SCIENCE

VOL. LIX APRIL 18, 1924 No. 1529

CONTENTS

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal.

Annual Subscription, $6.00. Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

THE CONTRIBUTIONS OF CHINA TO THE SCIENCE AND ART OF MEDICINE[1]

I. INTRODUCTION

FOR one who, from his medical infancy upwards, has been nourished on the teachings of Keen; who has paid homage to the personality and life of Weir Mitchell; who has seen Hobart Hare's writings translated into Oriental languages and has used them as text-books in his own classes; who has seen Chinese students become as devoted as those of Philadelphia to the radiating thought of Da Costa and others in the Jefferson faculty; for such a person to stand in the presence of a Jefferson audience and speak of a distant land might seem beside the mark, were it not that I rejoice to-day in this opportunity—especially since I have now become a son of Jefferson—to add my tribute of regard and gratitude to the teaching and life of the men on the great roll of honor of this college and to the wisdom and foresight of its trustees.

We are here to consider for a few minutes the essential unity, in development and maturity, of the medicine of the eastern and the western world. We do well to admit our indebtedness to a land that till recently had seemed an *ultima Thule* to many of us.

II. THE MEDICAL ANCESTRY OF OUR PRESENT CIVILIZATION

Will you travel with me to Peking, and make your way to the Forbidden City? There, in a temple within the precincts of the "Great Medical Court," we shall find gilded statues of three emperors, honored by all Chinese as the founders of their national system of medicine.

The two at our right are Shen Nung and Huang Ti. Even the simple-minded peasant knows that "Shen Nung sampled a hundred-herbs." From the time he came to the throne (about B. C. 2737), we are told that he spent a portion of each day in tasting botanical specimens. No wonder he is acclaimed as "Father of Medicine"!

Next to Shen Nung is the seated figure of Huang Ti, who began to reign in B. C. 2696. How little he realized that the "Canon of Internal Medicine," which is attributed to him, would become the final medical authority for China's four hundred millions for four thousand years.

[1] Commencement address at Jefferson Medical College, Philadelphia, June 1, 1923.

To the left, more completely apparelled, sits Fu Hsi, the inventor of clothing and the discoverer of the trigrams used in later years by Taoist soothsayers. Legend tells us that he was riding on the back of a dragon-horse that rose from the waters of the Yellow River—the date being given as B. C. 2852—when the intricate system was revealed to him. There are others, too, whom fame has crowned. Let me bring you to Central China where, hanging in the corridors of a modern hospital at Changsha, we shall find black and gold lacquered tablets, the gifts of grateful patients. On one of these, in great gold letters, is the inscription, "Ming Kao Ho Huan"—"A name as great as that of Ho or Huan." Accustomed as we of the west are to trace our civilization to a Mediterranean ancestry, or as physicians to think of Greek medicine as at the very beginning of the era of honest observation, have we ever stopped to think that China, too, must have had its outstanding figures, representatives in that eastern world of the highest ideals of medicine? Ho and Huan are legendary names, to be sure, but their teaching has lasted through countless generations. They are the Hippocrates and Galen of eastern Asia, and we of the west who come to practice in China are compared, for better or worse, with them!

Would that we might discover the link between eastern Asia and eastern Europe! Did Ho and Huan send their knowledge of the healing art across by some camel train through Mongolia and over the plains of Central Asia to the shores of the Aegean Sea? Did China and Greece have a common medical ancestry, or did their practice develop independently? The seeds of civilization, men say, were sown about B. C. 4000 by the Sumerians. Did religion and statecraft all spring from their home in central Asia, as well as pictorial writing, astronomy and the natural sciences?

We have, as yet, but little light on the unity of these early origins. They must be thoroughly studied. Meantime we may glance for a moment at the similarities between Greek and Chinese philosophy in the realm of medicine. Again and again the words of Fuller prove true:

> This world affordeth no new accidents, but in the same sense wherein we call it a *new moon*, which is the old one in another shape; and yet no other than that hath been formerly. Old actions return again, furbished over with some new and different circumstances.

How alike these ancients were in their thought that the elements in the macrocosm—the world at large—found their counterpart in the microcosm—the world of man's body! Empedocles taught that the four elements, fire, air, earth and water, were "the roots of all things." Chinese philosophers, long before him, delineated a macrocosm made up of five elements, metal, wood, water, fire and earth. Like the outer world, they said, the human body, too, is made up of five elements. So long as these elements remain in harmonious proportion, there is health; if the balance is disturbed, disease follows.

The mysticism of the figure five extends further still. Corresponding with the five elements are the five organs—spleen, liver, heart, lungs, kidneys, all of which are interrelated with a complex system including planets, colors, tastes and types of weather.

Thus, the heart is in the same series as the planet Mars, as fire, as the color red, as bitter, as heat, as south, etc.

As you read the "Canon of Medicine" or the "Medical Secrets of an Official," and note universal belief in a body full of channels through which spiritual influences flow, and where heat and cold, dampness and drought, course freely, you feel that these men must be prototypes of the Greek leaders of medical science.

III. The Sources of Our Knowledge about Chinese Medicine

There are several important sources from which we can learn about Chinese medicine.

In the first place, every family knows about the principles of physiology and of treatment laid down as long ago as B. C. 1000. As a result, the physician summoned to-day to prescribe for a patient is really appearing before a jury. He must satisfy the family that he can use accepted methods of studying the case; that he can explain the nature of the malady in orthodox terminology. He must gain their assent to his diagnosis, before he is allowed to "open the prescription" which is the objective of every physician's visit. Whether he is sent for again depends on the progress of the disease after the patient has taken one or two doses of the medicine ordered. The family is in charge, not the physician. It is they who try the physician; and make or break his reputation.

A second source is in the archaic forms of the Chinese ideographs. The ancient character for doctor was composed of three parts. At the top was a quiver containing arrows, and beside it a spear, while below was the character for a sorcerer (male or female). Thus the sorcerer was supposed to expel disease by the aid of his magic spear and arrows. Later on the lower radical was changed to the character for wine, suggesting that a transition had occurred. The profession was thus seen to be passing into the hands of trained men who fought disease, not with magic, but with elixirs or wines.

Still a third source is in the dynastic histories. Thus the records of the distinguished contributors to medical science, and of government regulations re-

garding the practice of medicine, appear in general histories rather than in medical annals.

The medical classics themselves are a most prolific source of material. Preeminent among these is the "Nei Ching" or "Canon of Internal Medicine," said to have been written by the Emperor Huang Ti, B. C. 2696, but probably composed as late as B. C. 1000. Dr. Wong writes:

> What the Four Books are to the Confucianists, the Nei Ching is to the native doctor. Upon it is built most of the medical literature of China and so important is it considered by medical men that even at the present time, three thousand years after it was written, it is still regarded as the greatest authority.

IV. The Supernatural in Chinese Medicine

(1) *Animism:* Earliest of all Chinese theories was the belief in a universal animism, all parts of the universe being animated by spirit.

> The universe was spontaneously created by the operation of its Tao or Eternal Principal; "composed of the two souls, the Yang and the Yin; the Yang represents light, warmth, production and life, as also the celestial sphere from which all those blessings emanate; the Yin is darkness, cold, death and the earth, which, unless animated by the Yang of heaven, is dark, cold, dead. The Yang and the Yin are divided into an infinite number of spirits, respectively good and bad, called Shen and Kwei; every man and every living being contains a shen and a kwei, infused at birth, and departing at death, to return to the Yang and the Yin. Thus man with his dualistic soul is a microcosmos, born from the macrocosmos spontaneously. Every object is animated, as well as the universe of which it is a part."
>
> In addition to charms and spells, there were certain famous poems which were repeated, one of which, by Han Yu of the T'ang epoch, had an extraordinary vogue. de Groot says that the "Ling" or magical power of this poem must have been enormous, seeing that its author was a powerful mandarin and also one of the loftiest intellects China has produced. In this poetic febrifuge, translated in full by De Groot, the demon of fever, potent chiefly in the autumn, is admonished to begone to the clear and limpid waters of the deep river.

To the ordinary observer animism is seen as the religion of the overwhelming majority of the Chinese. The Tai Shan stone put up facing the exit of every little street or alley in cities, undertaking to keep evil spirits from the house in front of which it stands; the evening worship, when boys come out from the recesses of the shops on every street, to burn incense and make obeisance in the presence of the spirits; the cannon on the city wall, once able to put an enemy to flight and now the abode of a potent spirit; these and many others are symbolic of a prevalent animism.

(2) *Magic and exorcism:* Not far removed is the belief in magic and in exorcism. These seem, in the first place, to have been brought in by Taoists as a method of combating the influence of rival religions. It is scarcely conceivable that the spiritual teaching of Laotze, who lived some six centuries B. C., could have become so degraded with the passage of time. Compare this extract from the Tao Teh King—"Why was it that the men of old esteemed this Tao so highly, Is it not because it may be daily sought and found, and can remit the sins of the guilty?"—with the ideas of spirit possession in later Taoism, each organ of the body being occupied by some animal spirit; in the lungs the spirit of a white tiger; in the gall bladder a turtle and snake.

During the T'ang dynasty (628–907 A. D.) the search for the philosopher's stone and for the elixir of life reached its height. Magicians, doctors, alchemists, were alike experimenting with herbs and minerals. Of twenty-two rulers during this period seven experimented with elixirs and died from the effects; while the time, health and fortunes of thousands were wasted. And yet, these superstitious experiments brought us much knowledge regarding the action of many vegetable and mineral remedies.

Buddhism, similarly, brought to China by the Emperor Ming Ti (A. D. 68) started out as a religion of asceticism and genuine self-repression; and yet when its monks saw the devices used by the Taoists, they, too, invented their own systems of charms, and added to the popular burden of superstition. We occasionally find the influence of Buddhism in anatomical charts.

V. The Progress of Medicine in China after 250 B. C.

(1) *Before the Han Dynasty.* Again we are standing in the hospital corridor! Our attention is called to a particularly handsome lacquered tablet presented by Governor T'ang, bearing the inscription "Tao Kuang Ch'ang-san"—"Teaching as broad as that of Ch'ang-san."

Could greater tribute be paid to the modern physician? Was not Ch'ang-san the teacher of Pien Chiao, the most eminent of China's historic medical men, father of narcosis, distinguished teacher of sphygmology, practitioner among kings? We have left entirely the age of legend and have reached the period of dependable records by B. C. 722. Literature and art flourished. Never before had so many men of genius appeared within one short period. Laotze, Confucius, Mencius and many other philosophers of note lived at this time. And yet, in the field of medicine, men were already turning away from sound observation to develop theoretical knowledge. Authority was reverenced more than observation, and speculation became universal.

Pien Chiao lived about 255 B. C. It is told that he was asked to treat King Wu, of the state of Lu, and Tsi Ying, of Chao.

Pien Chiao gave them a narcotic wine to drink which made them unconscious for three days. He opened their chests, removed their hearts, exchanged them and put them in again under the administration of some effective drugs. When they awoke, they felt as before, took leave and returned home.

(2) *In the Han Dynasty and after.* Chinese medicine proper received its greatest impulse during the Han dynasty (220 B. C.–206 A. D.), largely through the work of Tsang Kung, Chang Chung-king and Hua To. I quote from Dr. K. M. Wong:

Tsang Kung, who lived about 170 B. C., was the first to record personal observations of clinical cases. In the biographical section of the Ancient History we find a detailed list of his case-histories from which we may have a peep into the medical thoughts of that time. Of the twenty-five cases he has left us—almost the only record of its kind for 1,500 years—ten are reported as fatal. Unlike Galen and most medical writers, Tsang Kung was more modest, for he admitted that his prognosis was not always accurate and that he could not cure any disease unless the pulse indications were favorable.

Chang Chung-king was mayor of Changsha about 196 A. D.

He is often spoken of as the Chinese Hippocrates and is venerated as the sage of medicine. His fame rests chiefly on his "Typhoid Fever," which is one of the medical classics ranking with Huang Ti's Canon of Medicine in importance, and was the first book of the kind in Chinese. This book does not, as the name implies, deal with typhoid only but with other fevers as well. In it are found 113 prescriptions. These were scientifically written containing only a few potent drugs instead of the later "shot-gun" practice of one or two dozen inert ingredients. The antipyretic treatment of fever by cold baths was described. This antedates James Currie's method by 1,700 years. Chang Chung-king was perhaps the first to employ the enema to evacuate the bowels.

After his time,

diseases were studied more from a clinical standpoint, emphasis being laid on the physical signs, symptoms and course of an illness, the methods of treatment and the action of drugs rather than on the theories of disease as in former times. Chang Chung-king stands above the crowd not only on account of his keen power of observation but also because of his lofty ideals. He gives to the profession a high conception of its dignity and noble mission in life. After his death scientific medicine may be said to have degenerated into dogmatic formalism. No writings of any value or originality appeared until the Sung dynasty, a gap of nearly one thousand years.

The third of this Han dynasty trio was Hua To, the most famous surgeon in China's history. It is said that he administered to his patients an effervescing powder in wine which produces complete unconsciousness and that he performed all sorts of operations ranging from venesection and acupuncture to laparotomy, excision of spleen, intestines and liver. A pioneer of hydrotherapy, he was also an exponent of systematic exercise. Most of the notables of that period were his patients. Among them was Kwan Kung, a famous general now deified as the god of war, on whom he operated without an anesthetic for a poisoned arrow-wound of the arm, excising the infected area. King Tso Tso was another of his patrons. Hua To offered to cure the king's headaches by opening the skull under hashish. This roused the royal anger and the surgeon was ordered executed. Just before death he asked the jailer to receive all his manuscripts, but the man was afraid, so Hua To burned them, nothing being recovered from the ashes but a few leaves on which were found directions for a method of castration, an operation still known to the Chinese and practiced frequently by them. In one of his last works, Hua To gives a prescription which is the earliest record of the use of mercury in internal medicine.

VI. Certain Definite Contributions Made by China

(1) *To the Science of Medicine.* We may now attempt to glean from the records those outstanding observations that have proved to be among the definite contributions made by the Chinese.

First, dissection. Because of the great reverence for the dead, human dissection was seldom attempted; hence gross mistakes are found in their conception of anatomy and physiology. The following two facts, however, are very little known and deserve mention. Dissection was evidently permitted in 2697 B. C. In the *Lin Shu* it is stated that after death the body may be dissected and observations made as to the size of the organs, the capacity of the intestines, the length of the blood vessel, etc. In the Han dynasty (220 B. C.–206 A. D.) Emperor Wang Mang captured a revolutionary and ordered his physician to dissect his body. Measurements were made of the internal organs and bamboo rods were inserted into the blood vessels to see where they began and ended.

Secondly, studies of the circulation. Hear these very significant passages, dated at least 1000 B. C.—more than 2,000 years before Harvey. They are taken from the "Canon of Medicine" already referred

All the blood is under the jurisdiction of the heart. . . . The twelve blood vessels are deeply hidden between the muscles and can not be seen. Only those on the outer ankles are visible because there is nothing to cover it in these places. All other blood vessels that are on the sur-

face of the body are "loh" vessels (veins). . . . The harmful effects of wind and rain enter the system first through the skin. It is then conveyed to the "sun" vessels (capillaries). When these are full it goes to the "loh" vessels (veins) and these in turn empty into the big "chin" vessels (arteries). . . . The blood current flows continuously in a circle and never stops.

Thirdly, the doctrine of the pulse. This reached such extraordinary development that the

whole practice of the art centered round its different characters. There were scores of varieties, which in complication and detail put to confusion the complicated system of some of the old Graeco-Roman writers. The basic idea seems to have been that each part and organ had its own proper pulse, and just as in a stringed instrument each chord has its own tone, so in the human body, if the pulses were in harmony, it meant health; if there was discord, it meant disease.

Fourthly, systematic methods of physical diagnosis. No one can fail to be impressed with the care taken by the trained Chinese practitioner in carrying out the four orthodox steps in the examination: "Look, Listen, Ask, Feel." Each word is expanded to a chapter in the text-books. To look means training the eye to noting gait and posture, defect and discoloration. To listen signifies a detection of the meaning of abnormal sounds, such as dyspneic breathing; together with a recognition of many groans and grunts that the Chinese associate definitely with certain maladies. Every citizen and every physician interprets them correctly.

2. *To the Art of Medicine.* Several definite therapeutic methods practiced by the Chinese from time immemorial come to us to-day as their contribution.

Massage, for instance, has long been recognized. During the T'ang dynasty, 1,500 years ago, it was elevated to the position of a science, and formed one of the departments to which a special professor was appointed. It was finally brought to European notice for the first time in the 19th century by the reports of the Jesuit missionaries.

Acupuncture is a second established Chinese procedure. 367 points are described on the surface of the body, at which the insertion of a needle is supposed to afford outlet for harmful spirit influences. But while the dangers of infection and trauma are real, the physical benefits of its wise use are admitted. Acupuncture was carried to Japan, and thence to Europe by Ten-Rhyne, a Dutch surgeon, at the end of the seventeenth century. In France it had quite a vogue a century ago. British teachers, such as Sir James Cantlie, have tried it on sprains and chronic rheumatism and report successful cases.

Of antipyresis by cold baths, within the second century after Christ, mention has already been made.

The use of the catheter appears in China in the seventh century. First, hollow vegetable leaves and later, quills were used; though the method was not developed.

Inoculation against smallpox was practiced early, records being available of the transfer of virus from person to person in the seventh century, though the routine use of the method was not common until the eleventh. A century before Jenner, the standard materia medica mentions the use of cow fleas for the prevention of smallpox.

Organotherapy is described as early as the 6th century A. D., when sheep's thyroids were used for cretinism. The practice is familiar to house-wives throughout the land.

Perhaps the most extensive contributions are those dealing with materia medica. The "Synopsis of Ancient Herbals" published 300 years ago would delight the soul of Hobart Amory Hare. It took thirty years to prepare, and the author is reported to have consulted all the then known works. 1,892 distinct species are described and 71,000 formulae are provided for the budding practitioner. What an asset to the Jefferson Medical class of 1923 if its armamentarium could include such an array—surely weapons of attack for every known mortal ill.

Minerals were used even before the time of Christ. Thus the "Canon of Internal Medicine" describes arsenic and sulphur, copper and lead, in various forms, as established remedies. Mercury, both the red and yellow oxide, were used in ointments; calomel was well known.

VII. Conclusion

It is no longer true that east and west shall never meet! Jefferson Medical College has a distinguished array of graduates and teachers whose names are household words to the profession; but Jefferson's largest service will be found, in the future, as in the past, exemplified best by men who live the international life. Let a man like Victor Heiser be sent to the Philippines or to Siam or to China and you get more than health organization. You get transformed life; you get international brotherhood. He takes the message of sanitation, to be sure; but he lives the life that shares, and makes friends by sharing. In such men that have represented Jefferson, and in the thousands more that will represent Jefferson, you may rest your hopes. They go, not to get, but to give; and not to give merely, but to unite the world in sharing a common life.

As I have watched the graduating class arrayed in academic cap and gown, I have thought of a similar commencement occasion in Changsha in June, 1921, when the first class graduated from the Hunan-Yale

College of Medicine. A Chinese professor of history, seeing the academic garb, exclaimed: "You have borrowed the ceremonial costume of the T'ang dynasty!" The west has indeed received from the east!

And I think also of the great cathedral in Peking, the site for which was given to the Jesuit fathers by the great emperor Kang Hsi in 1698 after he was cured of malaria by the Peruvian bark which these fathers had brought with them. The west was sharing with the east its medical discoveries.

It is in this spirit that I look forward to the going out of the graduates of Jefferson Medical College to-day, that they shall endeavor to find, wherever their lot is cast, elements that may enrich and strengthen the common humanity of which we all are a part.

EDWARD H. HUME

THE COLLEGE OF MEDICINE,
YALE IN CHINA,
CHANGSHA

THE NET ENERGY CONCEPTION[1]

THE net energy conception of Armsby is the simplest and most inclusive of all general measures of nutritive value.

Net energy is the remainder after the deduction of all expenses and losses of utilization from the gross income of energy. Protein as well as non-nitrogenous nutriment contributes to the net energy, having an energy value, after its use as protein, and after deaminization, approximately equal to carbohydrate.

More specifically, the net energy of a feed is its total heat of combustion, that is, its gross energy, minus the energy equivalent of the feces, the urine, the epidermal offal, the methane and the heat produced by fermentation of carbohydrates in the alimentary tract, and the energy represented by the increase in heat production due to the feed consumption and utilization.

In terms of its use by the animal, the net energy of a feed is a measure of its capacity to contribute to maintenance, work and material production—as of flesh, milk, eggs, wool, etc.

The net energy conception implies nothing as to the method of utilization of the net useful nutriment. It simply measures that part of the total which is useful. Net energy may be used to supply any requirement, of whatever nature, for energy-producing nutriment.

Feeding standards based on the net energy conception, therefore, must consider all those conditions of practice which determine quantitative feed requirement in exactly the same way as do all other feeding standards.

[1] From an address before the American Society of Animal Production on December 2, 1923.

The use of net energy values does not imply that the total nutritive value of a feed or the entire nutritive requirement of an animal can be expressed in these terms. In fact, since the net energy value of a feed expresses its worth for only the one class of requirement implied by its designation (net energy) it is necessary in basing a feeding standard on this conception to make separate statements of other nutritive requirements, as of protein, mineral nutrients, etc., just as in the case of other feeding standards.

The justification for the use of net energy values as measures of food value generally is that, no matter what the purpose for which an animal is fed, several times as much nutriment is used, directly and indirectly, for energy production as is used for any other purpose or all other purposes combined. Admittedly, net energy is not a complete measure of nutritive value; no one unit can possibly measure the entire nutritive value of a feed, because nutrition involves several classes of nutrients, each of which is essential in the sense of not being replaceable by another. But net energy is the best possible standard for the expression of the most extensive nutritive requirement, and is, in this sense, the best possible single measure of food value generally.

Net energy of the same feed for different kinds of animals, or for different kinds of production, does differ, and so must be determined separately.

The following factors have determinable but practically negligible effects on net energy values: individuality, plane of nutrition, feed combinations (in relation to digestive efficiency and the dynamic effects of feeds), and the physical condition of feeds, as related to digestibility and energy-cost of handling.

Thermal environment, below the critical temperature, decreases net energy values, but in practice this does not ordinarily happen, because it is more profitable to keep the thermal environment above the critical temperature.

The following conditions affect quantitative feed requirement, but not the net energy values of feeds:

Exercise, as affected by fatness, sex, temperament, breed and type; light, as a stimulus to metabolism; age, as affecting intensity of metabolism, especially oxidative functions; temperature of air, feed and water, humidity of air, and wind velocity—so long as these factors, combined, do not exceed the animal's capacity for physical heat regulation.

The net energy conception, therefore, affords a discriminating method for determining and expressing important differences in feeds which are not revealed by other systems of feed comparison; recognizes the final energy-value of the protein of the feed; recognizes not only liquid and solid wastes, but also wastes in gaseous form and as heat; recognizes the different