SCIENCE

VOL. 87 FRIDAY, FEBRUARY 18, 1938 NO. 2251

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

SYPHILIS: A PUBLIC HEALTH PROBLEM[1]

By Dr. THOMAS PARRAN

SURGEON GENERAL, U. S. PUBLIC HEALTH SERVICE

FROM the papers delivered here this afternoon and in the days before, one can draw a large measure of satisfaction. Individually they document, together they epitomize that advancement of science to which this association is dedicated.

There is a satisfying humility too about the manner in which you scientists have reported the results of your studies. If there is any criterion which sets the scholarship of this age above that of other ages it is that implicit recognition that what we do not know extends infinitely beyond our known horizons.

I represent that section of your work which deals with medicine and public health. I have been asked to discuss one narrow sector within the broad scope of those two sciences, the sector of syphilis. It is a field of study which on the basis of its achievements in this century occupies a satisfying place in both medicine and public health. Syphilis, as Sir William Osler has said, is a great imitator. It mocks the symptoms of other diseases; but the physician has called upon the laboratory. We can diagnose syphilis more accurately than we can diagnose most diseases. Although the treatment for syphilis is a long and complicated one, medicine is surer of a cure than it is in the case of any other similarly serious disease.

Public health administration, on the other hand, has developed techniques which have made early syphilis a clinical rarity in several nations. I would devote myself to considering the scientific progress of our field as it relates particularly to medicine and public

[1] Delivered at the meeting of the Association at Indianapolis on December 30, 1937, in the Symposium on Syphilis organized by the Section on Medical Sciences. The symposium will be published by the Association in the near future.

health, to pointing out those unsolved problems which still remain and which must be solved before it has any great right to self-satisfaction. More particularly I would dwell upon the methods which have been employed in consolidating its progress and synthesizing the findings of many earnest workers in a complicated field; and I shall compare in terms of the social sciences progress that has been made in our administrative approach to syphilis through public health and to indicate those essential social facts which must condition our policies if America is to control syphilis.

Syphilis became epidemic in Western Europe just before the year 1500. Four hundred years of earnest medical research produced able medical descriptions of the course of the disease, empirical treatment for external symptoms but nothing more basic. Syphilis, in 1900, was still listed among the incurable diseases. It could not be satisfactorily diagnosed. The organism which caused syphilis had not been discovered.

Intuitive medical statesmen, like J. Marion Sims and Sir William Osler, had warned the medical profession of the dangers of syphilis and urged the practitioner to suspect its presence. One could not reasonably expect their admonitions to be observed, for in medicine, as in every other phase of life, few men move except under the compulsion of facts.

For medical research the first decade of the twentieth century was one of those great seminal times which come only occasionally for any scientific field. Metchnikoff and Roux in 1902 infected experimental animals for the first time. In 1905, Schaudinn peered through the lens of his dark-field microscope and saw the spirochete—*Treponema pallidum*—the cause of syphilis. In 1907 Wassermann gave us the complement-fixation test. Then in 1910 Paul Ehrlich announced that he had developed in his laboratory in Frankfort-on-Main salvarsan, a subtle compound of arsenic which could be injected into the blood and would kill the spirochete but would not harm the patient. In 1921 Levadite proved the superiority of bismuth over the traditional mercury as an adjunct to early salvarsan treatment.

This was progress. We were given the tools of research. We were given the means of diagnosis. We were given a new method of treatment which revolutionized our approach to the disease.

In the years since those epic discoveries, the methodologies of modern scientific research and clinical record have brought them to a point of fine perfection. We have defined the sero-diagnostic test and made it an adaptable and accurate instrument of diagnosis. Unlike our fathers we can find syphilis when it is hidden. We can measure the effect of the treatment that we are giving.

When Paul Ehrlich announced his discovery of salvarsan, he thought that one dose would cure syphilis. That utopia was soon shattered. It took many doses to rid the patient of the spirochete. Also it required long courses of mercury or bismuth to inhibit that tendency to relapse which is characteristic of syphilis.

Syphilologists throughout the world developed empirically their own systems of treatment. Syphilology as a consequence in 1925 was a chaos of different regimens of treatment, of different dosages, of private preference for different variations of the arsenical compounds. There were many piece-meal case studies but no accurate data upon which the scientist could judge the relative efficiency of these methods.

So under the sponsorship of the U. S. Public Health Service, the heads of five of America's leading syphilis clinics, Johns Hopkins, Mayo, University of Michigan, Western Reserve and the Philadelphia General Hospital were formed into a committee known as the Cooperative Clinical Group. As a result of ten years of effort, 75,000 case records had been subjected to critical professional and statistical analysis which reveals with almost slide-rule exactness what we may expect from specific amounts and types of treatment in early and latent syphilis. The Cooperative Clinical Group system of treatment for early syphilis, announced three years ago through the U. S. Public Health Service, stands to-day as the most effective treatment yet devised and one of the most effective known for any disease so serious as syphilis.

Since Wassermann developed the complement-fixation test, various refinements of his procedure have been introduced. Flocculation tests of great sensitivity such as the Kahn, the Hinton, the Eagle and the Kline had been developed which added precision to our diagnosis of syphilis. Different tests were performed by different laboratories. Every serologist had special reasons for his preference for one or another of the tests. There are three things necessary in a diagnostic test. It must be specific; that is, it must never allege syphilis in a non-syphilitic individual. It must be sensitive; that is, it must not miss syphilis when syphilis is present. It must be adaptable; that is, it must be capable of accurate performance by trained technicians, not merely a technical trick which can be performed reliably only by its originator. Carefully controlled researches by this committee have given us a new insight into these tests. We know to-day the high sensitivity, the hundred per cent. specificity and the relative degree of adaptability which the various diagnostic procedures can attain.

Other studies of the Public Health Service give us exact data concerning the number of new cases of syphilis which report for treatment each year; the number of cases constantly under treatment; the distribution of the disease by sex, color, age; the geographic variations in prevalence; the stage of the

disease when treatment is started and the length of time patients remain under care. These prevalence studies have been made in various states and cities embracing a population of more than 29,000,000.

Painstaking epidemiological work also has demonstrated the epidemic nature of syphilis. The disease spreads by a series of person to person epidemics. These epidemics can be traced, the source ascertained and infected persons brought under treatment.

The report of scientific progress in syphilology can be expanded in terms of papers that have been given at this meeting. We know much about syphilis, enough to control it, but not enough to discourage further research which will make prevention and control cheaper and more efficient. Dr. Eagle of our staff has described his approach to that uninvaded frontier of knowledge: "Just how do the arsphenamines kill the germ of syphilis?"

Did syphilis originate in America or was it an old disease in Europe which suddenly became epidemic following Columbus' discovery of America? No one has yet cultivated the *Treponema pallidum,* outside of the human or animal body. Success in this direction might point the way to immunization.

We know that the body develops a partial immunity to syphilis as a result of infection. Variations in this immunity may be responsible for variations in the results of treatment. Here again new knowledge is sorely needed.

Why does the nervous system of some persons allow the spirochete to enter, while in other patients there is a defense mechanism which protects the nervous system?

Related to immunity is the question of why pregnancy makes the course of syphilis more benign—fatal as it frequently is to the unborn child.

Why are men more likely than women to develop cardiovascular complications and what factors determine the presence or absence of these complications? The serodiagnosis of syphilis is one of the most precise of our laboratory tests, yet no one knows the why or how of these tests.

In recent years, non-specific, that is to say, heat treatment has proven to be a valuable adjunct in late syphilis. Its place in early syphilis needs further study. The present effective though long-continued treatment necessary to cure syphilis handicaps our control efforts. Urgently needed is a quicker, less painful, cheaper cure of the disease.

Knowledge is lacking also in the practical methods adapted to American conditions for the most effective control. I refer to the need for more reliable methods of determining the current incidence and distribution of the disease in the population, the most effective epidemiological procedures, the rôle of the chronic carrier versus the fresh case in promoting spread and the costs of various elements in a control program.

This is a formidable list of the deficiencies in our knowledge of syphilis. As scientific information replaces present uncertainty, our task will become easier. Fortunately, we do have now sufficient scientific knowledge to control syphilis if we *do* what we know how to do.

The essential facts which argue for syphilis control are that the disease can be diagnosed as soon as it is infectious by the dark-field microscope, later by efficient serologic tests. With one or two doses of an arsphenamine, we can render the patient promptly non-infectious, not cured; but in the arsphenamines, we have what is, in effect, a method of chemical quarantine which is as effective in preventing spread from person to person as is the physical isolation of a smallpox patient in a quarantine hospital. Our problem therefore simply resolves itself into a finding of new cases and treating them. It should be pointed out also that the causative agent of syphilis is delicate, lives only on moist surfaces, does not withstand drying. Infections occur singly from person to person by intimate contact. There are no explosive epidemics as occur in typhoid fever through pollution of a water supply. Even with our present sporadic control efforts syphilis is barely holding its own—one case on the average is giving rise to just one new case. If we can cut this infection rate in half the disease will progressively diminish.

Everywhere in science one finds a lag between the acquisition of knowledge and its practical application. This lag has been greater in syphilis than in other diseases. The taboo which until recently surrounded popular discussion has made it difficult for public health authorities in the United States to deal effectively with the problem. The lingering association of syphilis with sin has meant that it did not receive from public health officials the same sympathetic consideration that other and presumably more benign diseases have received.

We know to-day that syphilis is primarily a disease of youth; that more than half of all those whom syphilis strikes, it strikes before the age of 25; that more than a fifth are infected with the disease before they reach the age of 20, and that more than 11,000 per year are infected before the age of 15. We know that in addition to those figures for acquired infections, 60,000 babies are born in the United States every year with congenital syphilis; thus, our rate for congenital syphilis alone is twice as high per thousand of our population as Denmark's rate for syphilis of all types.

With these facts known, public opinion demands that health departments assume responsibility for dealing with syphilis. Health officers are glad to

assume it just as for other epidemic diseases. This is not radical; it merely follows the precept laid down by J. Marion Sims in his presidential address before the meeting of the American Medical Association in 1876: ". . . I would simply include syphilis in the great family of contagious or communicable diseases and make it subject to the same laws and regulations that we already possess for their management. . . ." We can prove to-day the case Sims stated on insight. We know more than Sims knew. We can face the problem of syphilis control with the same scientific objectiveness that we can face these problems of the laboratory and clinic and field investigation which I have spoken of heretofore. Syphilis has been controlled.

Sweden in 1919 was faced with the same epidemic problem of syphilis that the United States is faced with to-day. It inaugurated an effective control program which has reduced its rate to less than one twelfth of its rate in those years.

I have alluded to Denmark. If our syphilis rate was the same as that of Denmark, we would have only 26,000 cases of syphilis each year instead of 518,000 which report to doctors and the untold number which experiment on themselves with drug store compounds and the ministrations of quacks.

England has developed a system of public clinics which in a like period have reduced its syphilis rate to a fraction of what it was a decade and a half ago.

Some American states, notably Massachusetts, New York, Michigan and Wisconsin, have made a good start. It is hard for me to give you accurate trend figures on experience under American control programs. Our machinery for counting syphilis is too inadequate. The taboo which kept us from facing syphilis also kept syphilis from being accurately reported by physicians and clinics. It made doctors reluctant to suspect it and rather eager to find other plausible explanations for tenacious symptoms. Our knowledge of the extent of syphilis is gained from our intensive surveys conducted in carefully selected samples of the population. Send a corps of trained investigators into a community, as we did from 1927 to 1934. Visit in a single day every physician, every clinic, every hospital. Find out how many cases are under treatment, how many have been under treatment during the previous twelve months. You would find the real rate for syphilis going to doctors to be anywhere from two to twenty times the officially reported rates. You would find, too, how briefly these cases stay under treatment.

Before the Social Security Act was passed two years ago, it was apparent that a plan for public health would be an integral part. One does not assume risks for disability and unemployment without at the same time assuming responsibility for reducing preventable disability and unemployment. Syphilis is the preventable disease which probably takes the largest toll from our people and it must be controlled.

The Public Health Service two years ago appointed a specific advisory committee of noted local and state health officials and syphilologists to draft a program for venereal disease control which would synthesize the best features of work done here and abroad. The committee drafted recommendations for state and local venereal disease control which were essentially a summary of proven practice. They are as scientifically certain of success in the hands of capable administrators as were the diagnostic and pathological procedures in the hands of capable technicians and physicians. That committee recommended as a blueprint for a national plan:

1. There should be a trained public health staff to deal with syphilis in each state and city.
2. Minimum state laws should require reporting of cases, follow-up of delinquents, and the finding of sources of infection and contacts.
3. Premarital medical certificates, including serodiagnostic tests, should be a legal requirement.
4. Diagnostic services should be freely available to every physician without charge and should meet minimum state standards of performance.
5. Treatment facilities should be of good quality, with convenient hours and location. Wherever possible the clinic service should be a part of an existing hospital dispensary. Hospital beds should be provided for patients needing bed care.
6. The state should distribute antisyphilitic drugs to physicians for the treatment of all patients.
7. Routine serodiagnostic tests need to be used much more widely. In particular, every pregnancy, every hospital admission, every complete physical examination should include this test.
8. The informative program in modern diagnosis, treatment and control should be prosecuted vigorously, among physicians and health officers, especially through the use of trained consultants.
9. The public educational program must be persistent, intensive, and aimed especially at those individuals in the age groups in which syphilis is most frequently acquired.

Public health administration of syphilis control is thus geared to research, just as is dosage, drug and course of treatment.

These are the data upon which the current public health campaign against syphilis rests. It is clear from the record that the service has a long-time interest in scientific and practical aspects of syphilis control. It illustrates the function of the Public Health Service in dealing with all major problems of health and disease. We seek to expand the scientific knowledge upon which effective disease control must rest. We seek also

to apply to the welfare of the mass the ways and means of life-saving which have been worked out with endless patients in the research laboratory, at the bedside of the patient or in public health administration. The problems we attack must be important, that is, they must affect many people and affect them seriously. Our problems must be practical. We must not press ahead to mass application of a principle until it is proven applicable by the most rigid scientific criteria. Our whole public health program may be stated very simply. It consists of research in the laboratory, at the bedside and in the field to forge better weapons against disease. It consists of alertness along the whole front of preventive medicine to make sure that ground gained is held and gains consolidated, and a concerted attack upon the sectors where the greatest saving of human life can be made. It stems from professional colleagueship with physicians, technicians, and social scientists, unity of objective and common understanding.

Further inquiry into the sociology of our syphilis problem emphasizes its urgency as a public health problem. In the first place, so many people have it and when their disease is untreated or improperly treated, its results are so dangerous to them and so costly to the community. In the second place, it is contagious. In its untreated early stages, every person who has it is dangerous to those with whom he associates, and finally, syphilis tops the list of public health problems because we know how to be rid of it, yet are not.

Any approach to syphilis control must take into account these facts about syphilitics:

Every year 518,000 new cases appear for treatment; probably that many again experiment dangerously upon themselves with drug store nostrums or the ministrations of quacks.

Every year 598,000 advanced cases of syphilis which have never before had medical treatment report for first treatment. No serious communicable disease approaches these totals except gonorrhea.

Sixty to eighty per cent. of the patients who appear at five of the largest syphilis clinics with cardiovascular syphilis, the deadliest form of "heart disease," or neurosyphilis, have been untreated prior to the detection of these late manifestations. Half the patients with latent syphilis have had no previous knowledge of their malady.

Only one patient in five actually under treatment for early syphilis receives the minimum treatment necessary to render him non-infectious. A still fewer number receive the treatment necessary to attain a cure.

If the infected individuals actually seeking treatment remained or were kept under treatment until they had been rendered non-infectious or protected against the late manifestations of the disease, present treatment facilities would care for only 30 per cent. of the present syphilis load.

Only 20 per cent. of the physicians' syphilis patients have an income, $3,000 or more, sufficient to pay for treatment at average private rates. Twenty-eight per cent. have an income of $1,500 or less. Mind you, these figures do not include clinic patients, only private patients. This low income distribution would appear in larger proportion if we were here reviewing the syphilitic population as a whole and did not limit the analysis to those patients who already go to private physicians for treatment.

These facts which show how wide-spread the disease is, how inadequate are our facilities for treatment, our actual failure to give adequate treatment to those patients who do come for treatment and the low financial status of a larger proportion of our syphilis population are facts which must be taken into account in any objective approach to syphilis control.

These facts which we have discovered about syphilis and our population suggest considerable expenditures of public funds. It is to be pointed out in the first place that no control programs have been developed for the control of syphilis which have attained any success without such expenditures. We set up this control program, or you continue to have syphilis. If we are to control syphilis we must use those golden sinews which seem to be fundamental to any successful enterprise, public or private.

But I think we might pause to point out that money put into syphilis control may be properly classed under the heading of investment rather than expenditure. For America is spending some of its biggest medical bills to-day for the syphilis which it did not control in the years between 1910 and 1925.

Ten per cent. of our annual crop of the insane, we have said, owe their insanity to syphilis. The Bureau of the Census reported in 1933 18,700 cases of general paralysis of the insane—all due to syphilis—in our state institutions for the treatment of mental diseases. These are not all, for there are 43,000 beds for syphilitic mental and nervous patients in American hospitals, public and private. If all these are cared for at the $2.00 per day rate, which is the average for state institutions, we will show a cost of more than $31,400,000 every year for those cases of syphilis which develop nervous system complications.

Fifteen per cent. of our blindness is due to syphilis. The cost of pensions and institutional care for the blind in public institutions is conservatively estimated at more than $10,000,000 a year. There we have more than $41,000,000 for insanity and blindness.

That $41,000,000 does not include the maintenance

of the wives and children of these sufferers on relief. It does not include the cost of home care for thousands of other patients who are not in institutions. It does not include the cost of care for 160,000 patients who have cardiovascular syphilis or for the care of the wives and families of the 40,000 of them who die every year.

Some of the 60,000 babies who are born every year with congenital syphilis will die, but many of the others will grow up to be public charges.

Studies recently completed by the Public Health Service show that the loss of life expectancy for a syphilitic white male between the ages of 30 and 50 years as against the life expectancy for the general population varies from 19.5 to 16.7 per cent. And yet we all know that life insurance companies still do not include the Wassermann test as a part of the routine physical examination for life insurance.

I can not estimate the total financial cost to this country for these latter groups any more than I can estimate in objective terms the real cost of a war or a depression. But I can point out that the first $41,000,000 for institutional care is in itself a much larger figure than any one has yet suggested for the control of syphilis.

On that basis public funds for the control of syphilis become a matter of simple economy. One does not consider a balance sheet solely in terms of amounts expended but in terms of a balance between money spent and expected returns. That kind of economics is well understood by every business man when he deals with his own business.

This is the plan of our attack upon a single battle field. It is, in small, a blueprint for the national health program along a battle front. Few things which I have said about the economic gains from controlling syphilis but apply equally to other diseases—to pneumonia, to tuberculosis, to pellagra, to cancer, to malnutrition. In every field, however far our knowledge may have gone, we have that same basic problem of research. We must perfect our instruments. In every field there are techniques developed for applying that knowledge in public health administration or the means to so apply it can be perfected. This is the union of science and engineering. We are faced with the same social facts; the same shortage of hospital and other physical facilities for good health; the same lack of laboratory facilities; the same gap between individual income and the necessary minimum of medical care. It whatever field we enter we are reminded that bad health is waste. Just as it is good economics to fight syphilis, it is good economics to fight disease wherever we find it and to improve the efficiency of human beings, the greatest of our national resources.

THE SOCIAL SCIENCES AND ENGINEERING EDUCATION[1]

By Dr. WILLIAM E. WICKENDEN
PRESIDENT OF THE CASE SCHOOL OF APPLIED SCIENCE

AN engineer is a man who spends his life in solving problems. These problems assume an infinite variety of form and detail, but always end in two questions —"Will it work?" and "Will it pay?" The scale of the solution or judgment demanded in an engineering problem is never universal and seldom widely embracing. What the man in the head office wants to know is not "Will it always work?" or "Will everybody profit?" but rather "Will it work within stated limits or under particular circumstances?" and "Will it pay the investor within a given time?" For results beyond fixed limits the engineer is not held to account, but within them he is expected to be virtually right every time. Speculative inquiry and the formulation of broad judgments from loose masses of data, he willingly leaves to others, contenting himself with limited knowledge of assured character. The business world expects an engineer to know certain elemental things about the law of contracts, but when he gets into an involved situation he is expected to consult legal counsel. In much the same way, the engineer is expected as a matter of course to know certain fundamental facts and principles of economics, government, sociology and psychology, but a wise instinct prompts him to defer to expert knowledge and judgment where involved issues are concerned.

In this introductory statement, I have attempted to reduce the engineer's hard-headed philosophy to thumb-nail dimensions. Admittedly, it is not a satisfactory philosophy. It may satisfy the individual engineer in his day-to-day work, but it does not satisfy a profession increasingly proud of its achievements and aware of their revolutionary social results. Engineers do not like to think that the world has been transformed in the last century and a half merely as a by-product of their success in solving a long series of specific problems; that civilization has become what

[1] Address of the retiring vice-president and chairman of the Section on Engineering, American Association for the Advancement of Science, Indianapolis, December 29, 1937.