

Laboratory Division: Functions and Objectives
A REPRINT OF PAGES 1-27

April · May · June 1949

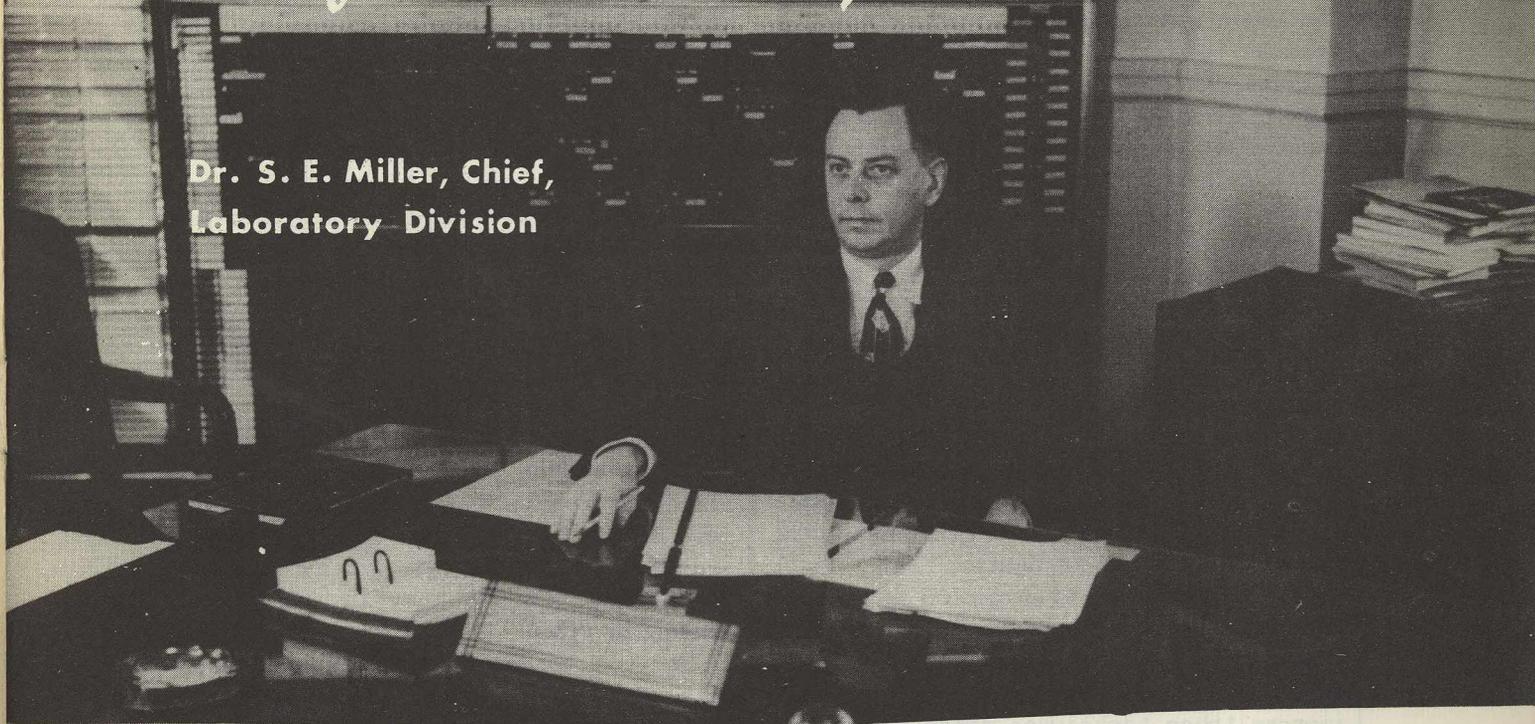
CDC BULLETIN



FEDERAL SECURITY AGENCY
Public Health Service
Communicable Disease Center
Atlanta, Ga.

Over-all Functions and Objectives of the Laboratory Division

**Dr. S. E. Miller, Chief,
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Dr. Reider
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Laboratory Division



Dr. Frobisher
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Branch

In 1944, the Committee on Teaching of the American Society of Tropical Medicine sent an urgent request to the Surgeon General of the Public Health Service asking that something be done to improve laboratory diagnosis in the field of parasitology.

It was decided to start refresher training courses in the laboratory diagnosis of parasitic diseases for persons already employed in diagnostic laboratories, and to establish a national reference diagnostic center to which parasitic disease specimens could be sent for diagnosis.

Accordingly, in 1945 the Parasitology Laboratory was organized and began functioning. At the same time, it was realized that other diagnostic laboratory facilities and services were inadequate in many places throughout the country and that some assistance should be given them.

In 1946, the Virus and Rickettsial Branch Laboratories were set up in



Dr. Brooke
i/c Parasitology
Branch



Dr. Schaeffer
i/c Virus and
Rickettsial Branch

Montgomery, Ala. In 1947, the Bacteriology Branch Laboratories were set up in Atlanta. In 1948, a modest start was made toward a Pathology Branch which will include sections in pathology, hematology, and biochemistry. It will perhaps be easier to understand the work of this Division if we discuss first the general functions which apply to all branches.

The first function is to assist the Epidemiology Division of the Communicable Disease Center in field and laboratory investigations of emergency epidemic problems when called upon by any State health officer, and to give whatever laboratory assistance is needed to special epidemiological and control operations of the Communicable Disease Center.

The second function is to undertake methodology research to evaluate the sensitivity and specificity of the various diagnostic techniques now available, to improve these techniques where indicated, and to devise new techniques where there is a deficiency. We are not aiming at establishing "Standard U. S. Public Health Service Techniques," but are trying to evaluate the reliability of the various techniques as an aid to laboratory workers throughout the country in formulating and standardizing their own routines.

The third function of the Laboratory Division is to act as a reference diagnostic center, offering laboratory diagnosis on difficult specimens which local laboratories may not be equipped to handle or on which they wish consultation. Some techniques are demanded so infrequently or are so expensive that many individual laboratories cannot maintain them. This is a need which we are endeavoring to fill.

The fourth function is to offer supplementary training for ALREADY EMPLOYED laboratorians by means of short, intensive refresher courses to improve their performance of techniques now in use and to acquaint them with the newer techniques.

The fifth function is to offer consultation services to State and local public

health laboratories which request them. Assistance is offered in solving technical or administrative problems. When necessary, our personnel go directly to the requesting laboratory to give such aid.

When specifically requested, surveys are made of State and local health department laboratories. These surveys consist of exhaustive program and technical reviews, with specific recommendations for improvement of services. It is hoped that we can thus strengthen the programs of the various State public health laboratories and that they in turn will evaluate and strengthen the performance of all other laboratories within their State. In this way we hope to obtain the greatest increase in efficiency of laboratory diagnosis throughout the country in the shortest possible time.

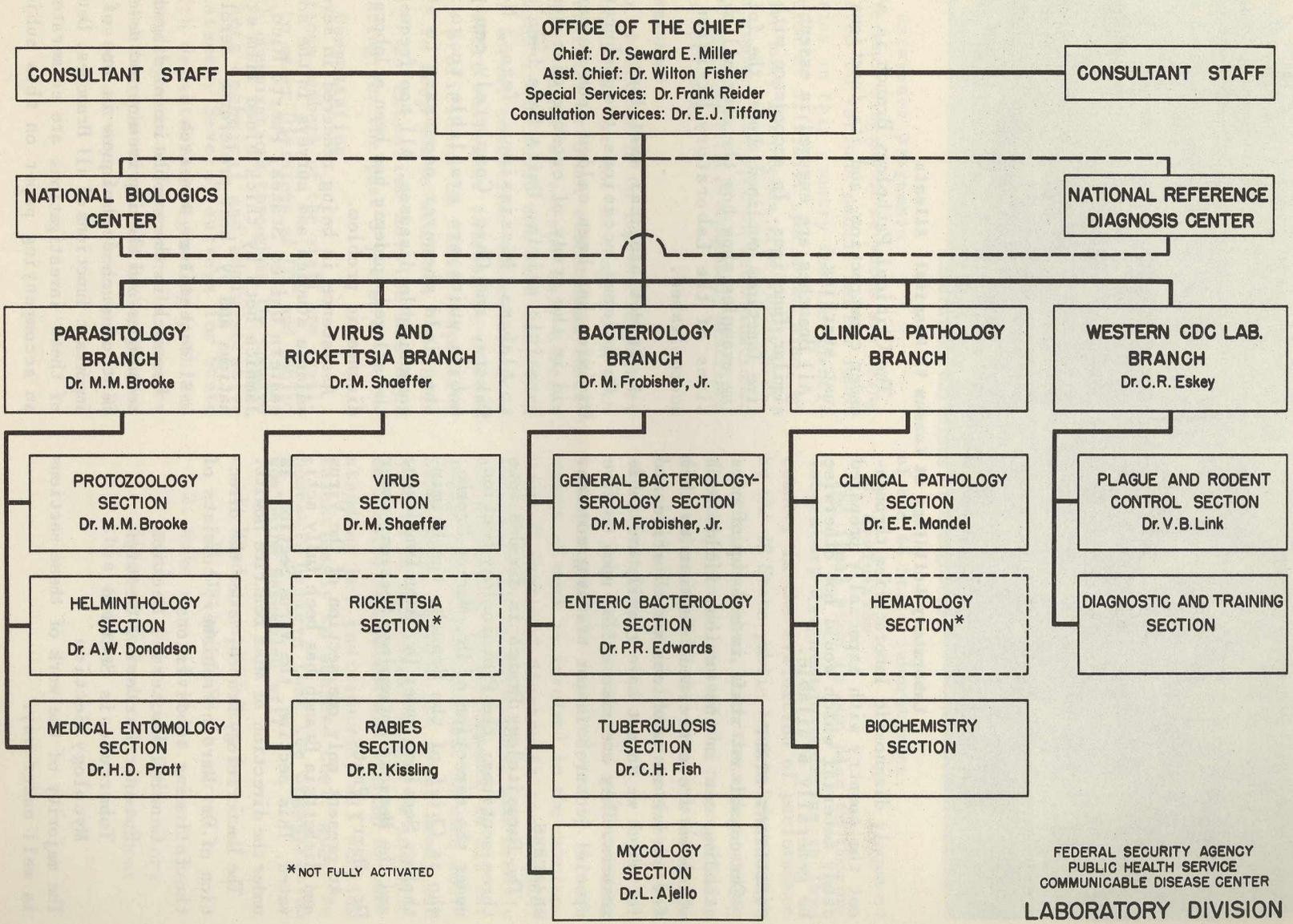
We want to make clear that we have no desire to offer routine services which can, and should be, provided by the already established laboratories and institutions. Our aim is to render whatever additional help is necessary to improve diagnostic services in this country.

The organization we are creating to render these services (see chart) is as follows:

OFFICE OF THE CHIEF

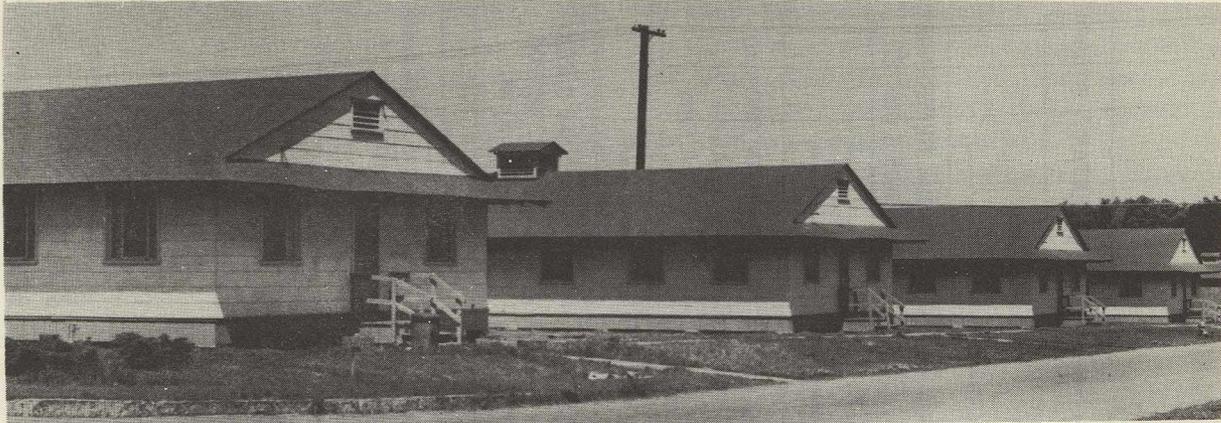
The headquarters office is concerned with planning and setting up the programs and organization of the entire Division. All the administrative details of personnel, budget, and supply are handled by this office. Dr. Wilton Fisher, the Assistant Chief of the Laboratory Division, handles all out internal administrative and operational problems.

Dr. Frank Reider maintains our contacts and relationships with the various State and local health departments. Other important functions of this office are the survey of State and city health department laboratories at their request, recruitment of students for the various training courses offered by the Division and the Extension Service. The Extension Service was developed



* NOT FULLY ACTIVATED

FEDERAL SECURITY AGENCY
PUBLIC HEALTH SERVICE
COMMUNICABLE DISEASE CENTER
LABORATORY DIVISION



Laboratory buildings at Lawson VA Hospital, Atlanta.

to supply diagnostic laboratories throughout the country with especially prepared study material which would not otherwise be generally available.

CONSULTANT STAFF

Our consultant staff is made up of outstanding men in the various fields with which we are concerned. We turn to them for advice on problems which arise and for which we do not have readily available answers. They are also called upon to give special lectures in our training courses.

BRANCHES

The Parasitology Branch is divided into three sections: the Protozoology Section, under the direction of Dr. Marion Brooke, who is Chief of the Branch; the Helminthology Section, under Dr. Alan Donaldson; and the Medical Entomology Section, under Dr. Harry Pratt.

At present only one section of the Virus and Rickettsia Branch has been fully activated. This section, the Virus Section, is under the direction of Miss Beatrice Howitt.

The Bacteriology Branch, under the direction of Dr. Martin Frobisher, consists of the following subdivisions:

- General Bacterial Section
- Enteric Bacterial Section
- Tuberculosis Section
- Mycology Section

The majority of the work of these sections is well under way.

The Clinical Pathology Branch is still under construction, and its functions are just starting.

All Branches are engaged in essentially similar functions. In accordance with the five functions outlined above, the following examples show how the over-all objectives of the Laboratory Division are accomplished.

1. Epidemiological Assistance

On several occasions the Laboratory Division has been called upon to render aid in the study of enteric diseases of parasitic origin. Units have been sent to Alabama, Mississippi, Texas, North Dakota, and Ohio. Completely equipped mobile units are available to go into the field whenever necessary to study communicable diseases. All too frequently the alleged epidemic has been a laboratory diagnostic problem.

Assistance is being rendered in several malaria studies and surveys in the southeastern United States, Puerto Rico, and Jamaica both by thick blood film examinations and by "host preference" serology.

2. Methodology Research

Research in the evaluation of diagnostic techniques and the improvement and development of such techniques is one of the important functions of all Branches. Details of these investigations are enumerated in an accompanying paper on this subject.



Laboratory buildings at Montgomery.

3. Reference Diagnosis

Reference diagnostic services are being rendered to various public health laboratories in this country for the identification of difficult specimens. Also, we receive many arthropods from widely scattered sources for species determinations. An accompanying article adequately describes these services.

4. Training

Our objective is to improve laboratory diagnosis. We are not in competition with universities or other educational institutions, since we accept only already employed individuals who have completed their formal education, and merely give them short refresher courses to improve their proficiency on their respective jobs. To keep these students "on their toes," an extension service has been operating for the past 3 years.

5. Consultation

Various members of the staff are available to other Divisions of CDC and public health organizations throughout the country for both technical and administrative assistance. Several surveys for State health departments regarding problems in the diagnosis of communicable diseases have been completed. In addition, program reviews or surveys have been made in 23

of the 48 State laboratories.

6. Evaluation

The final step in our plan to improve laboratory diagnostic medicine in this country is the evaluation of performance by the 48 State public health laboratories and their branches, with the understanding that they then will assume the responsibility for evaluating all the local clinical and hospital diagnostic laboratories within their States.

This job, of course, is a continuing task that must be repeated yearly. A vast amount of work is involved in the development of improved diagnostic techniques, the training of personnel, and finally the evaluation of performance in all our public health laboratories. No such ambitious plan, despite its great need, can hope to be successful unless it is built on a solid foundation and staffed by outstanding key individuals, all working relentlessly to achieve their goal. We honestly believe that the organization now being assembled will:

1. Render outstanding services to all CDC programs it serves.
2. Make a rapid start toward the goal of improving laboratory diagnostic medicine throughout this country.



**Dr. M. M. Brooke,
i/c Parasitology
Branch**

Methodology Research

Methodology research as engaged in by the Laboratory Division is the first step toward its goal of improving laboratory diagnostic medicine. This methodology research consists of two portions: (1) the evaluation of existing diagnostic procedures, and (2) the development of new techniques when these are needed. Thus the research activities of the Laboratory Division are, for the most part, in the realm of applied research rather than in the field of theoretical or basic research.

A large number of rather varied problems are being investigated by the Bacteriology-Serology, Tuberculosis, Virus, Parasitology, and Entomology Laboratories of the Laboratory Division. A few representative examples will be used to illustrate the scope of methodology research.

One of the research problems of the Bacteriology Laboratories involves several kinds of media used for the isolation of diphtheria bacilli. A comparison of some of the more promising of these media is being carried on by inoculating each throat culture received onto each of several

media under investigation. This investigation will continue for some time, as new diagnostic media are developed by various investigators. The various tellurite plate media containing whole blood vary somewhat, but are, as a group, uniformly much better than the tellurite media containing only serum. Later, it is planned to study these media for initial cultivation directly from the patient's throat in an effort to improve upon the present Loeffler's medium.

Comparative tests are being run by the Serology Laboratories to determine which of several complement fixation techniques will give the optimal sensitivity and specificity. In connection with this study, comparative tests are being performed on commercial complement to determine its status.

The serological diagnosis of brucellosis has inherent limitations, but the technique is widely used and thus is being investigated.

The Tuberculosis Laboratory has undertaken an extensive program of methodology

research concerned with the microscopical diagnosis, cultural diagnosis, animal diagnosis, typing, and virulence testing of tubercle bacilli. These studies are directed toward both the evaluation of existing laboratory procedures and the development of new, more efficient methods. For example: A study to ascertain the efficacy of centrifugalization as a concentration procedure is under way.

A major study has been the comparison of various tuberculosis culture media by inoculation of different media with the same material. The media being tested are modified Lowenstein's, Dubos' (both solid and liquid), Petraganinis', the Trudeau Society's, Sula's, Herrold's egg-yolk agar, and others.

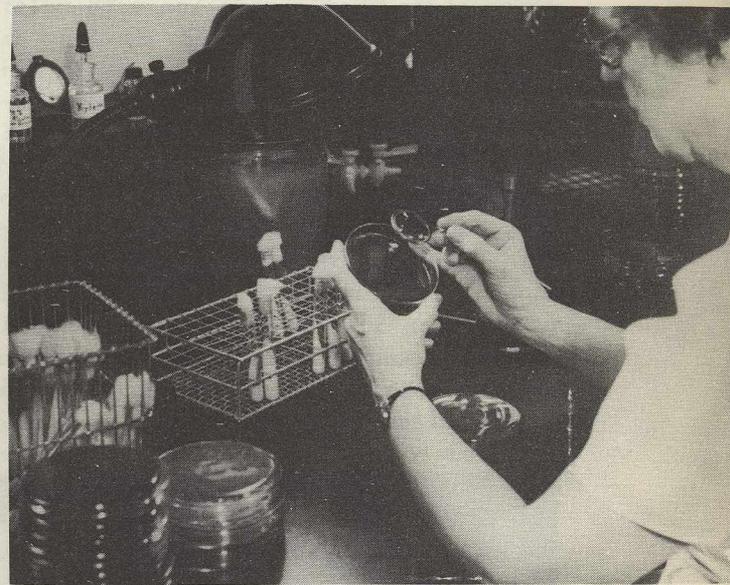
Because of the difficulty of shipping or storing pathological materials over any considerable period of time without having the tubercle bacilli die, studies are being made of various methods of preserving the organisms in a viable state for transportation and storage.

The neurotropic virus diseases are most difficult to diagnose clinically and study epidemiologically. At present, the Virus Laboratory possesses stocks of all the more important viruses. Complement fixation tests for many of the neurotropic virus diseases lack specificity and sensitivity. Studies are being carried on to develop better antigens and to improve the various tests.

It is frequently difficult for physicians to get laboratory assistance in establishing the diagnosis of amebiasis. Shipping the stool to a distant laboratory for diagnosis has been unsatisfactory since the trophozoites are completely disintegrated by the time the specimen is examined. Recently the Parasitological Laboratory has developed a technique that shows promise of markedly improving the diagnosis of this disease. It has been found that by mixing a water-soluble resin, polyvinyl alcohol (PVA), with a fixative, an effective preservative is obtained.

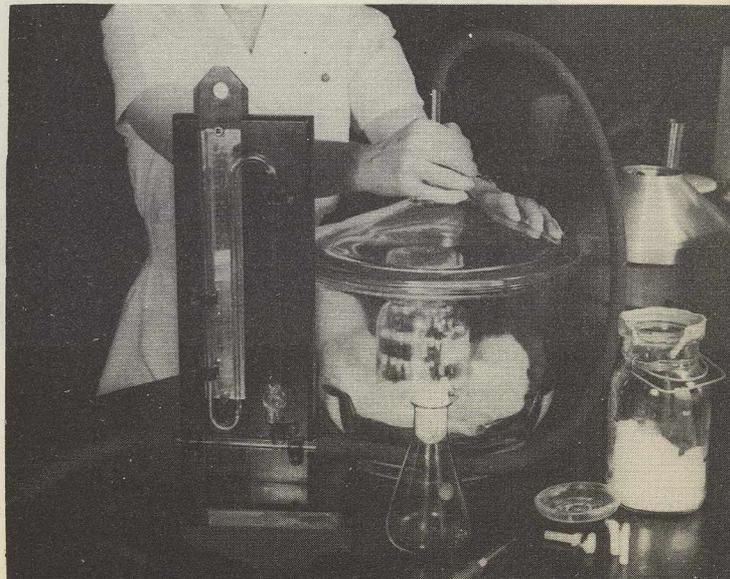


▲ Routine diagnostic serology in virus laboratory.



▲ Checking diphtheria cultures.

▼ Equipment used for dessication of bacterial cultures.



The diagnosis can be made from the preserved specimen immediately or months later. One of the distinct advantages of the PVA-fixative technique is that it makes possible the successful staining of organisms occurring in fluid specimens. To date it has been found that the technique triples the number of positive diagnoses.

The PVA-fixative technique illustrates a phase of methodology research devoted to the development of new techniques where none are available to meet the existing need.

Where large numbers of blood films have to be stained in connection with malaria surveys and other studies, it is a distinct advantage to employ a mass staining procedure. The one formerly used frequently permitted blood to wash off a positive film and to adhere to a normal blood film. If the transferred blood contained malarial parasites, a normal individual might be diagnosed as having malaria. After the discovery of this imperfection it was found that by adding a small quantity of a surface active agent (Triton X-30) all transfer was virtually eliminated.



▲ Staining of fecal smears following preservation by PVA - Fixative technique.



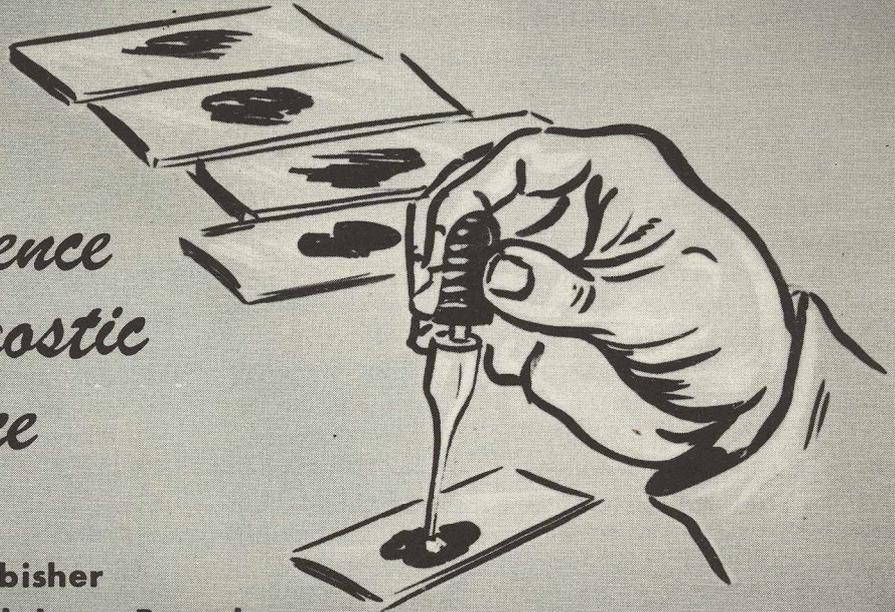
▲ Experimental staining procedures for thick blood film diagnosis of malaria.



◀ Entomologists comparing specimens submitted for identification with museum collection.

Reference Diagnostic Service

Dr. M. Frobisher
i/c Bacteriology Branch



The reference diagnostic service is available to all public health laboratories and all practicing physicians through their health departments with a bona fide diagnostic problem involving a communicable disease or infectious microorganisms. The service deals with rickettsial and viral infections, mycotic diseases, tuberculosis, parasitic infections, diptheriology, the bacterial enteric infections, leptospiroses, and general bacteriology, including any and all infectious diseases for which laboratory facilities are available.

In the process of organizing the growing reference diagnostic services, occasional relocation of laboratories has taken place, and thus it is sometimes not clear to what address various types of diagnostic specimens should be sent. To clarify this matter and to hasten the transmission of each specimen to its proper destination, a complete list has been prepared by the Office of State Services showing: (a) all

diagnostic services currently available in the Communicable Disease Center; (b) the sort of material most likely to yield a positive result; and (c) method for preparing and shipping it, with EXACT ADDRESS for each sort of material. An abbreviated form of the list is reproduced here for convenience of the reader.

THE DIAGNOSTIC SERVICES

Some idea of the nature and scope of the reference diagnostic work may be gained from the following outline of the activities of the various laboratories.

THE VIRUS LABORATORIES

The Virus Laboratory receives from State laboratories, private physicians, and numerous other sources, human blood serum, autopsy specimens, brain material, spinal fluids, feces, nasal washings, etc. Serum neutralization tests have been done against the viruses of Eastern and Western equine encephalomyelitis, St. Louis encephalitis,

**Correct Addresses of Laboratory Division, Communicable Disease Center
to Insure Prompt Delivery of Specimens Submitted for Reference Diagnostic Services.**

(Copy of letter or other information as to service desired should accompany specimen)

SERVICES AVAILABLE	ADDRESS
BACTERIOLOGY	
Identification of unknown organisms other than those referable to laboratory units listed below.	U. S. Public Health Service Communicable Disease Center General Bacteriology Laboratory Chamblee, Georgia
Examination of throat cultures for isolation of <i>C. diphtheriae</i> . Identification and virulence testing of pure cultures suspected of being <i>C. diphtheriae</i> . Typing of cultures of <i>C. diphtheriae</i> .	U. S. Public Health Service Communicable Disease Center Diphtheria Laboratory Chamblee, Georgia
Cultures or stools for isolation and identification of <i>Salmonella</i> and <i>Shigella</i> . Bacteriophage typing of <i>S. typhi</i> and <i>S. paratyphi B</i> . Grouping of other enteric bacteria by biochemical methods, etc.	U. S. Public Health Service Communicable Disease Center Enteric Bacteriology Laboratory Chamblee, Georgia
Acid fast cultures for typing and determination of virulence. Streptomycin sensitivity testing on cultures. Examination of pathological material for tubercle bacilli (problem cases only: not accepted routinely)	U. S. Public Health Service Communicable Disease Center Tuberculosis Laboratory Chamblee, Georgia
SEROLOGY	
Serological tests for leptospirosis, rickettsioses, lymphogranuloma venereum — psittacosis group of viruses, infectious mononucleosis, brucellosis, etc. Host preference serology. Streptococcus typing.	U. S. Public Health Service Communicable Disease Center Immunology-Serology Laboratory Chamblee, Georgia
MYCOLOGY	
Examination of specimens for fungi. Identification of mycological cultures. Examination of tissue sections for pathological changes due to fungi.	U. S. Public Health Service Communicable Disease Center Mycology Laboratory Chamblee, Georgia
PARASITOLOGY	
Identification of intestinal parasites in amebiasis, hookworm infection, ascariasis, echinococcosis, tape worm infection, etc.	U. S. Public Health Service Communicable Disease Center Intestinal Parasites Laboratory 291 Peachtree Street Atlanta, Georgia
Identification of blood parasites in malaria, filariasis, leishmaniasis, trypanosomiasis, etc.	U. S. Public Health Service Communicable Disease Center Blood Parasites Laboratory 291 Peachtree Street Atlanta, Georgia
MEDICAL ENTOMOLOGY	
Identification of arthropods of medical importance, (mites, ticks, lice, bed bugs, fleas, mosquitoes, cockroaches, flies, etc.)	U. S. Public Health Service Communicable Disease Center Medical Entomology Laboratory 291 Peachtree Street Atlanta, Georgia
VIROLOGY	
Serum neutralization tests, agglutination tests, hemagglutination tests and complement fixation tests for viral diseases. *Examination of body fluids, secretions, excretions, tissues and arthropods for virus. Examination of human and animal tissues for pathological changes due to viral diseases.	U. S. Public Health Service Communicable Disease Center Virus Laboratory Box 436, Rt. 3, Federal Drive Montgomery 5, Alabama

*Such examinations are also available at the Division of Infectious Diseases, Microbiological Institute, National Institutes of Health, Bethesda, Maryland.



Inoculation of embryonated
eggs for virus cultivation.

lymphocytic choriomeningitis, herpes, and the Newcastle disease virus of chickens. Complement fixation tests have likewise been done against the three encephalitic viruses, as well as for lymphocytic choriomeningitis and mumps. Fecal specimens and nasal washings have been inoculated into monkeys for isolation of the poliomyelitis virus, using a method developed in this laboratory, which employs a mixture of penicillin and streptomycin for inhibiting bacterial but not viral growth. By this method the percentage of virus isolations has been greatly increased. Human and animal autopsy materials (brain or cord) have been received from various States. Eastern equine encephalomyelitis has most frequently been recovered from such specimens received from Southeastern States.

Diagnostic services for the influenza viruses are designed to detect outbreaks of influenza in the initial stages, and to endeavor to isolate new strains of influenza virus.

Serum neutralization and complement fixation tests have been done on materials collected for various surveys by the Epidemiology Division of the Communicable Disease Center. In this connection, entomological materials (flies, mosquitoes, and other arthropods) have been examined for the presence of viruses. The virus of Eastern equine encephalomyelitis has been recovered on several occasions in such studies.

Occurrences of particular interest in the course of the laboratory studies have been the finding of antibodies for the virus of Newcastle disease of chickens in



the blood of a large number of human cases showing a particular type of neurologic syndrome; and the development of an improved technique for inoculation of bacterially infected fecal material into animals for recovery of the virus of poliomyelitis.

THE SEROLOGY-IMMUNOLOGY LABORATORIES

The work of these laboratories has consisted in large part of complement fixation tests on sera from rats trapped in connection with murine typhus control studies. In addition, complement fixation tests are made on sera from persons with undiagnosed febrile diseases, the antigens including Rocky Mountain spotted fever, Q fever, rickettsialpox, and murine typhus. Weil-Felix tests are also done on these sera.

The Serology Laboratories also carry on active studies on the host preference of mosquitoes of medical importance. The purpose is to determine the kind of animal on which disease-bearing mosquitoes prefer to feed. The antisera used in this work are prepared in our own laboratory.

Other services of this laboratory include

complement fixation tests for the lymphogranuloma-psittacosis group of viruses. These are available upon request. The heterophile antibody test for infectious mononucleosis is also performed. The absorption technique for this test has recently been inaugurated in order to yield results of greater specificity.

In the near future, diagnostic complement fixation tests for amebiasis, histoplasmosis, and coccidioidomycosis, will be available. The agglutination tests for leptospirosis and brucellosis are being rendered.

A reference diagnostic service for the grouping and typing of hemolytic streptococci has been completed.

THE MYCOLOGY LABORATORIES

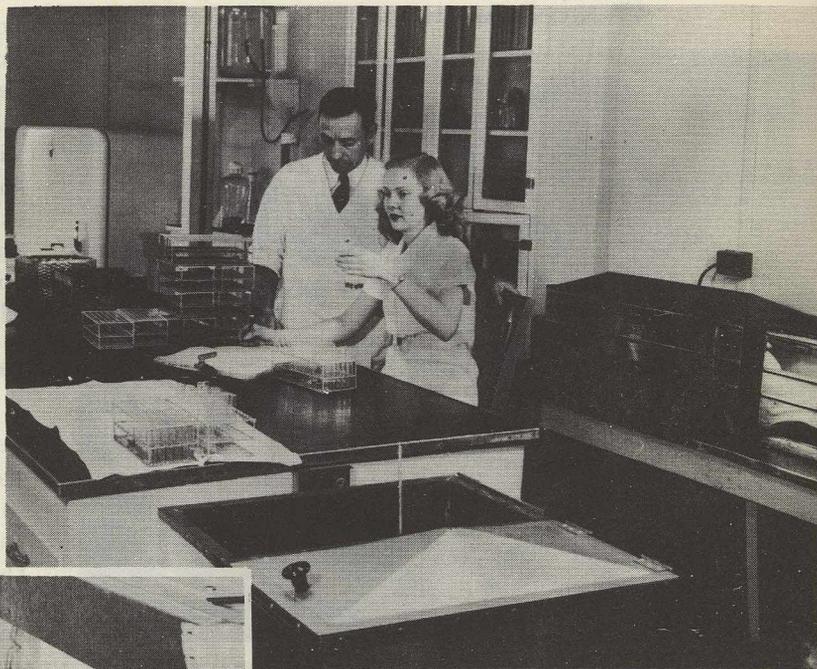
The mycological reference diagnostic service has been widely welcomed because mycological diagnosis is available in only a few laboratories. Three general types of diagnostic services are available; those now carried on are (a) the identification of fungi sent to the laboratory and attempts at isolation of pathogenic fungi from various types of clinical material, such as sputum, spinal fluid, blood, hairs, and nail and skin scrapings; (b) examination of histological slides for pathogenic fungi; (c) skin-testing

antigens for blastomycosis are at present available for distribution and, during the coming year, antigens for histoplasmosis and coccidioidomycosis will be made ready.

THE TUBERCULOSIS LABORATORIES

Reference diagnosis in tuberculosis is carried on at the Communicable Disease Center in collaboration with the Tuberculosis Control Division of the Public Health Service. The laboratory handles a large volume of work, the nature of which is shown by the following outline:

- a. Routine microscopic diagnosis is made on specimens of sputum, gastric wash-



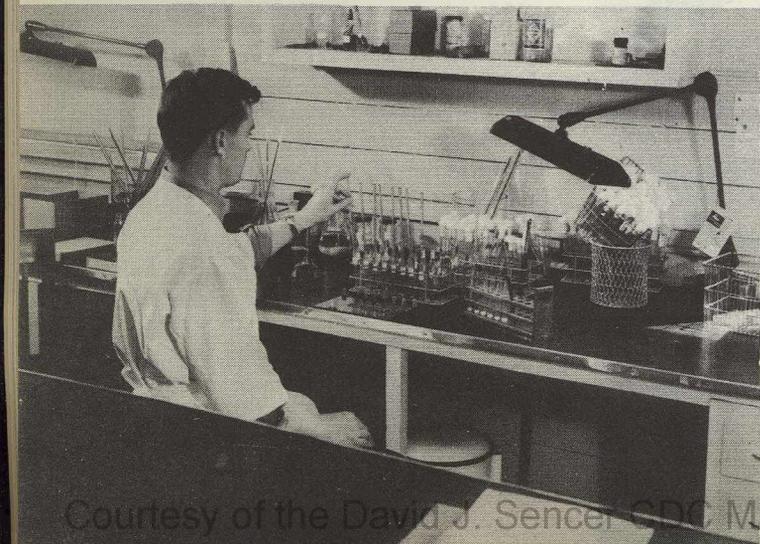
▲ Reading results of diagnostic rickettsial serology tests.

◀ Isolation of pathogenic fungi from clinical material.



▲ Incubator containing cultures from reference diagnostic material.

Testing tuberculosis cultures for streptomycin sensitivity.



ings, and other body fluids. The microscopic diagnoses are supplemented by cultural methods and, when advisable, by animal inoculation.

- b. Reference diagnostic service is rendered on cultures of acidfast bacilli from many sources. These are examined culturally and by animal inoculation when determination of type is requested.
- c. The streptomycin sensitivity (or resistance) of the tubercle bacilli isolated from various patients is being determined. Tubercle bacilli that are not only resistant to, but **ABSOLUTELY DEPENDENT** on, streptomycin (veritable microbiological drug addicts!) have been found.

The following media have been evaluated with respect to their adaptability to routine streptomycin sensitivity assays: Lowenstein (Jensen-Holm modification), Herrold's egg-yolk agar, Dubos' Tweenalbumen, and Sula's. An evaluation of a simple egg-yolk medium recommended by the American Trudeau Society has also been started, especially in regard to its use in the sensitivity testing of primary cultures. A slide culture technique is also being investigated.

THE ENTERIC BACTERIOLOGY LABORATORIES

This important phase of diagnostic bacteriology has developed greatly in volume and degree of complexity. From qualitative biochemical reactions, it has now entered the fields of immunology and serology in their most profound qualitative and quantitative aspects. These facts are evident in the following brief list of reference diagnostic activities of the Enteric Bacteriology Laboratory:

1. Serological typing of *Shigella* and *Salmonella* cultures.
2. Grouping of paracolon bacteria, *Proteus*, etc., by biochemical methods. Certain groups are identified serologically.

◀ Serological typing of *Salmonella* cultures.

3. Bacteriophage typing of *S. typhi*.

The Enteric Bacteriology Laboratories are now the U. S. national representatives for the International Committee on Bacteriophage Typing, with headquarters in London.

Not only are these services currently available on an international scale, but it is hoped that in the near future the following services may be added:

1. Distribution of bacteriophages for typing *S. typhi*.
2. Distribution of *Salmonella* typing serums. These materials will be distributed only to laboratories having the personnel and facilities for their proper use.
3. Serological grouping of *Klebsiella* cultures.

Several unusual observations made from reference diagnostic material are:

1. *S. typhi*, phage type E, was recognized among cultures isolated from cloacal swabs from chickens. The organism was isolated in the laboratories of the Dysentery Control Project in New Mexico.
2. Cultures from an outbreak of *S. anatum* infection among restaurant patrons were identified. There were seven cultures from patients, three from cooked turkey (which was the vehicle of infection), and one from a normal carrier who was a food handler in the restaurant. It is not often such a complete chain of evidence revealing the source and vector of the outbreak is compiled.
3. Three new *Salmonella* types were recognized.
 - a. *S. corvallis* — VIII, XX:z4z23 — from turkeys.
 - b. *S. colorado* — VI, VII: 1,w — 1,5 — from man, clinical condition unknown.
 - c. *Unnamed type* — I, XL: R — 1,6 — from a food handler.
4. A culture isolated from the heart blood of a 5-month-old infant who died of enteric infection, was recognized as an Arizona paracolon, formula 10:1, 2, 10.
5. Cultures of *S. typhi* from several epi-

demics have been typed by bacteriophage. In every instance all the cultures from a given epidemic belonged to the same type. The types most frequently found are A, C, and E.

THE GENERAL BACTERIOLOGY LABORATORIES

Under this heading are comprised all bacteriological diagnostic problems not referable to the other laboratories discussed in this outline. For the past several months this laboratory has concerned itself largely with problems in the diagnosis of diphtheria. This disease has increased markedly in prevalence and severity during the last few months. Included in the large volume of work already handled has been the isolation of strains of corynebacteria from throat cultures, the determination of their identity, type (*gravis*, *mitis*, *minimus*), and virulence. Observations of special interest are the increase in numbers of *gravis*-type strains, and the occurrence of *minimus*-type strains and of virulent saccharose-fermenting strains in the southeastern part of the United States.

THE PARASITOLOGY LABORATORIES

The Parasitology reference diagnostic work has developed to a very large volume with many ramifications.

Some interesting problems in diagnosis not concerning diphtheria were also encountered. For example, a culture of unknown nature from an undiagnosed disease condition turned out to be the glanders organism (*P. mallei*); a supposed diphtheria culture was found to be a species of *Nocardia*; and from the sputum of a patient suspected of having a pulmonary mycosis, another species of *Nocardia* was isolated.

The types of specimens submitted to the Blood Parasite Laboratory are blood smears, thick and thin (thick blood smears to be examined for malarial parasites constitute the bulk of specimens submitted), whole blood, biopsied lymph nodes,



PARASITOLOGICAL REFERRAL DIAGNOSIS

Specimens are received in the mail, marked for identification, and microscope slide preparations made in saline, iodine, and Quensel's stain. These preparations are sealed with paraffin and are then ready for diagnostic study under the microscope.

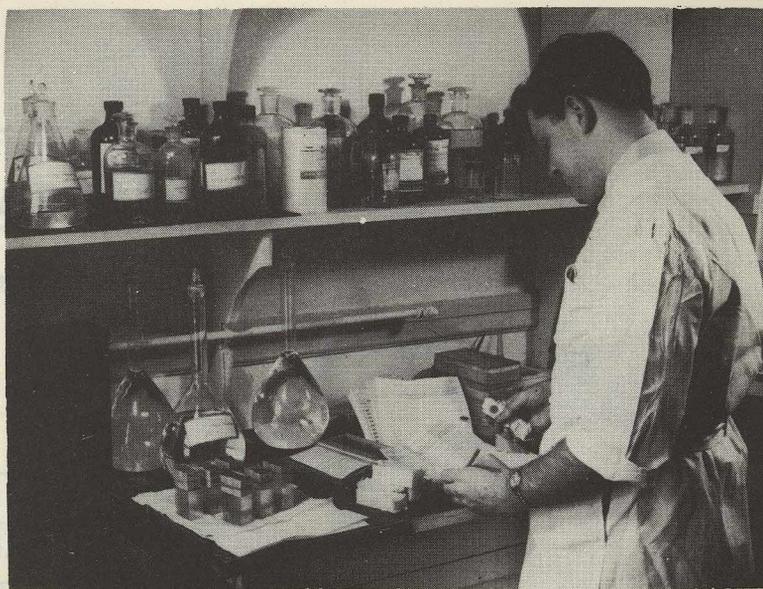


and bone marrow smears. The organisms diagnosed are malaria (*Plasmodium falciparum*, *P. vivax*, and *P. malariae*), *Wuchereria bancrofti*, *Trypanosoma cruzi*, and *Leishmania donovani*.

Specimens submitted to the Intestinal Parasite Laboratory include feces, urine, sputum, pus, adult worms, deer meat, tissue sections, pleural fluid, peritoneal fluid, fish, and cellulose-tape anal swabs. These organisms have been identified: *E. histolytica* and other intestinal protozoa, intestinal nematodes (roundworms), intestinal cestodes (tapeworms), exotic parasites (*Schistosoma haematobium* and *Paragonimus westermani*), hydatid cysts of *Echinococcus*, and *Trichinella*.

The materials for diagnosis come from every State in the Union and from foreign countries.

Reference diagnostic specimens often are the first evidence of unusual incidence of many diseases, as subsequent investigations have shown. Reference diagnostic services have frequently backed up local laboratory diagnoses. However, local laboratory errors have been corrected at times.



▲ Checking slides preparatory to staining blood smears from malaria survey.

▼ *Ascaris* in specimen submitted for diagnosis.



Laboratory Training and

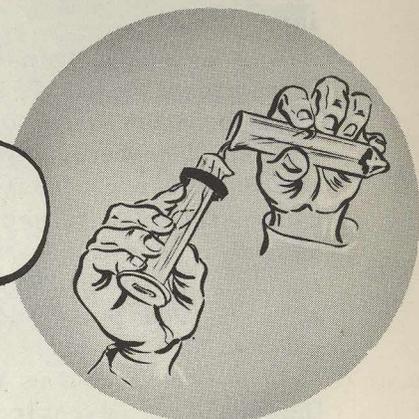
The lack of trained laboratory personnel capable of identifying parasitic organisms was recognized as a serious handicap during World War II. Health authorities were concerned by the many servicemen returning home with both recognized and hidden parasitic infections.

The Communicable Disease Center was charged with the responsibility of providing facilities for training of laboratory personnel to correct this deficiency. Laboratories were built and equipped, a staff was assembled, and the first 6-week course in the "Laboratory Diagnosis of Parasitic Diseases" was given in October 1945.

A policy was established whereby students are selected only from already employed laboratory personnel, first consideration being given to employees of State and local public health laboratories and Federal agencies. This policy is intended to improve proficiency in the performance of daily work and to train students in the use of improved and newly developed techniques, rather than to replace the basic training for laboratory workers which is

Extension Service Programs

**Dr. Frank Reider, Senior Surgeon
Office of Chief**



provided in schools and colleges.

A feature of the training offered is the degree of individual instruction made possible by a high instructor-student ratio. Improved proficiency in identification is obtained through repeated examinations of unknown specimens. Both fresh and preserved materials are in plentiful supply, and materials not readily available in this country are imported from tropical regions. A member of the Laboratory Division staff is stationed at the School of Tropical Medicine in Puerto Rico for the purpose of collecting such materials.

Fortunately, the fear that there might be a major extension of imported parasitic infections to the civilian population proved to be unfounded. The great majority of imported parasitic infections are encountered in the Veterans Administration Hospitals at the present time. In 1947 an agreement was made with the Veterans Administration to accept one student from each of the 13 VA districts throughout the country for refresher training in each of the parasitology courses.

Twelve 6-week courses in the "Laboratory Diagnosis of Parasitic Diseases" have been given to date. Refresher training has been provided for approximately 250 laboratory workers from 44 States, 2 Territories, and 5 foreign countries. About 40 percent of the students came from State and local public health laboratories; 40 percent came from Veterans Administration Hospital laboratories; and 20 percent came from general hospital

laboratories, the Public Health Service, and foreign countries.

The success of the training courses in parasitology, in addition to fulfilling the original purpose, led to an opportunity to extend the scope of the program to improve laboratory diagnosis in the other fields of medicine. As the various branches of the Laboratory Division were organized and the methodology research programs developed, training courses were established to provide refresher training in their respective fields. Thus, 4-week courses in the "Laboratory Diagnosis of Tuberculosis" and in the "Laboratory Diagnosis of Mycotic Diseases" were given for the first time in 1948.

The scheduled laboratory training program in 1949 consists of 14 courses in eight subjects as refresher training for laboratory personnel. In addition, two courses of 2 weeks' duration and two courses of 1 week's duration are being given for laboratory directors—courses designed to acquaint them with the material that is taught to their technicians in the longer courses.

A brief description of each of the courses now being offered follows:

1. A 6-week course in the "Laboratory Diagnosis of Parasitic Diseases" includes laboratory diagnosis of diseases due to intestinal parasites, with special emphasis on amebiasis, hookworm disease, echinococcosis and schistosomiasis, and diagnosis of all the blood parasites. Some consideration is given in this course to arthropods of medical

importance.

2. A 2-week course in the "Laboratory Diagnosis of Parasitic Diseases," designed for laboratory directors, senior laboratory staff members, physicians, and others of comparable professional standing, includes the same subject material as that listed in course No. 1 above, but less emphasis is placed on improving performance of techniques and on drilling with unknown specimens.

3. A 4-week course in the "Laboratory Diagnosis of Mycotic Diseases" covers identification of common saprophytic fungi and methods of cultivating and identifying the dermatophytes and the fungi causing subcutaneous and systemic infections, represented by organisms such as *Trichophyton*, *Sporotrichum*, *Coccidioides*, and *Histoplasma*.

4. A 1-week course in the "Laboratory Diagnosis of Mycotic Diseases" for laboratory directors and supervisory personnel, which includes the same subject material as that listed in course No. 3 with less emphasis on improving technical proficiency.

5. A 4-week course in the "Laboratory Diagnosis of Bacterial Diseases (Part I. Tuberculosis Bacteriology)," which covers such topics as preparation of culture media, microscopic techniques, methods for cultivating acidfast organisms from pathological material, and of diagnosis by animal inoculation.

6. A 1-week course in the "Laboratory Diagnosis of Tuberculosis" for laboratory directors and supervisory personnel, covers the subject material of course No. 5, with greater emphasis on discussion groups and demonstrations and less on technical proficiency and unknown specimens.

7. A 4-week course in the "Laboratory Diagnosis of Bacterial Diseases (Part 2. General Bacteriology)," which covers the diagnosis of spirochetal infections, streptococcal and pneumococcal infections (with exercises in serological-type determination) and brucellosis in the first 2 weeks. The last 2 weeks deal especially with accepted methods for the diagnosis of infections due to *Hemophilus* species, the *Neisseria* and the *Corynebacteria*.

8. A 4-week course in the "Laboratory Diagnosis of Bacterial Diseases (Part 3. Enteric Bacteriology)," covers the bacterial infections (salmonellosis and shigellosis), including methods for isolation, biochemical identification, and serological and bacteriophage typing.

9. A 1-week course in the "Serological Diagnosis of Rickettsial Diseases" includes practice in all details of complement fixation and the Weil-Felix test.

10. A 2-week course in the "Laboratory Diagnosis of Bacterial Diseases" for laboratory directors and supervisory personnel, covers the subject material of courses Nos. 7, 8, and 9, with less emphasis placed on improving technical proficiency.

11. A 1-week course in the "Laboratory Diagnosis of Rabies" includes techniques for gross brain dissection, mouse inoculation, smears, and staining.

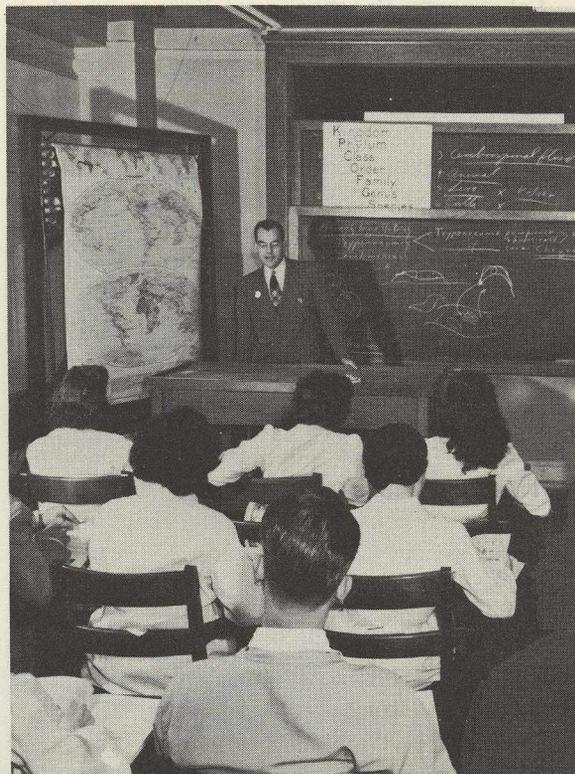
12. A 2-week course in the "Laboratory Diagnosis of Influenza" includes training in techniques of hemagglutination

Discussion session in conference room. Instructor explaining a diagnostic technique.





Part of a Laboratory Section in a course in Diagnosis of Bacterial Diseases.



Lecturing to students attending course in Laboratory Diagnosis of Parasitic Diseases.

tests and virus isolation by fertile egg and animal inoculation.

The preceding courses are scheduled during 1949 as follows:

1. Laboratory Diagnosis of Parasitic Diseases (6 wks.)
Mar. 14 to Apr. 22
Sept. 12 to Oct. 21
2. Laboratory Diagnosis of Parasitic Diseases (2 wks.)
June 20 to July 1
3. Laboratory Diagnosis of Mycotic Diseases (4 wks.)
Aug. 1 to Aug. 26
4. Laboratory Diagnosis of Mycotic Diseases (1 wk.)
June 6 to June 10.
5. Laboratory Diagnosis of Bacterial Diseases (Part 1. Tuberculosis Bacteriology) (4 wks.)
Feb. 28 to Mar. 25

Aug. 29 to Sept. 23

6. Laboratory Diagnosis of Tuberculosis (1 wk.)
June 13 to June 17
7. Laboratory Diagnosis of Bacterial Diseases (Part 2. General Bacteriology) (4 wks.)
Mar. 28 to Apr. 22
Sept. 26 to Oct. 21
8. Laboratory Diagnosis of Bacterial Diseases (Part 3. Enteric Bacteriology) (4 wks.)
Apr. 25 to May 20
Oct. 24 to Nov. 18
9. Serological Diagnosis of Rickettsial Diseases (1 wk.)
Feb. 21 to Feb. 26
July 25 to July 30
10. Laboratory Diagnosis of Bacterial Diseases (2 wks.)
May 23 to June 3

11. Laboratory Diagnosis of Rabies (1 wk.)
 Apr. 25 to Apr. 29
 Oct. 24 to Oct. 28
12. Laboratory Diagnosis of Influenza
 (2 wks.)
 Mar. 14 to Mar. 25

The necessity for restricting the size of classes to 20 students in each of the various training courses, dictated by the number of instructors and available space and materials, limits the number of laboratory personnel who can be trained each year to a small proportion of those who are employed in laboratories. This proportion is further reduced by the loss of trained personnel. It is obviously impossible to provide this training to the great majority of laboratory workers. Selection of students is, therefore, influenced by the education, training, position, and organization in which the applicant is employed. Preference is given to applicants from laboratories located in geographical areas where the subject

matter is of regional importance, or where there is a marked deficiency of such laboratory services available. Preference is also given to persons in positions that will enable them to institute the improved methods in their own laboratories, and to transmit their training to their coworkers and those in neighboring laboratories by means of intrastate training programs.

To assist most advantageously in the selection of trainees, it is required that applicants be nominated by the State health officer and/or the State laboratory director. Certainly, the State health authorities are in the best position to know where the needs are greatest in their State.

An Extension Service was developed in 1945 to supplement the number of laboratory people who could be trained in courses each year, and to provide former students with refresher training. The Extension Service mails two specimens each month,

Inoculating mice for diagnosis of rabies.



consisting of well-prepared stained and unstained slides, preserved and fresh materials, and various arthropods of medical importance. Much of the especially collected and prepared study material would not ordinarily be available to most laboratories in this country. A key is sent with each set of specimens which identifies the specimen and gives pertinent information about the staining, preservation, and stages of organisms present in the material.

The materials remain the property of each laboratory to which they are sent. Thus a valuable collection is being built up to serve a number of purposes. The specimens and instruction keys can be used as refresher material for the former students, and as training material for new laboratory workers. They can also be used to test the diagnostic proficiency of employed workers and as reference material to compare with unusual specimens sent in for reference diagnosis. Finally, they are valuable as demonstration material at meetings and conferences.

The shipments up to the present have consisted of parasitological and entomological specimens, and are sent to more than 310 laboratories located in every State and Territory. It is estimated that more than 2,000 laboratory workers have an opportunity to study this material each month. We are thus able to reach a much larger group than is possible through the training courses themselves.

Plans are now under way to develop similar extension services in the other fields of laboratory diagnosis, and we expect to start shipping mycological, acidfast, rabies, diphtheria, *Salmonella*, and *Shigella* specimens this year. It is also planned to send other types of training aids consisting of filmstrips, photographs, charts,



Preparation Laboratory Unit — Preparing specimens for extension service.

and keys of various kinds.

A small number of special loan sets have been made up to meet particular needs. These are available upon special request for periods of 1 or 2 months, as needed.

Extension Service materials also have been used by State health departments in evaluation programs to determine the proficiency of local laboratories.

The plans for the future are to continue to develop courses and other refresher training aids in the entire field of laboratory diagnostic medicine, so that the best possible laboratory services will be available to the people throughout the entire country.

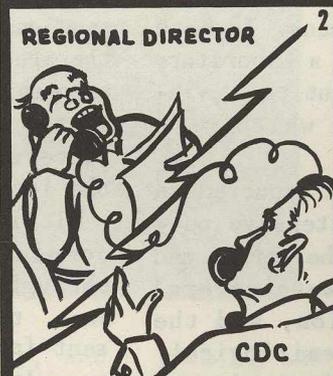
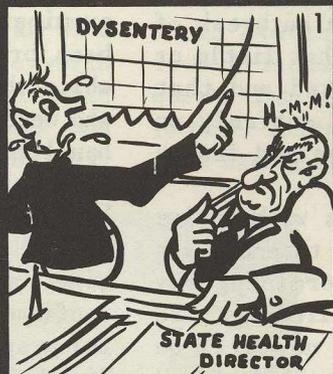
Since diagnosis of disease can never rest entirely with the laboratory, an evening session on amebiasis was held with the local physicians in order to acquaint them with some of the problems and limitations of laboratory diagnosis and to help correlate the laboratory with the clinical aspects of the problem.

In the other State the situation was somewhat different. Numerous cases of amebiasis were being reported from the vicinity of one of the larger cities by one physician who, with commendable enterprise and energy, was making his own microscopic examinations and diagnoses. However, this physician was, in all good faith, the victim of the same difficulties of recognition. The problem was resolved by extending to that area the regular reference diagnostic service of the Parasitology Branch, and by arranging for a technician from the nearby State branch laboratory to attend the course given in Atlanta by the Laboratory Division on the laboratory diagnosis of the parasitic diseases.

In 1945 and in 1947 there were outbreaks of dysentery in mental institutions in Alabama and in Ohio. These institutional epidemics received intensive on-the-spot study by teams of consultants from the Atlanta laboratories. The investigation of the outbreak in Ohio was joined by the Epidemiology Division, CDC, by the National Institutes of Health, and by the Ohio State Department of Health.

• CONSULTATION SERVICES

"My Day"



In both institutions an unusually high incidence of parasitic infection was discovered among the inmates. A similar field investigation was made in 1946 of a reported epidemic of diarrhea in Mississippi.

During the past year other occasions have arisen calling for consultation in the fields of diphtheria and tuberculosis diagnosis. A consultant from the Bacteriology Branch investigated one outbreak of diphtheria, only to discover that little or no diphtheria actually existed and that local apprehension was based entirely on incorrect laboratory diagnoses and faulty procedures.

Two other State laboratories with active services for the diagnosis of tuberculosis asked for assistance in determining why their laboratory bacteriology findings were not in line with what would normally be expected in regard to colony morphology and incidence of positive specimens. In both instances it was possible for a Laboratory Division consultant to point out the deviations from good technique which were responsible.

In the summer of 1947 there occurred in southwestern Louisiana an extensive outbreak of encephalitis among the horses and mules of that area. There were several instances of human infection, and the situation presented an epidemiological, diagnostic, and public health problem of great importance. The facilities of the Virus Laboratory in Montgomery were used. Consultants from that laboratory and the Epidemiology Division were sent into the epidemic area; there, tissue and serum specimens were taken from diagnosed and suspected cases, as well as from apparently normal individuals and animals. Examinations made in the Montgomery Virus Laboratory showed the causative agent to be the virus of Eastern equine encephalomyelitis.

In April of 1948 a call for assistance was received from a Federal institution in the Midwest for what appeared to be a relatively mild but troublesome enteritis outbreak. The authorities of this institution were apprehensive lest this mild epi-

demio might mean that there was a serious fault in the sanitary regime. Consultants from the Bacteriology Branch, familiar with the laboratory diagnosis of acute enteric disease, were on the way by plane in a few hours carrying a considerable supply of necessary equipment and special culture media. They spent approximately 2 weeks in the hospital laboratory, making some 190 examinations on 137 of the inmates who had been previously involved, who became ill while the investigation was in progress, or who were concerned with the preparation and handling of food.

In July 1948 an important town in the Virgin Islands appeared to be threatened with a serious outbreak of typhoid fever. Nine cases were reported as having been confirmed by laboratory examination, and a telegraphic request was received by CDC for diagnostic assistance. We were asked to send one or more consultants immediately to the area, prepared to set up and operate a temporary laboratory for the identification of the typhoid bacillus or other enteric bacteria and for the proper evaluation of the local water and milk supply.

Within 24 hours, arrangements had been completed, by wire and by telephone, through public health facilities in San Juan, to have equipment and special media sent from Puerto Rico. At the same time, a consultant left Atlanta by air. Within 16 hours he was on the spot, and within 10 days he had completed his investigation. It was found that there was in fact no epidemic of typhoid fever or other enteric infection and that the reports had been based upon the mistaken interpretation of laboratory technical procedures.

Laboratory diagnosis as performed by State or city laboratories is generally at a fairly high level of accuracy, and yet it would seem that people everywhere are equally deserving of accurate public health diagnostic service. We live in an age of scientific medicine. It is difficult, particularly in the field of infectious disease, to make valid diagnoses without laboratory support of one kind or another. The

best physicians have come to rely more and more upon assistance from the laboratory. A State department of health is no stronger than its laboratory division, and yet in some States the laboratory is treated as a stepchild. The quarters may be crowded and antiquated—firetraps in some instances—the equipment out of date, and the staff overworked and underpaid.

In this connection we should speak of a second type of consultation service which the Laboratory Division has made available through the Bureau of State Services and the Public Health Service Regional Offices.

This service takes the form of laboratory surveys and program reviews, performed by Laboratory Division consultants for a State or city health department at its own request or as a part of a State health department program review for the Regional Office. A laboratory survey consists of a thorough examination and evaluation of a health department laboratory, both from the point of view of administration and of technical procedures used.

A program review is pointed more to administrative, budgetary, and program planning with less emphasis on techniques. However, all aspects of the laboratory organization and service are weighed. What portion of the laboratory funds is supplied by the State and what portion from Federal sources? Is the State bearing a fair share of its own expense or does it lean too heavily on Federal support? What is the salary scale? Is a State Merit System in force governing appointment, tenure, and advancement? Is the State laboratory service well distributed through the agency of branch laboratories? Are branch laboratories needed?

What of the technical procedures? Are they in line with good modern laboratory practice? Are the technical workers well

trained? Have they a good educational foundation and formal training in this work? Does the State laboratory provide for in-service training of its personnel—does it support a program of research? These are examples of the phases of the problem vital to the operation of a good laboratory.

Since 1946 laboratory surveys or program reviews have been completed in 2 cities and in 23 States from Oregon to Florida and from Arizona to Vermont. Additional requests for review have been accepted from 10 other States and 3 cities.

It has been rare indeed to find a State laboratory without administrative and technical problems of one kind or another and which is up-to-date with respect to all procedures. However, almost without exception the directors of the laboratories are good administrators and able bacteriologists, who themselves recognize what should be done. Often an outside observer is able to see aspects of a problem which quite escape those who are constantly working with it. Adequate funds and quarters are frequently

lacking and State legislatures are not always well informed as to the vital importance of the State laboratory.

At the conclusion of a survey or program review, a report is made embodying the observations and recommendations for improvement. These consultative services are rendered in the spirit of a cooperative venture. The Laboratory Division shares with all the public health laboratories the common desire to promote and further the quality and variety of diagnostic services available to the public. Whether these services emanate from a public or private laboratory is of little importance. What is important is that every sick individual and every physician in this country have readily available to him adequate diagnostic laboratory services.



