

1964 Ramazzini Oration

The Metamorphosis of Occupational Medicine to Environmental Medicine

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NUMEROUS WIDELY diversified events have created renewed interest in man's response to his environment. Yet the precise limits of man's tolerance for many environmental stresses are unknown. Medicine (particularly public health'), aerospace medicine, occupational medicine, industrial nursing, industrial hygiene, safety, engineering, and health physics are the health professions most concerned. At the same time, social evolution impresses its alterations on our way of life. Therefore, it seems desirable to examine these scientific and social forces in order to understand clearly our current situation, and then to peer for a moment into the future.

First, let us consider some of the effects of environmental stress upon man. We all are aware of the great travesties man has suffered over the centuries from hostile forces in his environment. Long have the physical stresses such as heat, cold, and ambient atmospheric changes plagued man in his constant battle for existence. In addition, famine and infectious diseases have been the scourge of mankind from his

earliest days. In recent years a few of the more fortunate peoples on this earth have secured relative immunity from starvation through improved methods of food production, preservation, storage, and distribution. Also these same groups of peoples now suffer much less from the ravages of infectious diseases through the application of environmental sanitation, personal hygiene, specific chemotherapy, and immunizations.

Integration of Science into Medicine

Ministering to the sick and disabled by the ancient "medicine men," barbers, and early physicians was largely an art, for diagnostic tools were few, and no specific therapeutic agents were available. With the development of the biological sciences, medicine found a scientific ally. Quickly medicine embraced these new sciences that have contributed so much to our understanding of disease. Anatomy became more meaningful with an appreciation of the cellular structure of tissues. Physiology gave purpose to the multitude of diverse structures in the human body. Bacteriology shed brilliant light upon the etiology of some of man's most feared enemies. Immunology, the sanitary sciences, and preventive medicine devised methods of eradicating or controlling many infectious diseases. Pathology contributed an understanding of disease

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processes in all organs and body tissues. Much of this occurred only in the last century.

It was inevitable that medicine should seek greater understanding of organ and cellular function. One of the physical sciences, chemistry, eagerly was embraced, and the science of biochemistry has flourished. Its contributions to our understanding of disease are well known. Moreover, in the development of specific chemotherapeutic agents, chemistry has added infinitely to the efficacy of curative medicine.

The other physical sciences were not far behind. With the discovery of the properties of γ -radiations, x-rays were harnessed as a diagnostic tool and therapeutic agent. Safety engineering, industrial hygiene, and more recently, health physics emerged and joined the ranks of the health professions.

During the first half of this century, so zealous became many physicians in practicing scientific medicine and so enamored were they with the application of science, that in each patient they saw and treated only the diseased organ. Gradually a realization of the patient's need for something more than cold cataloguing, as a case of mitral stenosis or a cirrhotic liver, resulted in an appreciation for the need of embracing the social sciences into medicine. In fact, these vague feelings were crystallized by Dr. Christopher Leggo in the 1952

Ramazzini Oration entitled "Invite the Professor to Dinner." In his inimitable facetious style, Dr. Leggo dramatically portrayed the need for medicine, particularly industrial medicine, to incorporate the concepts of sociology and psychology into its day by day practice. He sounded a note since echoed back and forth across the land for treating the "whole man." In occupational medicine, some of the techniques of the social sciences have been utilized in counseling and dealing with so-called "well employees" to help them to a proper understanding of their work and home situation. As a result, much emotional stress has been alleviated, thus contributing to their productivity and happiness.

But this is not all. Rehabilitation also has been developed by the successful application of a combination of social and medical sciences with the result that it has become standard practice in communities large and small. In addition, the concept has evolved that prevention, diagnosis, and treatment do not comprise the total field of medicine, but a fourth element, rehabilitation, is essential for the complete practice of medicine.

Environmental Stress and Physical Sciences

Recently, numerous developments have added impetus to our quest for more knowledge concerning the biological effects of en-

vironmental stresses. I will name only a few. The American Medical Association, in its reorganization a few years ago, recognized the importance of environmental stresses in medicine by establishing a Division of Environmental Health that embraces occupational health, air pollution, aerospace medicine, industrial toxicology, and industrial hygiene. Still more recently, the AMA has created a new Committee on Environmental and Public Health. In 1960 the AMA changed the name of its specialty journal, *ARCHIVES OF INDUSTRIAL HEALTH*, to the *ARCHIVES OF ENVIRONMENTAL HEALTH*, and broadened its scope to preventive medicine, occupational medicine, and aerospace medicine.

The American Physiological Society, in 1964, published the *Handbook of Physiology, Section 4, Adaptation to Environment*, which is a monumental publication dealing primarily with the physiological effects of environment upon man.

In aerospace medicine there has developed a crucial need for precise knowledge of the extremes or limits of man's tolerance for many of the physical stresses in our environment. Two of the more troublesome biomedical problems are the oxygen content and air pressure requirements of the atmosphere for prolonged periods of inhalation, and man's reaction to prolonged decreased air pressure. Currently astronauts are being given 100% oxygen at 5 lb per square inch during flights, and this is the atmosphere planned for the Apollo space craft cabin. Other environmental stresses of concern include abrupt intense temperature changes, ionizing radiations, toxic chemicals, and the limits of G force in acceleration and deceleration that can be sustained without body or tissue damage. Also, the biological effects of sustained lack of gravity, although not established, are believed to vary from muscle weakness to the decalcification of bones and the loss of blood fluids. These and many other aerospace medical problems have further accentuated our need for more precise knowledge concerning both the immediate and long-term effects of the physical and chemical environ-

mental stresses on man. In addition, the intensity of the psychic stress and man's tolerance for this needs to be equated.

Exploration of the deep sea in order to exploit its riches has been a long-time dream of man. The 1964 development of a one-thousandth-inch-thick perfect polymer membrane, that permits oxygen from sea water to pass through quickly and carbon dioxide to diffuse out, is a significant new device to aid man in his conquest of the deep sea. The ill-fated Keller deep sea diving demonstration with the loss of two lives off Catalina Island last year, and indeed, new techniques in deep sea diving and unique equipment for "housing" man on the ocean bottom for prolonged periods, have caused reexamination of man's reaction to the environmental stresses of increased pressure, oxygen consumption, carbon dioxide disposal, and resistance to cold.

Preventive medicine, and particularly that developing new area denoted by the term "community health," now recognizes need for knowledge beyond communicable diseases, maternal and child health, sanitation, and the social sciences in dealing with new emerging community health problems. Some of these community environmental stresses have created definite health problems, while others are feared as detrimental to health, but no health problem has been established. Air pollution, water pollution (chemical), vibrations, noise, and intensity of electromagnetic radiations, including of course the various wavelengths of light, are among the physical and chemical stresses causing concern to community health authorities. To cope with these entities, the Public Health Service and some state and local health departments have established Environmental Health Bureaus or Divisions employing individuals particularly skilled in the physical, chemical, and biomedical sciences.

The sciences of physics, engineering, and physical chemistry have produced in recent years many astonishing new concepts. Some have forced themselves into medicine and industry, while others are being examined for possible application by industry and medicine. Ionizing radiations and radioac-

ive isotopes are extensively used both in industry and in medicine. Cryogenic materials have found wonderful uses in industry and medical research with further application in medicine to be expected. Cryogenic liquid hydrogen and oxygen are used widely in rockets and space vehicles.

Maser, an acronym standing for Molecular Amplification by the Stimulated Emission of Radiation, and Laser, also an acronym standing for Light Amplification by Stimulated Emission of Radiation, are being investigated extensively by industry. They pose significant health hazards. The ability to excite electrons into higher orbits about the nucleus of certain atoms and the harnessing of this energy as in controlled Laser emissions staggers the imagination with its possibilities in communications and as sources of intense energy, particularly pinpoint heat. In addition, it is becoming clear that the full long-term biological effects of these radiations are as yet unknown.

Lastly, permit me to mention the physical chemical phenomenon of Clathration. Investigation of the physical structure of molecules has revealed many variations in the configuration of molecular structure. Curiously enough, molecules are far from compact solid structures. It turns out there are many holes of various shapes and design in the structure of molecules. Some molecules have a latticework structure while others have well-defined tunnels running through them. By intricate physical chemical means, the diameter of these open spaces has been calculated for some materials. This would be scientifically interesting, but irrelevant to our discussion were it not for the fact that certain gaseous atoms, under appropriate circumstances, can be forced to enter these spaces and reside there. They literally become trapped in the latticework or tunnels when there is a tight fit. Molecules supplying the hole or space are called the host, while the gaseous atoms taking up residence in these spaces are termed guests. No chemical bond exists in this situation. The guest atom apparently is held in position by attraction between the electrons in the

outer orbits of the atom and those electrons composing the inner surface of the cavity in the host molecule. Amazingly the chemical properties of such substances become exclusively those of the host which remains unaltered by the acquisition of these guests. The chemical properties of the guest atoms disappear completely until these atoms are released by physical or chemical means from their abode in the host molecules. The Clathration technique now is being utilized by the petroleum industry in removing certain objectionable paraffins from high grade oils. Another current use lies in capturing and holding molecules of the so-called noble gases: argon, neon, krypton, and xenon that are practically inert chemically. Other wide industrial applications are anticipated, and the possible use of this phenomenon in medicine appears likely.

First the biological sciences, then biochemistry and the social sciences, have contributed greatly to the ability of medicine to serve mankind. Now physics, engineering, and the physical sciences are coming to the fore. Biophysics and bioengineering not only are bona fide fields of endeavor, but trained individuals in these fields are in demand to work on most exciting projects in connection with man's conquest of space, the atom, the deep sea, or to assist in the reshaping of our communities by the application of environmental health science and technique. At least one of the nation's major universities has devised a new graduate area of instruction, bioengineering, to help meet the need for trained individuals in this new aspect of Environmental Medicine.

These are some of the forces contributing the tools and the technical know-how for medicine to serve the growing and changing needs of mankind better. Yet, curiously enough, these startling scientific forces are not the dominant factor in shaping the changing pattern of medical services, particularly of occupational medicine. The most potent force by far operating relentlessly in reshaping the pattern of medicine, and especially occupational medicine, is social evolution.

Social Evolution

Curiously, social evolution has determined the present character of occupational medicine to a far greater extent than has technical and scientific know-how. Moreover, there is every indication that it will continue to do so. Let us turn for a moment from the intriguing technical considerations we have been dealing with, to take a serious look at social evolution of this century. Place it along side current scientific progress and on this basis appraise the metamorphosis occurring in occupational medicine.

At the turn of this century, no occupational health services, as such, existed on this continent. There was technical, engineering, scientific, and medical knowledge to operate broad occupational health and safety programs commensurate with the industrial technology of the day. But no such services were present either in industry or in government agencies. The few nurses and physicians then employed by industry in isolated lumber camps and mining communities were engaged full time in the practice of curative medicine, totally oriented to the treatment of the sick and injured. Overt prevention of occupational diseases or traumatic injuries was not practiced. No form of what we currently term occupational health and safety existed.

Partly because of the wanton and flagrant disregard for human life and disability by the hard-hitting industrialists of the day, workmen's compensation and insurance legislation came into being early this century. Industry was forced to accept responsibility for those employees killed, injured, or disabled in the course of their employment. Then, for the first time, industrialists engaged physicians to render in-plant medical services particularly pre-employment examinations weeding out all except the most physically perfect applicants. Safety engineering as a profession emerged, and industrial nursing came into being.

Eut what was the basic force that caused the enactment of the workmen's compensation legislation? It was the result of the evolution of the social conscience of the day. For the first time, there had developed

in man an acknowledged concern for the well-being of one's fellow man. Also at that time, citizens were beginning to look to government for more protection and for specific services. Workers began to ask government agencies for protection from death and disability accruing from the work environment. In response to this social expression, in 1913 two of the more industrialized states, Ohio and New York, established the earliest official state occupational health programs, or as they were then called, industrial hygiene programs. Shortly thereafter, state labor departments began developing industrial accident prevention programs and factory inspection services.

Social concepts continued to grow, and in 1935 the Social Security legislation was enacted. However, in 1935 only seven states had official industrial hygiene programs. Funds for support of state and local health agency services then became available under the Social Security Law. Through the stimulation provided by the Public Health Service and using the general public health state grant funds, 23 additional states initiated industrial hygiene programs as part of the expanding services of their state health departments.

Present Social Trends.—Social progress did not cease with the passage of the initial Social Security legislation; in fact, the pace of social evolution has accelerated rapidly, particularly during the past two decades since World War II. As a result, today many social changes are in prospect that will result in sweeping alterations in occupational health services.

It may be argued that the public does not have the technical background or scientific know-how to decide what is best, and that these problems are scientifically too complex for the public to resolve. Therefore, upon this basis, all decisions as to the amount, type, and technical content of occupational health services, and how best to execute them, can be planned and carried out by health scientists and technically trained personnel only. This line of reasoning, although attractive, is nonetheless fallacious.

For although labor, the workers, do not know the technical means of achieving what they want, they can express precisely their desires. Simply and broadly stated, these consist of the following:

1. Workers do not want disease or disability to accrue to them from the work environment; that is, they demand a safe healthful place in which to work.

2. When taken ill or injured, workers want immediate expert medical care without protracted arguments or delays over which insurance, workmen's compensation, or group health insurance is to care for them and pay their bills.

3. When disabled, workers want assurance of a continued income for their own protection and that of their families, again without delay, and for certain they do not want to pay half, or any portion, of the paltry disability compensation to a lawyer in order to secure for them what is rightfully theirs.

The working public knows what it wants and is beginning to perceive clearly how to get it. It is by social legislation that workers and their leaders hope to achieve these objectives.

Next let us examine another social development that is gaining momentum in this countn, specifically the problem of providing for the disabled. Socially it is no longer acceptable, and happily so, that the disabled and their families be relegated to various community welfare rolls and forgotten. The Social Security Act was amended a few years ago to provide disability retirement for those incurring total permanent disability before age 65. In addition, vast sums of money have been spent by federal and state rehabilitation programs in an attempt to return disabled individuals to the active productive work force of the nation.

Eased on the argument that a disabled worker has given his all in serving a particular industry, the social concept that industry, not public welfare, should support him has been gaining favor in social planning circles. Moreover, this concept has been expanded to cover all disability.

It is being contended that support for the disabled should come from industry no matter what the disability, or where or how it is incurred. In recent years this enlarged social concept has been the motivating force in greatly expanding workmen's compensation awards to cover death or disability from heart disease, cancer, mental illness, and so forth—disabilities usually not arising out of and often not in the course of employment. This socio-economic philosophy, that it is preferable for each industry to support its own regardless of the etiology of the disability than for community welfare services to do so, when carried to its logical completion, and this now is in progress, ultimately can result only in further broadening of the Social Security legislation to cover all disability, partial as well as total, and temporary as well as permanent. Moreover, expansion of Social Security to cover all disabled individuals is to be anticipated because there will be many disabled who are not employed by industry, and social legislation is coming to be all inclusive rather than simply designating benefits for specific groups.

At the same time, another facet of social evolution lies in providing medical care for those over age 65 under Social Security. With the death of Senator Kerr, who was the dominant force behind the Kerr-Mills Act, and the man who was credited with defeating President Kennedy's plan for Medical Care for the Aged under Social Security, one could have predicted that medical care for the aged would pass the Senate as it did in 1964. Likewise, it can be predicted that in 1965 at President Johnson's insistence, this legislation along with certain other changes in the Social Security law will be enacted by the Congress. The amended Social Security Act will provide complete and free medical care, although with some limitations, for all citizens over age 65 whether or not there is financial need and whether or not the individual ever has worked under Social Security coverage. Now when medical care for all over age 65 under

Social Security becomes a reality, there is every indication that the Social Security Act further will be extended by great socioeconomic-political pressure to cover total medical care. Perhaps at first this will be only for workers and their families covered under Social Security, but ultimately every individual will be eligible to receive complete medical care under some type of government-sponsored medical care program. Whether we as physicians and health scientists like it or not, and whether such legislation will produce the best medicine for our people or not, this clearly is the trend of social evolution. It represents the application of socioeconomic and sociopolitical measures by the people in the hope of resolving pressing health and health-economic problems of the day. It appears inevitable that it will occur despite the well-organized conservative groups who oppose such developments. The course of social evolution presses on relentlessly.

Current Trends in Occupational Medicine.—Let us now examine in greater detail our growing concern with environmental stresses and how they affect the practice of occupational medicine.

To begin with, so efficient have our industrial hygiene, safety engineering, and medical controls become that new cases of frank occupational diseases are comparative rarities, and workers also are safer from traumatic accidents at work than on the highways or at home. In medical centers we no longer easily are able to find cases of overt occupational disease to show our students.

Today the growing concern of many social planners and scientific researchers lies in the long-term effects of environment on longevity and disability. Are there work or community, or combined work and community environmental stresses, that aggravate or early precipitate the onset and hasten the development of cancer, heart disease, or any of the many chronic degenerative diseases? New types of epidemiological environmental studies with broad epidemiological bases must be devised and executed to

assay these vexing and complex problems and to establish clearly the role of environmental stresses in connection with the development of overt chronic degenerative disease.

Let me present one example, that of the chronic pulmonary disease problem, chronic bronchitis and emphysema. Chronic bronchitis has become so universal in Great Britain that it has been characterized as a national disease. Earlier it was popularly ascribed to the numerous dusts, vapors, fumes, and irritant gases so prevalent in many of the older industrial working environments. Just a few years ago a painstaking, detailed, epidemiological study comparing British workers and their wives resulted in the surprising finding that the wives, who had experienced little of the dusts, gases, or fumes of the industrial work environment, nevertheless had as much chronic bronchitis as their husbands. More recently the US Surgeon General's report on smoking stated repeatedly that smoking was more causatively related to the development of chronic bronchitis and emphysema than the work environment.

In this country, in the male, chronic bronchitis too frequently is followed by the gradual development of emphysema. Once emphysema becomes full-blown, the victim is a pitiful object. Day and night he is gasping for breath and holds on to life tenaciously by a most slender thread. They are the "short of breath" patients who today have been kept alive to reach this miserable plight by miracle drugs and antibiotics. Heretofore, most of these pulmonary cripples afflicted by recurrent respiratory infections were carried away long before they reached the terminal stages of emphysema.

Currently the ranks of the chronic pulmonary patients, particularly those with emphysema, are swelling daily while physicians and health scientists stumble around fumbling for an explanation, but not knowing how to go about preventing this rising tide of disability. Once the unhappy victim of chronic emphysema becomes totally disabled, if employed, he invariably can recall

experiencing a work environment laden with dust or an irritant vapor mist or gas. He frequently attributes his disability to such a work exposure while the specialists in this area are unable, uniformly and with certainty, to equate the relationship between the disability present and the past work or community environment. Constantly physicians are harassed by questions regarding the significance of cigarette smoking, genetics, various work environments, and community air pollution in relation to the development of chronic bronchitis and emphysema. In this situation, occupational medicine is in a most uncomfortable and untenable position. The failure of occupational medicine to produce the answers to this and many other health problems of older workers lies partly in the fragmentation of medicine and partly in the "state of the art."

The narrowness of the base on which occupational medicine operates, ie, the work environment of the eight-hour work day five days a week, while largely ignoring the influences of community environmental stresses accruing in the other 16 hours a day and 128 hours a week, manifestly make solution of these problems impossible for occupational medicine. Herein lies one of the potent forces pushing for the expansion of occupational medicine to total environmental medicine.

The Future of Occupational Medicine

What then of the future of occupational medicine? Let us assume that (1) biophysical and bioengineering knowledge continue to grow, (2) man will sustain increasing physical, chemical, and psychological environmental stresses in his work and community, (3) overt occupational disease and injuries continue to decrease, (4) employer, workers, and health and social scientists all continue their demands to know the long-term effects of various work and community environmental stresses on health, (5) social changes will continue, that society will not become frozen as is, and (6) inevitably complete medical care for employed workers and their families will be under

Social Security, or some similar form of compulsory health insurance, government sponsored, and that all forms of disability will be under Social Security.

Under these circumstances a gradual succession of changes in occupational medicine during the next 50-75 years is inevitable. Logically, it follows that all present state workmen's compensation legislation will become obsolete. Also all private forms of workmen's compensation insurance will disappear when all medical care and disability payments are under government auspices. The entire voluntary health insurance system, and most, if not all, group health insurance plans will be doomed when government-sponsored complete medical care for everyone comes into being. Obviously, this state of affairs will be reached only after long sociopolitical effort accompanied by much anguish. Also, it will come about bit by bit, permitting time for adjustment of current programs to the newly created circumstances.

Gradually then, there will evolve marked changes in the practice of medicine with a new format for occupational medical services. Permit me to list some of the major points:

1. Personal preventive medical programs of the occupational health type will be extended to cover all members of the community. Trained occupational medicine physicians will operate broadly in the community as well as in plants in cooperation with local community health services.

2. The retained in-plant health and safety programs will be oriented largely towards the specific health hazards of that industry with emphasis on safety, first aid, health education, and counseling. Special examinations will be accorded various groups of workers incurring specific exposures. Improved health maintenance programs for groups of workers will be integrated with community health maintenance programs. However, human relations problems will be the chief concern, for numerically, they will greatly exceed physical injury and occupational disease.

3. Pre-employment physical examinations, or as today we euphemistically term them, pre-placement examinations, will be re-designed not only to identify those physically fit for employment, but also to serve as sound base-line health audits primarily for health maintenance purposes. Placement of those medically fit for employment will be made largely by psychological aptitude and personality testing in the personnel department. This will be based upon the concept that every industry or business, or both, must employ its portion of the cross section of the community.

4. Insurance companies as a source of industrial health services, particularly safety, industrial hygiene, toxicology, medical, and nursing consultation services, will disappear.

5. More and more, small industry will come to rely on official agencies for such routine services as the following: (1) industrial hygiene, (2) advice and counsel on building proper controls into all new construction and all remodeling, (3) industrial accident prevention services, (4) advice on evaluation and control of all types of environmental hazards, chemical, physical, psychological, and traumatic, and (5) physician and nurse consultation services.

6. In the continuous reorganization of health agency functions, the official occupational health programs are destined to become broad sanitation and environmental health programs. Inevitably, government occupational or environmental health programs will become closely aligned with the growing chronic disease control programs now sponsored under community health services.

7. In such an era the communities themselves will come to be regarded as complex industrial organizations from a health and epidemiological point of view. The long-term complex epidemiological studies of the influence of all the various environmental stresses on health will require total environ-

mental orientation, i.e., both industrial and community.

8. Inevitably the technical industrial hygienist must become an expert, well-rounded, total, environmental hygienist. The industrial safety engineer also must become a broad environmental safety engineer. The industrial physician, today preoccupied with the health of only one group of employees, will become a specialist in total community environmental medicine as well as occupational medicine. Industrial nurses also will become more closely integrated with preventive community health nursing. Such physicians and nurses will promote and coordinate adult health maintenance programs with close integration of chronic disease control and expanded rehabilitation services. Not rehabilitation directed and oriented primarily toward reemployment as is so highly emphasized today, but rather rehabilitation aimed at achieving maximal self-care and enjoyment of living for every disabled individual.

9. Industry will demand and employ more and more sophisticated bioenvironmental and bioengineering specialists to work side by side with design engineers and creative scientists inside its research laboratories.

The metamorphosis of occupational medicine to environmental medicine then will be complete. Let me stress that we as individuals can do little either to accelerate or delay social evolution, but we can do much toward accelerating the development of scientific environmental medicine. Of particular import to environmental medicine are those new concepts, both social and scientific, affecting the character of occupational medicine and the development of integrated community environmental health programs. To paraphrase from Dr. Christopher Leggo, "Invite Environmental Physiology, Bioengineering, and Biophysics to Dinner." I only wish he had added—"And Fear Not, Social Evolution."