SOME EXERCISES IN SOCIAL ECOLOGY: HEALTH, DISEASE, AND MODERNIZATION IN THE RYUKYU ISLANDS

by

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Most of the world's population today finds itself part of a vast aggregate of different races and contrasting cultures conveniently lumped under the title "developing countries." While this division of the globe into "developed" and "developing" implies a homogeneity within each group which may be more apparent than real, there seems to be little doubt that what distinguishes the one from the other is the elusive process known as "modernization." The "modern" countries are thus considered "developed" while the process of modernization is widely identified as the great need of the "developing areas." Basically this process is one through which a relatively stable, rural, agrarian society is transformed into a more mobile, urbanized, industrialized state. As C. E. Black has pointed out, it is an agonizing process involving the destruction of old institutions, the creation of new ones, and fundamental alterations in the function if not the structure of those institutions which manage to survive.(1) Modernization is thus a process of social revolution, the goals of which are usually stated in economic terms.

Government officials spend much of their time pondering over problems of foreign exchange, gross national product, balanced growth, and the vexing question of consumption vs. investment. At the level of sophistication of most citizens, however, modernization has a meaning far more concrete and specific than the abstract economic concerns

of government. After extensive travel in Asia and less extensive travel in Latin America, I am convinced that the meaning of modernization to the vast bulk of these people can be adequately summarized by almost any billboard that advertises Coca-Cola, washing machines, refrigerators, televisions, or other consumer items. Modernization is consumer hardware and consumer services. The proverbial house in suburbia may still be a century away for most Asians, but bicycles and transistor radios are often meaningful substitutes in the existing life situation.

For these citizens then, modernization is seen not as a dynamic process but rather as a static entity characterized by the general availability of goods and services unavailable to them at the present time. There is little or no awareness of the enormous changes which must occur as prerequisites to a more bountiful life. What is desired is to a great extent determined by the observation of resident Americans or Europeans and by the growing use of mass media advertising. The people want things rather than an uprooting of their entire social system. This is not to suggest that a people would not deliberately destroy their social system to obtain higher living standards, but it does point out that the prime concern is apparently materialistic rather than ideological. In my experience, there seems to be no great admiration or respect in Asia for American (i.e. western) institutions such as democracy, free enterprise, or Christianity. On the other hand, American technology is greatly admired. It is as if the goal were the grafting of western technology onto a society that

is to remain basically unchanged.

If we can accept scientific technology and its material fruits as the essence of modernization for most Asians, it is not difficult to understand the ready acceptance in many of these countries of whatever is perceived to be "modern" and "scientific." While the wearing of western clothes may not seem very "scientific" to us, it may be to an Asian for whom no real distinction exists between these two terms. That which is "modern" is necessarily also "scientific." The adoption of new habits, customs or behavioral standards because of what we may conveniently label the "modernization syndrome" can produce unpredictable and potentially tragic consequences. Viewed in ecological terms, this grafting-on process often alters the ecosystem by changing man without a compensatory change in his environment. Of course the converse occurs as well, in which the application of technology alters the environment while man remains essentially unchanged. In either case, the equilibrium of the ecosystem is disrupted and its manifestations are all too often the emergence of new problems more difficult to solve than the old ones.

Perhaps the disruptive impact of the more superficial aspects of modernization have been most apparent in the area of nutrition. Two of the most widely publicized examples have to do with changes in food habits. It has been pointed out, for example, that millions of Asians now refuse to eat unpolished rice, insisting on the more expensive, less nutritious white variety. Millions of Asians also exist at the brink of starvation and their rejection of unmilled rice robs

them of a valuable source of dietary protein and while they may be acting in a modern way, it is difficult to see how they are better off as a result. Similarly, Latham has recently condemned the growing trend among African mothers to switch from breast to bottle feeding.(2) The bottle is considered "scientific," the breast anachronistic. Yet the African mother has no facilities for sterilization or refrigeration of bottled milk, and this added cost in an already marginal budget usually means a poorer quality diet for other members of the family as well. An equally disturbing trend in Africa is the increasing rejection of traditional foods which, while bizarre to western tastes, provide a substantial part of the protein in the African diet. Thus the consumption of rats, dogs, flies, locusts, animal blood, and curdled milk is falling into disfavor even though no equivalent protein sources are presently available as replacements. In each of these cases, man has altered his relationship to his environment without compensatory environmental changes. What is too often ignored is the manner in which changes such as the above may operate in more complex situations involving nationwide programs or even entire social systems. Even in these less apparent cases, the basic problem is one in which a change in one part of the ecosystem is not accompanied by compensatory changes in another.

It is the object of this paper to discuss some of these less apparent interactions between man and his social environment and to point out how these relationships can exert a preponderant influence on the health and welfare of a population. While the examples cited

are all taken from the Ryukyu Islands, it is probable that similar examples can be found in any country if one seeks them out.

THE RYUKYU ISLANDS: HISTORICAL PERSPECTIVE

The Ryukyus comprise seventy-three islands lying on the China perimeter between southern Japan and Taiwan. The history of this island people (who prefer to be called Okinawans) is a chronicle of the relations between a small, weak country and three great powers, China, Japan, and most recently the United States. Okinawa was first visited by a delegation from China in 608 A.D. and for 500 years between 1372 and 1870 the Chinese emperor was recognized as overlord of the Ryukyus. The Chinese were displaced by Japan in 1872 when the Ryukyus became a Japanese prefecture. This state of affairs endured until 1945 when Okinawa fell to advancing American forces in the most savage battle of the Pacific war. During the period of Japanese dominance, the monarch of the Ryukyus was downgraded to the status of viceroy and the central government came to be dominated by civil servants from the Japanese mainland. Self-government was limited largely to the local level and an important tradition of village and regional autonomy developed which persists to the present time.

This traditional localism was encouraged by the Americans in the early years of occupation. Between 1945 and 1952 central government disappeared entirely having been replaced by three separate bodies, each controlling the internal affairs of an island group. Central government was vested in the United States Civil Administration of the Ryukyu Islands which in 1952 created by executive decree a counterpart

national governing body known as the Government of the Ryukyu Islands. During its sixteen year history GRI has gradually assumed more and more autonomy and at present USCAR's role is primarily restricted to foreign affairs and advisory services in the various governmental functions.

In spite of long experience with foreign domination, the Ryukyus today differ in many respects from the frequently cited "typical" developing area. First and foremost, the Ryukyus are prosperous, at least by Asian standards. The economy has been booming since the late fifties. The average annual rate of economic growth has been 19% since 1960 and annual per capita income has risen from $202 to $426. The process of urbanization which began immediately after World War II with the influx of almost 100,000 Okinawans displaced from every part of the Japanese empire continues at a brisk rate. More than fifty per cent of the people now live in cities and in recent years light industry has developed at a rapid rate. Unlike virtually every other developing country in Asia, the Ryukyus do not have a significant population problem. The annual rate of population growth which approached 3.0% in 1955 had fallen to 1.6% by 1966 and economic planners are increasingly concerned about a growing shortage of labor.

Progress has been steady if not spectacular against the communicable diseases so prevalent in the developing world. Malaria eradication was achieved in 1961 and other important insect borne diseases such as filariasis and Japanese encephalitis are under vigorous attack. Waterborne diseases have declined with the increasing avail-

ability of treated water. In 1966 a broad health insurance program was established which dwarfs anything now operating in the United States. Increasingly the disease patterns of the Ryukyus have come to resemble those of Japan and the United States. While data on morbidity is scant, the leading causes of death in 1965 were heart disease, cancer, stroke, and accidents, the same afflictions so prevalent in industrialized countries.(3)

The control of the various communicable diseases is a continuing process and as of December 1966 there were thirteen separate programs in operation, some more successful than others. Each of these programs, viewed ecologically, involves the alteration of the existing ecosystem through the manipulation of man or the environment or both. The remainder of this discussion is devoted to a brief description of the manner in which these alterations often produced unpredictable results with a direct influence on the eventual success of the program in question.

FILARIASIS ERADICATION: PRESERVING HEALTH BY FILLING A SOCIAL VACUUM

Filariasis (sometimes known as elephantiasis) is a disease transmitted by certain species of culex mosquitoes. While rarely fatal, it is a significant cause of low productivity because it is both chronic and debilitating. Surveys carried out in the early sixties revealed a prevalence rate of 19% in the southern most island group of the Ryukyus, the Miyako gunto, and a mass campaign to eradicate filariasis in this area was initiated in early 1965.

The Miyako Gunto consists of eight small islands with a total land area of 85 square miles and a population of about 73,000. There is one urban trade center, but the way of life is largely rural and

agricultural, sugar cane being the most important crop. Like most Okinawans, the people are very receptive to applied western technology and their attitudes toward health programs are favorable.

The mechanics of filariasis eradication are virtually identical to those of malaria. In both cases the attack is a dual one aimed at identifying and treating human cases while spraying each home with residual insecticide to reduce the mosquito population. Yet the conquest of malaria required fifteen years of more or less constant effort. In contrast, the prevalence of filariasis was reduced from 19% to less than 3% in fifteen months.

Now there are many possible reasons for the rapid success of the filariasis program. Fifteen years of prior experience with the methodology is certainly an important consideration. The extensive use of Okinawan as opposed to American personnel, better organization, more money, an effective drug, and less mosquito resistance to insecticide, are only a partial list of the many factors which doubtless played an important role. Yet in the final analysis, the great limiting factor in any mass campaign is its success in reaching the target population, i.e. popular support of and cooperation with the program. More than any other consideration, it was this which distinguished the filariasis program. Ninety-nine per cent of the population volunteered for examination and the cooperation with home spraying was 100%. More than 90% of those found to be positive for the filarial parasite completed the prescribed course of therapy and 82% were cured.[4] When I left the Ryukyus in June of 1967, examination figures were still over 99% and

the prevalence of filariasis had fallen to about 1%.

While those of us who worked in this program were startled and, indeed, amazed at its success, the actual reasons for its remarkable popular acceptance remain enigmatic and no specific research into this question has been carried out. For this reason, it must be kept in mind that the proposed explanation which follows, while perhaps correct, remains speculative.

Unlike any other disease entity vulnerable to mass campaign attack, people must be examined for filariasis at night. The reason for this is a peculiar property of the parasite; it is nocturnally periodic and disappears from the bloodstream by day. Given the rural, semi-isolated setting of the program, the noctural habits of the parasite proved to be a boon rather than a burden.

Life in Miyako tends to be cyclic and these cycles are dictated by the process of sugar cane cultivation. Life is busy and difficult during the planting and harvesting and quite dull during the growing season. The population lives in 92 separate villages and social contacts are minimal except during the six month growing period. The eradication program began at the beginning of the harvest season and while it was recognized that evening examinations were perhaps preferable in view of the family's total immersion in the work of harvesting during the day, there was nevertheless great concern over the dim view the farmer and his family would take to a request to leave his home after a hard day and submit to an unpleasant procedure such as blood-letting. In fact, the farmers and their families were delighted and,

as we have already seen, highly receptive.

The examination sessions became social occasions furnishing as they did a legitimate excuse for what turned out to be a series of parties. Women prepared food, children brought toys, men brought alcohol, and in general everyone seemed to enjoy these sessions immensely. Unwittingly, this program filled a social vacuum at a difficult and dreary time of year. By this manipulation of the social ecosystem, those of us whose main concern was the collection of thirty cubic millimeters of blood and the passing out of diethylcarbamazine tablets had produced a program which unintentionally built a specific, tangible reward into a health program.

TRACHOMA: A PARADOX OF SANITATION

Trachoma is an infectious disease of the eyes which, in untreated cases, sometimes leads to permanent blindness. It is caused by a virus and is thought to spread from man to man either by direct contact or indirectly by way of water, towels or even clothing. It is widely considered to be one of several diseases whose prevalence is inversely related to the degree of personal hygiene and the level of general community sanitation. Indeed there is much to suggest that this is in fact the case. Trachoma has virtually disappeared from the western world with the exception of those groups whose living standards are far below the norm such as American Indians in the southwest United States.

Generally the Ryukyus fall into a similar pattern. In those areas with treated water, adequate waste disposal, and generally higher

living standards, trachoma prevalence is relatively low. In contrast, 40% and sometimes more of the people suffer from this disease in areas with no water supply and low standards of community and personal hygiene.(5)

In view of the strong association between trachoma and sanitation, one of the more curious aspects of this disease in the Ryukyus is the strong possibility that the insistance on the practice of personal hygiene in the schools actually facilitates the transmission of trachoma from child to child. This process is related to different patterns of water use in certain areas, and these patterns in turn depend on the local availability of water.

People living in areas without piped water must rely on wells often located some distance from the home. Because the collection of this water is laborious, residents of such areas usually build rain catchments attached to the home and depend on this water as their primary source of supply. Yet it is an uncertain source, especially in summer. For this reason, water is very carefully preserved. The same may be said of well water which is preserved because its collection is laborious. In both cases, circumstances dictate whole family use of a single bowl of water for bathing purposes. In this way, trachoma virus is easily passed from one family member to another in dirty bath water. Of these areas it may be said with a fair degree of accuracy that hygienic bathing under existing conditions is impractical and that one of the prime determinants in trachoma transmission is the scarcity of water.

Most Okinawans, however, now enjoy a piped-in water supply. These people are more often than not located in urban areas where prevailing standards of sanitation are usually higher than those in rural areas. Residents of cities rarely share bath water because water is plentiful and collected without effort. In such areas, the transmission of trachoma is most probably focused primarily in the school system. Here the factor of personal hygiene takes its bizarre twist. All school-children receive a hot lunch in the Ryukyus and in water-scarce areas stringent standards of personel hygiene are not demanded of the children before eating. Not so in water-rich areas where each child must wash his hands and face and be inspected by the teacher before he is allowed to eat. This hand washing process takes place at long, multi-fauceted troughs capable of accommodating a dozen or more children at a time. But while the schools insist on this procedure, they lack the funds to provide individual paper towels for drying the hands and face. Usually one or two children volunteer the use of their handkerchief for this purpose and I have seen one handkerchief used to dry the hands and faces of ten children. Thus it is almost certain trachoma is transmitted from child to child in this manner. What is at fault here is not bathing per se but the inability of the schools to provide the means of completing the process in a sanitary manner. Like white rice in Asia and bottle-fed babies in Africa, hand-washing in the Ryukyus represents a superficial acceptance of something considered modern, but new dietary protein sources, adequate refrigeration, and paper towels are missing and their lack negates whatever benefits these changes may offer. Modernization itself is a system which depends not

only on pure water and personal hygiene but on the existence of a governmental framework capable of maximizing rather than undermining the effects of improved hydrology and personal hygiene. In this case, we are dealing with an item as mundane as a paper towel yet its absence in this context proved to be a crucial determinant in the transmission of a serious disease. The manipulation of the environment through an improved water supply was accompanied by an incomplete and therefore inadequate alteration in man himself.

DYSENTERY: THE PROTECTIVE EFFECTS OF OLD HABITS

Kin son (son = county) is a semi-rural area in northern Okinawa whose population is increasingly shifting toward a preponderance of children and old people as the young adults migrate increasingly to the cities. In July of 1966, Kin was the scene of an extensive outbreak of dysentery. Like so many health problems in the Ryukyus and developing countries generally, this outbreak involved water. It also involved a selective attack pattern in that all of the more than four hundred reputed cases were children or young adults. Bacillary dysentery is a very common problem in the Ryukyus and this outbreak more or less followed the general pattern in that cases were mild, no deaths occurred, and the disease was water-borne. While it is usual for dysentery symptoms to predominate in young people, the total lack of cases among older people in Kin was quite peculiar and for several days this curious distribution impeded the epidemiologic investigation.

The village affected is located on a large hill with houses built up along its sides and at the top. At the base of the hill, an underground spring reaches the surface and this spring has been used as the

community water source for centuries. Until quite recently, the collection of water for home use was most difficult, involving a trip down the hill to the spring and the long trek back up with several heavy buckets filled with water. Women were also required to go to the spring to wash clothes. Again we are dealing with a situation in which water becomes quite a precious commodity. Probably because of its value, water was rarely consumed raw. It was almost always served as tea. Of course, tea is served hot and the brewing process requires several hours of boiling and simmering before drinking. In all likelihood this habitual heating of water for long periods tended to protect the residents from many a water-borne pathogen and this benefit may indeed be the original reason for drinking tea since it has the effect of making hot water potable.

In 1964 this ancient water source was converted into a simple water system. A pump was installed which drove the water through a pipeline to a large storage tank at the top of the hill. From this tank water was piped to individual homes by gravity flow. At the bottom of the hill provision was made to divert some of the water into two concrete-lined encloses, one for washing clothes, and one for swimming. An important result of these changes was a rapid change in the community attitude toward water. Suddenly it was accessible without effort and it existed in such abundance that the villagers could now enjoy the luxury of a swimming pool. Although the water was supposed to be chlorinated this was rarely done by village officials and at the time of the outbreak the chlorinating apparatus had not

been used for six months. At the same time the hill itself was largely porous coral rock and any contaminants such as human fecal matter readily found its way into the spring below. The stage was thus set for an outbreak of water borne disease, but it should be remembered that this same stage had been set for centuries. The changes of 1964 made the water easier to obtain but did nothing to change its quality for, as we have seen, the chlorinator was rarely if ever used. Yet what seemed to trigger the outbreak was a change in the way water was consumed.

With the advent of a water system, younger adults abandoned the use of tea and began to drink water directly from the tap. The decline of tea drinking is general in the Ryukyus as this ancient drink yields increasingly to a formidable "modern" rival -- Coca-Cola. At Kin, children emulated their parents and in the two years between the construction of the water system and the dysentery outbreak, tea drinking came to be prevalent only in the old people who continued to prefer it out of long habit. And so it was that the distribution of dysentery was largely restricted to children and young adults.

In this case, the outbreak of disease might have been averted in either of two ways. The people would have been protected if they had continued the old tea drinking habit. Of course they would have been equally well protected if the chlorinator were used properly. In the case of the trachoma, the problem was a complete environmental change (treated, piped water) accompanied by an incomplete, inadequate human response (hand washing but no towels). In the dysentery example, the

problem is the reverse, for the environmental change was only partial (no chlorination) while the change in human habits was total for a large segment of the population.

TUBERCULOSIS: THE INADEQUATE INSTITUTIONAL RESPONSE

It was pointed out earlier in this paper that health officials in the Ryukyus are increasingly called upon to deal with a new array of chronic illnesses such as heart disease and cancer even though their entire previous experience has been in the area of acute, communicable diseases such as malaria, filariasis, trachoma, and dysentery. As these "tropical" diseases fade in importance the entire emphasis of health delivery and medical care must be shifted from emphasis on mass campaigns to the creation of a system organized for the long term care of people whose disease can be managed but never cured. Unlike filariasis or malaria, there is no eradication program for cancer or diabetes. In a very real sense, applied medical technology finds that its great successes against communicable diseases lead to a confrontation with chronic illness against which a totally new technology must be applied backed up by a totally new organizational framework. Yet meeting this challenge is a difficult process which represents a major crisis in health care.

At the root of this crisis lies the continuing commitment of the health care system to a communicable disease orientation which becomes less and less relevant as chronic illnesses become increasingly important. To a greater or lesser degree, communicable diseases come to mean mass campaigns and relatively short-term patient contact with

emphasis on a diagnostic and therapeutic blitzbrieg (e.g. filariasis). The focus is on the disease rather than on the delivery system because the latter is designed to accommodate the peculiarities of the former. Thus there is no general health care system. Instead there are multiple systems, one for malaria, one for filariasis, one for water borne disease, one for trachoma, etc. Because each system exists only so long as the particular disease remains under attack and because the mass campaign methodology tends to overshadow more routine functions of health departments, opportunities for the development of a viable general delivery system are lacking. For these reasons, the Ryukyus now face the chronic disease challenge without a realistic system of health services delivery and, what is more important, little appreciation of the need for one.

Tuberculosis serves as an excellent example of the application of mass campaign techniques to a disease which is only partly susceptible to this methodology. Tuberculosis is without question the major communicable disease problem in the Ryukyus. It is the most common cause of death among communicable diseases and a major cause of economic embarrassment both to the government and to individual families. Eighty per cent of the working time of the 162 public health nurses is devoted to T.B. and it is the single great preoccupation of the six regional health centers. Tuberculosis control is an open-ended mass campaign which began in 1952 with the inauguration of a case-finding program relying primarily on Mantoux testing. Between 1960 and 1965, for example, 1,877,000 skin tests and 675,000 chest films were admin-

istered to persons of all ages and occupations. Since 1965 almost one half of the population (about 430,000) has been skin-tested each year. While the prevalence of positive reactors of Mantoux testing has declined steadily, the 8.2% positive rate among fourteen-year-old children is far in excess of the W.H.O. target of less than 1%.(6) Furthermore, there is no reason to believe that this goal will ever be achieved under the present control program. As a result of this massive case-finding effort, an average of 2500 new cases are identified each year. While this is a successful mass case-finding campaign, it raises the important question of what should be done once the disease is uncovered, for TB unlike many other communicable diseases does not yield to a short-term therapeutic blitz.

Here the mass campaign approach breaks down. Each year 2500 new cases of TB are fed into a medical care system which is not, in fact, a system at all. It is much like pouring water into a container with a hole in the bottom. Most of the water immediately leaks out. The basic problem is, of course, the hole and what is needed is a new container, not more water. In 1966, 41% of the 904 available general hospital beds were given over to tuberculosis, and 700 additional beds were available in the three tuberculosis hospitals. Beyond this, 1000 more patients were hospitalized in Japan. The remaining 11,000-12,000 patients were part of the home care program which is administered by the 162 public health nurses mentioned above.

The cost of treatment for tuberculosis (i.e. hospitalization and drug therapy) is borne by the government and in 1966 came to about

$1.25 per capita, an amount considered high for Asia. In addition, hospitalized patients receive an allowance to provide for their families during the period of incapacitation. In contrast, patients on home care, even though their working is limited by law and often by physical impairment, receive no compensation beyond the cost of drugs. It is not unusual, therefore, for home care patients to move from one village to another in search of work. This is quite expedient because if the move takes the individual out of the jurisdiction of the regional health center to whom he is known, he drops out of the home care system because each regional health center is completely independent, and there is no central record system for tuberculosis. The same is true for hospitals, and a patient discharged from one institution is free to seek hospitalization at another without being followed by any record whatever. Since hospitalization assures a family subsidy, the rotation of individual patients from hospital to hospital is not uncommon. Both the patients who move to a new locale and those who move from hospital to hospital are quite likely to turn up as a "newly diagnosed case," the former through compulsory examination at his new job and the latter simply by presenting himself for examination at a second or third or fourth hospital. It is estimated that perhaps 25% of all "new" cases are actually renegade patients previously diagnosed. Thus incidence cannot be distinguished from prevalence and the true status of this disease remains uncertain, even after sixteen years of intensive mass case-finding.

To make matters worse, hospitals tend to select only those persons whose disease may be amenable to surgical intervention. This practice

varies somewhat among the eight hospitals providing TB care because, like the health centers, each is entirely independent of the others with respect to admission practices, diagnostic procedures, therapeutic regimens, and record keeping. Generally speaking, however, chronic excretors of tubercle bacilli with extensive lesions are not admitted, and no institution exists for the isolation of such patients. These people are placed on home care along with the less serious cases, and, as we have seen, they may or may not stay in the program. As we have also seen, very ill patients often attempt to secure hospitalization at another institution to insure the security of their families while those who are more or less asymptomatic often move to another jurisdiction to find work. At the same time, six months is the maximum period of hospitalization in all eight hospitals and patients at various stages of arrest are automatically released at the end of this period to make room for new patients. These discharged patients also end up on home care.

Meanwhile, the home care system is about to collapse completely because the size of the nursing staff has remained constant while the patient load has greatly increased. Nursing is losing ground in the Ryukyus because new fields are now open to women and because nurses are underpaid and enjoy very little status in the eyes of the general public and the health care hierarchy. It is not unusual for a single nurse to be responsible for as many as one hundred patients spread out over a wide area. There is no transportation provided for the nurses who are nevertheless expected to visit each patient once every four to

eight weeks in addition to her other duties, one of which is the never-ending case-finding campaign. She is also called upon to involve herself in mass campaigns to immunize school children against the usual diseases (recently the "usual" list has included the use of BCG) and to do contact tracing for venereal disease control. There is also a growing leprosy home care program for which she is responsible. Few nurses, if any, are able to devote their full-time to T.B.(7)

Such is the state of tuberculosis control in the Ryukyus. It is perhaps supreme irony that much of this state of affairs is due to a very successful mass case-finding program. Yet this approach cannot solve the medical care problem inherent in TB therapy, and it is largely the failure to deal with this problem which undermines the best efforts of the mass campaign to accurately define the incidence and prevalence of the target disease. It is unfortunate that the very success of mass campaigns against some diseases tends to suggest its application to diseases like TB which are only partly susceptible to this technique. Ultimately, the control of TB is a problem in chronic disease care which requires a highly sophisticated organization framework which considers not only the disease itself but the people needing care, the providers of care, and the institutions for care. These must all be coordinated on a permanent basis while retaining the flexibility required to change the system as new needs arise.

The present tuberculosis program is plagued by overloaded facilities; a growing manpower deficit in home care, an unrealistic system for the support of patients and their families; a decentralized, unco-

ordinated network of hospitals and health centers; and little apparent concern over the release of chronic active cases into the community. None of these problems applies to those communicable diseases susceptible to mass campaign methods. Long term medical care facilities have no real place in the mass campaign and because vast resources are diverted into mass campaigns the entire hospital system tends to remain anemic and underdeveloped. At the same time, skilled manpower deficits are not of primary concern as the emphasis is on the use of unskilled workers who can be trained on the job. The system of family support which places what amounts to a 100% tax on home care patients is of little relevance in the era of rapid cure without long term patient involvement. The decentralized, antonomous network of regional health centers springs naturally from the strong tradition of localism. Also enormous efforts such as malaria or filariasis eradication, while highly centralized in themselves, operate as programs entirely outside the jurisdiction of regional centers. To these centers fall the less exciting, lower priority tasks such as putting down "brush-fire" outbreaks of dysentery, immunizing the local children, and sporadic attempts to convince the local people to abandon the use of night soil. Jobs of this kind are best done through a decentralized system because each center is responsive primarily to local problems.

Unfortunately, the prevailing tendency has been to regard the morass of tuberculosis control as the failure of individual, independent entities -- too few hospital beds, not enough nurses, uncooperative home care patients, etc. -- when what is involved is an inadequate

system of care. Curiously enough, there is very little concern about the economic penalties imposed upon home care patients, as this is regarded as a welfare rather than a health problem. Yet this economic penalty is a major reason for the failure of the home care program. A failure to appreciate the importance of welfare legislation is characteristic of a disease specific outlook. Indeed, the health establishment is so indifferent to this area that the national health insurance scheme was drawn up by the labor department with minimal assistance from the health department.

Interestingly enough, the present program represents an attempt to integrate tuberculosis control into general health services as recommended by the World Health Organization.(8) But neither general health services nor the TB control program is organized to cope with the chronic aspects of this disease. For this reason, integration has simply superimposed a mass campaign requiring centralized administration on a network of decentralized regional health centers whose administration is locally autonomous. Thus the very process of integration has confounded the situation and produced a hybrid program in which the mass case-finding component is continuously negated by a fragmented system of patient care. The very nature of tuberculosis and of chronic diseases generally requires a medical care system which is centralized, country-wide, and permanent. The Ryukyus, in contrast, enter an era of chronic diseases with a system which is decentralized, regional, and sporadic.

The limitations of mass campaigns have been well known for many years and have been a constant theme of the World Health Organization.

Most recently, Gunnar Myrdal, in his monumental work on Asian development, has reemphasized the restricted applicability of this technological approach even in countries still burdened with great communicable disease problems.(9) The more care people require the more crucial become the economic, social, and legal environments in which care is provided. Health systems which cannot or will not address themselves to this widening sector of concern will find themselves increasingly irrelevant to the health care needs of the people the system is supposed to serve. Yet the health department has never requested funds to evaluate these problems while it continues to request and to spend large amounts on diseases such as Japanese encephalitis, of which there were twenty-two cases in 1967. Already the Labor Department has moved into the health care field in championing the national health insurance plan, and this may well signal the beginning of more extensive involvement. The importance of these events in the Ryukyus lies in the very real possibility that similar difficulties lie ahead for other developing areas. The incipient need for improved medical care organization and administration is perhaps the least recognized health problem of the developing world.

CONCLUSION: THE EMERGING PROBLEM OF ENVIRONMENTAL POLLUTION

Each of the examples discussed in this paper has focused on a recognized problem and how man's interaction with his environment contributed to the success or failure in seeking a solution. The case of tuberculosis, while very complex and involving virtually every facet of Okinawan social and economic life, is nevertheless essentially similar to the

less complex discussions which preceeded it. In all cases, either man or the environment or both is altered and the results of these changes are sometimes beneficial and sometimes harmful depending on a wide range of determinants -- social isolation, long established habits, local traditions, or an increasingly irrelevant system of medical care delivery.

In sharp contrast to these recognized health problems is an incipient one which, at least for the moment, seems at worst a distant menace of little immediate concern. Nevertheless, the assertion that each society creates its own health problems is to a great extent correct, and one can predict with near certainty that environmental pollution is the next great health crisis the Ryukyus will be forced to confront. The mosquito vectors of filariasis are being driven from the skies only to be replaced with smoke and gasses from new industry. The chronic water supply problem will add new and quite different dimension as the few remaining dysentery organisms are either destroyed by chemical wastes or floated away in a sea of detergent.

If the experience of the industrial countries can be used as a guide, coping with pollution problems will prove extraordinarily difficult in the Ryukyus. Tuberculosis has been difficult because its control demands a change in the ecosystem involving health care delivery and the broader social system. Nevertheless, tuberculosis is a specific disease entity and although its control is quite difficult, it does not present itself as a problem demanding methods of solution quite unlike anything ever used before.

Environmental pollution, on the other hand, is quite unlike anything which preceeded it. Air and water pollution are not diseases, rather they are terms used to describe an environmental situation. Furthermore, epidemiologic studies to confirm the association between disease and, let us say, air pollution are very difficult to carry out because exposure is hard to quantify. Yet such studies are crucial because in an area which finds itself totally committed to economic development through industrialization, costly pollution control devices are not likely to enjoy wide popularity. Presently there is little interest in this area within Okinawan governmental circles. Lay officials are only dimly aware of pollution and health officials are overwhelmingly oriented to communicable disease control through tried and true methods. Thus an objective assessment of this problem has never been carried out. This should not come as a surprise if one considers that virtually nothing specific to the Ryukyus is known about the epidemiology of the four leading causes of death and relatively little about the fifth, tuberculosis. A health care system slow to adjust itself to the widening role demanded by the chronic diseases is unlikely to respond readily to the still wider dimensions of environmental pollution which is not only social and economic but very much political as well. It is perhaps the supreme irony that the Okinawan health system, floundering and inadequate as it now seems, finds itself in this position largely because of its past victories. Thus it is victimized by its own success. Called into existence to cope with the communicable disease and sanitation problems of a developing country, it has remained unchanged in outlook and method

even though the society of which it is a part has entered the industrial era and is no longer underdeveloped.

It is very difficult in a paper of this kind to avoid what might be interpreted as criticism of the Ryukyus and of its health officials. However, criticism is not my intent. The Okinawan people in two decades have transformed a poor infertile country devastated by war into a dynamic economy with a standard of living second only to Japan in their part of the world. The communicable disease and population problems which plague other developing countries are rapidly receding in the Ryukyus and while the Okinawans have received assistance from both the United States and Japan, this fact detracts not at all from what must be considered a great achievement. Few places have accomplished as much with foreign aid as the Okinawans. If, therefore, we now find the Ryukyus somewhat slow in responding to new problems such as chronic diseases and industrial pollution of air and water, we should be neither surprised nor critical. Those of us who might be inclined in this direction need only consider the present status of these problems in the United States to realize that our own efforts have been equally slow and our own errors equally apparent.

Rather than a critique, then, this paper seeks to point out through examples from the health field that a community's problems represent the disturbance of an ecosystem and that if studied properly, the lessons from one part of the developing world may be applied to other areas to avoid endless repetition of the same mistakes. Once it is appreciated and each challenge met creates or unmasks still new challenges, those who are concerned with the process of international development (i.e.

"modernization") should begin to widen our focus to include not only existing problems but the new problems created by our solutions as well.

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