlistment was taken for

granted. McCulloch, in his turn, enrolled in the Officer's Training Program at Yale and spent some time at sea on a destroyer while still pursuing his college courses. He greatly admired the Navy organization and discipline and kept contact with the Navy throughout his later life as a scientist, often working on Navy grants.

At Yale McCulloch experienced a tremendous growth of intellectual activity, well nourished by the opportunities offered at the University. He began to organize his thinking. In a paper contributed to these volumes, Professor F.S.C. Northrop, of Yale, describes the steps by which McCulloch became a scientist. McCulloch also tells his own story, carrying it on through his later career.

As a young man he found time to write poetry, to become a first-rate carpenter, to learn blacksmithing and welding. He had a very practical knowledge of surveying and a great deal of experience sailing and navigating. He read rapidly, remembered an enormous amount and, until the end of his days, studied and learned new things.

Everything he learned was put to use and contributed to his remarkable sense of wholeness. He had an intense love of life in all its varied phases. Perhaps this was the basis for his ease of communication with every age and every sort of person.

Understanding man and man's understanding became his goal. He started with physical man. In 1927 he became an M.D. with a special background in the physiology of the brain and the nervous system, and in 1934 he was delighted to become a Research Fellow in the Laboratory of Neurophysiology of Professor Dusser de Barenne at Yale University. It was his good fortune to work with a man whom he greatly admired. Professor D de B, as he was fondly called, had the qualification of a true scientist; he saw, in his experiments, only what was there, not what he would like to have seen. The great integrity and intelligence of this man was an influence that stayed with McCulloch throughout his scientific career.

Professor Dusser de Barenne brought with him from Holland the technique of strychnine neuronography. The importance of this research method is explained in these volumes in a paper by Dr. Jerome Y. Lettvin of M.I.T. It led to a fundamental investigation of the anatomy of the brain and the behavior of neurons, which still remains basic information for understanding how the nervous system works. After the untimely death of Dr. Dusser de Barrenne, McCulloch stayed on at the Yale laboratory until he had finished and published the work Dusser de Barenne had started.

McCulloch's life, from 1898 to 1968, spanned an important period for science in this country. The first World War shook the United States out of its isolationism and parochialism and effectively resulted in thousands of Americans going abroad, first by sea, then by air. After the second World War the United States became a magnet for thousands who came here from abroad, and scientists from every country swarmed to our universities and laboratories.

Communication of all sorts improved enormously during and after World War II. In the United States and internationally scientists were finding it necessary to communicate and make themselves understood. To the joy of some and the discomfort of others the enormous growth in technology brought about a quantum leap in cultural changes. A few small examples of this are the replacement of simple old apparatus like a string galvanometer or the smoked drum for making continuous records, or the replacement of microscopes of modest magnification by entirely different types of hardware; electronic equipment, much of it so novel that for biologists and others the know-how of engineers became essential. A serendipitous result, of course, was that valuable increments of knowledge were in their turn acquired by engineers through this cooperative experience, and this process still goes on. In an early paper about this time McCulloch wrote "Then it was that the dream began of team play between biologists, mathematicians and communication engineers which eventually flowered into cybernetics" [171].

Among medical schools, laboratories, universities and government research centers an actual exchange of personnel became common; people went to work in each other's laboratories and exchanged lectures to keep each other and themselves up to date. Money for science was available as it had never been before. Another example of this blossoming of enlightenment was the proliferation of scientific meetings held all over the world. The newspapers, periodicals and news broadcasters flourished, and more and more meetings took place, scientific meetings in particular getting bigger and bigger. The ten famous Josiah Macy Jr. Foundation Meetings on Cybernetics held in Chicago, New York and other places from 1946 to 1953 were unique. They were organized by Dr. Frank Fremont-Smith, Medical Director of the Macy Foundation, and McCulloch was the chairman. Through face to face encounters among scientists of all sorts of persuasions, a bold attempt was made to deal with some of the difficulties of scientific communication and understanding. These were mostly people of strong opinions and important positions in science. The sessions were dramatic! Every scientist had his or her own vocabulary and they all bitterly accused each other of obscurity. The meetings are well described in a contribution to this collection by Heinz Von Foerster, who was one of the participants. McCulloch's report on the last of the Macy Meetings is also included in this book.

By 1941 McCulloch had moved to Chicago at the invitation of Professor Percival Bailey to become the head of the new Research Laboratory of the Neuropsychiatric Institute of the University of Illinois Medical School. He arrived a few weeks before Pearl Harbor, and moved into a vast but completely empty basement laboratory! It soon became apparent that it would take ingenuity to staff and equip this lab. Every hardware store in and around the city had been bought out of tools and supplies by the industries supplying the war. Even hammers, saws and nails had disappeared; what is more, everyone could find a job - the war factories were crying for workers, and scientific workers were in great demand.

However, the changing world events had more interesting consequences than these; they brought to our shores from all over Europe refugee scientists, many of whom were able to quickly gear themselves into American science, and who brought new ideas to this country. McCulloch was very busy assisting the process of finding and helping these people to get jobs and to adjust. Many of them became his close friends and in peaceful years later were able to invite him to their homes abroad. In the early 40's Chicago had become a lively place for science, and McCulloch was in the center of it.

The activities of the Laboratory centered about pathological conditions of the nervous system. A lot of interesting work was done on epilepsy, schizophrenia and metabolic disturbances of the nervous system. The long range plan was to build up a team of specialists to lay the biological foundation for the Department of Psychiatry of the University of Illinois.

Administration and research kept McCulloch very busy but he never forgot his central problem for long. He wanted to understand the functioning of the brain as an organ that remembered and thought. Eventually he turned back to the East where M.I.T. beckoned and the Research Laboratory of Electronics offered him his own laboratory to study whatever he liked. In 1952 he moved to Cambridge, Massachusetts where he stayed until the end of his career.

The nervous system and the brain, which are our links with the outside world, are destined eventually to be as well understood as the genetic system. It has long enthralled scientists as a machine, more complex than any that ever was envisioned. But the ancient, troublesome subject of mind and brain pops up like a stop sign at the crossroads of physics and metaphysics.

Recognizing that the brain is a machine which one uses, somewhat as a typist uses a typewriter, the problem becomes knotty when the brain-user, unlike the typist, is inseparable from - is in fact integral with - his brain machine. To the cybernetician the user is inseparable from his environment.

Throughout the long time it has taken to assemble Warren McCulloch's papers for publication the invaluable help I have received from my daughter, Taffy Holland, Jerome Y. Lettvin, Cornelia Bessie, Heinz von Foerster and Jack Cowan has finally made possible what often seemed unattainable. There have been others whose help, with knowledge and enthusiasm, was most generously given. To all these I owe a great debt of thanks; Michael H. Arbib, Manuel Blum, Valentino Braitenberg, Jan Droogleever-Fortuyn, Jose da Fonseca, Norman Geschwind, Robert C. Gesteland, Gotthard Gunther, Stuart Kauffman, William L. Kilmer, Nilo Lindgren, F.S.C. Northrop, Arnold Scheibel, Mallory Selfridge, Henk Van Der Tweel, M. Vasalis, A.S. Verveen, and Patrick D. Wall.