proached in the test animal and therefore may be compared with malignant cytology in human beings. A parallelism may throw light on possible conditions of carcinogenesis in human beings, but certainly parallelisms are no proof, and no direct implication that human tumors are virus-induced is allowed or intended. However, it is noteworthy that all the foregoing details in stained frog-kidney sections may be observed in comparable living cell nuclei in tissue culture under the highest powers of phase-contrast microscopy, and it may be pointed out that tissue-cultures of human malignant cells have, in many instances, exhibited nucleolar abnormalities identical with those described in this preliminary presentation (*12*).

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Introducing Modern Medicine in a Navajo Community

Physicians and anthropologists are cooperating in this study of changing patterns of culture and disease. The second of two parts.

Walsh McDermott, Kurt Deuschle, John Adair, Hugh Fulmer, Bernice Loughlin

In part I of this article (see last week's issue of *Science*) were presented the background, the goals, and certain of the preliminary findings of a joint medical-anthropologic research program on cross-cultural technologic development in the field of health. The studies are being conducted with the cooperation of the Navajo Tribe and the U.S. Public Health Service in an 800-square-mile area situated in the approximate center of the Navajo land in the southwestern United States.

Few better illustrations of the significance of cross-cultural matters in medicine can be cited from the present study than the situation observed with respect to congenital dislocation of the hip. Indeed the experience has been an excellent lesson in the basic principle that what constitutes a "disease" in one culture does not necessarily constitute a "disease" in another culture.

"Congenital" Hip

As had been expected, the prevalence of congenital dislocation of the hip at Manyfarms-Rough Rock was found to be quite high. Indeed the number of cases found represents a prevalence rate of 1090 persons afflicted per 100,000 population, in contrast to a rate of 3.8 persons per 100,000 in New York City. To what extent this disease is truly hereditary has never been precisely established, although it is generally designated as a congenital disorder. It has also been strongly suspected that cultural factors, notably the use of cradleboards, contribute substantially either to the condition itself or to the degree of permanent disability resulting from it. For, on the cradleboard, the infant is securely laced with the outstretched legs bound together in a position that does not favor continued insertion of the head of the femur in the pelvic joint.

Irrespective of the relative roles of genes and culture in causation, there is an increasing body of evidence that the major portion of the disability in congenital hip disease can be prevented if the condition is discovered and appropriate nonsurgical treatment is started during the first year, or at most the first two years, of life. During the next two years (ages three and four), the only satisfactory treatment is surgical and consists of exposing the joint and inserting the femur in its proper location. Once the child has attained the age of five or six years (school age), the only treatments available are the more elaborate surgical procedures of attempting to create a "shelf" of bone, or, if this fails, fusing the hip joint. The latter operation is seldom employed as the initial treatment unless the child has reached the age of 12 or 13 years, and the operation results in a completely stiff and "frozen" hip joint. The reason for purposely producing the obvious physical handicap of a completely fused hip joint is that unless this is done, the patient runs a considerable risk of having a chronically painful traumatic arthritis of the hip when he or she attains the age of 40 or 45.

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When in the course of the research program the time seemed appropriate to begin a special study of congenital hip disease, it became abundantly clear from the reactions of the Navajo staff that a highly "tender" area was being approached. Contrary to the immediate assumption, moreover, it speedily became clear that the delicate nature of the matter was quite unrelated to its obvious familial connotations. Something quite different was at issue—namely, that in Navajo culture congenital dislocation of the hip, even when bilateral, is not viewed as a disease or even as a particularly important disability. Boys with this condition are not generally mocked, and girls who have it have no difficulty in obtaining husbands and raising families. Indeed, the fact that one child in a family has congenital hip disease appears to be regarded, not quite as a positive blessing, but as a sort of continuously visible relative blessing. By this is meant a blessing in the sense that when evil struck the family, this was the worst it could do, and evil is not apt to strike one family on too many occasions.

What made the issue such a delicate one was the fact that a number of years previously the members of our Navajo staff had happened to witness the consequences of the surgical treatment of congenital hip in older children in their own homes. As explained above, when congenital hip disease is not discovered until the child has passed a certain age, surgical fusion may be all that can be done. Moreover, this procedure is a perfectly sensible one for an older child or adolescent in the non-Indian culture of the United States. The stiff hip does not prevent the child from getting around, and the risk of a more serious handicap in mid-adult life is prevented. With a Navajo child whose hip joint is fused, however, the situation is completely different. Life around a hogan is enormously complicated for one with a stiff hip. For example, such a person cannot join the family for meals because the whole family usually sits on the ground or on sheepskins at mealtime. Moreover, such a child is unable to ride horseback. In Navajo eyes, these are present realities that cannot be effectively offset by the thought that some other disability, not too well understood, will not be present 20 or 30 years hence.

From the viewpoint of the Navajo staff, therefore, the sole contribution of modern medicine to the question of congenital hip disease was to transform something that was no real handicap, and was almost a blessing, into something that represented a very serious handicap indeed. Once it became clear what was bothering the staff, it was possible to design a study with the initial object of developing ways to identify congenital hip disease sufficiently early in life so that nonsurgical treatment might be applied. A genealogic study of the occurrence of congenital hip disease has been started, with the thought that, if it could be established that the condition is genetically determined, the use of diagnostic x-ray could be limited to infants in families that had a history of hip disease. Although this study is only in its early stages, there appears to be no cultural problem at all with respect to asking questions about antecedents, because kinship relations are matters of considerable interest in Navajo society.

This episode is cited because it illustrates the danger in attempting to build a health program on the illusory concept that health is the absence of disease. In reality, "health" is a relative matter and signifies the degree to which a person can operate effectively within the particular circumstances of his heredity *and environment*. The wisdom of our Navajo staff on this point undoubtedly saved us from considerable difficulty.

From this study of the disease pattern of the community certain general findings appear significant. First, the virtual absence of most of the diseases that are fatal in non-Indian society in the United States serves to emphasize the fact that in reality all societies are disease-ridden; it is only in the disease pattern that the great differences lie (*1*). In economically underdeveloped areas such as the Navajo country, the disease pattern is one of high infant mortality, juvenile invalidism, and premature death, in contrast to the disease pattern in the non-Indian part of the United States, which permits many decades of productive life. Second, in the Manyfarms-Rough Rock community, microbial diseases or their consequences constituted more than three-quarters of the disease found. For most of the diseases, and for virtually all of the fatal ones, effective and practicable measures for treatment or prevention exist. Third, more than 97 percent of the illness encountered could be quite properly and effectively treated in the field clinic facility. Fourth, in such a society, a health program based on the school children is largely a "repair the damage" program.

By the time the child arrives at school at five or six years of age, much of what is going to happen has already

Aerial view of the headquarters of the Field Health Research Project, which is situated on tribal property at Manyfarms, Arizona. The clinic facility and research laboratories are in the white-roofed building at lower right. The living quarters for the staff (left and center) consist of trailers and modified railroad refrigerator cars. The latter were hauled overland 125 miles from the nearest railroad. The building at upper left is a shed for storage of road-maintenance equipment, and the buildings and trailers at upper right form the Manyfarms day school (grades 1 through 3). Many members of the project community reside on top of the mesa seen in the background. [James Bosch, Window Rock, Ariz.]

A Navajo Health Visitor administering penicillin in the field clinic. The Health Visitors are trained to perform certain nursing procedures, such as intramuscular injection of drugs, both in the clinic and in the hogan, thereby freeing the public health nurse for other activities. No medication can be given without a specific prescription by a physician, but in emergencies in the hogan the Health Visitor can obtain such a prescription by means of the radio-telephone with which each automobile is equipped. [American Museum of Natural History]

happened, and he is a "veteran" of human disease. He may be infected with tubercle bacilli, may be deaf from streptococcal infections of the ear, may have some visual difficulties because of trachoma, and may have been walking since infancy with a congenitally dislocated hip. Obviously, therefore, a program in *preventive* medicine, to be fully effective, must be inaugurated with the preschool children. In a society in which the people live in compact villages, the preschool children are relatively accessible. In a society such as the Navajo, with its vast distances between homes, a considerably greater effort in required, in terms of staff and facilities, to organize a health program for preschool children than to organize such a program for any other age group.

"Health Visitors"

The third of the three general studies undertaken by the medical-anthropologic research group has to do with determining to what extent only partially educated Navajo men and women can be trained to function as effective field auxiliaries of the public health nurses. This program is designated the "Health Visitor" program. In a very real sense this program in medical and nursing research represents an attempt to study certain of the implications of the technologic revolution represented by the development of powerful and simply administered antimicrobial drugs.

In conditions such as those that obtain in the Navajo country, where the population is thinly dispersed over the rugged terrain, it is quite difficult for a trained public health nurse to make more than one or two home visits per day. Moreover, she must be accompanied by a driver-interpreter. Obviously no proper field program could be set up until some way could be found to multiply the effectivness of the highly trained public health nurse. An essential feature of the study under discussion is the concept of a *single* all-purpose subprofessional worker—that is, an auxiliary to the field nurse, a driver-interpreter, a sanitarian, and a community worker all in one.

It must be emphasized that the Health Visitor program is not one of training "feldshers," or "half-baked" physicians, but rather a study of the use of subprofessional workers who are constantly under the direction of the public health nurse. Each Health Visitor has an assigned group of patients all residing in a particular area, and when out in the field, the Health Visitor regularly communicates with and receives instructions from either the nurse or the physician by radio-telephone installed in the automobile. At the present time a single public health nurse can manage the activities of three or four Health Visitors. The latter can perform all immunization procedures, can administer penicillin and other medication that must be injected, can obtain the patient's basic history, can assist in obtaining the history of the current complaint, and can perform many of the tasks that so frequently consume the time of more highly trained personnel. The types of relationships that are developing between the Navajo Health Visitors and the community on the one hand, and between Health Visitors and the professional staff on the other hand, are being studied in detail by the social scientists.

Segmental Studies

The term *segmental* is used to describe studies in areas that are more sharply defined than the three areas of the general investigations. The range of subject matter in the segmental studies is understandably broad. As a consequence, the research necessarily involves the use of both "field" techniques, in the epidemiologic, genetic, and social-anthropologic studies, and laboratory techniques, for such studies as those on viral disease, anemias, and coronary arterial disease. Segmental studies are in progress for each of the problem disease areas included in the community disease-pattern investigation, and such studies are also in progress in a number of other areas. No attempt will be made to present a complete listing of the studies, but four are briefly outlined to illustrate the varied techniques involved, the type of problem encountered, and the fact that the particular questions chosen could not really be profitably studied by either the medical or the anthropologic investigators working alone.

Self-Administration of Drugs

The first is a study of the extent to which an uneducated, nonliterate people (with partially educated children) can assume personal responsibility in a tuberculosis therapy or prophylaxis program based on the long-continued daily self-administration of isoniazid tablets. Although this question is being studied in terms of drug therapy in tuberculosis,

in reality the point at issue has far wider implications. For one of the major trends in medicine today is the unprecedented extent to which successful control of disease has come to depend on long-continued daily self-administration of a variety of powerful drugs by completely asymptomatic patients. To be faithful in the daily ingestion of a pill appears to be strangely difficult in any society. As the act is usually closely related to such personal habits as morning ablutions, the circumstances that surround it may be quite different in different cultures. The first step chosen in the study under discussion was simply to prescribe daily isoniazid tablets for an 18-month period for a group of 150 persons, two-thirds of whom were children. The degree of effectiveness of this practice was evaluated by the only means then available—namely, analysis of the patients' requests for additional supplies of the drug, supplemented by random visits for "pill inventory" in the hogans. By this admittedly crude method it was estimated that approximately 75 percent of the people managed their chemotherapy satisfactorily; an additional 10 percent did so if they were regularly prodded and supervised; and approximately 15 per cent of the group, for one reason or another, could not be relied upon to do their part. The obvious next step was to define these three crudely differentiated groups more precisely, so that the relevant individual factors might be identified. Before this could be done, however, it was first necessary to develop a laboratory technique, suitable for field conditions, whereby the fact that the drug had been recently ingested could be established. Several procedures for chemical analysis of the urine were available but were not satisfactory for conditions as they existed in the field (*2*). For it was essential that the procedure should not involve the administration of any new chemical compound of undefined toxicity; the discoloration of the urine or a marked change in its odor; or any chemical extraction process or technique of similar complexity, beyond the capacity of the subprofessional Navajo laboratory workers to carry out. In association with Gladys Hobby, a technique was developed that met these criteria (*3*). The vitamin riboflavin is incorporated in the isoniazid tablet, and the presence of the riboflavin in the urine is easily detected by its capacity to fluoresce. It has thus become technologically possible to return to the field studies, but because of certain social problems it is essential to proceed with caution. For in order for the technique to be useful, it will be necessary at some time to reveal the information it discloses. Once this is done, there will occur a change in the relationship of family and physician from one of trust to one of resentment of a mysterious form of "inspection." This problem in itself can presumably be managed through careful conduct, but there is a further problem that is even more delicate. This has to do with the fact that certain Navajo are members of a cult that use the alkaloid peyote in a religious ceremony. This practice has been outlawed by the Tribal Council, and if the practice of peyotism can be proved, the user is subject to a sentence in jail. In the course of the tuberculosis studies at Manyfarms, but before the particular riboflavin technique had been developed, it was discovered that families from certain camps were reluctant to participate.

An entire family leaving their camp for a trip to the field clinic for examination, because the father was recently discovered to have pulmonary tuberculosis in a potentially infectious stage. In the left foreground is a "shade" or temporary summer dwelling. The permanent hogan may be seen in the background. Approximately half of the transportation in the area is by horse; the remainder is by automobile, chiefly by "pickup" truck. The family was found to be free of infection, and the father is receiving self-administered antituberculosis chemotherapy, with periodic supervision by a Health Visitor and the professional staff. [Kenneth Marthy, Chappaqua, N.Y.]

On discrete inquiry it developed that they had heard a rumor that a test was available for the identification of peyotists by detection of the material in the urine. By treading a difficult course between the obvious wishes of the Tribal Council to stamp out peyotism on the one hand and the desire to obtain patient cooperation on the other, it was possible to "get the word around" that no such test was known to the staff. This process now has to be repeated, and whether this can be done successfully remains to be seen.

Thus it is that a "drug self-administration" study that has proceeded "logically" from the investigator's standpoint has developed its own set of complications. The experience represents one more example of a principle familiar in cross-cultural work in any field—namely, that a technique which produces information is looked upon as something quite mysterious, and hence may be accorded a completely unpredictable role in terms of the prevailing fears of the culture.

Translation of Medical Concepts

The second of the segmental studies that deserves mention is that on the subject of "conceptual transfer." This study is being conducted by both the social and the medical scientists in association with a noted student of the Navajo language, Robert Young. The basic techniques involve the paraphrasing of passages from a selected medical textbook into two English versions—a version readily intelligible to a person of average education in the United States, and a version thought to fit Navajo concepts. The two versions are then translated orally into Navajo by a number of persons who bear a greater or lesser responsibility as interpreters at medical facilities in the Navajo country. The translations are recorded and are analyzed as they are retranslated into English. The disease descriptions include diseases familiar to the Navajo and diseases concerning which they have no knowledge.

Certain of the points established thus far are general ones that are presumably valid in fields other than health. For example, it was discovered that the common practice of defining with synonyms gave rise to considerable difficulty. Some interpreters presented with the statement "the disease known as arthritis or rheumatism" would proceed to attempt to describe two separate diseases from that point on. A more important specific finding, however, has been that the problem of physician-patient communication with Navajo people is a formidable one, not so much because there are wide differences between the Navajo and the English language as because there are wide differences between the two cultures with respect to concepts of bodily disease. If both cultures had essentially the same concepts of disease and its treatment, any person reasonably fluent in both languages could serve as a satisfactory "bridge" between the patient and his physician. As it stands, however, with the wide difference in medical concepts that exist, an interpreter may be completely bilingual in discussing the ordinary affairs of life yet wholly unreliable in discussing medical matters unless he is quite generally familiar with the medical concepts of both cultures.

To be sure, this same principle applies in some degree to technologies other than medicine. But in most other technologies—for example, animal husbandry or agriculture—the two people involved in the attempt at communication are both usually concerned with the visible world around them and not with the inner feelings of one of the two persons. By contrast, for the proper application of modern medicine the physician depends to a very considerable extent (exclusively, for some diseases) on the subtleties and minor gradations in the patient's own account of how he feels as compared with his usual state.

Thus, in the case of the Navajo, the patient's own standards, by which he judges his degree of well-being, are not only not known to the physician but they derive from concepts of whose very existence the physician may be unaware. It is possible to learn about the concepts from the person serving as interpreter, but this is a lengthy process and the sessions must be conducted in private. For to establish effective interchange with the patient it is essential that the interpreter should not be placed in a position of embarrassment with one of his own people because of a particular approach used in questioning. Ideally, the physician should learn both the concepts of health and the language of the community in which he is working. But for him to acquire the language, particularly to a degree that would permit him to make fine distinctions among symptoms, is frequently not practicable.

An approach that is practicable is to train the physician and the technicians to work effectively through interpreters. The principal lesson already learned, however, is that for effective interchange it is necessary for both the physician and the interpreter to acquire a very considerable body of information concerning the disease concepts in the two cultures. And the educational effort necessary to train the interpreter in "Western" medical concepts is very little less than that necessary to train him as an effective subprofessional technician. Consequently, at least in the specific case of cross-cultural work in medicine and health, there is no real place for a special training-school for interpreters. It is more realistic to go the whole way and train the subprofessional auxiliaries of the physicians and nurses.

Ischemic Heart Disease

The third study for mention is one concerned with ischemic heart disease—that is, the myocardial damage that results from coronary arterial disease. Impressive evidence has been accumulated in recent years that this disease is culture-linked. The factor in various cultures that is most often singled out as perhaps the most significant in this disease is the amount of fat, specifically the amount of hydrogenated fat, in the diet. It has been thought that the Navajo, like many peoples who live in relatively primitive surroundings, have a low prevalence of ischemic heart disease, but that, unlike most such peoples, the Navajo consume a diet high in animal fat. It seemed of importance, therefore, to test the long-held clinical impressions that ischemic heart disease was rare among the Navajo by making detailed clinical, electrocardiographic, and other laboratory studies on all members of the Manyfarms-Rough Rock population who were 30 years of age or older. If the suspected low prevalence were to be confirmed, the impression that the people consume relatively large quantities of animal fat could then be tested, and indeed any other culturally-linked factors that might reasonably be thought to have significance could be studied.

The suspicion that the prevalence of ischemic heart disease was low was definitely confirmed, and the other studies were started. The observations made thus far have included complete histories and physical examinations on approximately 500 of the 600 persons 30 years of age or older; electrocardiograms with standard and unipolar leads;

measurement of the serum cholesterol; determinations (in selected groups) of the pattern of urinary excretion of 17-ketosteroids and ketogenic steroids (*4*); characterization of the daily diet by investigators who arranged either to live with a number of the families or who made systematic visits to a larger sample at mealtime; determination (by the same observers) of sleeping habits; measurements of cigarette consumption; and crude estimates, based merely on observation, of the amount of physical exercise generally involved in hogan living. In addition, studies of the fatty-acid composition of samples of fat obtained by biopsy of appropriately selected subjects are in progress; actual measurement of physical exercise has been made; and an attempt is being made to measure crudely what might be termed "relative peace of mind" by ascertaining the number and the effectiveness of religious ceremonials held for this purpose among an appropriately selected population sample. (Navajo religious ceremonies are not held on a regularly scheduled basis but are organized on an *ad hoc* basis, according to the particular needs of an individual.)

As indicated above, virtually all of these data have been obtained, except in the last three areas, and the data are now undergoing analysis. Consequently, only very tentative statements can be made at this time. When due allowance has been made for this fact, however, it appears that the prevalence of ischemic heart disease is indeed low [three cases in a three-year period among the approximately 600 (actually 607) people 30 years or older]; that the apparent absence of angina pectoris is not a reflection of failure of "conceptual transfer" on the part of the interpreters; that the range of values for serum cholesterol is the same as for urban dwellers in the United States; and that consumption of cigarettes is rare and, when found, is low (maximal consumption being 40 cigarettes weekly). It further appears (although the analyses are less complete) that the usual diet will be found to approach the United States average in terms of content of fat; that the obvious differences between Navajo and non-Navajo in terms of hair distribution are not accompanied by significant changes in the pattern of hormone excretion in the urine; and that aortic calcification occurs at a later age in the 50- to 69-year age group among Navajo than among non-Navajo. It is believed, therefore, but it cannot as yet be stated as definite, that of the factors studied, the principal differences between the Manyfarms-Rough Rock Navajo and residents of urban communities in the United States may be found in such factors as amount of physical exercise, duration of sleep, consumption of cigarettes, and perhaps relative "peace of mind."

Medicine Man and Physician

The fourth segmental study to be mentioned has to do with relationships between the Navajo medicine man and the "Western" physician, and the effects of these relationships on community life. This study has two components. The first is an investigation of what might be termed "the healing process" in a selected sample of nine families. An attempt is being made to determine what is considered to be a health problem in the home and what factors appear to determine whether help is first

(Left) A medicine man makes a "sand painting" on the earthen floor of a hogan, with earth pigments, in preparation for a healing ceremony. [Courtesy of the American Museum of Natural History] (Right) A Navajo mother with a sick child kneels on the sand painting during the healing ritual. The medicine man may be seen in the background. [Courtesy of the American Museum of Natural History]

sought from the Navajo medicine man or from the physician. The other component of the study has to do with the reactions of the medicine men themselves and with whether, as a consequence of the availability of "Western" medicine, young men are no longer willing to expend the not inconsiderable effort necessary to acquire status as medicine men. Thus far the relationships between the medicine men in the community and members of the project staff have been excellent. Every effort is made to accord the medicine men the respect they deserve as the spiritual leaders of the community. Many of the medicine men themselves consult the physicians as patients, and they have raised no objections to the use of "Western" medical methods for patients they are caring for by Navajo methods. Nevertheless, an obvious potential problem exists in any attempt to preserve the spiritual influence of the medicine man while removing from him responsibility for the management of "somatic" disease. The medicine men believe they can distinguish between the type of "illness" most likely to be benefited by their procedures and the type that is better managed by the project staff. Moreover, they are quick to recommend the employment of both sets of "healers" in situations that appear to have any urgency. The danger obviously exists, however, that an acute illness that could be easily treated by modern medical methods might be allowed to progress significantly while Navajo medicine men were being employed. Thus far this has happened only rarely. It is to be hoped that the issue may not become serious and that the present good relations can lead both parties to make adaptations in their practice that will make it possible to preserve the essentials of both "ways."

Significance of the Study

It seems appropriate to comment on the problems involved in the evaluation of studies such as those under discussion and on the possible applicability of any findings to cross-cultural medical technologic development in general.

One of the obvious problems that has to be faced in mixing medical and social-science studies in a single whole is that methods suitable for evaluation in one field cannot always be adapted to another. In the Manyfarms project, the drawing of inferences from the data consists of evaluating a variety of observations, of widely different nature, on the influence of the technology on the community. Some of these observations can be expressed numerically, but many cannot. Thus we have to find ways of arriving at conclusions based on a mixture of various types of evidence.

It would be foolish to defer facing the fact that in many of the issues of greatest importance, the major inferences, in the last analysis, are in the form of subjective judgments. Every effort has been made, therefore, to ensure that the observations and the subjective judgments are made in as systematic and organized a way as possible, and that the conclusions represent the consensus of the greatest number of people in a position to make an informed judgment. It appears that the strictly medical findings should have generality. What cannot be decided at present, however, is whether the particular observations that have to do with working with a people represent research findings that have generality, or whether they merely represent experience, and a certain wisdom presumably acquired thereby, that must remain an essentially individual affair.

Many problems remain that are not being studied. Certain of these are beyond the scope of the project or the competence of the present investigators; others represent wholly proper research subjects for which no approach has as yet been imagined. Nevertheless, they deserve brief mention.

There is the fascinating question of the character of the period during which a community might have the "best of both worlds," when its "primitive" pattern of disease has been suddenly suppressed artificially, rather than by the century and a half of socioeconomic development that produced the same result in our society. Is it not possible that we achieved this result at too high a price, as reflected by the particular diseases that are plaguing us today? Will the artificially altered communities necessarily follow directly in our footsteps, as seems to be tacitly assumed. Might it not be that a people who will necessarily continue to live for some time in a rustic environment will develop wholly new disease patterns, quite unlike our own, as they adapt to this relatively isolated but drastic change in their environment. This whole subject is obviously no mere philosophic speculation, for even the preliminary data on births and deaths at Manyfarms strongly suggest the emergence there of just such a phase as "the best of both worlds."

Another major area has to do with the markedly changed sovereignty relationships of recent years, whereby technologic development activities are now almost invariably conducted with recipient governments and peoples who are politically independent of the nations supplying the bulk of the technicians. Even a nation's own trained people are frequently quite alien to its rural peoples and exert only nominal political authority over them. This general phenomenon has many implications, but a major one is that to all intents and purposes public health programs today are obliged to proceed solely by persuasion. But "persuasion" in a cross-cultural situation is a highly deceptive word, for it really means the use of an enormous body of information and skills that have nothing to do with technological knowledge. Moreover, in most economically underdeveloped areas, persuasion in the area of health must proceed without the powerful support of an immediate prospect of rapid change in social and economic status. Such a hope for improvement of social status has undoubtedly been a very powerful force in determining our own hygienic practices as individuals.

It must also be noted, as was recently emphasized by the Banfields (*5*), that the degree of community organization necessary for the exploitation of a technology does not necessarily arise automatically just because the technology is made easily available, and that in some cultures the necessary organization may not arise at all. With the Navajo, the problem of organization should not prove too difficult because the tribal organization is rapidly assuming a well-directed responsibility for the management of its affairs. Inevitably there will be some lag between effective organization at the general tribal level and effective participation by the individual communities in their own affairs. The latter is something that differs widely in degree at present among the many "communities" of the large tribal area.

How Rapid the Change?

It would not seem proper to close this consideration of certain aspects of research in technologic development without mention of the pace or rate of the introduction of a technology. Cer-

tainly it is not clear whether this is something that is controllable or even susceptible to study or whether, once a significant innovation is made, others inevitably follow in an essentially uncontrollable fashion. In large measure, any attempt to control the pace of introduction of a technology involves ethical considerations, and these become of primary importance when the technology is medical. With the Manyfarms project we have not really had to face up to this formidable question. For many delays, of a type to be expected in any field program, resulted in a situation in which we could not have simultaneously introduced the many individual elements of a total program even if we had wanted to do so. Consequently, we have tended to introduce one thing at a time. Moreover, in making our choices we derived considerable freedom from the fact that the governmental and tribal programs are both expanding at such a rate that by the time our long-term studies are completed, any appropriate services from our program can be maintained.

In most development programs in health, however, this question of pace looms importantly, especially in the case of programs devoted to the control of a single disease, such as tuberculosis. Unless we can acquire wisdom in this matter, the possibility of actually doing harm through technologic development programs in health is very real. At the present time, however, we cannot pretend that we have found a way to investigate this question of "rate of introduction" in the Manyfarms studies and can only state that we are devoting considerable attention to attempts to find such a way. In the meantime, in our thinking we try to be guided by the thought expressed several years ago by the distinguished former United States diplomat George Kennan (*6*): "Wherever the authority of the past is too suddenly and too drastically undermined—wherever the past ceases to be the great and reliable reference book of human problems—wherever, above all, the experience of the father becomes irrelevant to the trials and searchings of the son—there the foundations of man's inner health and stability begin to crumble. Insecurity and panic begin to take over, conduct becomes erratic and aggressive. These, unfortunately, are the marks of an era of rapid technological or social change. A great portion of our globe is today thus affected. And if the price of adjustment to rapid population growth is to cut man's ties to the past and to catapult him violently across centuries of adjustment into some new and unfamiliar technological stratosphere, then I am not sure that the achievement is worth the price."

References and Notes

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5. E. C. Banfield, *The Moral Basis of a Backward Society* (Free Press, Glencoe, Ill., 1958).
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Science in the News

Scientific Activity in Africa Growing; U.S. Education Aid Rising Slowly

The political and economic changes that are taking place in many African countries as they struggle for independence seem to be stimulating rather than retarding scientific activity.

Munitalp Meteorological Institute

A recent event that augurs well for African science is the announcement that an Institute of Tropical Meteorology is to be established in Kenya with funds provided by the Munitalp Foundation. This news was reported on 1 December by Lord Twining, chairman of the board of the foundation, when he welcomed scientists from 26 countries to the opening of a 17-day symposium on tropical meteorology that took place in Nairobi, capital of Kenya. Kenya is a British colony and protectorate that is seeking independence. The symposium was sponsored by Munitalp and the World Meteorological Organization.

The Munitalp Foundation will contribute £40,000 for capital expenditure on buildings and equipment and £12,000 a year for 10 years to meet operating costs. The institute will probably be located in Maguga, on the outskirts of Nairobi.

Munitalp ("platinum" spelled backwards), which has now transferred its headquarters to Africa, was incorporated in 1949 in the state of Connecticut. The foundation has long supported basic meteorological research in the United States—research such as the cloud physics investigations of Vincent Schaefer.

In his December announcement, Lord Twining explained that agreement had been reached with the East African High Commission for the new institute to be associated with the East African Meteorological Department and with the East African Agricultural and Forestry Research Organization in Maguga. He emphasized that while the institute would work in close cooperation with these two bodies, it would retain its independence and would be free to carry out work for the benefit of all countries in tropical Africa.

Lord Twining invited the countries and organizations participating in the Nairobi symposium to cooperate with the new organization, pointing out that although the institute will initiate and conduct particular investigations, among its most important functions will be the collection and collation of data and the dissemination of knowledge.

United States Delegate Comments

V. D. Rockney of the U.S. Weather Bureau in Washington, who attended