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## ADVANCEMENT IN THE SCIENCE OF PUBLIC HEALTH\*

BY

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The public health movement is still very young. Compared in age with such institutions as the church, the monetary system and the military, public health service is at best only a youth. Like a healthy, vigorous human, the public health movement has grown rapidly during its early life.

Within the first year of life a healthy infant doubles in weight. Then he settles down to a less rapid but steady increase in height and weight until about twelve years of age. At that, as though the youngster had just seized upon a glimpse of the richness of life and the rare privileges of human existence upon the earth, he begins to grow in height and weight and in breadth of intellect and vision at a rate far beyond any previous experience since the first twelve months. During about four years of that period known as adolescence, a child grows with such amazing rapidity that his parents are taxed to the limit to keep him supplied with clothes that fit, food that meets his needs and a thousand things which are required to satisfy his expanding physical and mental horizon. It requires, furthermore, the closest observation on the part of acquaintances and friends of the family to recognize and keep informed about the changes that take place in growth and habits of an adolescent.

It appears that the public health movement is now in the midst of its adolescent growing period. During its infancy, the period prior to 1900, it suffered from inanition. Having survived that hazardous and critical period, the public health movement then settled down to a reasonably steady growth that continued until about the opening of the World War. That conflict gave a tremendous impetus to public health service. It demonstrated on a large scale the infinite possibilities of controlling disease and maintaining health through the application of scientific knowledge. Since then the growth of public health service in this country has been phenomenal. It has enjoyed a healthy adolescence, expanding and spreading out in all directions. The results have been astonishing. A study of appropriations by municipal and state legislative bodies indicates that this youthful activity may suffer somewhat from a lack of nourishment during the immediate future. It requires more than a short ration, however, to seriously discourage a robust adolescent.

An omnivorous appetite is characteristic of youth. Food in great quantities for body and mind is drawn from a multiplicity of sources if healthy development results. So it is with the public health movement. No one science and no one profession can provide this service with a program

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worthy of the name. Indeed, public health work depends upon knowledge and skill drawn from the fields of medicine, engineering, bacteriology, epidemiology, biometry, biology, zoology, geology, psychology, psychiatry, sociology, chemistry, dentistry, eugenics, physics, nutrition, education and numerous others. Advancement in any of these fields is at least a potential advancement in the public health movement. A delineation of advancement in public health must therefore be limited to a broad vision of progress along the whole sweeping front of this significant movement. So able a scientist as Dr. H. Levy, the mathematician, declares that no scientist would claim to know all about tobacco-growing, let alone the other factors that enter into the manufacture of a cigarette. How much less would an administrator profess to know all about all of the sciences involved in public health.

The most important advancement in respect to public health is doubtless the change in popular attitude toward the meaning and significance of this movement. Only 27 years ago an impetuous president of the United States entertained grave doubts in his own mind as to whether or not he should retain as chief sanitary officer of the Panama Canal Zone a man who spent, as he had been informed, all of his time in trying to kill mosquitoes. About two weeks ago a nationally known educator (Dr. Robert K. Speers) roundly upbraided health education instructors for being too gullible in the acceptance of fads and half truths. Among these he cited "a clean tooth never decays" and "a daily bath for positive health" as examples.

These two illustrations show that within thirty years the best popular attitude has changed from skeptical to critical in respect to preventive medicine. From the mountain peaks to which he has swiftly climbed the well informed public health specialist looks back upon the valley of limited knowledge that he used as stepping stones to higher altitudes. The knowledge he used for tools then, he now recognizes were crude and simple. These tools served well their purpose, however. Now the public has reached those valleys and are already striving to climb the higher grades. This is proved by the critical attitude of mind.

The shift from skepticism to confidence in preventive medicine made possible the improvement that has taken place in the public health. It made possible appropriations to health departments and contributions to the many voluntary public health agencies throughout the country.

The next step, according to J. B. S. Haldane, is to bring about a popular attitude so that both the electorate and the lawmakers will think in terms of human biology. Popular thought today is almost wholly in economic channels. Tariff walls are built up and torn down chiefly for economic reasons. If thought were redirected into biological channels the basis for tariff and other laws would shift to human instead of monetary values. Suppose the steel industry petitioned Congress for a protective tariff. The death rate from pneumonia is much higher among steel workers, particularly those subjected to strenuous labor and radical changes in temperature, than among employes in any other industry. With this knowledge at hand the biologist-politicians would say to the steel magnates, "We cannot protect your industry until you protect more adequately the health of your employes."

Lead poisoning, silicosis, and asbestosis are three important hazards involved in various manufacturing, industrial, and commercial employment. The lawmakers who think in terms of human biology would grant no favors in the form of protective tariffs or other legal advantages to any of these industries until all reasonable precautions were taken to protect the employes. This is the next great step in the advancement of public health. The prevailing popular tendency to criticize the shortcomings of health education encourages the belief that progress is being made in that direction.

*Record Keeping*

Next to the change in popular attitude toward preventive medicine the next most important advance in public health service is probably the collection, classification, and utilization of records. It is an astonishing fact that reliable records of mortality, the prevalence of diseases and of births date back only to 1918 in Illinois. Prior to that time the mortality records in only 27 states were acceptable to the United States bureau of the census as reliable. Mortality records are now accepted by the bureau from all of the states except Texas and South Dakota. These records, which are constantly being more refined and accurately executed, are the very foundations upon which the public health structure is built. They show what diseases are most hazardous, what age groups fall victims most easily to this or that danger. They show the results of efforts at disease control and the gains and losses in the public health program. We know from the death records, for example, that diphtheria killed one thousand, one hundred forty-two people in Illinois during 1918 and only two hundred forty last year. We know that mortality from tuberculosis fell from 8,579 in 1918 to 4,273 in 1932. We know also that the greatest risk of diphtheria is to the child between two and five years of age while the hazard of tuberculosis is three times as great as that from all other health dangers to young women between 14 and 35 years of age.

The statistics, moreover, show that improvement in public health protection has advanced at an uneven rate from a geographical standpoint. This is true when considered on a state, national or international basis. Smallpox, typhoid fever and malaria are as prevalent and fatal as ever throughout a large portion of Mexico. Within the United States both typhoid fever and diphtheria have been practically eradicated in some commonwealths while in others these two diseases are still problems of large magnitude. Last year, for instance, typhoid fever was responsible for only 1 death or less per 100,000 people in New York, Connecticut and Wisconsin, while diphtheria was charged with less than 3 deaths per 100,000 people in California, Iowa, Massachusetts, Michigan, Minnesota, New York and Wisconsin.

In Illinois two counties last year experienced death rates from diphtheria of a magnitude comparable with those prior to the discovery of antitoxin and toxoid or toxin-antitoxin while 58 counties suffered no loss of life whatever from that disease. When grouped together the 34 counties that make up the extreme southern third of Illinois have a mortality rate from typhoid fever that is fifteen times greater than that of the 33 counties in the extreme northern third of the State. The death rate from diphtheria is three times as great, and the infant death rate is 30 per cent higher in the southern than in the northern third of this State. In the southern third the death rate from tuberculosis is 20 per cent greater than in the central third.

Statistical records bring out, moreover, that a tremendous shift is taking place in the age level of the population. At the turn of the century nearly one-half of all mortality was among children under five years old. Now less than 10 per cent of the mortality is in that age group. This means that a much larger percentage of the population is reaching maturity and the upper age levels than at any previous time in history. Fully 40 per cent of the population of Illinois are over 35 years old now whereas about 30 per cent of the people in the State had reached that age in 1900.

This aging of the population brings to the fore a host of problems. Instead of diarrhea, diphtheria, typhoid fever, tuberculosis and other hazards of infancy, childhood and early maturity, such health risks as cancer, heart disease, diabetes and nephritis dominate the picture. In addition to this, industry, commerce, and the government find themselves with an increasingly large percentage of leaders who have reached three score years of age. Al-

though still physically vigorous and mentally alert these men experience great difficulty in adjusting their point of view to the swiftly changing conditions brought about by scientific development. The records at least make us aware of a problem that grows daily in complexity and magnitude.

Sickness records have likewise marked an important advance in public health service. Not only are case reports required for a constantly increasing number of diseases but sickness surveys have brought to light some astonishing knowledge. No one suspected until recently, for instance, that chronic rheumatism is the greatest single cause of all chronic illness. This opinion is based upon a study of one per cent of the population of Massachusetts which indicated that fully 145,000 people are suffering from chronic rheumatism at any one time in that state. The Committee on the Cost of Medical Care brought together a mass of valuable records in respect to the prevalence and cost of sickness and medical care.

Activities which stimulate the collection and study of records constitute a tremendous contribution to the advancement of public health. They point the way toward better adjustment in a rapidly changing world.

Mental health is by all odds the most important problem of the future. Advancement in application of mental hygiene has not progressed very far but there has been a tremendous growth in knowledge concerning this subject on the one hand and a recognition of the problem on the other.

The sheer magnitude of the problem compels serious thought and stirs up apprehensions. Nearly one-half million hospital beds in the United States are filled with nervous and mental patients. The ratio of feeble-minded and epileptic patients per 10,000 people in the United States has increased from 2 to 5 since 1904. In Illinois the patients in State hospitals for the mentally defective (insane, feeble-minded and epileptic) have increased from 27 to 40 per 10,000 population since 1914. While the entire population increased 30 per cent the institution population increased 48 per cent. The actual number of mental defectives under the care of the State has increased from 16,402 in 1914 to 31,367 on the first of April of this year.

Turner points out that more children are headed for the insane asylum at the present rate of commitment than for college. Birth reports filed by the Illinois State Department of Public Health show that reproduction among the best stock has declined far more rapidly than among the less desirable. The number of children born to mothers of mental defective and retardates is almost twice the number born to mothers of children who are sufficiently intelligent to attend high school and college.

Statistical studies indicate that about 11 per cent of the feeble-minded in any generation come from the mating of feeble-minded parents while 89 per cent come from the mating of carriers. The latter are people, who though normal themselves, carry over to their offspring the mental defect. This is an illustration with the Mendelian recessive type.

Another phase of the mental health problem is that of maladjustment. Mental illness is frequently functional rather than pathological. Bad training and lack of adjustment to modern conditions can destroy usefulness as completely as biological incapacity. Fully 40 per cent of the crime in this country is committed, according to newspaper reports, by boys under 25 years old. Perhaps three-fourths of these youngsters have sound minds biologically. They are badly trained.

These are disquieting symptoms. They constitute a distinct advancement in public health if they stimulate action in the right direction. The extension of sound eugenics, programs and the employment of psychiatry in our schools are the ways in which to attack the problem. The great store of technical knowledge that makes possible the maintenance of community and individual health at a high favorable level depends upon an intelligence high enough to apply the knowledge.

*Technical Advancement*

Recent advances in the field of nutrition and food values are voluminous and remarkable. These relate principally to the vitamins. Probably the most far reaching development is the perfection of a method for impregnating milk with vitamin D. This can be done economically and practically in three ways. The fluid milk may be irradiated with ultra-violet rays from a carbon arc lamp, the cows may be irradiated in this way, or yeast may be added to the ration of the dairy herd.

These processes yield a milk that has a high anti-rachitic value. It will prevent rickets in babies and children who have no cod liver oil or other vitamin D concentrate. Even when less than a quart per day is given the children show no more evidence of rickets than do those under the care of competent pediatricians who prescribe cod liver oil or other anti-rachitic preparations.

The cost of irradiating milk by the carbon arc lamp is above 15 cents per 100 gallons under quantity production methods. Thus an economical method capable of almost universal application has been opened up for the control of rickets. Advantage of the opportunity has been seized upon by forward looking dairymen, especially in New England where anti-rachitic milk is a regular market product.

Perhaps the newest trend of thought in the field of nutrition is that a balanced ration of vitamins is required to yield satisfactory results. Thus a concentrate of vitamin A, for example, would not produce the desired results unless the patient has a proportionate volume of vitamin B, vitamin C, etc.

Another refinement of knowledge in this field is a recognition of the fact that humans are born iron-rich and calcium poor. This is a natural condition which has, as Sherman points out, important survival value but it creates a health problem that must be solved by the intelligent use of artificial methods. Poverty of calcium makes the bones of an infant at birth much softer and more pliable than those of an adult. This reduces the hazards of birth to both infant and mother. It also reduces the chances of acquiring sound, durable teeth and sturdy bones. This deficiency must be met by a dietary regimen rich in calcium and phosphorus.

Early this year the Agnews announced that they had succeeded in controlling caries by adding vitamin D and phosphorus to the diet. During recent years Mrs. Mellanly reported that pyorrhea could be produced or prevented at will in puppies by withholding or giving vitamin D in appropriate quantities.

These fragmentary references suggest how rapid have been the advances in the knowledge of nutrition and food values during the last decade or two and indicate the importance which diet is assuming in respect to public health.

Refinement of technique and the adjustment of old ideas to meet new situations has marked the practical advancement in immunology and epidemiology. Knowledge has reached the point where practically all of the gross disadvantages of quarantine can be eliminated under ideal circumstances. With an adequate health service, for instance, it would not be necessary to quarantine at home or prohibit from school the children who have been exposed to measles until the ninth day after exposure. In the face of a scarlet fever outbreak it is a more scientific course to keep open the schools under medical supervision than to close them. The isolation of patients suffering from communicable diseases is now considered a measure that results more in benefit to the patient than in protection of the public.

Under prevailing conditions the carrier is now recognized as a more important source of infection to others than bedfast patients.

Of outstanding importance because of the magnitude of the problem is the refinement of epidemiological methods concerning tuberculosis. The skin test which shows whether or not a person has been infected, together with x-ray pictures of the chest, make possible the almost complete control of this disease. The procedure is based upon the principle that no person can have tuberculosis without being infected with the tubercle bacilli. An individual might slowly starve to death or gradually waste away on stale air and a shortage of sunshine but he would never suffer from tuberculosis unless the germs of that disease got into his body. The source of those germs, moreover, is nearly always a human being. The skin test shows whether or not the tubercle bacilli have gained access to the body.

Children under school age have a narrow range of human contacts. Opportunity of infection is limited to family members, servants, close friends and perhaps nursery school and kindergarten teachers. Thus a positive tuberculin test on a young child indicates a nearby source of infection. Meyers points out that 60 nursery school children were tested under his observation. The test was positive on four children. A search for the source led to the discovery that one of the teachers was tuberculous. Her removal saved the other children from infection. In Massachusetts the source of infection of school children is found to be a member of the family in more than one-half of all cases. Frequently these sources of infection are people who do not know that they are tuberculous. They are all the more dangerous for that reason.

A positive tuberculin test indicates infection only. It does not necessarily mean active disease. Indeed, only about 1 in each 100 children with positive tests is found to be suffering from the disease. Diagnosis in these early and minimal cases can be established only by the x-ray.

This refinement in procedure with respect to tuberculosis must be rated as one of the larger advancements in public health service. It has great potentialities. Tuberculosis still heads the list of fatal communicable diseases with the possible exception of pneumonia.

Methods of scarlet fever control have reached a point of advancement which makes practicable the complete elimination of this disease from institution populations. At least two Illinois schools, that at Mooseheart with an enrollment of some 1,500 and the soldiers' orphans school at Normal with about 700 have succeeded in eradicating scarlet fever. All children are given the Dick susceptibility test. Those who show a positive reaction are given a series of immunizing doses of scarlet fever toxin. A similar course was followed before it closed, a victim of the depression, by the Durant Hospital for Contagious Diseases in respect to candidates for training as nurses. Experience in all three places showed that the test is thoroughly reliable as an index to susceptibility or immunity. In no case did any pupil or nurse who had been vaccinated and thereafter showed a negative Dick test experience an attack of scarlet fever. All three institutions remained practically free from the disease over a period of years although scarlet fever was frequently epidemic in the communities round about.

While it seems impracticable to attempt general vaccination against scarlet fever in the way employed with respect to diphtheria and smallpox, the use of the Dick test might be employed to great advantage especially among school children in the lower grades. The Dick test applied to school children in the fall would show which ones are susceptible. Not more than one-third would fall into this group and they would be mostly in the lower grades. If scarlet fever appeared in the community during the year all

efforts at control could be concentrated on the susceptibles. Even in the face of an epidemic the use of the Dick test and the observation of susceptible children is a far more scientific, practicable and economical procedure than closing the schools.

A particularly promising advancement is the development of serum treatment for patients with lobar pneumonia. An experimental demonstration of this procedure has been underway in Massachusetts since 1931. Progress reports indicate that serum treatment, when given to patients suffering from types I and II prior to the fourth day of the disease, reduces mortality to about one-third of that in non-serum treated patients. This trial in Massachusetts is being observed with the greatest interest. Lobar pneumonia of types I and II is the form which the disease most frequently takes among young and middle aged adults. The perfection of the serum treatment method would be of the greatest significance to public health. Pneumonia usually ranks second or third among the leading causes of death in Illinois. Importance of control is therefore manifest.

Very recently Sauer has reported significant success in preventing whooping cough by vaccination. He used a vaccine prepared under his own direction. A fairly large number of vaccinated children who were undoubtedly exposed to repeated infection escaped sickness entirely. While the procedure may be regarded as still experimental it undoubtedly has value and can be utilized by experts to advantage.

Health problems associated with industry have come to the fore very rapidly in recent years. To cope with these medical knowledge has progressed as rapidly as the need has manifested itself and more rapidly than it has been applied. The McCord test for lead poisoning, for example, seems to be a reliable means for controlling that growing hazard. Some people are much more susceptible to lead poisoning than others. More and more manufacturing processes involve an exposure of employes to this risk.

The McCord test indicates by changes in the blood whether or not an individual exposed to the danger is reacting unfavorably to the risk. Blood changes pointing toward disabling illness can be observed long before definite clinical symptoms of poisoning manifest themselves. The McCord test is, therefore, of significant value in controlling lead poisoning among employes.

The medical examination of candidates for employment in various occupations has become routine practice in a number of industries. These include railroads, bus companies, steel corporations, aeronautics and many of the public services such as policemen, firemen, military, etc. This precaution is a service to both the employes, the public and the industry concerned. Individuals of unstable nervous systems and those with disqualifying physical defects are in this way prevented from undertaking functions that might endanger both themselves and others.

A substantial number of industries have created medical departments through which the growing volume of knowledge concerning industrial hazards are applied. On the other hand, there is room for great expansion in this direction. The chief problem concerns small industrial units. In some localities, as in Philadelphia, this situation has been met through the organization of a medical group the cost of which is pro rated among the industries served on the basis of employe population.

In the field of sanitary engineering the methods of sewage disposal have progressed to the point where it is possible to obtain from the outlet of sewage treatment plants clear, sparkling water that is perfectly purified and safe for drinking. Our esthetic sense would doubtless rebel at drinking water obtained from that source but the sanitary quality of the water is unquestioned.

This sketchy outline of the more noticeable developments and trends in the public health field suggest how rapidly knowledge of a practicable character has come to light. Advancement has taken place along the whole broad front. The gains in end results have been solid and durable. This is proved by the fact that health conditions have been maintained at unusually favorable levels throughout the current economic depression. Under the pressure of prevailing financial conditions no scandals of consequence have come to light in health departments.

These are significant observations. The public health movement is built upon solid ground. Its achievements are a monumental tribute to scientific thought. The methods employed in extending its benefits are a beacon to guide activities in other departments of life.