# The Public Health Laboratory

## —Yesterday, Today, and Tomorrow—

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THE SUBJECT upon which I have been asked to speak is timely for me since this is the 50th anniversary of the opening of Florida's public health laboratory. At such a time one is stimulated to look to the past, is at liberty to critically examine the present, and may be at ease in suggesting desirable or possible trends for the future. The history, present activities, and outlook of the various State public health laboratories, though differing in some aspects, still have many features in common. Due to my familiarity with it, Florida's experience will be used as illustrative of the past and present and as a point of departure in considering the future.

The nature of the work of Florida's public health laboratory as it has developed in the past five decades is shown in broad outline in table 1. The rapidity of growth is striking. From 996 specimens in 1903, there was an increase to 15,949 in 1910. The requests for service quadrupled in the next decade, trebled in the twenties and in the thirties, and doubled in the forties. At first the laboratory must have been used almost exclusively to aid in the diagnosis of clinical cases, since prior to 1910 from one-quarter to more than one-half of the specimens were positive in the test requested. At present there is an active concern with the detection of carriers and with case finding, and many specimens sent in for examination come from healthy individuals. Even with exacting techniques the current proportion of positive findings is low. Having grown in an era of development and change, the public health laboratory manifests these characteristics of the age.

*Dr. Hardy has been the director of laboratories, Florida State Board of Health, since 1946.* *His review of public health laboratory services was presented to the laboratory section of the Southern Branch of the American Public Health Association at its annual meeting in Atlanta, April 23, 1953. It was one of a series of papers arranged by the chairmen of the respective sections, each dealing with one phase of the general subject "Public Health, Yesterday, Today, and Tomorrow."*

### The Change in Emphasis

The laboratory experience with malaria, diphtheria, and typhoid in Florida is shown first in table 1 by the number of specimens examined and then is further related to available morbidity and mortality data in table 2.

At the beginning of the twenties, when there were 1,865 reported malaria cases and 352 deaths due to malaria, there were 6,537 examinations for this disease in the Florida State public health laboratories. This was an average of 4 examinations per reported case and 19 per reported death. Malaria declined in the years following, but the number of laboratory examinations increased, reaching its peak in the early forties. In the latter half of the past decade, the incidence of malaria fell rapidly while the number of requests for laboratory tests for the disease decreased slowly. In 1950, there were 351 laboratory examinations per reported case of malaria and 614 per reported death. It was then necessary to call to the attention of physicians the rarity of positive findings for malaria and to urge a

**Table 1. Number of specimens submitted for examination to the laboratories of the Florida State Board of Health, and percentage found positive, by year**

| Examination | 1910 | | 1921 [1] | | 1930 | | 1940 | | 1950 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number | Percent positive | Number | Percent positive | Number | Percent positive | Number | Percent positive | Number | Percent positive |
| Malaria | 2, 379 | 26. 3 | 6, 537 | 3. 9 | 11, 614 | 6. 3 | 20, 758 | 2. 1 | 2, 456 | 0. 2 |
| Diphtheria | 716 | 27. 4 | 13, 688 | 13. 1 | 14, 916 | 4. 9 | 19, 570 | 2. 3 | 4, 439 | 2. 3 |
| Typhoid [2] | 1, 958 | 27. 7 | 4, 679 | 10. 8 | 7, 226 | 2. 1 | 10, 318 | 2. 5 | 10, 036 | . 7 |
| Tuberculosis | 1, 515 | 25. 4 | 3, 880 | 17. 7 | 4, 239 | 14. 9 | 11, 658 | 11. 3 | 31, 038 | 13. 3 |
| Syphilis [3] | 0 | | 17, 459 | 34. 2 | 64, 377 | 16. 8 | 346, 638 | 17. 8 | 627, 092 | 16. 3 |
| Gonorrhea [4] | 605 | 42. 2 | 3, 180 | 31. 2 | 9, 363 | 21. 4 | 35, 087 | 12. 8 | 52, 836 | 12. 2 |
| Hookworm | 7, 408 | 56. 0 | 8, 956 | 38. 4 | 38, 342 | 28. 0 | 97, 936 | 28. 8 | 130, 447 | 18. 6 |
| Rabies | 53 | 54. 7 | 218 | 45. 0 | 233 | 29. 6 | 303 | 22. 1 | 513 | 14. 2 |
| Culture diagnosis: | | | | | | | | | | |
| Enteric | 0 | | 0 | | 0 | | 3, 016 | [5] 3. 0 | 30, 810 | [5] . 2 |
| Gonorrhea | 0 | | 0 | | 0 | | 79 | 22. 8 | 31, 062 | 5. 3 |
| Miscellaneous | 0 | | 0 | | 0 | | 0 | | [6] 5, 378 | |
| Veterinary public health | 0 | | 0 | | 0 | | 0 | | 767 | |
| Water | 51 | | 2, 296 | | 6, 200 | | 10, 003 | | 47, 554 | |
| Milk | 80 | | 133 | | ([7]) | | 6, 027 | | 19, 704 | |
| Chemistry | 0 | | 0 | | 0 | | 84 | | 68, 391 | |
| Research | 0 | | 0 | | 0 | | 0 | | 8, 489 | |
| Other | [8] 1, 184 | | 5, 778 | | 20, 069 | | 0 | | [9] 14, 708 | |
| Totals | 15, 949 | | 66, 804 | | 176, 579 | | [10] 561, 447 | | 1, 085, 720 | |
| State population | 753,000 | | 993,000 | | 1, 480, 000 | | 1, 915, 000 | | 2, 797, 000 | |

[1] Data for 1920 not available. [2] Widal. [3] Serology. [4] Smears. [5] Positive for *Salmonella typhosa*. [6] New activity. [7] Data not available. [8] Predominantly clinical laboratory examinations. [9] Rh tests entirely. [10] In part an estimate based on the number of examinations reported.

discontinuation of a relatively routine submission of specimens for malaria examination in undiagnosed febrile illnesses.

When malaria was common, an erroneous positive finding would have had minor public health and little clinical significance. Now, one of our problems in malaria is the occasional apparently unfounded positive report offered by clinical laboratories. In earlier years, it was acceptable for competent technicians in the clinical or public health laboratory to examine malaria slides. Now, accuracy of the highest degree must be attained, and this requires the participation of qualified parasitologists.

There has been a similar experience with diphtheria. The laboratory activity in this disease increased from 4 examinations per case and 55 per death in 1910 to a peak of 88 examinations per case and 725 per death in 1940. Thereafter the requests for examination fell more rapidly than the incidence of the disease. The individual test is better at present so fewer examinations may be adequate, but perhaps there is undue complacency and insufficient activity. The volume of work in typhoid increased even more markedly (tables 1 and 2). Thus the trend in laboratory examinations in these three communicable diseases has been an increasing number of specimens with a decreasing proportion of positive findings. As the incidence of the infections fell to low levels there was a slow decline in examinations requested, a large number of examinations per reported case or death, and a much lower proportion of positive findings, but each laboratory test and particularly each positive finding now has increasing significance, and reliability of the highest order is required.

### Better Diagnostic Tests

By comparison, consider Florida's present position in examinations for tuberculosis and

syphilis (table 1). The laboratory is still in the phase of trying to provide adequate diagnostic and case-finding services. The percentage of positive findings remains high.

The objective in tuberculosis is to detect the infection prior to the onset of clinical symptoms. The mass X-ray surveys and routine radiological examinations of all patients admitted to some hospitals point to individuals warranting study, but it is the responsibility of the laboratory to ascertain whether the suspicious radiological shadow is caused by *Mycobacterium tuberculosis*. Much more sensitive bacteriological tests than those available in the past or at present are needed, and the best available present procedures must be applied by highly qualified workers. Laboratory work in tuberculosis is at its beginning, not nearing its end.

In syphilis, the laboratory has even broader responsibilities since it must provide both the screening and the diagnostic tests. Considering their nonspecific nature, the standard serologic procedures have proved surprisingly effective. These simple examinations undoubtedly still need to be used freely in Florida. Standard serologic tests for syphilis are satisfactory as screening tests, but they have serious limitations as diagnostic laboratory examinations. A more highly specific test is needed. The *Treponema pallidum* immobilization test probably represents an early step to this end. If an obvious need is to be met, State laboratories in the future must make available both a simple screening test and a more highly specific diagnostic test for syphilis. The latter will be more costly, will increase the volume of work, and will require unusually competent professional workers, but it is one of the many challenging tasks ahead.

There is no basis for pride in the record of attainments in the laboratory diagnosis of gonorrhea. Treatment for gonorrhea is simple at present. The laboratory procedures, however, are difficult and their reliability is uncertain. For these reasons there has been a tendency to omit diagnostic laboratory tests, and serious consequences are evident. Nonspecific urethritis is being diagnosed in epidemic proportions, but such a diagnosis signifies only that the case was not proved to be a neisserian infection. Here is a bacteriological problem. Gonorrhea and similar conditions appear to need more, not less, attention.

There will be no disagreement in public health history as to the past prevalence and significance of parasitic infections in the Southern States. Hookworm disease in the early part of the 20th century was a serious cause of morbidity. Many parasitological examinations have been done in the past and in Florida this work continues to increase. There will be differences of opinion as to the present importance of this activity. Optimum health, not the mere absence of obvious illness, is the objective of public health and obstacles to the attainment of this goal must be removed. The individual has a right to be free of parasites. This may be attained by sanitation, a slow but a permanent solution. The rapid and still needed approach is through laboratory diagnosis and treatment. There is unfinished business here.

**Table 2. Number of reported cases and deaths from malaria, diphtheria, and typhoid in Florida, and number of laboratory examinations per reported case and death, by year**

| Year | Reported cases | | | Examinations per case | | | Reported deaths | | | Examinations per death | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Malaria | Diphtheria | Typhoid [1] | Malaria | Diphtheria | Typhoid [1] | Malaria | Diphtheria | Typhoid [1] | Malaria | Diphtheria | Typhoid [1] |
| 1910 | (2) | 182 | (2) | (2) | 4 | (2) | (2) | 13 | (2) | (2) | 55 | (2) |
| 1920–21 [3] | 1,865 | 576 | 525 | 4 | 24 | 9 | 352 | 78 | 140 | 19 | 175 | 33 |
| 1930 | 576 | 491 | 141 | 20 | 30 | 51 | 332 | 79 | 72 | 35 | 188 | 100 |
| 1940 | 140 | 223 | 109 | 148 | 88 | 95 | 102 | 27 | 23 | 203 | 725 | 449 |
| 1950 | 7 | 97 | 30 | 351 | 46 | 334 | 4 | 8 | 1 | 614 | 555 | 10,036 |

[1] Widal. [2] No data on reported cases and deaths. [3] Cases and deaths for 1920; laboratory examinations for 1921.

### Culture Diagnosis

Except in diphtheria the relative newness of bacteriological culture diagnosis, as is evident in table 1, is surprising. Enteric and gonorrhea cultures have been used chiefly in the past decade; those for tuberculosis, in the past half decade. Miscellaneous bacteriological service is a recent and relatively undeveloped addition to public health laboratory work in this area. To illustrate opportunities, for example, otitis externa is a widely prevalent and troublesome disorder common in summer months in the South. Physicians commonly call this entity "otomycosis" but recent studies have indicated that this is a bacterial rather than a mycotic infection. The modes of treatment are being radically changed as a result of bacteriological studies. Rightly or wrongly, swimming and the quality of water in pools and at our beaches are under suspicion. Here is but one of many neglected bacteriological diagnostic fields which warrant attention.

With the growth of veterinary public health has come the need to provide laboratory service for our public health veterinarians. The development of this work in Florida in the past 3 years has proved most interesting. The bacteriological diagnostic work in anthrax was new to us. Leptospirosis in cattle and dogs has come to the fore. There have been tests for a wide variety of poultry infections. Bacteriological studies of edible meats and in abattoirs have been revealing. Lacking a veterinary diagnostic laboratory in Florida, the veterinarians have looked to us. It proved practicable for a public health laboratory to provide diagnostic service in animal as well as in human infectious diseases. Wherever there is no animal diagnostic laboratory, interdepartmental cooperation, rather than separate and independent laboratories, would be economic and advantageous.

No progress in providing aid in the diagnosis of virus infections, other than rabies can be reported from Florida's public health laboratories. These new and newly recognized entities are of increasing importance. It appears probable that within one to two decades it will be standard practice in public health laboratories to use tissue cultures and embryonated eggs as well as serologic procedures and animal tests for rather routine diagnostic studies of virus diseases. State laboratories need to begin to provide opportunities for some of their workers to obtain training in the exacting field of virology.

Public health laboratories were developed as a result of the urgent pressure for the control of communicable diseases. There has been gratifying progress in this field and the laboratory has played an essential role. The goal of the virtual elimination of communicable diseases is beginning to be attained. In those infections in which there has been most progress in control, increasingly dependable laboratory diagnostic tests are required to identify accurately the residual infections. In such major diseases as tuberculosis and syphilis, there is much work ahead in satisfying the diagnostic laboratory needs; in others, notably the virus diseases, scarcely a beginning has been made. In communicable diseases, well acknowledged to be a responsibility of public health laboratories, there are still unmet needs and new opportunities.

In the above activities the laboratory is providing service to physicians, health officers, and epidemiologists. There is work also requested by sanitary engineers and sanitarians. There has been a recent marked increase in the examinations of water and milk in Florida. As local health departments have been organized in the State the quality of the water and milk available to the public has been checked more adequately. There are still localities in the State, and undoubtedly in every State, which do not receive this elementary public health protection. This work must continue and will undoubtedly expand.

### New Responsibilities

The fluoridation of water has added a new responsibility. Periodic checks will be required at the water plants. It is the proper function of the public health laboratory to serve as a control laboratory; highly dependable findings on specimens submitted periodically will be required.

The chemical services appropriate for a public health laboratory are only beginning to

develop in Florida. At present this work includes: some diagnostic tests such as tests for protein in spinal fluid, hemoglobin tests which are given to the prenatal cases attending public health clinics, and check tests for the diabetes screening program. The service also includes the detailed chemical analysis of water and other miscellaneous chemical tests. But the toxicological problems are the ones of most interest and of highest importance, and their solution is a service needed by the law enforcement agencies of the States and their counties. Unless otherwise covered, this important field is open to public health laboratories.

The environment of the industrial worker properly receives special attention. Commonly, but in my opinion unfortunately, the industrial hygiene laboratory functions apart from the general public health laboratory. Concerned for so long with communicable diseases, the general public health laboratory was not well prepared for the responsibility of providing laboratory service to industrial hygiene units in health departments when that work was initiated. Eventually this work should be incorporated with the broadened activities of the public health laboratory. Such an arrangement will be economical, and with carefully selected personnel and desirable cooperative relationships it will be a more efficient organization of public health services than the widely prevailing present arrangement.

In the future it is probable that substantial attention will be given to air sanitation. Control of environmental pollution caused by radioactive substances may be required in many localities rather than in a few. The extent of laboratory participation in such activities cannot be estimated at this time.

In the past and largely at present, the public health laboratory has been and is a diagnostic laboratory performing simple tests in large numbers. In general, it has been given the type and number of personnel adequate only for this work. No laboratory can grow satisfactorily under these conditions. If laboratory personnel are to develop, and if laboratories are to retain able workers, satisfying opportunities for special studies must be provided. Moreover, there are numerous investigations which can be conducted only through public health facilities. An urgent need for the public health laboratory is to attain a satisfactory balance between diagnostic services and special studies, a development which is still at a very early stage.

What of tomorrow's work in the chronic diseases? It is reasonable to expect that case-finding programs will eventually be accepted as a proper field of public health activity. Useful tests to indicate the probable occurrence of early malignancy or to detect chemical aberrations leading to arteriosclerosis could drastically modify the extent and character of laboratory work. When the Florida laboratory was organized, there was no serologic test for syphilis but now the performance of these examinations is a major activity. The early detection of predisposing causes or the early signs of chronic disease conceivably may be the major activity of the public health laboratory 50 years from now.

### Educational Opportunities

In considering programs of the future, careful attention needs to be given to educational opportunities and responsibilities. It is well to examine programs of this type which have established their value in our sister bureaus. Seminars and short courses are an accepted part of the maternal and child health and venereal disease programs. More recently, educational programs of this type have proved notably effective in cancer, diabetes, and heart disease activities. They are designed solely to help the practitioner serve his patients better. Likewise, in the laboratory field, there are rich opportunities to aid clinical laboratory workers to provide more dependable and uniform results to the physicians they serve.

This will bring the public health laboratory into intimate contact with the medical technologists. Laboratory workers in the medical field need to develop as a professional body. There should be strong State and local organizations drawing together all those in this field who serve in hospitals, clinics, physicians' offices, private laboratories, public health laboratories, or elsewhere. In any such organization the bacteriologists, serologists, parasitologists and clinical chemists should join with the general

medical technologists. The public health laboratory is in a position to give leadership. Every influence must be used to assure that the strength of an organization of medical laboratory workers rests on its high educational value. In the future we can aid in bringing to maturity an allied professional body of high importance in the medical field. When this is attained, it will be natural to work with, or as a part of, this organized professional body and its allied State and local groups to improve the quality of laboratory practice—an activity which eventually should receive the endorsement and commendation of pathologists, medical practitioners, and the public they serve.

It has proved advantageous in Florida to work closely with laboratory personnel in the dairy industry. An annual refresher course giving detailed attention to selected problems, with opportunities for laboratory practice, has been received favorably. Representatives of the State Department of Agriculture, the dairy science division of the University of Florida, and the State Board of Health cooperated in planning the course which has served to draw together technologists from the dairy industry and the public health "control" laboratories. The initiative and leadership in this activity came from the State public health laboratory.

Educationally, there is a continuing need to participate in discussions at meetings of physicians, nurses, sanitarians, and others who use public health laboratory services.

## Personnel Practices

The development of laboratory programs and planning for laboratory personnel must go hand in hand. There have been gratifying advances in personnel practices in public health. Retirement plans offer inducements for long-term career service. Salaries have been raised to a more adequate and equitable basis. These are some of the favorable features, but there are also weaknesses and problems.

Under any plan providing for slow advancement in long-term careers, there is always the possibility of losing the better workers, and, through personnel seniority policies, the possibility of having the less ambitious, the less imaginative, and the more easily satisfied persons in senior positions. The only solution to this potential problem is its prevention. There must be greater flexibility to permit the rewarding of exceptional persons; there must be even greater care in personnel selection, and especially in promotion to positions of senior responsibility.

Stagnation is a real hazard of career service and a particular risk to those in repetitive routine activity such as in the laboratory where large numbers of the same tests are performed day after day. There are safety devices here. Academic advancement is to be encouraged. We have been highly pleased with a cooperative relationship between the Florida State public health laboratory and the University of Florida, which permits promising junior workers to accumulate academic credits while employed and, equally important, which requires senior workers to teach. The limited investigations required for the master's degree thesis has stimulated keen interest in these activities. Workers advancing academically who are given opportunities and encouragement in research will not stagnate.

Laboratory work today is teamwork, not individual activity. This accentuates the importance of the problem of personnel management. The reliability of laboratory findings varies with the worker's emotions as well as his ability. Directors or departmental chiefs are managers of laboratory teams and need a sympathetic understanding of human emotions quite as much as technical skill and scientific knowledge. The laboratories of the future must be recognized above all as groups of human beings working together. Facilities, equipment, and reagents are required, but harmonious teamwork, just as much as material tools, determines the dependability of findings.

## Summary

The record of the past has been written. During the first chapter of the history of the public health laboratory, attention was concentrated on the acute communicable diseases. Tests at first were employed largely for confirmation of diagnosis; later they were used in increasing numbers for case finding and the detection of carriers. More exacting tests by more expert personnel became essential for the

accurate identification of residual infections.

Major emphasis is directed to the chronic infections during the second and present chapter of the history. The need for simple procedures for case finding and for more highly sensitive and specific tests for diagnosis has become evident.

For the future, there are numerous unexplored problems in viral and other infectious diseases. Ahead, there is a call for continuing and increasing work in sanitary bacteriology, a broad development in public health chemistry, closer integration of all laboratory services provided at public expense, new and expanding work in chronic diseases, and an educational program designed to aid in improving the quality of medical laboratory service wherever it is performed. Special studies and active research programs will be required to encourage the development of laboratory personnel and to elevate the stature of the public health laboratory.

Looking to the future, we must obtain adequate facilities; acquire, train, and retain highly competent professional laboratory workers and aid each in attaining a highly satisfying and productive professional experience. Opportunities and needs of the future equal or exceed those of the past.

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## Amyotrophic Lateral Sclerosis

A major study of amyotrophic lateral sclerosis is under way on Guam where the disease is highly prevalent. The contributions of heredity and environment to the development of the disease will be investigated on the island which has a population that is relatively fixed. The National Institute of Neurological Diseases of the Public Health Service, the Bureau of Medicine and Surgery of the Navy, the Department of the Interior, and the Government of Guam are cooperating.

Amyotrophic lateral sclerosis is a degenerative disease of the nervous system which strikes most frequently between the ages of 30 and 55. There is no treatment for it. Its cause is unknown. Frequently assigned to the large class of demyelinating diseases of which multiple sclerosis is the best known, the disorder is pathologically characterized by demyelination of the brain and spinal cord—a breakdown of the fatty covering of nerve fibers. Popular attention was directed to it when Lou Gehrig, a baseball player, became one of its victims.

There seem to be two types: one, a slow progressive type primarily paralyzing the muscles of the hands and arms, and eventually affecting other organs; the other, a more rapidly progressive type, where shoulders, neck, tongue, lips, palate, and pharynx are initially involved and paralyzed. In the latter, the bulbar type, death by asphyxia or from aspiration pneumonia usually occurs within 2 years.

Whether amyotrophic lateral sclerosis is as prevalent on Guam as is believed, whether it is exactly similar to the disorder as it is known elsewhere, and what may be its possible cause or causes are objectives of the study. Neighboring islanders will also be studied to determine if the disease is typical for Guam alone or for other islands in the Marianas as well.