influence of oxygen or its chemical equivalent has not been appreciated, largely because the experimental methods employed have not adequately excluded oxygen from the sphere of reaction. With properly controlled experimental technic it can be shown that oxygen occupies a unique position concerning the oxidation-reduction power of cysteine and glutathione. This action is not concerned with the oxidizing power of oxygen but with the activation of the sulfur atom in the presence of thermolabile oxygen addition products so that the –SS and –SH groups can manifest their latent powers of oxidation and reduction.

EDWARD C. KENDALL

MAYO FOUNDATION

CONTRIBUTIONS OF ANTHROPOLOGY TO MEDICINE[1]

IN the first number of the *American Journal of Physical Anthropology* for this year, I had occasion to point out the intimate and direct relations of anthropology with medicine and to show, briefly, what medical men, more particularly the anatomists, have done for anthropology. On the present occasion I want to call attention, equally briefly, to what anthropology has done for medicine.

The subject will, I think, be at once clearer and more sympathetic to you when I remind you that anthropology, in a large measure, is merely the daughter and a continuation of the medical sciences. The best and briefest definition of physical anthropology that we are able to arrive at to-day is that it is the human *phylology* of the past, the present and the future. More in detail it is, first, the science of human origin and evolution, or of human phylogeny; second, it is the comparative science of the human life cycle from its inception to its end or human ontogeny; and third, it is the science of human variation. All of which means merely that it is human biology, and advanced, comparative, human anatomy, physiology, chemistry and even pathology.

The distinctive feature of anthropology and the one that separates it most from the regular medical sciences is its *comparative* nature. It deals not with the characters and manifestations of an abstract or average human being, as do the medical branches, but studies human groups, whether they be age, sex, racial, social, occupational or even abnormal groups, comparing them with others. As to "practical" application there is the difference that medicine tries essentially to restore the damaged or diseased goods, while anthropology endeavors to find and to show the harmful as well as the favorable means for further human evolution. Anthropology, with much justice, could be called the medicine of human groups.

Being what it is, it must be quite plain to all of us that indirectly or directly the bulk of the research in physical anthropology is of more or less value to medicine. That medicine does not or can not as yet make fuller use of anthropological knowledge is quite another matter, related to its similar inabilities in respect to biology, physics and even chemistry; it is the difficulty of assimilation. It may be said at once, however, that medicine is already using many results of anthropological research without being always conscious of the source.

Let us approach the concrete facts. Research in physical anthropology began materially in the fifties of the last century. The register of printed anthropological articles and books since then reaches many thousands.

Taking the card catalogue of these publications in my division, I find that over 50 per cent. of the titles are direct contributions to comparative human anatomy, physiology or pathology. A few examples may elucidate this further. Let us take, quite at random, the three items of "skull," child" and "pelvis," and see the nature of the anthropological studies under these heads:

Skull	Children	Pelvis
Anomalies	Abnormalities	Age changes
Architecture	Backward	Anomalies and abnormalities
Asymmetries	Births, multiple, etc.	Anthropological differences
Capacity	Brains of defective	Deformations
Capacity vs. stature in defectives	Development	Dimensions
Deformations	Dimensions	Evolution in fetus and child
Development and growth of distinguished men and women	Infanticide	Ossification
Evolution	Pathology, comparative	Sexual characters
	Pulse, respiration, temperature	Variation

Practically every more civilized country has already one or more periodicals devoted largely or entirely to physical anthropology. Let us take the first page or two of the index of the oldest of these journals, the *Bulletin* of the Anthropological Society in Paris, and we find such items as these:

Abdomen: (racial differences in the muscles of);
Acclimatization;
Accouchement (childbirth), among different peoples;
Achondroplasia;
Acrocephaly;
Acromegaly;
Agraphy;
Albinism;
Alcoholism, and depopulation, criminals, suicides;
Algiers—demography, psychology;
Alienation, mental, and the brain, etc.

[1] Presented as part of a symposium on "The Contributions of Other Sciences to Medicine" at the annual meeting of the American Association for the Advancement of Science, Nashville, December 28, 1927.

A still better illustration, perhaps, may be furnished by our own journal of physical anthropology (*The American Journal of Physical Anthropology,* Wistar Institute) which I had the privilege of founding in 1918. Taking the more formal communications alone, we have the following record for the first ten volumes:

Human Evolution Early man Origin of races	Embryology Childhood and Adolescence Senility Elimination General body proportions	Human Variations; Racial; Individual parts and organs (External parts, internal organs, brain, skeleton, etc.) Teeth	Heredity Eugenics Demography Abnormal Classes	Comparative human physiology Chemistry Pathology Teratology Primitive surgery	The characteristics, morphological, physiological, etc., of the people of the U. S. A.	General, Historical, Methods, Instruments.
(23)	(20)	(75)	(6)	(19)	(6)	(23)
Per cent.						
13.4	*11.6*	*43.6*	*3.5*	*11*	*3.5*	*13.4* Total: 172

Another illustration, and one of some interest also to the chemists, may be had by reading the titles of papers published in the first three numbers of the journal just named, of the current year. They are:

Hrdlička (Aleš): Anthropology and Medicine.
Manoiloff (E. O.): Discernment of Human Races by Blood.
Poliakowa (Anna T.): Manoiloff's "Race" Reaction and its Application to the Determination of Paternity.
Suk (V.): Anthropological and Physiological Observations on the Negroes of Natal and Zululand.
Davenport (C. B.): Measurement of Men.
Connolly (C. J.): Relation of the Orbital Plane to Position of Teeth.
Hirsch (N. D. M.): Cephalic Index of American-born Children of Three Foreign Groups.
Cummins (Harold) and Midlo (Charles): Dermatoglyphics in Jews.

McMurrich (J. Playfair): The Evolution of the Human Foot.
Morton (D. J.): Human Origin.
Hrdlička (Aleš): Anthropology of the American Negro.
Appleton (Vivia B.): Growth of Chinese Children in Hawaii and in China.
Larsen (Nils Paul) and Godfrey (Lois Stewart): Sacral Pigment Spots.
Cameron (John): Cranial Studies.
Ingalls (N. W.): Studies on the Femur.

Manoiloff (E. O.): Blood: Species Reaction.
Scammon (R. E.): The First Seriatum Study of Human Growth.
Dodge (C. T. J.): Weight of Colored Infants.
Hrdlička (Aleš): Quadruped Progression in the Human Child.
Bushkovitch (V. J.): An Automatic Apparatus for the Measurements of Cranial Capacity.
Slome (D.): The Curvature of the Bushman Calvarium.
Bernstein (Morris) and Robertson (Sylvan): Racial and Sexual Differences in Hair Weight.
Cady (Lee D.) and Francis (Byron F.): The Supracondyloid Process in the Feeble-minded.
Ingalls (N. W.): Studies on the Femur in the White and the Negro.

Among the more noteworthy individual contributions of anthropology to medicine may be mentioned—to select only a few of the older names—those of Paul Broca and Gustaf Retzius on the brain; of Manouvrier on brain physiology; of Rudolf Virchow on deformities of the skull; of Quetelet and Vierordt on human proportions; of Galton, Lombroso on human heredity, on men of genius and on the defective classes; those of Sir Armand Ruffer on prehistoric pathology, etc., etc.

Taking the older American anthropologists,[1] we see Samuel D. Morton, as early as 1850, contributing on "the size of the brain in various races and families of man"; Joseph Leidy, in his anthropological work, contributes on acephaly; blood crystals; causes of monstrosities; senile changes in the jaw; reversed viscera in man, and the anomalies of the human skull. J. C. Nott, in 1857, writes on "Acclimatization," or the comparative influence of climate and disease on the races of man; Jeffries Wyman, in 1849, publishes "Twelve Lectures on Comparative Physiology"; in 1854–1862, "Dissections of a Human Fetus, a Chimpanzee, a Hottentot"; in 1864–68, on "Symmetry and Homology in Limbs," and on "Malformations." Henry P. Bowditch, beginning to publish in 1877, gives us valuable papers and memoirs on the growth of children; relations between growth and disease,

[1] See full bibliographies in Hrdlička, A., "Physical Anthropology: Its Scope and Aims; its History and Present Status in the U. S. A." 8°, 1919 (Wistar Inst., Phila.).

and the physique of women in Massachusetts. Harrison Allen publishes (1867–97) on the effect of the bipedal position in man; the Siamese twins (autopsy); edentulous jaws in man; congenital defects of the face; hyperostosis of lower jaw; effects of cretinism on the nasal chambers, and the effects of senility and disease on the teeth. Thomas Dwight, Burt G. Wilder, Dudley A. Sargent, the two Spitzkas, A. F. Chamberlin, Geo. S. Huntington, F. P. Mall left us studies of value on the spine, the appendix and viscera, the brain, the embryo, the child, the college boy and girl. And this by no means exhausts the lists.

Coming to the still living American anthropologists, we find Bean contributing to our knowledge of the weight and size of the internal organs, in health and disease, and to the relation of man's build to pathology. Boas has dealt with growth of children, effects of hybridism and race mentality. Davenport deals with human heredity and the defectives. Hooton has published, among other works, on herbivorous and carnivorous types of man; on the evolution of the human face, and on surgery in ancient Egypt. Terry and his associates, and Danforth, are contributing to our knowledge of the human hair, bone variation, anomalies, and human variation in general. Todd and his students have published on age changes in human bones (pelvis, scapula), on the femur, on structural differences between the white and negro. The anthropologists of the Smithsonian Institution have or are still carrying on researches on prehistoric trephining; on physiological and medical observations on the Indians; on tuberculosis in the Indians; on brain weight, brain preservation, racial brains; on the dental arches and teeth; on the physical and physiological characteristics of the adult white Americans; on ear tumors and other ear abnormalities in prehistoric Indians, etc., etc.

Taking all this impersonally and from a wider angle, we see that anthropology has given medicine, and is now giving, three lines of contributions of both weight and value. The first of these is the ever-growing light on human evolution, and that both in the past and at the present; the second comprises the results of our studies on human variation; and the third is the furnishing to medicine of normal standards.

A knowledge of human evolution, past, present and with indications for the future, is indispensable to medicine if this is to fathom the deeper causes, and the trends, of a large part of human pathology, with its differences according to race and type and group.

Equally indispensable to scientific medicine of the future will be a sound knowledge of human variation. For this teaches that even under the most "normal" or uncomplicated conditions, everything, in our frame, organs, functions, and even the causes of disease, and the process of the same, is subject to an important range of variation. The medical text-books, your anatomies, physiologies and pathologies, deal not with the realities as they are, but with "workable" abstracts or gists of these realities. Yet without the understanding of the normal variation of every feature, every process, every manifestation of man, normal and abnormal, a true understanding of any part of medicine is not possible.

Here anthropology has been and continues to be a veritable handmaid of medicine. It shows that, for example, the normal weight of the child, at any age, is not just *that,* but between so much and so much. The normal stature of an adult American male is not 5 feet 7½ inches, but anywhere between, say, 5 feet 4 inches and 6 feet 3 inches. The normal male pulse is not invariably 71.5, but ranges between 66 and 78 per minute. The normal pelvis, head, any part or organ may show as much as 10 to 16 per cent. normal variation in size, with a considerable variation in form. The "normal" course of lobar pneumonia or any other affection is not "just so," but will oscillate between such and such limits.

The third main service of anthropology to medicine, the determination of standards, is connected with the preceding. It is self-evident that the medical man to judge properly must have normal standards of the parts in which he is interested at the time, in the particular people with whom he is dealing. And to find these standards (or averages), with their range of normal (non-pathological) variation, is the peculiar function of anthropological endeavor. A concrete example of this may be found in the recently published work, the "Old Americans,"[2] which brings such data on the principal morphological or physiological characters of the older white American population.

The value of anthropology to medicine is much better appreciated in the Old World, and even in such countries as Japan and China, than it is as yet in this country. There is not a first-class medical school abroad in which anthropology would not have more or less of a part. One of the best examples of this is Great Britain. In our own country, more or less anthropological instruction is given in the medical schools of Johns Hopkins, Harvard, University of Virginia, Western Reserve, Washington University (St. Louis), the University of Chicago and Stanford; the only regular course with a special lecturer in the subject (Professor A. Schultz) being that of the Johns Hopkins.

Many of our medical colleges and graduates, regrettably, do not as yet know sufficiently of this source of

[2] Large 8°, 1926, Williams and Wilkins, Baltimore, Md.

helpful knowledge. Our anthropological journals have less subscribers and readers among the medical men, even the medical teachers, than they have among, for instance, the dentists, and the vast collections of both normal and pathological material in our osteological, brain and other collections are not used nearly so much as they should be by the medical man and the surgeon. All of which is due essentially to a lack of mutual contact and understanding. An improvement in these conditions is not merely desirable but necessary, and the anthropologist therefore welcomes the occasion of this symposium where he may point out some at least of the advantages of medicine and anthropology getting closer together.

ALEŠ HRDLIČKA

U. S. NATIONAL MUSEUM

EDWARD SANDFORD BURGESS

DR. EDWARD SANDFORD BURGESS, for thirty years professor and head of the department of biological sciences and for a time acting president of Hunter College, New York City, died after a brief illness on February twenty-third. He was born in 1855 at Little Valley, New York. His father, the Reverend Chalon Burgess, D.D., was long the pastor of the Presbyterian church at Silver Creek and was one of the most scholarly of the clergymen of western New York. His mother was Emma Johnston, daughter of the Reverend Charles Johnston, of Ovid, Seneca County.

Professor Burgess graduated from the State Normal School at Fredonia and later in 1879 with high distinction from Hamilton College. For two years he held a graduate fellowship in Greek, under the eminent scholar, Professor Gildersleeve, at Johns Hopkins. But because of his ardent love of nature and his habit from early boyhood of scientific observation, he decided to make the teaching of science his life work. In 1899 he received the degree of doctor of philosophy at Columbia University. Hamilton College, wishing to honor him for his distinguished work as a teacher and his contributions to scientific research, conferred upon him, in 1904, the degree of doctor of science.

He was for thirteen years professor of botany in the Central High School of Washington, D. C., and, during the same period, at the Martha's Vineyard Summer Institute. He taught also at Johns Hopkins (1885) University. In 1895 he was called to the professorship in biological sciences at Hunter College. His special spheres of labor were: (1) Botany, especially in asters; (2) botanical names, Indian names; (3) paleontology, anthropology, evidences of human descent.

Among his published works are the Chautauqua Flora (1877); botanical descriptions in the Century dictionary; the asters of the northern United States (in Britton and Brown's "Illustrated Flora"—with Dr. N. L. Britton (1898)); the asters of the southern United States (in Small's Southeastern Flora (1903)); history of Pre-Clusian botany (1902); species and variations of biotian asters (1906); essays on Indian lore, and poems. His unpublished manuscripts include a work on anthropology and research material in several fields.

Dr. Burgess was a member of Phi Beta Kappa; the American Association for the Advancement of Science; the New York Academy of Sciences; the Torrey Botanical Club, of which he was at one time the president; American Anthropological Society and American Folklore Society.

Professor Burgess is survived by Mrs. Burgess and his sister, Miss Julia Burgess, professor of English in the University of Oregon. His brother, Dr. Theodore C. Burgess, was for many years professor of Latin and Greek at the State Normal School at Fredonia and later the president of Bradley Institute, Peoria, Illinois.

At the time of his retirement from the professorship the following tribute was offered to him:

A TRIBUTE

IN GRATEFUL RECOGNITION OF THIRTY YEARS OF DISTINGUISHED SERVICE TO SCIENCE, TO THE CAUSE OF HIGHER EDUCATION, AND IN PARTICULAR TO HUNTER COLLEGE, NEW YORK CITY, AND TO THE THOUSANDS OF YOUNG WOMEN WHO HAVE STUDIED THERE, THIS TRIBUTE IS OFFERED TO

DOCTOR EDWARD SANDFORD BURGESS

PROFESSOR AND HEAD OF THE DEPARTMENT OF BIOLOGY AND SOME TIME ACTING PRESIDENT.

AN ORGANIZER AND EXECUTIVE OF MARKED ABILITY, A GIFTED AND INSPIRING TEACHER, A MODEL OF DEVOTION TO DUTY, A MASTER OF HIS SUBJECT AND A THOROUGH SCHOLAR IN MANY OTHER FIELDS, A MAN INSPIRED BY THE HIGHEST IDEALS AND RESPONSIVE TO ALL THE FINER AND NOBLER THINGS OF LIFE, BELOVED AND ADMIRED BY HIS PUPILS AND ASSOCIATES, HIS SERVICES CAN NOT BE MEASURED, FOR THEY HAVE BECOME A PART OF THE LIVES OF ALL WHO KNOW HIM. HE HAS GIVEN OF HIS BEST, AND A BEST FAR ABOVE THE AVERAGE, AND HE ALSO RECEIVES OF THE BEST —THE CONSCIOUSNESS OF HIGH SERVICE NOBLY DONE. COULD ALL THOSE WHO HAVE BEEN MADE BETTER BY HIS PRESENCE, INFLUENCE, AND EXAMPLE GIVE ADEQUATE EXPRESSION TO THEIR APPRECIATION, IT WOULD BE AS A FADELESS GARLAND IN WHICH THE LAUREL OF VICTORY IS ENTWINED WITH THE ROSES OF LOVE.

THEODORE E. HAMILTON