

REFERENCES

1. Niboyet JH. La moindre résistance à l'électricité de surfaces punctiformes et de trajets cutanés concordant avec les points et méridiens, bases de l'acupuncture. Luis Jean Gap, 1963.
2. De Vernejoul P, Darras JC, Reguin C, Cazalas JR, Daury G. Approche isotopique de la visualisation des méridiens d'acupuncture. *Aggressologie* 1984;25:1107-1111.
3. De Vernejoul P, Darras JC, Albarède P, et al. Approche isotopique de la visualisation des méridiens d'acupuncture. *Innov Tech Biol Med* 1984; 5:465-472.
4. Lazorthes Y, Esquerre J-P, Simon J, Guiraud G, Guiraud R. Acupuncture meridians and radiotracers. *Pain* 1990;40:109-112.
5. Simon J, Guiraud G, Esquerre J-P, Lazorthes Y, Guiraud R. Les méridiens d'acupuncture démythifiés. *Presse Med* 1988;17:1341-1344.
6. Simon J, Guiraud G, Lazorthes Y, Esquerre J-P, Guiraud R. La méthodologie des radioisotopes permet-elle de justifier l'existence des méridiens d'acupuncture. *Bull Acad Natl Méd* 1988;172:363-368.
7. De Vernejoul P, Albarède P, Darras JC. Etude des méridiens d'acupuncture par les traceurs radioactifs. *Bull Acad Natl Méd* 1985;169:1071-1075.
8. Young HG. *Atlas of veterinary acupuncture charts* second edition. Thomsville GA: Oriental Veterinary Acupuncture Specialities, 1978.

EDITORIAL

Anatomic Divisions

Most western physicians, with mixed to negative feelings, relegate acupuncture to the perjorative world of "alternative medical practices." This reflects both responsible clinical conservatism and scientific disdain for the credulous. Acupuncture was little known in the west until James Reston's 1971 account of his appendectomy in China. Since then, increasingly reliable reports have suggested its value in circumscribed areas of medical practice, particularly those related to pain management. Unfortunately, most curious physicians have neither the time nor expertise to verify these methods for themselves. They must instead rely upon second-hand data to validate a medical system whose tenets are at odds with western models of physiology and disease causation.

Just recall, four years ago, a startling report that appeared in the pages of *Nature*. The authors claimed that extremely dilute suspensions of IgE antibody, so dilute that no IgE molecules were even statistically present, caused basophil degranulation (1). Accompanied by an assurance of editorial incredulity, this paper prompted formal attempts at "debunking" (2-3) and much dissension in the scientific community. Rejoicing homeopaths envisioned the scientific validation of their methods, while main-

stream scientists were infuriated at this "lapse" in a prestigious journal. The dispute was at least as interesting as were the effective, but absent, IgE molecules.

This paper was more than just another piece of the jigsaw. It assaulted one's sense of reality and broke the agreement as to what constitutes a reasonable act on the part of nature. This tacit understanding allows us to design experiments and interpret data. It does not appear in the methods section nor in the discussion, nor is it controlled for by statistical analysis. Without this agreement as to what is reasonably real, our scientific efforts would be as doomed as Babel. Yet even the necessary *weltanschauung* tends toward ossification. Respected scientists have passed cursory judgments on matters outside their purview on the grounds of inconsistency with preestablished world views. How many of us believe in astrology and on the basis of what evidence? Are we likely to have similar predispositions toward the interpretation of thallium washout rates? Too often, it is not the quality of our work but its orthodoxy that determines how we will be regarded by our peers. Charles McCutcheon suggests that the cooperation of referees with the establishment forces a "deadening uniformity" and serves to "force innovators into the arms of the establishment" (4). The authors of the article in *Nature* crossed that political "line in the desert" that separates the real from the imagined.

On the other side stand a large number of lunatics and fools, with a smaller contingent of the courageous and innovative.

This reality sense constitutes, from a Bayesian perspective, an a priori probability. A heavily weighted prior probability requires stronger evidence to contradict than does a weak one. Yet the production of such convincing evidence is a time- and resource-intensive task for the research establishment. Is the investigation of such alternative hypotheses worth the cost in view of their presumably low chances of success?

Certainly it is not unless provocative evidence justifies this investment. Acupuncture, a discipline within the larger field of both traditional Chinese and Tibetan medicine, carries a several-thousand year tradition of practice. This longevity alone bears some validity as testimonial. The concept of controlled studies (as we understand them), however, is a new one in traditional Chinese medicine. Anecdotal evidence by reliable observers (5-6) has encouraged preliminary efforts in this direction, but there is still disagreement as to whether the effort is justified, given competing demands made upon the research establishment.

Recently, there has been a good deal of public attention paid to these traditional "eastern" medical models. Most interest has centered around Ayurveda (7) (an Indian tradition), Tibetan (8) and traditional Chinese

Received Nov. 1, 1991; accepted Nov. 6, 1991.
For reprints contact: James A. Scott, MD, Nuclear Medicine Department, Massachusetts General Hospital, Boston, MA 02129.

medicine (9). The most prominent advocate of their scientific investigation has been the fourteenth Dalai Lama of Tibet, a Nobel peace laureate. Experientially convinced of the utility and validity of Tibetan practices, he believes that only controlled scientific study will bring about their cross-cultural acceptance. Review of the available data does suggest that some meditative disciplines are associated with a unique physiology inaccessible during ordinary forms of sleep or relaxation. These changes have included increased EEG coherence, striking alterations in body temperature and other autonomic functions (10). These changes are usually evident only in highly trained meditators. Similar claims have been made for traditional Chinese medical practices, including both acupuncture and Chi Kung (a type of exercise related to the martial arts) in the treatment of cancer and other diseases (11). While many of these claims appear fantastic, some have been made by responsible individuals not readily dismissed as naive.

These eastern models differ from our own in several ways. They replace the organ-system approach, a model inspired by the industrial revolution, by one of several "energetic" models. Health and disease are postulated to arise from changes in the flow of specific "energies." In Ayurvedic medicine, these energies are termed vata, pitta and kapha; in Tibetan medicine wind, bile and phlegm; and in traditional Chinese medicine, wood, fire, earth, metal and water. The translational simplicity of these terms unfortunately belies the complexity of the models. These systems view the individual as a component in a type of thermodynamic open system, whose health is in a constant interplay with the environment of social, seasonal, climatic and nutritional influences. The view of diet is highly developed compared to our relatively neglected clinical views of cholesterol, fiber and the four basic food groups. Perhaps the most striking characteristic of these models is the importance they

place upon the mind's effects on the body. Habitual patterns of thinking predispose to specific diseases, an area of mind-body medicine into which we, in the west, have only recently ventured. It is a truism that the sense of participation in one's health care afforded by these models accounts for much of their popularity. Despite this, few consumers would rely upon these systems as primary interventions in the course of life-threatening diseases.

Research in these areas requires that the investigator live with one foot in each of two worlds. A purely western approach engenders unique problems of paradigmatic conflict by failing to examine these methods on their own terms. For example, some workers have confused eastern spiritual and medical traditions. Although both benefit health, the purpose of the former is soteriological. For example, a mantra (usually a sanskrit phrase) often induces relaxation as might any repeated phrase in english. Traditionally, however, the significance of the mantra transcends its quality of repetition. The physiologic changes induced by meditative practices, no matter how scientifically remarkable, are epiphenomenal to the goals of the monk (12-13). To borrow an analogy, eastern spiritual documents are to their practice what a menu is to a meal. Most methods require years of study and appear opaque or fantastic from the extra-cultural vantage point.

There are lesser, but substantive problems in the translation of eastern medical documents. Although the eastern models present diagnosis and treatment systematically, a single diagnostic entity from our perspective may encompass an array of diseases in these other models, and vice versa.

Dr. Kovacs and coworkers (14) have provided intriguing preliminary data regarding the path of radionuclide migration after hypodermic injection in the dog. There is disagreement as to whether the meridians of traditional Chinese medicine need correspond to anatomic structures since the meridians are primarily energetic channels. Regardless of their

nature, however, Kovacs' group showed clear differences between injections made at points of low cutaneous resistance (characteristic of some acupuncture points) and at points of normal skin resistance. While provocative, however, the data are not completely persuasive. First, it is unclear why equivalent doses of ^{201}Tl , ^{131}I and $^{99\text{m}}\text{Tc}$ -rhenium sulfide acted so differently than did $^{99\text{m}}\text{TcO}_4^-$. Without a clear explanation for these differences, their relevance to the anatomic issues being examined is unclear. Also, since no lymphatic vessels were shown with any tracer, lymphatic transport has not been convincingly excluded as a mechanism. In this regard, it would be interesting to know whether the skin resistance superficial to known lymphatic and vascular structures is similar to other points on the body. Finally, if the paths of $^{99\text{m}}\text{TcO}_4^-$ transport do correspond to the traditional meridians, stimulation of certain acupoints remote from the site of injection (and unlikely to act through known physiological mechanisms) might modify the rate of tracer migration. This would add to the persuasiveness of the data. These concerns will hopefully be addressed in future studies.

As the scientist Eric Ashby said, "To train young people in the dialectic between orthodoxy and dissent is the unique contribution universities make to society." This dialectic truly has a razor's edge. Both orthodox and unconventional systems of thought attempt to model our experience in a meaningful way. Perhaps after examining a variety of these models we will, in the words of T.S. Eliot, "arrive where we started and know the place for the first time."

James A. Scott
Massachusetts General Hospital
Boston, Massachusetts

REFERENCES

1. Davenas E, Beauvais F, Amara J, et al. Human basophil degranulation triggered by very dilute antiserum against IgE. *Nature* 1988;333: 816-818

2. Maddox J, Randi J, Stewart WW. "High-dilution" experiments: a delusion. *Nature* 1988; 334:287-290.
3. Benveniste J. Dr. Jacques Benveniste replies. *Nature* 1988;337:291.
4. McCutcheon CW. Peer review: treacherous servant, disastrous master. *Technology Rev* 1991;94:29-40.
5. Eisenberg D. *Encounters with Qi*. New York: Norton; 1985.
6. Sheikh AA, Sheikh KS. *Eastern and western approaches to healing*. New York: Wiley; 1989.
7. Chopra D. *Perfect Health*. New York: Crown; 1990.
8. Donden Y. *Health through balance*. Ithica: Snow Lion; 1986.
9. Porkert M, Ullmann C. *Chinese medicine*. Translated by Mark Howson. New York: William Morrow; 1988.
10. Wallace RK, Benson H. The physiology of meditation. *Sci Am* 1972;226:84-90.
11. International Symposium on Chinese Qigong Health Preservation and Qigong Techniques. Beijing: Foreign Languages Press; 1991.
12. Eliade M. *Yoga: immortality and freedom*. Translated by Willard R. Trask, Princeton: Princeton University Press; 1969.
13. Iyengar BKS. *The concise light on yoga*. London: Unwin; 1980.
14. Kovacs FM, Gotzens V, Garcia A, et al. Experimental study on radioactive pathways of hypodermically injected technetium-99m. *J Nucl Med* 1992;33:403-407.

EDITORIAL

Nuclear Medicine and Acupuncture Message Transmission

For several years, a number of authors have attempted to scientifically investigate the field of acupuncture, specifically the anatomic relevance of acupuncture points and their connections, known as "meridians."

It has long been known that skin impedance varies significantly in areas related to the classic acupuncture points (1,2). Correlations have also been made between the acupuncture "meridians" and subjective physical sensations in areas of specific dermatological lesions (3).

We have attempted since 1978 to study the migration of radioactive tracers injected at acupuncture points using a scintillation camera coupled to a computer system with image analysis capability (4). Other authors have also examined this subject and obtained reproducible results, including Bagu (5) and Tiberu (6) in Romania, Lafont and Munsch in France and Jia-He Tian and Gu (7) in China. Finally, Dr. S. Kovacs in Barcelona, Spain has obtained similar results in the dog using an identical protocol, as described in this month's issue of the *Journal* (8).

The most commonly used radioactive tracer for these studies has been ^{99m}Tc as sodium pertechnetate. The injection at the acupuncture point, localized with anatomical landmarks, palpation and measurement of local

impedance, is performed with hyperdermic needles of 5/10 mm, at a depth of 3-5 mm, as determined by a specific sensation felt by the subject. The injected volume must be as small as possible, approximately 0.05 ml with an activity of 10-20 MBq.

These efforts have led in two directions: morphological and quantitative dynamic studies. Our work has been conducted in over 250 normal and abnormal subjects. Each experimental protocol has been carefully controlled.

Morphologically, most authors have reported that in analytical studies, a radiotracer injected at a control point shows no preferential migration after 5 min, and only a very slight centrifugal isotropic diffusion around the injection point.

Conversely, when the injection is performed at an acupuncture point, a linear migration is seen from the site of injection. For instance, when the injection is performed at the "Renal 7" acupuncture point (located on the internal side of the leg, above and behind the medial malleolus), the migration distance is 30 cm from the injection point proximally. Such migrations, arising from various acupuncture points located on both the upper and lower limbs, have always been found to follow identical pathways in both control subjects and in patients with various disease.

The pathways thus evidenced are anatomically superimposable with those described in traditional Chinese medicine under the name of "meridians." Twelve meridians are described

in traditional Chinese medicine in the upper and lower limbs. Preferential paths of radiotracer travel are found along these pathways.

Quantitative analyses performed on images and on blood sampled up to 60 min after injection, in both normal and abnormal subjects, show that less than 5% of radiotracer injected at the acupuncture point migrates along the preferential pathway. The remainder of the tracer shows a slow isotropic diffusion from the point of injection. This diffused component of the injected tracer does not produce a sufficient signal to noise ratio to constitute an interpretable image of any linear definable structure such as a vein or lymphatic vessel. However, 15-20 min after injection, uptake appears in organs for which the tracer has a high affinity, such as the thyroid and salivary glands for technetium.

Due to the energy of the ^{99m}Tc gamma photons, it is difficult to visualize the deeper pathway of the meridians in the upper body because of extensive soft tissue attenuation.

Similar results have been obtained using other radioactive tracers, such as ¹³³Xe, ²⁰¹Tl and ¹⁹⁷Hg. In man, no different molecular migratory behaviors between neutral molecules, anions or cations have been shown.

We have tried to establish the uniqueness of the observed pathways and thus eliminate a vascular or lymphatic explanation (9).

Experimental data suggest that these pathways do not correspond with vascular routes. The migration

Received Nov. 13, 1991; accepted Dec. 11, 1991.
For reprints contact: Pierre de Vernejoul, Service de Biophysique, et Medecine Nucleaire, C.H.U. Necker-Enfants Malades, F-75 743 Paris, Cedex 15, France.