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WARREN AS A TEACHER

Jerome Y. Lettvin

McCulloch brought to the University of Illinois a style of neurophysiology very different from that of any other teacher in that discipline. Being by appearance as by temperament a swashbuckler, a man who probably would have been more at home in the 15th century than in the 20th, he acted the part with great vivacity. One always imagined him carrying a rapier at his side, and with a kind of Cyranoesque ability of repartee and immediate inventiveness. To him ideas were not clear except as they were somehow or another imbedded in a larger structure which had to be described. Brute empirics had no excuse for being themselves alone. They had to be revelatory or connected with ideas of one sort or another. Furthermore, he made no fuss about fanciful notions or what are presently called far-out ideas. He would consider in a charming and poetical way any notion offered, however bizarre.

To learn under him was very different from learning under any other clinician or clinical professor. He brought a cavalier spirit to the art of experimentation and of arranging data that I have not experienced before or since. For him, philosophical foundations were far more important than for any other man who has been in this field since the time of Helmholtz. Sometimes this led to great peculiarities. For example, he would never abandon a notion proposed by a friend until the bitter end of a demonstration that the idea was improper. But since he told you about this in advance, in fact, made it very clear that this was what he was doing, it was not an exercise of authority which would have inhibited disagreement: it was valid argument.

Elsewhere, I mentioned the great gray eminence of Lashley acting like a pall over all investigations of cortex. Warren was not so much directly influenced by Lashley as indirectly through Hans Lukas Teuber and other members of Lashley's group with whom he was friends. In spite of the fact that he would personally argue against the notion of a uniform gray matter, publicly he did not do so unless he was forced to, as in a clinical conference. It is evident enough (for example, in his work on the structure of the visual cortex versus the auditory cortex in his paper with W. Pitts, *A Logical Calculus of the Ideas Immanent in Nervous Activity*) that he took the structural considerations of cortex most seriously and was convinced that the nature of the processing lay in the anatomy. This 1943 paper is the only one at variance with all reports of his supposing the cortex to be a uniform material, *a la* Lashley. Similarly, when it came to higher functions and questions of aphasia, agnosia, and the like, which were first beginning to be of interest to Midwest clinicians, Warren had his own notions of how language was made and of how the arts of writing and of listening were accomplished. These he never made available in print, principally because he did not feel as sure of them as he might have been had neurology itself been more developed. Clinical psychologists were not very adept at that time, and the Midwest had no better clinical psychologists than the rest of the country. McCulloch, who was amiable in the extreme, would take whatever dross they offered and somehow or other try to arrange it in more pleasing patterns.

What he brought to the student was the art of criticism, that is, how to take all possible avenues toward breaking up notions and resynthesizing them. There was no art of the fantastic that he really disputed, except, of course, when he was in solemn conference with people whom he respected very highly. For example, he respected Wiener, von Neumann, and mathematicians more than almost any others, and would do his very best in their presence never to intrude fantastic notions that he would have tolerated daily from his students and his colleagues in the university. In a word, he had taste and also a certain political sense of how to

handle ideas. He did his very best to impart this to those around him.

His personal anecdotes with which he illustrated most of his teaching were remarkable. He made them literary adventures rather than simple essays or newspaper reportage of a kind that would leave no impact. There wasn't a single event in his life which did not, in fact, metamorphose itself into a fable with a moral or a scientific objective. This excellent way of presenting both his personal life as well as the remote past served as a model for looking at the world and particularly at the problems in neurology and neurophysiology as works of art, not simply collections of data.

He made a game of being allusive. That is, whatever he had recently read, he assumed everyone else had read, and this sometimes led to the most peculiar sorts of lectures one could imagine. Various members of the audience, prestigious people, would nod solemnly as if they knew exactly what Warren was talking about when, in fact, very often they hadn't the vaguest notion. From the point of view of a teaching experience, this is probably the best kind of attitude to have: the assumption of ability and knowledge on the part of one's auditors, a kind of mock humility that says "...of course all of you know much more about this than I do." It cannot help but raise the ego of the auditor to where he actually listens to an argument. Indeed, Warren's ability to quote things was a greater spur to education than one might imagine, because rather than confess one's ignorance and insist on details, one would accept the oracular style with which Warren delivered them and later go and check for oneself. He also had a habit of finding the point of outrage of his auditors, that is, there would be a certain level beyond which you would not tolerate what he was saying, and he always picked these levels precisely, specifically, at a point where, if you checked, what he said was quite true. In a word, the world, which to him was always fantastic and somehow or other an enormous adventure, was tied together through anecdotes so outrageous that you felt that at least some of them must be false. Then, when you checked the most outrageous ones, they were never false; only the minor ones were.

Unfortunately, this literary way of presenting material fell flat on many of his adult hearers. However, it seemed to inspire the young men around him in a way which was unusual. Among the people in the laboratory of the Neuropsychiatric Institute were those whose work was not so much pedestrian as repetitive, not so much concerned with ideas as with data and only data. Among these people there would be an instant rejection of Warren at his most flowery, but it was precisely at that point that the students, listening to him with mouths agape, were most awakened. He had an extraordinary clinical acumen, perhaps intuition, sometimes wrong but almost always something from which one could learn. In a sense, he had exactly the same properties as Derek Denny-Brown at Harvard. While you would not rely on the diagnosis made by a more practiced clinician, you learned more from Warren's diagnostic techniques than from the diagnostic techniques of others, just as you learned more from Denny-Brown than from any other neurologist. Norman Geschwind and I have discussed this point frequently: that Denny-Brown was probably the best single teacher in neurology that we have ever experienced, not because he made right diagnoses, but because he would insist on argument over any diagnosis, wrong or right, until the right one emerged. Warren had the same method, that is, he would advance an idea and insist on argument. Sometimes he would advance a flagrantly wrong idea to provoke discussion. He believed that one had to sharpen one's wits as well as one's tools in this field.

One of the things that Warren insisted on in his students was a kind of literary excellence. That is, you either had to rival him in your stories and poems or cap his epigrams, or you felt somehow or other incompetent. This benign one-upmanship I think did a good deal to stimulate his students ad his colleagues. His imagination was vivid, and he would convert an experience you and he had had together into a fabulous story which was not ever untrue in nature, but beautifully embellished in detail. In a sense this is a kind of model of the way one wants to think. Nothing arises from tedium except tedium, and it is very difficult to make tedium an esthetic experience. But converted, as it were, into a system of

high adventure, one's life and one's experiences with patients take on a different nature in memory than would otherwise be the case. This ability to make vivid points by simply rearranging unnecessary details around them is an art form that is unfortunately misunderstood in the period where unnecessary accuracy is a *sine qua non* of publication. This extremely benign and admirable trait also did more, unfortunately, to adversely affect his reputation than anything else.

If one checks McCulloch's techniques of education against those that have been successful in other fields, one finds an enormous similarity of Warren's handling of data to that of eminent scientists in the physical or chemical fields. For example Pauling, whose profound abilities in chemistry are certainly attested by his works, and whose insight into chemistry has not been surpassed in recent years, is a man also given to hyperbole as a way of impressing matters on his students, and a man also given to elaborating extended metaphors in conveying an idea.

It is a pity that the science of the nervous system, which is the most backward of all sciences in having no central theory at all, should hold continually to a regurgitation of data without the application of any imagination whatsoever. Certainly no theory can arise from data alone. One must bring to the data an image, however wrong, of the way things are arranged in order to be able to set an idea of a theory that is proper. To approach the whole business of the most complex system known to us, that of the brain, in a manner that supposes that if enough mounds of data are built up a theory will somehow or other emerge, is to go contrary to the history of science and to go contrary to all the practices that one observes in other fields. Wrong guesses and wrong theories may be much more important than the acquisition of new data, and Warren continually practiced theorizing and taught his students the practice of theorizing as a way of designing proper experiments.

Nobody was more appreciative of fundamental experiment than Warren. It was he who expounded the extreme power of David Lloyd's findings in the early forties, and it was he who led

us through the immense contribution made by Hodgkins and Huxley in 1952. He instantly noted not only the importance of the findings but how they might be extended in the realm of what I can only call experimental epistemology. These teachings, which are precious to those who remember his work, are more important in some respects than almost anything he wrote, because he would never put any of the discussions to which he treated his students in print. Somehow, one can sympathize with him since those things that he took as most basic and most sacred were handled so inelegantly by his colleagues.

It would be good to revive the imaginative approach to the nervous system in Warren's way rather than in the way it is presently treated. There is something so pedestrian, so dull about the current views of the nervous system as to inhibit the imagination, and it is about time for a new McCulloch to appear, unfettering the minds of students in this field from the drabness of data that have mounted without end and have led to no conclusions whatsoever.

Warren took everybody with great, if somewhat humorous, seriousness. Children, as well as adults, were treated as if they were experts in whatever they were talking about. This most engaging way of dealing with the young provided Walter Pitts and me with an early adulthood that neither of us recovered from. He and Rook took Walter Pitts and me in as children in their family at a time when we most needed it, and the year we resided in their home made the profound difference in the way we later treated the materials of science, the ideas of science and the poetry of science. I do not think either Walter or I would have emerged in any sense as skilled - Walter in idea, myself in experiment - had it not been for the tutelage of the sort that I have described. The same can be said of most of his colleagues: Elwood Henneman at Harvard remembers quite vividly the same kind of thing from Warren, and so also do the various other students who had briefer contact with him, but whose lives were equally strongly affected by Warren.

One thing that all of us learned from Warren was that at no time ever does one backbite another person; that is, even those people Warren most palpably disliked he would never talk about as objects of contempt or derision but always find something good to say to them. Sometimes this led to most amusing pauses, Warren trying to find something good to say when he was asked an opinion; learning this one art was very difficult for those of us who had been brought up otherwise!