call out for chemical assistance. It may be that in the lifetime of some of us those confluent streams of thought and experiment are to be joined by yet another that rises in the vast, remote and, as it must appear to some, muddy swamps of physiological chemistry; and it then, forgetting its "foiled, circuitous wanderings," will form with them a "majestic river, brimming and bright and large."

J. B. LEATHES

THE RELATION OF EVOLUTION TO MEDICINE[1]

NOT so very long ago the phrase "art of healing" covered quite satisfactorily nearly every activity of the medical profession. To-day the term "scientific medicine" seems to have displaced the older phrase—but not actually, for while recent advances in medicine can definitely be laid to the development of scientific methods of investigation and to our increasing familiarity with fundamental facts concerning organic life, the *art* of medicine still relates to the skill with which our newly acquired knowledge is applied in the fields of medicine and surgery. Medical science, therefore, pertains more specifically to our efforts toward acquiring a better understanding of biological laws which may serve as a basis for originating newer and improved methods of curing and of preventing human ailments and diseases. In other words, it constitutes the foundation upon which the practice of medicine is being remodelled along more substantial and scientific lines.

This recent development has brought within the range of medical research certain branches of biological science whose relevant value has heretofore been rather obscure, if recognized at all.

While the practice of medicine is primarily concerned with that which lies beyond the range of normal variation, our ability to analyze any abnormality is directly proportional with our knowledge of what constitutes normal conditions and the normal range of variation. In the past, the treatment of an abnormality has consisted, figuratively, of an attempt to directly force it back within the normal; modern medicine, however, tries rather to preserve normal conditions, or, in the presence of abnormalities, to eliminate them by reinforcing those factors which ordinarily safeguard the body against them. Hence the very basis of our future progress may be said to depend upon our knowledge of what constitutes normal conditions and of the biological factors which ordinarily maintain them, quite as much as upon our familiarity with those factors which are capable of disturbing that state of normalcy.

[1] From the Department of Surgery, Yale University, New Haven, Conn.

Health, and disease or abnormality of any sort, are merely interactions between the human organism and its environment; health constitutes the normal phase, the others result from the introduction of some element of disturbance.

In the study of human ailments and disorders, we must realize that man is *not* a specially created being placed here to dominate over all the previous inhabitants of this globe; physically, he is merely one of a countless number of similarly constructed, highly complex organisms. So completely does he duplicate in his physical being the vital organs, the various distinctive tissues and an almost uniform homology of the skeletal segments of other creatures that the physical modifications by which he is distinguished from them seem very superficial. All his physiological processes and specific structures carry so far back into the remote past that, in comparison, man's stature and body-form would seem to be a very superficial source of differentiation and a very modern acquisition, while his mental superiority would seem to be an endowment of only yesterday.

What is the relationship of evolution to medicine? The problem of evolution permeates every fundamental branch of medical education in such a manner as to signify that it represents a most important and unexplored source of biological knowledge which should prove of inestimable value to future medicine.

After the anatomist has familiarized himself with the structures of the modern human body, he immediately finds himself plunged into the problem of evolution. Why? Because in his search for advanced knowledge he must naturally turn his attention toward their original source and attempt to learn the history of their development.

The various branches of biology consider the phenomena of life as displayed by all types of living organisms, ranging from the tiniest single-celled protozoa to the largest and most highly organized forms, including man. In those studies a classification of these forms of life according to their grades of organization and according to phylogenetic strains disclose their evolutionary relationships in a striking manner.

Embryology explains to us the modern development of the highly complex individual from a single-cell stage. It has bared to us many secrets regarding the evolution of mankind. But the present embryological process is, of itself, a product of evolution, having become more intricate as each higher level of organization was attained by the matured creature. Thus while the prenatal process serves primarily for the creation of a new individual, it still retains phenomena which bind man inseparably with the lower forms of life—a fact which is more clearly demonstrated in comparative embryological studies.

There is one branch of biological science, however, which unfortunately has hardly as yet been mentioned in the same breath with the word "evolution." I refer to physiology, and I use the word "unfortunately" because I feel convinced, as a result of my own studies, that the greatest strides in our knowledge of organic evolution, and especially in its usefulness to medicine, will follow the time when the problem of evolution is investigated on a basis of physiology at least equal with that of morphology.

Organic life implies organic activity, and this activity, in turn, implies function. Function is the interaction between an organism, or a part of an organism, and its immediate environment. Change in the organism or in the environment inevitably imposes some difference within the usual scope of that interactivity. Hence, physiology as a study of various organic interactions (either physical or biochemical) started at practically as simple a beginning as did organic morphology. Consequently, since every important physical change must have been associated with a corresponding physiological one, the evolution of organic interactions must form no less important a part in our problem than the various alterations of structure.

The strong condemnation of Lamarckianism has, undoubtedly, operated to discourage much effort in this line, so that scientific attention has been centered upon the morphological side as a source of more positive and accurate information. But in view of our recent advances in biological knowledge it would seem as though conditions were now suitable for a serious attempt to investigate this less tangible, but none the less actual, physiological phase of the problem.

Although the factors by whose action all the modern forms of life have become evolved display themselves in such a wide range of scientific study, our common perception of the phenomenon of evolution is far from perfect. Biology gives a fair representation of the process, but dealing as it does with the final products of evolution, its nature is that of a modern cross-section of organic life, and the representation is without actual depth. Embryology supplies some depth to the picture, but in a hazy and incomplete manner, since it can only reflect, briefly, certain high spots in the course of evolutionary chance—a process which extended over hundreds of millions of years. It is only by enlisting the aid of geology, paleontology and their allied sciences that we may hope to gain a true perspective of the phenomenon of evolution.

Since the medical profession is primarily concerned with the human species, our interest would naturally be focused upon that part of the problem which relates to man. Hence it is with no great surprise that we learn that one of our leading medical institutions has definitely established a department for such study, under the title of physical anthropology. This appears to be a real progressive step which invites the attention and similar action of all our other important institutions of medical learning and research. It is only a question of time when the practical value of a clear insight into the evolutionary development of mankind and his exact relationship to other organic forms will be generally recognized, and especially its benefits to the medical research worker of the future.

I believe that I may state without fear of contradiction from a single one of them that fully one hundred per cent. of all those to whom we owe our important advances in modern medicine are not only fully assured of the *fact* of evolution, but, in addition, that they are strongly convinced that the scope and rate of our future advances bear a direct ratio with our better understanding of the biological laws which have guided the course of evolution. Although the same percentage undoubtedly holds among our research workers, we can hardly claim it as prevailing among our colleagues who are engaged in various lines of clinical practice. Their duty lies in distributing to the public the benefits of our improved methods, and their interests are not so intimately associated with the fundamental facts of biology. Nevertheless, only a small minority of them are so unfamiliar with these facts as not to subscribe to their belief in evolution.

If it were commonly known how thoroughly medical science ratifies the phenomenon of evolution and if the public had a true realization of how intimately this phenomenon is correlated with the present interests and the future progress of medicine, there would surely be far less controversy concerning it among laymen.

Just as the ancient Hebraic laws would be poorly adapted to the legal needs of modern communities, so the biblical account of creation given to a people without scientific training can hardly be expected to satisfy the demands of our present state of common and scientific knowledge. No crime can be attached to our amplifying the worthy traditions of our ancestors, any more than to a modification of their customs and rules of conduct; rather would the wrong-doing lie in a failure on our part to actively seek those benefits for ourselves and our progeny which our higher knowledge is constantly bringing more closely within our reach.

Because the indications point to the probability that many of the greatest benefits to mankind resulting from a better understanding of evolution will be of a physical nature and fall within the jurisdiction of the medical profession, it does not seem unreason-

able that we should be looked to to take a leading part in this work. The particular confidence and regard with which we are held by the public impose a fearless seeking after truth on our part wherever it may result to their advantage; and because of that confidence, probably nothing would do more to convince the people at large of the truth of evolution than an open declaration of some sort by the profession of our acceptance of its principles and of our firm belief in the advantages to be gained by its further study.

DUDLEY J. MORTON

YALE UNIVERSITY

FIELD TRIPS IN GEOLOGY

A NOTE in SCIENCE for June 18th last, contributed by W. C. Morse under the above caption, reminds the writer of another "traveling field course" which provides a close parallel to the western trip of the Summer School of Geology and Natural Resources conducted by Princeton University during the present season.

Eleven years ago Columbia University offered a summer course in physiographic geology under the direction of the writer and two assistants. The party numbered twenty-eight (or thirty-two, counting those who joined for part time only), and spent two months on a trip to the Pacific Coast. We had a special car part of the time and a suitable equipment, including portable blackboard and wall maps, as well as topographic quadrangles and published reports for areas to be specially studied. Lectures and examinations supplemented and checked the field studies, and full university credit was allowed for work satisfactorily completed. Among the places visited were the Yellowstone National Park, Glacier National Park, the Grand Coulee and the Columbia River Gorge, Lake Chelan, Crater Lake National Park, the Klamath Lake block mountains, the San Francisco earthquake rift, Yosemite National Park, Lassen Peak volcano and the Cinder Cone, Lake Bonneville shorelines and the Wasatch fault north and south of Salt Lake City, the Hagerman Pass region of alpine glaciation, Pike's Peak and the Garden of the Gods, the foothills regions of Morrison Park, Golden and Canyon City, the Rocky Mountain peneplane west of Palmer Lake, the Royal Gorge of the Arkansas River, the Petrified Forest at Adamana, and the Grand Canyon of the Colorado (the last two on a side-trip taken by some members only). Special opportunities for seeing the country were afforded through the hospitality extended by chambers of commerce and other organizations which placed automobiles at the service of the party at a number of points along the route. Still more valuable was the expert guidance enjoyed in the San Francisco region, where we joined a party under the direction of Professor Lawson, in the Lassen Peak district, where Dr. Diller was our host for several days, and in other areas where those best acquainted with the local geological features generously placed their special knowledge at our service.

For a number of years Columbia University has offered each summer several physiographic field excursions, varying from twelve days to three weeks in duration and commonly attended by from twenty to thirty persons.[1] One of these, offered jointly with the University of Wisconsin, usually covers, among other points, the Pike's Peak, Estes Park, Yellowstone Park, and Glacier Park regions; another traverses the Highlands and parts of the Catskill, Adirondack Mountains, White Mountains, and New England coast regions; and a third, introduced more recently, crosses the Atlantic Coastal Plain, Piedmont, Blue Ridge, Great Valley and Folded Appalachians to the Appalachian Plateau region of Virginia and West Virginia. These excursions are in addition to others on which other phases of geology are emphasized, and have been under the direction of Professor A. K. Lobeck (for the first two) and Professor F. J. Wright.

In this connection it may not be out of place to call attention to an experiment in field work for elementary students in geology now being tried at Columbia University, although no claim to novelty is made. Building operations in and about New York City, while involving temporary excavations most useful to students of the local geology, progressively restrict access to many of the exposures formerly utilized for purposes of field instruction. An increasingly larger proportion of the field period must be spent on subway or other transit lines, for classes are forced to go farther and farther afield to make satisfactory observations. The change in this respect since the writer attended field classes in geology at Columbia some twenty-five years ago is very marked, and the task of providing a series of interesting field excursions of proper educational value has become more difficult each year. To meet this situation the department of geology last year offered a three days' excursion by motor bus across the Triassic Lowland of New Jersey with its trap ridges; over the crystalline highlands where the Schooley peneplane finds its typical development; down the Great Valley past the Crystal Cave near Kutztown, the end of the highland

[1] In the summer of 1926 both the number of excursions offered and the number of registrations have for special reasons been temporarily reduced.