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CURRENT SERIAL RECORDS

FOOT-AND-MOUTH DISEASE
RINDERPEST
TESCHEN DISEASE
AFRICAN SWINE FEVER
FOWL PLAGUE
BOVINE PLEUROPNEUMONIA
SHEEP POX
NAIROBI SHEEP DISEASE
AFRICAN HORSESICKNESS
RIFT VALLEY FEVER
ASIATIC NEWCASTLE DISEASE
LOUPING ILL
EAST COAST FEVER
VENEZUELAN
EQUINE ENCEPHALOMYELITIS



THE
PLUM ISLAND
ANIMAL DISEASE
LABORATORY

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Prepared by

Animal Disease and Parasite Research Division

AGRICULTURAL RESEARCH SERVICE

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THE
PLUM ISLAND
ANIMAL DISEASE
LABORATORY

RESEARCH ON FOREIGN
DISEASES OF ANIMALS

The Plum Island Animal Disease Laboratory, the Nation's only research center for the study of contagious foreign animal diseases, occupies an island off the eastern end of Long Island, N.Y. It is operated by the U.S. Department of Agriculture, which is responsible for preventing the introduction of foreign animal diseases into our domestic animal population and for establishing a program of preparedness, aimed at eradication if outbreaks of these diseases should occur. Such diseases, if introduced into this country, could result in high death tolls or cause serious economic losses among susceptible livestock.

Federal inspectors at U.S. borders and ports have the job of keeping out these foreign diseases. Widespread use of transportation facilities connecting the United States with once-remote countries has increased the risk of outbreaks of contagious diseases, and has made the inspectors' work more complex. At the same time, inspection has become more effective through application of new research findings.

Some of these findings have been made at the Plum Island Laboratory, a part of the Animal Disease and Parasite Research Division of the Agricultural Research Service. The purpose of

the Plum Island Laboratory is to discover basic scientific facts that can be used in combating the foreign animal diseases by—

- Preventing their entry into the United States.
- Controlling and eradicating any diseases that might gain entrance.
- Supplying scientific information to foreign countries, thus decreasing hazards to the United States.

DISEASES STUDIED

The contagious foreign animal diseases studied in the Plum Island laboratory include:

- Foot-and-mouth disease, which primarily affects cattle, swine, sheep, and goats.
- Rinderpest, a disease of cattle.
- Teschen disease of swine.
- African swine fever.
- Fowl plague.
- Contagious bovine pleuropneumonia.

The first five are virus diseases. Pleuropneumonia is caused by an organism intermediate in size between bacteria and viruses.

The laboratory also is concerned with other foreign diseases of animals, including—

- Sheep pox.
- Nairobi sheep disease.
- African horsesickness.
- Rift valley fever, a disease of sheep, cattle, and goats.
- Asiatic Newcastle disease, which affects poultry.
- Louping ill, a disease of sheep.
- East coast fever, a disease of cattle.
- Venezuelan equine encephalomyelitis.

Some of these diseases affect wild animals and birds, in addition to domestic animals.

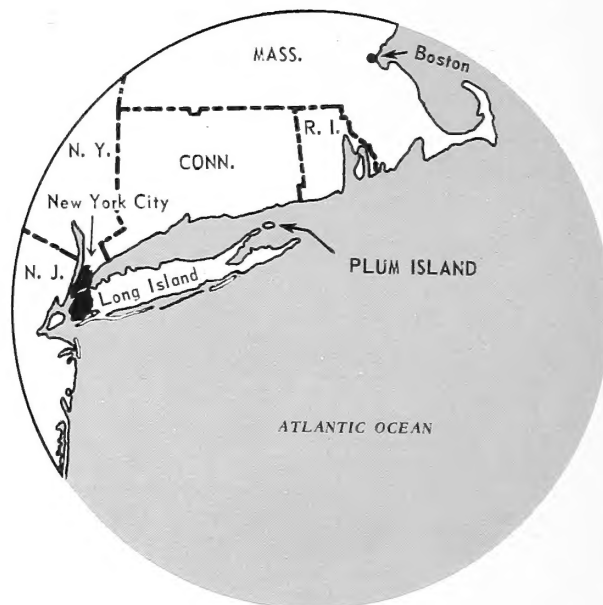
Primary research emphasis at the Plum Island laboratory is placed on foot-and-mouth disease, because of its great economic importance. Techniques and materials are being developed for rapid diagnosis of this and other foreign diseases in the event of outbreaks here.

The laboratory's program is flexible enough to allow the study of additional disease problems when necessary. The work of the laboratory is divided into two parts—research and service.

RESEARCH

Veterinarians, virologists, bacteriologists, pathologists, chemists, physicists, and their technical assistants—all have a place in the laboratory. Working alone or as teams, they are assigned to one of the five research sections: Biochemical and physical, cytological, diagnostic, immunological, or microbiological investigations.

These researchers are well equipped with the most modern instruments, and they make use of advanced techniques—including electron microscopy, histochemistry, microcinematography, ultracentrifugation, fluorescent antibody microscopy, and radioautography. New developments in basic and applied sciences are regularly incorporated in the laboratory program.



Plum Island lies off the eastern end of the north fork of Long Island. It is between Long Island Sound and Gardiner's Bay, about 6½ miles south of Connecticut.

SCIENTISTS in biochemical and physical investigations are concerned with problems in physicochemistry and biophysics.

Animal virus particles are examined for their chemical properties, including resistance to mechanical treatments, pH changes, thermal changes, and variations in ionic strength. The effects of enzymes and chemicals as purifying agents, inactivants, and mutagens are determined.

Viruses are studied intact and broken down into their protein and infectious nucleic acid subunits. Size, shape, and diffusion, electrophoretic, and sedimentation rates of viruses are determined.

Correlations of physicochemical properties with infectivity, immunogenicity, and antibody-antigen relationships are investigated.

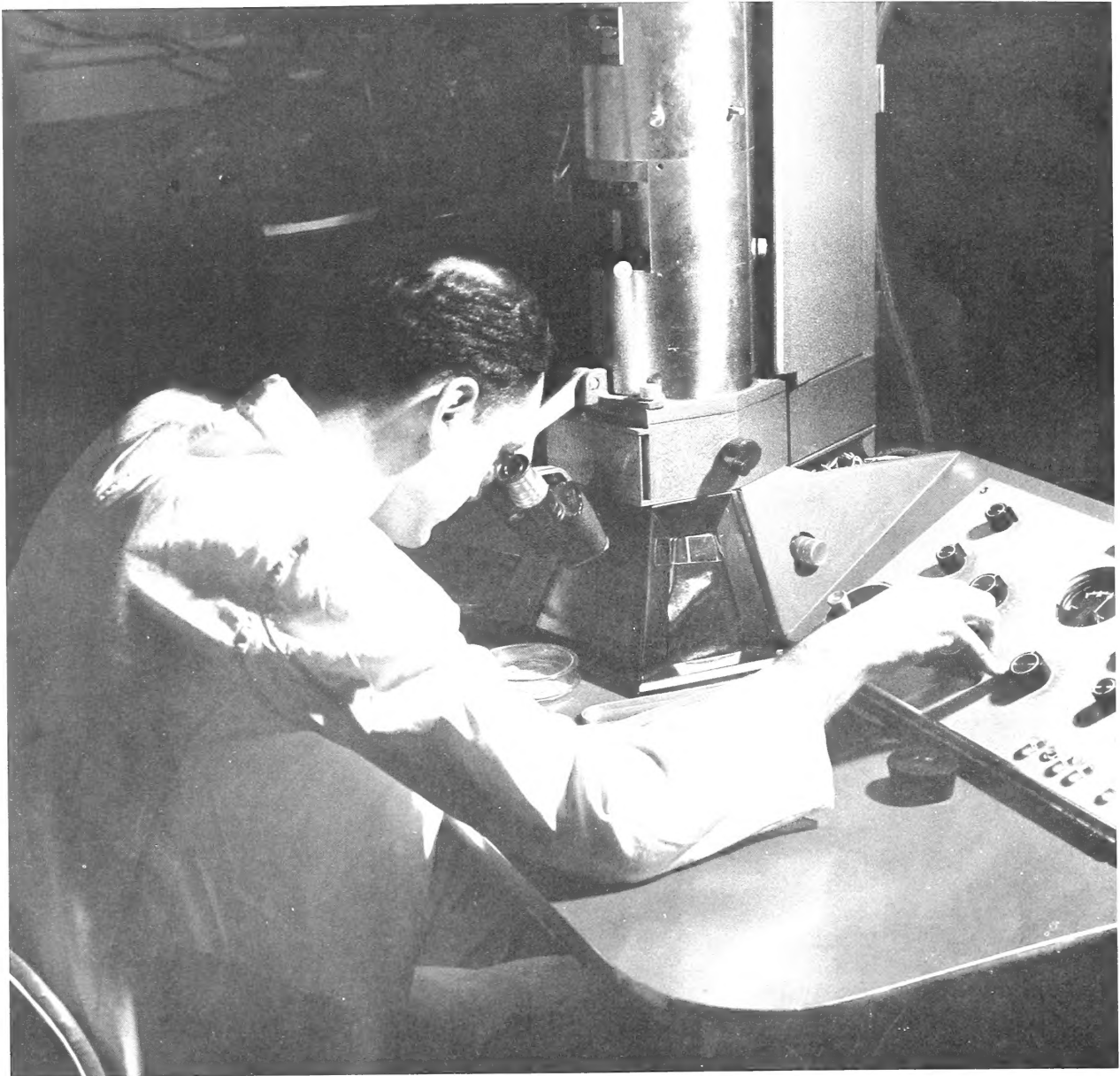
Virus-host-cell relationships are studied in tissue culture by biological and chemical methods, respirometry, ultrathin sections, and radiobiological tracers.

SCIENTISTS in cytological investigations study the effects of viruses on animal cells, the location of virus within cells, and the relationship of cell changes to animal susceptibility and immunity.

Changes in the various tissues and organs of animals infected with viruses are studied by the pathologists of this group. Although most foreign animal viruses cause disease signs that are readily seen, there also are significant micro-

scopic changes. Knowledge of all these disease alterations is essential for recognition and differentiation.

In tissue-culture studies, practical methods for producing large quantities of virus are being developed for fundamental and applied research. Virus-cell relationships also are studied by developing virus-susceptible cell cultures, specialized cell lines, and modification of virus by repeated passage in tissue culture.



N2113-8

Physicist examines foot-and-mouth disease virus particles under the electron microscope.



Electron micrograph shows foot-and-mouth disease virus particles (about one-millionth inch in diameter). One polystyrene reference particle is at left center.

- R**
- ▶ Pioneered in the use of electron microscopy in the study of animal viruses.
 - ▶ Adapted vesicular stomatitis virus to tissue culture.
 - ▶ Isolated vesicular stomatitis virus from a man being.
 - ▶ Developed a tissue culture method for the study of foot-and-mouth disease virus.
 - ▶ Developed a line of tissue culture cells for the growth of the seven types of foot-and-mouth disease virus.
 - ▶ Viewed foot-and-mouth disease virus particles with an electron microscope, and described their structure as being 23 millimicrons (about one-millionth of an inch) in diameter, made up of a protein coat surrounding a core of ribonucleic acid (RNA).
 - ▶ Confirmed that the RNA is the infectious portion of the virus.
 - ▶ Established that foot-and-mouth disease is widespread in animals and that the disease does not affect humans. He also discovered that foot-and-mouth disease virus is inactivated by RNase.
 - ▶ Showed that FMDV is inactivated by heating at 80°C for 30 minutes.
 - ▶ Demonstrated that RNA of foot-and-mouth disease virus may be obtained from infected cells.
 - ▶ Found that FMDV causes foot-and-mouth disease infection in several species of animals, including naturally susceptible animals.

RESEARCH HIGHLIGHTS

tissue-culture monolayers in the

atitis virus to growth in tissue

atitis virus from an infected hu-

ture plaque assay for foot-and-mouth disease virus (FMDV).

epididymus testis cells, which supports the growth of FMDV.

Foot-and-mouth disease virus in the electron microscope as a particle approximately one-millionth inch) in diameter, with a protein coat which protects a core of RNA.

The protein coat may be removed from FMDV, and that the RNA core is the infectious agent.

RNase (RNase)—an enzyme which digests RNA—rapidly digests RNA, but not FMDV. Developed methods to purify FMDV.

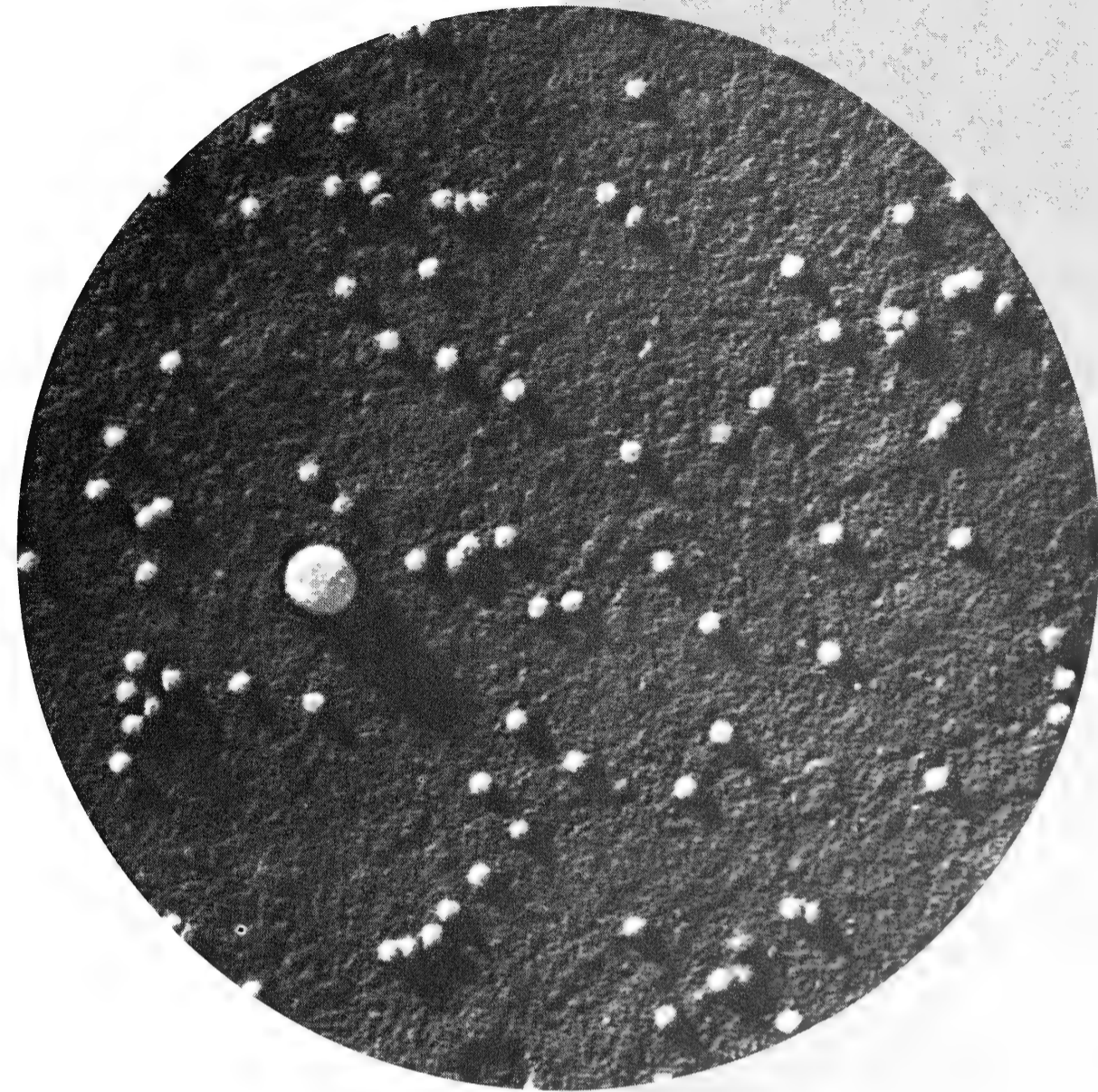
Heat resistant, but may be inactivated by autoclaving at 121°C. for 6 hours.

FMDV is capable of producing infection in a wide range of animals. Killed FMDV.

FMDV multiplies without clinical signs of disease in a wide range of animals not known to be susceptible.

- ▶ Confirmed that the separated RNA core can reproduce whole FMDV when inoculated in cattle.
- ▶ Established that FMDV survives in lymph nodes and blood of beef carcasses for as long as 60 days, in bone marrow for more than 6 months, and in lymph nodes of wet, salt-cured meat for as long as 50 days.
- ▶ Determined that FMDV persists in cattle kidneys after clinical signs of disease disappear.
- ▶ Demonstrated that glycolytic metabolism (nonoxidative breakdown of sugar) is more essential to FMDV viral reproduction than are oxidative reactions.
- ▶ Found that FMDV is inactivated by organic acids, and by ethylene oxide gas, when sufficient humidity is present, and that beta-propiolactone, acetyleneimine, and ethylene oxide may be used as inactivants when retention of antigenicity is desired.
- ▶ Determined that FMDV may be present in semen of infected bulls and may be transmitted to cows by artificial insemination.
- ▶ Developed a rapid laboratory diagnostic test for African swine fever, in cooperation with the East African Veterinary Research Organization.
- ▶ Attenuated a strain of rinderpest virus, which shows promise as a live-virus vaccine for cattle.
- ▶ Found that rinderpest virus suspensions contain at least two different particles.
- ▶ Developed a rapid serological test for diagnosis of rinderpest.
- ▶ Improved procedures for differentiating the types of vesicular exanthema virus.

RESEARCH HIGHLIGHTS



Electron micrograph shows foot-and-mouth disease virus particles (about one-millionth inch in diameter). One polystyrene reference particle is at left center.

- ▶ Pioneered in the use of tissue-culture monolayers in the study of animal viruses.
- ▶ Adapted vesicular stomatitis virus to growth in tissue culture.
- ▶ Isolated vesicular stomatitis virus from an infected human being.
- ▶ Developed a tissue culture plaque assay for foot-and-mouth disease virus (FMDV).
- ▶ Developed a line of lamb testis cells, which supports the growth of the seven types of FMDV.
- ▶ Viewed foot-and-mouth disease virus in the electron microscope, and described it as a particle approximately 23 millimicrons (about one-millionth inch) in diameter, made up of a protein coat which protects a core of ribonucleic acid (RNA).
- ▶ Confirmed that the protein coat may be removed from the RNA core of FMDV, and that the RNA core is the infectious portion.
- ▶ Established that ribonuclease (RNase)—an enzyme widespread in animal tissues—rapidly digests RNA, but does not affect intact FMDV. Developed methods to inactivate RNase.
- ▶ Showed that FMDV is heat resistant, but may be inactivated by heating at 85° C. for 6 hours.
- ▶ Demonstrated that RNA, capable of producing infection, may be obtained from boiled FMDV.
- ▶ Found that FMDV multiplies without clinical signs of infection in several species of animals not known to be naturally susceptible.
- ▶ Confirmed that the separated RNA core can reproduce whole FMDV when inoculated in cattle.
- ▶ Established that FMDV survives in lymph nodes and blood of beef carcasses for as long as 60 days, in bone marrow for more than 6 months, and in lymph nodes of wet, salt-cured meat for as long as 50 days.
- ▶ Determined that FMDV persists in cattle kidneys after clinical signs of disease disappear.
- ▶ Demonstrated that glycolytic metabolism (nonoxidative breakdown of sugar) is more essential to FMD viral reproduction than are oxidative reactions.
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- ▶ Improved procedures for differentiating the types of vesicular exanthema virus.

SCIENTISTS in diagnostic investigations are developing methods to identify the causative agents of infectious foreign animal diseases and methods to detect infected animals. They also are exploring possible relationships between certain existing domestic diseases and foreign diseases through cross-protection and serologic tests.

SCIENTISTS in immunological investigations check the response of animals infected with or vaccinated against disease agents. Research is conducted on the antibodies that protect against disease. Serum is separated into elemental components, which are then analyzed by serological, chemical, and animal-testing techniques.

A major function of this section is the development and testing of vaccines appropriate for use in the event established disease-eradication procedures should fail to control invasions of foreign diseases. These studies involve chemical inactivation of virus and development of critical tests to determine the safety and potency of vaccines produced. Such research requires the vaccination of many animals and the study of their immunity by serological and challenge methods.

SCIENTISTS in microbiological investigations study the susceptibility of various species of animals to virus diseases, explore ways in which the diseases spread, and determine in what organs and tissues virus may be found. They trace the survival of virus in meat, blood, semen, and other animal products. From the results of these studies, the Department of Agriculture is able to assess the hazards of importing animal materials from foreign countries in which dangerous diseases exist. Scientists also study the effects of chemical and physical environments on viruses, thus contributing to knowledge regarding methods of virus inactivation, disinfection of contaminated materials and premises, and survival of virus under various conditions. Such information is vital in the prevention of disease and in eradication of outbreaks.



N205

Technician dispenses kidney cells into tissue-culture bottles.

SERVICE

The laboratory provides two types of service:

- Local support for the research program.
- Technical support to Federal agencies engaged in control and eradication of animal diseases.

Because of its isolation, the laboratory maintains all services needed to support its own research. It employs an administrative staff, engineers, animal caretakers, maintenance men, a safety staff, guards, firemen, and other workers.

THE OFFICE OF THE DIRECTOR provides overall guidance and management for the research and supporting groups.

ADMINISTRATIVE MANAGEMENT SERVICES include personnel work, procurement and delivery of supplies, and operation of food, photographic, and duplicating services.

THE SAFETY GROUP places major emphasis on preventing the escape of disease agents from the

laboratory. Other programs involve industrial and fire safety, first aid, and plant security.

ANIMAL QUARANTINE maintains colonies of disease-free guinea pigs, mice, and other small laboratory species to supply research sections. All large animals brought to the island are inspected; quarantines are placed on cattle, sheep, swine, and other normal animals until they are needed for research. Animal quarantine also provides whole blood, tissues, and serum from normal animals for use in diagnostic tests and tissue cultures.

RESEARCH SERVICES provide tissue cultures and prepare media and sterile equipment for use in the laboratory. This group also operates a laundry and glassware washing services.

THE LIBRARY has a specialized collection of scientific books, journals, and reports necessary for animal disease research. It provides reference and reprint services.

TECHNICAL SUPPORT to other Federal agencies includes diagnostic services, specialized studies on animal products, and development and evaluation of new techniques.

The laboratory performs emergency diagnostic services for foreign animal diseases, as required. When materials from disease outbreaks of suspected foreign origin are submitted by control agencies, the laboratory conducts studies to determine whether a foreign animal disease is involved.

Specialized studies on animal products are made to assist control agencies in determining if certain animal products should be admitted from foreign countries and what may be done to render products safe from a disease standpoint. Studies on meat and semen are examples of this type of service. Certain foreign biological products require similar safety evaluation.

If this service had been available in 1908, an outbreak of foot-and-mouth disease in this coun-



N1451

Research library.

try might have been averted; the outbreak was traced to contaminated imported smallpox vaccine, which was propagated in calves.

New disinfectants and sterilization techniques also are evaluated to assist the work of control agencies dealing with foreign animal diseases.

RESEARCH WITH SAFETY

Because of the communicability of the diseases under study, the laboratory operates under rigid safety regulations. These regulations are designed to protect the U.S. livestock industry from foreign animal diseases by preventing the escape of disease-causing agents from the laboratory buildings. They also protect experimental studies by preventing the spread of disease agents from one research area to another, and by preventing the accidental introduction of extraneous diseases not under study.

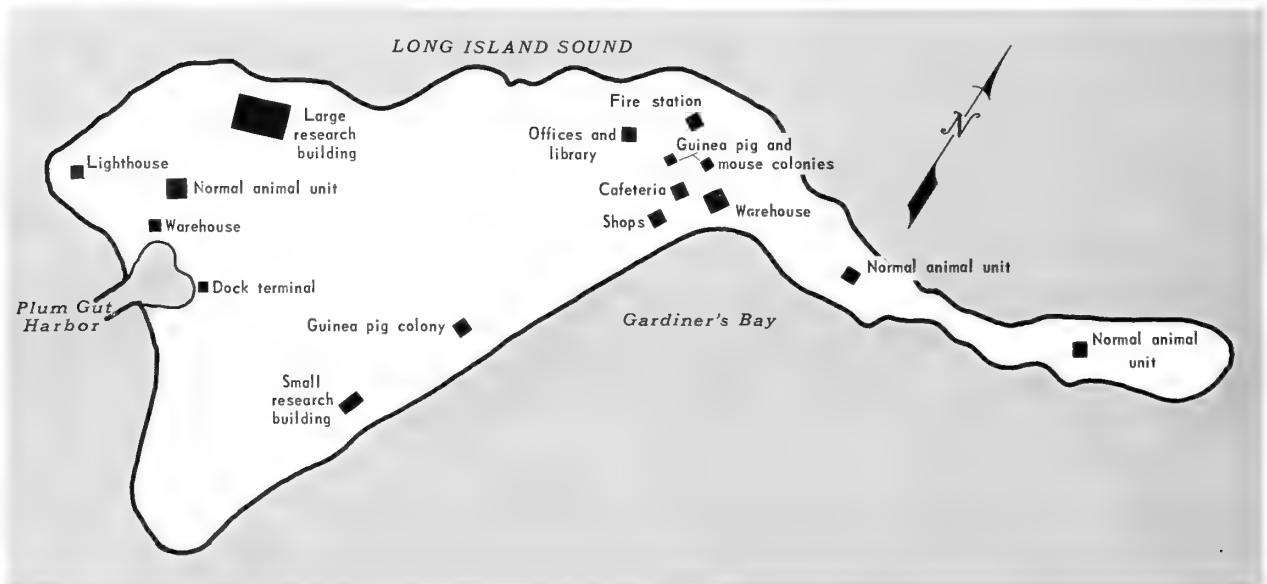
The two main buildings on Plum Island, which were specifically designed for research on highly communicable diseases, are considered among the safest in the world for work on animal viruses.

All entrances and exits for personnel, animals, and supplies are strictly controlled. Exhaust air from these buildings is decontaminated through a system of filters, and all liquid wastes are sterilized by heat before being discharged. Solid wastes—including animal carcasses—are destroyed by incineration within the research buildings.

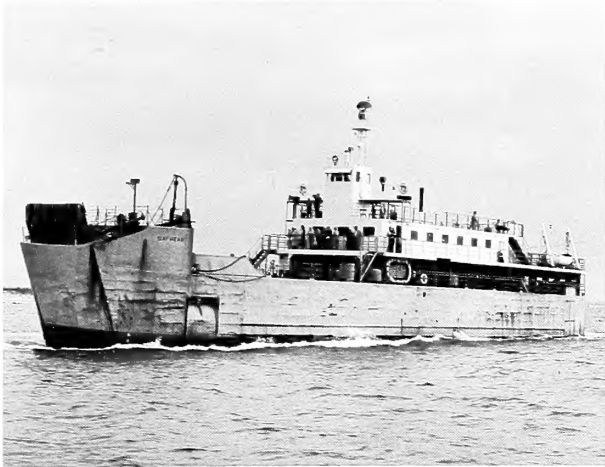
Persons entering the research buildings must leave street clothing and personal belongings in outer locker rooms and use laboratory clothing while in the building. Upon leaving, each person must take a complete shower before putting on his street clothing.

The Federal Government controls all movement to, from, and on the island. Only authorized persons are permitted entry to the island; entrance to laboratories and animal quarantine areas is restricted.

All personnel of the laboratory are prohibited from contact with susceptible species of animals, or premises where such animals are held, for specified periods of time after leaving the island.



The Plum Island Animal Disease Laboratory facilities occupy all of Plum Island except for a U.S. Coast Guard lighthouse station. The large research building, opened in 1956, is at upper left. A smaller research building, where work was started in 1954, is at lower left.



N1368, N1457

A ferry (left) and the laboratory's boat transport personnel and materials between Orient Point and Plum Island.

THE ISLAND LABORATORY

The island location of the laboratory is itself a part of the safety precautions. Because of its isolation, as well as its special facilities, the laboratory is able to study devastating foreign animal diseases without endangering livestock on the mainland. Congress provided this protection for U.S. livestock by specifying that the laboratory be on an island entirely under Federal control, and be separated from the mainland by deep navigable water.

Plum Island is located 110 miles from New York City—1½ miles from the eastern end of the north fork of Long Island and about 6½ miles from Connecticut. It is reached by ferry from Orient Point, and by small craft operated by the laboratory.

The island was named by early explorers who observed beach plums growing along the shores. In 1659 the ruling Indian chief of Long Island sold Plum Island to the first European owner for a coat, a barrel of biscuits, and 100 fishhooks.

The U.S. Government bought the island in the 1890's and established Fort Terry, a coast artillery post. The island was assigned to the Army Chemical Corps after World War II. On July 1, 1954, Plum Island—except for a light-house—was formally transferred to the USDA.

Preliminary studies were started in 1954; the laboratory's research was expanded into a broad program covering many foreign animal diseases when additional facilities became available in 1956.



N19057

Laboratory sewage is heated in these 30,000-gallon tanks for decontamination.

The Laboratory's Future

This is the first research facility of its kind to be established in the United States with such a broad program of objectives. Knowledge of specific animal diseases and methods of combating them developed at the laboratory have become important protections for this country's supplies of food and other animal products. As the basic research work progresses, it can reasonably be expected that the results will also be valuable contributions to the entire field of medical science and to other fields of research.

The location of the laboratory close to many other scientific institutions makes consultants from various fields of related research easily available. Furthermore, in the atmosphere created by the scope of the research program, highly trained research scientists can be expected also to continue joining the laboratory staff to carry out studies that might not be possible in other institutions because of lack of facilities and safeguards.

The very nature of research prevents the prediction of the exact character and the timing of conclusive results. But achievements of the program already have been outstanding. In the years ahead, the Plum Island Animal Disease Laboratory undoubtedly will continue to add to the stature of American and international research.

