

SCIENCE

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THE SPIRIT OF INVESTIGATION IN MEDICINE¹

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THE first Greek poet of whose personality we are certain, Arctinus of Lesbos (B.C. 770), sharply differentiated medicine and surgery, and held medicine responsible for the advancement of medical science. He relates how Esculapius "endowed one of his sons with nobler gifts than the other; for while to the one, Machaon, he gave skilled hands to draw out darts, make incisions and heal sores and wounds, he placed in the heart of the other, Podilarius, all cunning to find out things invisible and cure that which healed not." How can we, disciples of Podilarius, best proceed in this day and generation to "find out things invisible and cure that which heals not"?

The problem is as old as medicine itself. The story of medical investigation unfolds itself in the history of medicine. Progress comes through ideas. Great investigators have appeared from time to time in medicine. They have contributed new ideas, in the elaboration of which they recorded new observations, recognized new facts, established laws, advanced the art of practise, and thus developed the science of medicine. As time passed the so-called underlying or fundamental sciences evolved, and in turn made fresh opportunities for the medical investigator, but they have taken a large proportion of medical investigators from the field of active practise. Some are still left who are attempting to "find out things invisible" and to solve the ever-present problems of treatment of the sick.

Recently, to further such ends, a national Society for Clinical Investigation was created (1909). According to the constitution the objects of this society are "the cultivation

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¹ From The Mayo Foundation, Rochester, Minnesota. President's address before The American Society for Clinical Investigation. May 9, 1921.

of clinical research by the methods of the natural sciences, the unification of science and the practise of medicine, the encouragement of scientific investigation by the practitioners, and the diffusion of a scientific spirit among its members." Broadly speaking, these simmer down to the better care of the sick, the broadening of the bounds of medicine, and the development of the physician himself.

To the public generally, medical investigation makes no great appeal. The research worker is commonly regarded as impractical. Yet the routine practise of to-day is based on the investigation of yesterday. Wassermann tests, renal functional tests, and spinal fluid findings constitute substantial phases of the medical practise of to-day. Yet, we did not have them fifteen years ago. The public and many physicians fail to appreciate that practise is based on investigation, and that clinical investigation means better care of the sick, greater public health, and happier communities.

Investigation is complex. It demands certain mental attributes. The most essential is a veritable lust for truth. This has to be supported by skill in experimentation, accuracy in observation and record, correct interpretation of findings, and due appreciation of their significance. The lust for truth must result in active search which recognizes no sacrifice. Skill in experimentation involves insight and ability in the selection and the carrying out of well-controlled experiments. Accuracy in observation implies capacity to see, a knowledge of the subject, and an appreciation of the phenomena observed. Accuracy of record demands precise and prompt notations, made preferably during the course of experimentation, for, as a rule, observations made to-day and recorded tomorrow are lost to science. Correct interpretations of findings and due appreciation of their significance demand a well-trained mind, critical judgment, and a familiarity with the subject in relation to contemporary science.

This may be stated in a somewhat different way. Investigation consists of four fundamental factors: (1) the clear conception of

the problem, that is, a definite "Fragestellung"; (2) the selection or development of methods capable of solving the problem; (3) ability to recognize relationships, to orient the problem to existing facts; and (4) accurate measurements and records.

The spirit of investigation is a living force, born within or rendered kinetic by contact from without, which, when first awakened, is usually feeble and requires cultivation, but when fully developed directs action and controls destiny. It is difficult to define, to understand, to acquire, to cultivate, and to communicate.

The cultivation and the diffusion of the spirit are our problems. Once the investigator is imbued with the spirit, investigations will proceed and bring results. But in diffusing, the spirit must be communicated so that it may be acquired by another. Consequently we must consider its acquisition as well as its cultivation and diffusion.

Acquisition of the Spirit of Investigation.—The statements of Hippocrates relative to the attributes desirable in the student for instruction in medicine apply equally well to the prospective investigator. Hippocrates says:

Whoever is to acquire a competent knowledge of medicine ought to be possessed of the following advantages: a natural disposition, instruction, a favorable position for the study, early tuition, love of labor, leisure. First of all, a natural talent is required, for when nature opposes everything else is vain, but when nature leads the way to what is most excellent, instruction in the art takes place, which the student must try to appropriate to himself by reflection, becoming an early pupil in a place well adapted for instruction. He must also bring to the task a love of labor and perseverance, so that instruction taking root may bring forth proper and abundant fruit.

Instruction in medicine is like the culture of the production of the earth, for our natural disposition is, as it were, the soil; the tenets of our teacher are, as it were, the seed; instruction in youth is like the planting of the seed in the ground at the proper season; the place where the instruction is communicated is like the food imparted to vegetables by the atmosphere; diligent study is like the cultivation of the fields; and it is time

which imparts strength to all things and brings them to maturity.

But we need not concern ourselves unduly about the extent and character of the soil. Every year brings into medicine thousands of young men—"good ground" capable of bringing forth fruit, "some thirty, some sixty and some an hundred fold." To be sure, we must participate in the cultivation of the soil, but to the planting of the seed in the ground at the proper season we must first direct our efforts.

The present season is unusually favorable. Formerly much of the sowing and early cultivation among Americans was done abroad. Since this is no longer possible, the responsibility is clearly ours. Never in the history of American medicine has the responsibility been heavier, the opportunity greater. Seed time in medical life rarely lasts more than ten years. It is represented by years in the medical school and those immediately following graduation. In the undergraduate years, intensive cultivation, as a rule, preempts the field and permits sowing and cultivation, but rarely harvesting. Unless fruit is brought forth within five years of graduation it is rarely forthcoming. In this crucial period of growth there are in this country at the present time probably a thousand young men properly seeded, but in need of cultivation. In this period environment is all important and includes subsidiary factors necessary to production, such as time, space, facilities for work, inspiration, guidance, criticism, advice, and access to literature. Growth at this period is, as a rule, not sufficiently advanced to permit the investigator to control these factors personally. The responsibility rests, therefore, upon the sowers.

Some of these factors are supplied by the creation of the so-called "atmosphere." Our greatest need in medicine is institutions with atmosphere. All of us who have worked in certain medical centers have recognized the existence of atmosphere and have felt its influence. It results from the reciprocal stimulation of many capable workers in diversified fields. It constitutes, as it were, a high tension

center capable of furnishing inspiration to many.

The Cultivation of the Spirit—Work.—Osler's masterword in medicine is also the masterword in investigation. Every member of this society should possess the spirit, and is pledged to its diffusion. This means always more work. American medicine looks to the members of this organization for leadership in clinical investigation. It is self-evident that real leadership can not be exercised with work that is finished. Only he who continues to work continues to lead.

Great efforts have been put forth in this country during the last decade to do away with the old system whereby the energies of so many clinical investigators of merit are diverted into other fields. A man capable of high-grade investigation should not be converted into a routine teacher, administrator, or practitioner solely. For it can not be too strongly emphasized that capable investigators are more rare than good administrators, and a first class teacher must be an investigator.

The medical way is but a succession of decisions. The successful investigator faces continuously the situation described by William James. In one of his letters he says,

I stand at the place where the road forks. One branch leads to material comfort, the flesh pots, but it seems a kind of selling of one's soul; the other to mental dignity and independence, combined, however, with physical penury. On one side is science, on the other business.

The further the medical road is successfully travelled, the more enticing are the by-paths leading from investigation, and they need not all be paved with gold. The sign posts carry such inscriptions as "deanship," "professor," "director," or "chief." These signs on the medical way are dangerous, and oftentimes deceive the very elect, especially if the elect be hampered with physical penury or blessed with a large family. Despite position failure to continue to investigate leads to loss of those attributes necessary for leadership. Neither position nor worldly possessions should insure leadership in medicine. Work is the masterword, work in the class-room, laboratory,

ward, and office. Investigation can not be done solely from the office desk nor from over the tea cups.

Science rests on investigation, and investigation is measuring. With the modicum of science at his disposal, the busy practitioner is not equipped mentally, nor has he the time nor the technical facilities necessary to deal with the more complex problems of disease. The investigator must needs keep pace with contemporary science, in itself a big undertaking, and must apply it to medical problems as opportunity arises or can be created. As Galileo was engaged in the creation of the sciences of physics and mathematics, Santorini through his assistance was engaged in applying the thermometer and balance, that is, the new instruments of science, to the problems of physiology. This is as it should be. In these days physiologists and physiologic chemists at times intervene, but some times as liaison officers only, between the clinician and pure scientists. The field in medicine for the pure scientist is still great, despite the splendid contributions to medicine which constantly pour forth from the laboratory workers in the fundamental branches of medicine. Closer and more direct points of contact are desirable, more direct intercourse, in order that the problem, as seen by the physician, may be placed first-hand and in its true light before the pure scientists.

Diffusion of the Spirit.—There are at present in this country a relatively large number of young men capable of developing into investigators. This society has approximately 150 members, all of whom are obligated to the diffusion of its principles. As a society, to my mind, we are not even approaching the possibilities in diffusing the love of investigation among the younger men.

Membership in this society entails responsibilities. Eligibility for membership is simple. Any practising physician in the United States who has accomplished a meritorious, original investigation and who enjoys an unimpeachable standing in the profession is eligible. But once a member, the responsibility of a leader is assumed, since one of the obligations im-

posed upon its members by this society is to be "active in the diffusion of the principles of this society."

This is a national organization comprising members from every part of the country. It meets once a year and presents and listens to twenty-five papers. Many younger men are scattered throughout the country who have no access except through abstracts to the proceedings of this society. The founder of this society recognized this truth. He met the situation, however, in his own locality by founding the Society of Experimental Biology and Medicine in New York City with a constitution embodying principles identical with ours. The local society functions locally and attempts to accomplish locally what we are attempting nationally. It meets frequently, whereas we meet annually. It reaches those who need its influence most.

As president of this society I wish to suggest that we consider and adopt some plan whereby we can be more effective in the cultivation of the spirit of investigation. It might be wise to follow the example of Dr. Meltzer and create subsidiary, local societies of clinical investigation in various medical centers throughout the country, societies which would carry some sort of affiliation with the national society.

How could such a plan be carried out in Boston, for instance? At the present time each institution entering into consideration has, in all probability, its own society intended for the cultivation of the spirit. Without disturbing their present organization or function, it would be possible to hold joint sessions once a month in the various institutions, as the Boston Society for Clinical Investigation. Such an organization would afford each Boston member an opportunity to attend, to bring with him his young associates and to meet those of the others, and to diffuse and instil the spirit into the entire group. On a small scale such an organization would afford the beginner the same opportunities and advantages enjoyed by us through membership in this society. By holding the meetings in the various institutions, each beginner would be afforded an op-

portunity to acquaint himself with other institutions and their staffs, such advantages as some of us on a larger scale have enjoyed through membership in the Interurban Clinical Clubs. From the local programs could be selected the best material for presentation before the national society. From the local society could be selected those most fit for full membership in this organization. Thus, without necessarily increasing the number of meetings, through the organization of subsidiary, local societies, the spirit of investigation could be better cultivated among those whose need is greatest. Since the aims are identical, the advantages accruing to the members of the local organization are obvious, but whether their relation to us should be official or unofficial is for us to decide.

Dr. Meltzer, the founder of this society and the prototype of the clinical investigator, recognized very clearly the need of encouraging younger men in their investigative aspirations. We could not do greater honor to his memory than to follow his example and create local centers fostering clinical investigation.

LEONARD G. ROWNTREE

THE MAYO CLINIC

OBSERVATIONS OF THE AURORA AT THE LOWELL OBSERVATORY

MAY 14, 1921

THE very brilliant auroral display which appeared on May 14 exhibited frequently the phenomenon of streamers diverging from a definite point in the heavens, and it was often possible to locate this radiant, with reference to the stars, with considerable accuracy. The resulting positions, with the times of observation, are as follows:

Mountain Time	Hour Angle	Declination
8 ^h 54 ^m	+ 47 ^m	+ 4° .5
8 56	+ 39	+ 3 .6
9 00	+ 39	+ 4 .4
9 01	+ 44	+ 4 .4
9 04	+ 30	+ 3 .7
9 06	+ 34	+ 3 .1
9 13	+ 39	+ 3 .7
9 16	+ 38	+ 2 .6
9 19	+ 40	+ 3 .0

9 20	+ 37	+ 2 .7
9 24	+ 31	+ 2 .2
.. ..		
10 49	+ 21	+ 2 .3
10 55	+ 31	+ 2 .8
11 02	+ 26	+ 3 .8

Jupiter, Saturn and β Virginis served as comparison stars for the earlier observations and ζ Virginis for the last three. The means of the first eleven estimates and of the last three, give:

Mountain Time	Hour Angle	Declination	Altitude	Azimuth
9 ^h 08 ^m	+ 38 ^m	+ 3° .4	57° .2	S 17° .4 W.
10 55	+ 26	+ 3 .0	57 .4	S 12 .1 W.

The average deviation of a single observation from the mean is $\pm 0^\circ .7$ in declination and $\pm 3^\circ .5$ in hour angle, so that the difference between the two positions appears to be real.

The mean of the two, giving the first double weight, places the radiant in altitude $57^\circ .3$, azimuth S $15^\circ .6$ W. The magnetic dip at Flagstaff is 62° and the variation 15° E. so that the radiant was very nearly on the magnetic meridian but about 5° south of the "magnetic zenith."

The aurora was not only very bright, in spite of the light of the half moon, but extended surprisingly far south. About 9 P.M. several bright patches were seen low in the south, and at 11 the whole southern sky was full of streamers and patches of light.

At 10:57 a remarkable group of short curved streamers appeared surrounding the radiant. These were but a few degrees in length, but very bright, and a distinct motion of the luminosity along the streamers was visible,—outward in all directions from the radiant, and with a curvature in a counter-clockwise direction. The motion was rapid, covering the length of the visible streamers in less than a second, and the impression was strong that what was seen was the actual motion of the particles which enter the atmosphere and cause the luminescence.

HENRY NORRIS RUSSELL

May 16, 1921