Letters

Hands and Brains

In these immediate years, new medical schools are being created in the United States. Each school, prior to its actual existence, will enjoy a happy honeymoon period. This honeymoon will extend from the beginning conversations until the first faculty members are appointed. At that moment, a series of inevitable arguments will begin: (i) hands or brains; (ii) status or dollar; (iii) town or gown; (iv) generalist or specialist; (v) grant-eater or teacher.

How can one say with such assurance that these arguments are inevitable? Your confidence can rest on the secure foundation that the existing 80 medical schools in this country have devoted years of total staff time to committee in-fighting, maneuvering, and challenging; that the medical journals for 40 years have offered a steady diet on the pros and cons of these five versions of the truth and that the presidential address before any self-respecting medical society must cover, with vigor and bias, some aspect of one of these slogans.

Perhaps any social organization as complex as a medical school must, by its very nature, expect to be a permanent center of controversy. I will admit that this problem is not limited to the United States. Every country that I have visited has been hung with equal enthusiasm on this same five-pronged dilemma.

The senior (or resigned) approach is one of calmness and with quiet murmur suggesting that the only real form of education is student, log, and speaker and that all these present discussions are due to immature enthusiasts (the word *aggressive* or *ambitious* is frequently used).

However true, this end-of-the-road attitude of the tired committee veteran does not justify an acceptance that what has been done is the best we can do.

The exact sequence in which these five arguments will appear at any given medical school will vary; however, item i is usually the basis of the original debate. The degree of heat engendered by item i varies also but, if allowed its full potential, sufficient hostility can be produced to weaken the school's growth possibilities for several years to come. Items ii, iii, iv, and v are of simpler dimensions, and I comment here only on the initial argument: hands or brains.

The term "hands or brains" is a shorthand phrase squeezing all the issues which should be concerning the new school down into a sterile discussion of whether a medical school's responsibility is to produce a practicing physician or an educated, thinking scientist. Or, are we to be a guild shop or a true university? Or, are we interested in perpetuating the pseudoscience of medicine or is it not time to create a center for human biology with graduates who are finely groomed in the basic disciplines of biochemistry, immunology, genetics, and other areas and thus end this dependence upon the classic graduate of a medical school—a man who succeeds principally through the "art" of medicine.

From the slanted phrases used above, it is obvious that the proponent was a *basic* scientist. Equal myopia can be demonstrated by the *clinical* scientist. His line of argument will run along these lines: Are we to produce cold, insensitive technicians or true physicians who *care* and who have compassion? Or, of course, medicine is an applied science—at least, when I am sick, I want someone who applies his hands and skills to my well-being and who doesn't simply order another blood test. Or, this medical school was created by the taxpayers to make doctors, not a group of ivory tower researchers.

These phrases appear in all disguises and in all degrees of kindness and unkindness, but the central theme remains the same.

The proponents of the "basic" concept have an interesting dilemma, incidentally. It has to do with degree. I am reminded of George Orwell's *Animal Farm* in which the tenet is advanced that "all animals are created equal . . . except some are more equal than others." The same definition of membership is beginning to separate the basic sciences into those which are "basic" and those which are "basest." For a happy 40 years, the physiologist has been secure in his medical school role, knowing that *his* was the pure discipline, the exact science, and that the careless methods of the clinician could only be excused because someone had to do the labor around the medical school. But now the truth becomes apparent: there are baser people in baser fields and he was not truly basic but just a canine doctor. In fact, as the clinician has steadily moved into the fields of chemistry and physiology, it has become apparent that perhaps these always were clinical fields and that the proper distance between clinician and physiologist was actually a hyphen: a clinician-physiologist.

The pharmacologists, the physiologists, the pathologists are now finding themselves "debased" by the enzyme chemist, the cellular physiologist, the cellular geneticist. And it must give them a feeling of temporary victory to know that the mathematician *knows* that he is the purest of them all.

At some point in this discussion of "hands or brains" another area of thought will enter the argument, namely, the role of the social sciences or the behavioral sciences.

This collection of ideas will be advanced under various phrases including *ecology, bionomics, behavioral sciences,* and *preventive medicine* and all of these phrases will be considered suspect by the clinical half of the discussion groups.

This is an interesting trait of the clinician (teacher or practitioner). His distrust of anything dealing with overall or group medicine is usually attributed to Franklin D. Roosevelt or to the influence of the American Medical Association.

The nearest thing to behavioral medicine that the clinician has allowed himself to accept has been psychiatry or psychosomatic medicine. Even here there has never been a wholehearted endorsement but more of an acceptance

because of intimidation. In fact, as the physician begins to realize how slender the facts are behind the ego and id vocabulary of psychiatry, he also begins the downgrading of this field which was inevitable.

Perhaps the fact that as a physician he knows the one-to-one ratio, the confinement upon which the physician-patient relationship depends, makes it difficult for him to understand how an educational structure could be developed around group concepts, or around any field (social or behavioral sciences) which allows a nonphysician a large role in the construction of a curriculum.

It is interesting that basic scientists (brains) can understand that the very social framework of medical education and subsequently medical care may need changing whereas the clinician (hands) finds this beyond his imagination. Some of the reasons behind the clinician's attitude have been indicated above. Perhaps it is true, to state it differently, that the clinician has come through such a long, confining, and restricting discipline that he has become a victim of it and even against his own judgment or without his own knowledge, he cannot see the issues as clearly and originally as the basic scientists, M.D. or Ph.D. The latter group can think, perhaps, of problems of world health, of Malthus, of mass destruction, and of mass well-being.

The clinician, because of the initiation rites of his club: after 10 or 15 or 20 years of thinking of sickness, not of health, and of responsibility for *a* patient, not a population, finds himself trained into a mold. This mold has been defined by the profession as the way in which it wants its physician to perform. The fact that there may be a better way to care for the health and sickness of the population is occasionally suspected by the individual physician, but only occasionally. Day after day the method keeps shaping him and unconsciously he finally *knows*, right or wrong, that this is the way a physician should be made and this is the way a physician must practice.

The "brain" half of the discussion cannot accept this argument as a reasoned one. Why can not a new school develop a new curriculum which is designed for a world which has changed? What is so changeless about the practice of medicine which would make it correct to produce doctors now, using the Flexner report as a guide book? The 40 years since its appearance have seen a change upon obsolescence upon change in practically every other form of human endeavor.

This can be deprecated by saying that these changes have been in mechanistic fields, transportation, communication, and industry, and that medicine and medical care reflect changeless qualities, as fundamental as love or hate, and therefore the qualities which make a good physician are durable and have remained so, on through Hippocrates, to Harvey, to the present.

This answer is a retreat behind phrases. The caring or concern for the sick is a continuing enlightenment of man. This does not mean that the individual who applies therapy has been unchanging. Society has continued to evolve a physician to suit its temper, time, and tolerance. The physicians of Rome read the entrails of animals, the physicians of Medieval Europe prepared decoctions of urine, pearls, and toads, the physicians of the 18th century bled and purged.

The argument of "hands or brains" can be a good one. If wise enough men are engaged in it, and if the hostile elements can finally come not to a compromise but to a level of originality and even daring, then not only a new medical school but an experiment which is long overdue will come forth from their labors. It is possible to consider the hand, the brain, the behavioral sciences, and the individual, as well as the society.

Such opportunities for originality come but infrequently and they come to a given institution but once. That moment is gone and lost if the original handful of men, who sit down to dream and define, are unable to separate their own ambitions and bias from the potential before them.

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Ozone: Protection of Plants from Injury

It is interesting that particulate agents as diverse as clay and sulfur can protect plants against damage by ozone [E. L. Jones, *Science* **140**, 1317 (21 June 1963)]. However, I must express skepticism regarding Jones's idea that the catalytic decomposition of ozone would be expected to produce enough heat to "burn" plant leaves.

The net reaction, $O_3 \rightarrow 3/2\ O_2$, is exothermic to the extent of 34.1 kcal/mole of ozone decomposed, but the ozone concentration in polluted air is only about 1 part per million; hence the heat available from this source is only about 0.034 cal/mole of atmosphere, equivalent to a temperature rise of about 0.005°C. Reaction of ozone with reducing substances at the leaf surface would yield a somewhat higher heat of reaction, but certainly not by a factor of 10. Thus the protective effect of these substances must be attributed to their ability to destroy ozone, rather than to their ability to dissipate heat.

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In a physical sense, the kinetic recombination of oxygen atoms on the leaf structure, a third body, could result in the evolution of sufficient heat to degrade specific leaf cellular structure.

A rough calculation yields a potential oxygen atom pair impact per tomato cell of at least 65 per second when the ozone concentration is 1 ppm.

The mechanism of leaf "burn" by ozone has not been established.

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Eradicating the Gypsy Moth

The successful isolation, characterization, and synthesis of gyplure, the sex attraction of the gypsy moth, which was described by Jacobson and Beroza [*Science* **140**, 1367 (28 June 1963)] represents a milestone in the 60-year-old battle against this forest pest. Synthetic gyplure is quite inexpensive, and as little as 10^{-8} mg has attracted male gypsy moths in the field. Since it became available it has replaced benzene extracts of virgin females as a lure in survey traps. There have been suggestions that it might be valuable in controlling the insects through massive trapping programs. However, very little attention has been given to the potential use of gyplure in a control program designed to frustrate mating by confusing the males during the brief flying season, when they must locate by smell the heavy-bodied and essentially flightless females. This could be accomplished by saturating the en-