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U. S. DEPARTMENT OF AGRICULTURE

The Plum Island Animal Disease Laboratory

Miscellaneous Publication No. 730



UNITED STATES DEPARTMENT OF AGRICULTURE

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Washington, D. C.

Issued September 1956



The Plum Island Animal Disease Laboratory

The opening of new facilities of the Plum Island Animal Disease Laboratory, Plum Island, N. Y., in 1956 initiated an extensive research program in the United States on dangerous foreign animal diseases. The laboratory is operated under special authorization of Congress to develop broader knowledge of how to combat contagious diseases that might be introduced into this country and threaten the livestock industry.

Protection against the introduction of foreign diseases is provided by the Federal inspection and quarantine service at borders and ports of entry. However, with increasing use of fast transportation, diseases of any country in the world are only a few hours away from our livestock population. It is impossible to guarantee that all dangerous foreign animal diseases will be kept out indefinitely. The best defense is a complete program of preparedness based on scientific research in methods of diagnosis, prevention, control, and eradication.

Major emphasis of the Plum Island Laboratory research program is on foot-and-mouth disease, considered one of the most contagious foreign animal diseases, and one of the most serious in its effects. The last outbreak of foot-and-mouth disease in this country was in 1929, but the disease exists throughout most of the other major livestock producing countries of the world. Recent outbreaks in Mexico and Canada serve as a reminder of the constant threat of this dread infection.

United States scientists have worked in a number of foreign laboratories in cooperative research programs on foot-and-mouth disease. The program on Plum Island is the first study of foot-and-mouth disease to be conducted in the United States.

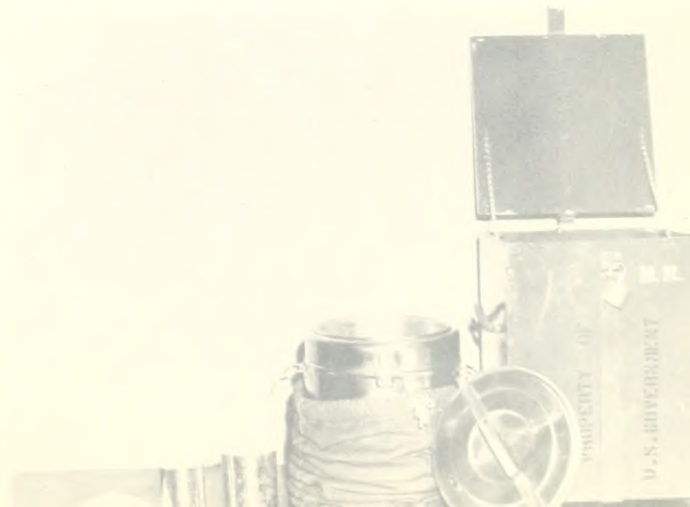
Other diseases, similar in outward appearances to foot-and-mouth disease, are being studied to the extent necessary to improve techniques of differential diagnosis (differentiation between similar diseases in making an accurate diagnosis). Additional foreign diseases requiring special safety facilities will be included in the research program.

Because of the contagious nature of the diseases under study, the safety precautions incorporated in the Laboratory and the regulations under which the work is carried out are the most rigid ever developed among research institutions throughout the world. The purpose of these precautions is (1) to protect the livestock industry from animal diseases not existing in this country by preventing the escape of disease-causing agents from the laboratory buildings and (2) to protect the experimental studies by preventing the spread of disease agents under study from one area of the research buildings to another, or the accidental introduction of diseases not under study.

LOCATION ON PLUM ISLAND

The location of the Laboratory itself is actually a part of the safety precautions. The Congress, in authorizing the establishment of the Laboratory, specified that it be located on a coastal island, separated from

Virus of foot-and-mouth disease used for research at the Plum Island Laboratory was shipped from England. The photograph shows the precautions that were taken to prevent its escape in transit. The virus was sealed in glass ampules, packed with cotton in sealed double-can containers, and placed in a larger stainless steel container. This was placed in a canvas insulated bag and locked inside a strong wooden box.



the mainland by deep navigable water. The Congress also required that the entire island be under the jurisdiction of the Federal Government in order to provide for complete control of movement to and from the island and on it.

Plum Island, in Long Island Sound, met all specifications and was proposed as the location for the Laboratory. After public hearings had been held within a radius of 25 miles of the site, the Secretary of Agriculture officially announced on July 28, 1952, that Plum Island had been selected as the site for the Laboratory.

Plans for the principal research building were reviewed by outstanding American and European scientists, experienced in research on foot-and-mouth and other animal diseases.

In 1954 construction of the principal research building was started. In the meantime, a smaller existing building on the island had been remodeled and made safe for conducting experiments with contagious diseases so that limited research could be started before the new structure was completed.

HISTORY OF THE ISLAND

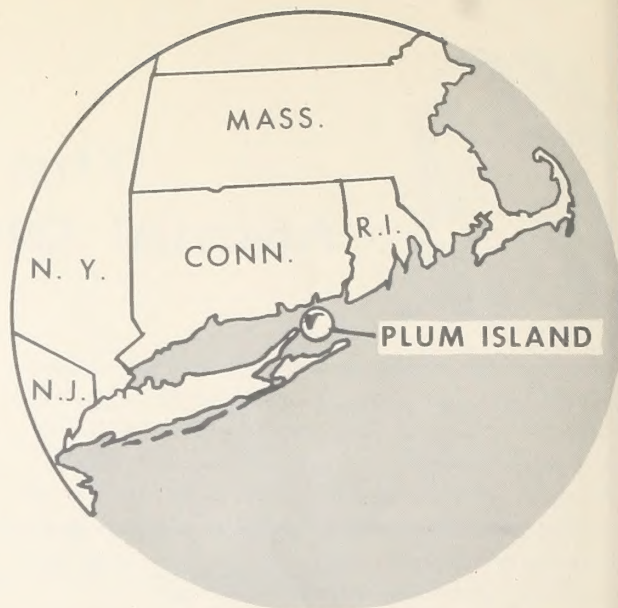
Plum Island is located about 1½ miles off the eastern end of the North Fork of Long Island, N. Y. It is about 3 miles long and 1 mile wide at its widest point, and has an area of about 800 acres. The nearest village is Orient, on Long Island. Ferry service to Plum Island is provided from Orient Point.

Plum Island was probably first seen by Europeans in 1614 when Adrian Block, an Englishman employed by the Dutch West India Company, charted the area. The island was named from the beach plums that grow along the shores, and an old Dutch map made about 1640 shows the name "Pruym Eyelant" (Plum Island).

In 1659 the little island was purchased by Samuel Willis, son of the Governor of Connecticut, from Wyandanch, the ruling Indian chieftain of Long Island, for a coat, a barrel of biscuits, and 100 fishhooks.

After passing through the possession of more than 20 families, the island was purchased by the United States Government about the time of the Spanish-American War for approximately \$90,000. A Coast Artillery post, later known as Fort Terry, was established there. This post was deactivated after World War II; it was later reactivated and assigned to the Army Chemical Corps.

The Department of Defense, through the Chemical Corps, made available to the Department of Agriculture, docks, certain buildings, equipment and other



Plum Island is at the eastern tip of the North Fork of Long Island. It is located in Long Island Sound, south of Connecticut and Rhode Island.

facilities that permitted the early establishment and operation of the Plum Island Animal Disease Laboratory, and on July 1, 1954, the entire island, except for a lighthouse station, was formally transferred to the Department of Agriculture.

ORGANIZATION AND FACILITIES

The Plum Island Animal Disease Laboratory is a unit of the Animal Disease and Parasite Research Branch, Agricultural Research Service. Research studies of the Laboratory are organized into the following groups: (1) Microbiological Investigations, (2) Chemical and Physical Investigations, (3) Immunological Investigations, (4) Cytological Investigations, and (5) Diagnostic Investigations.

Laboratory employees on the island, in addition to research scientists, include the administrative staff, engineers, animal caretakers, maintenance workers, a safety staff including guards, and a permanent staff of firemen.

In addition to the new research building, facilities on the island include: A one-unit research building, sewage decontamination building, administrative offices, firehouse, cafeteria, electrical and other workshops, powerplants, warehouses, residences, a health unit,

facilities for holding and breeding small laboratory animals, and facilities for holding large animals in quarantine before they enter the research building.

BROAD LABORATORY PROGRAM

To provide maximum protection for the livestock population of the United States against dangerous foreign diseases, the program of the Laboratory is divided into two parts: (1) Research and (2) Service.

(1) RESEARCH.—The program of research, the major responsibility of the Laboratory, is directed toward the study of the following aspects of animal diseases:

- *Viruses* that cause foot-and-mouth and other foreign diseases. Basic studies of the characteristics of various types and strains of viruses, how they are spread, and better methods of artificial cultivation for more efficient research on specific phases of disease prevention and control.
- *Diagnostic procedures* and how to improve them. More efficient and exact methods of differentiating virus diseases.
- *Susceptibility* of different species, breeds, and classes of animals—both domestic and wild—and the part they play in spreading and perpetuating the diseases being studied.
- *Disinfection* of contaminated premises and materials and how to improve methods.
- *Preventive measures* including immunization.

(2) SERVICE.—The Laboratory provides the following service features:

- *Diagnostic facilities* to provide rapid and positive identification of causative agents in disease outbreaks of suspected foreign origin.
- *Improved disinfectants and animal biological products* for use in supplementing and supporting prevention, eradication, and control programs.

FIRST RESULTS OF RESEARCH PROGRAM

Outstanding results in the artificial culture of viruses were reported during the first 2 years of the research program conducted in the original one-unit research building before the completion of the larger multiple-unit research structure. The methods developed are similar to those used in growing other viruses, such as polio virus.

The first laboratory work involved studies of vesicular stomatitis, a comparatively minor disease of cattle, hogs, and horses in the United States and other parts of the Western Hemisphere. This relatively mild virus was studied to train the staff and to test the Laboratory's safety measures before research on dangerous foreign diseases was started.

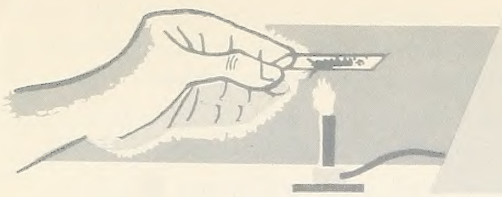
In 1954 Laboratory scientists reported that the virus of vesicular stomatitis could be successfully grown on the kidney cells of guinea pigs and bovine-tongue tissue. This achievement is a fundamental contribution toward more efficient research methods and differential diagnosis of foot-and-mouth and other vesicular diseases.

In 1955 the Laboratory reported the development of
(Continued on page 8)

Plum Island is entirely devoted to the Animal Disease Laboratory with the exception of U. S. Coast Guard property surrounding Plum Island Lighthouse. Prin-

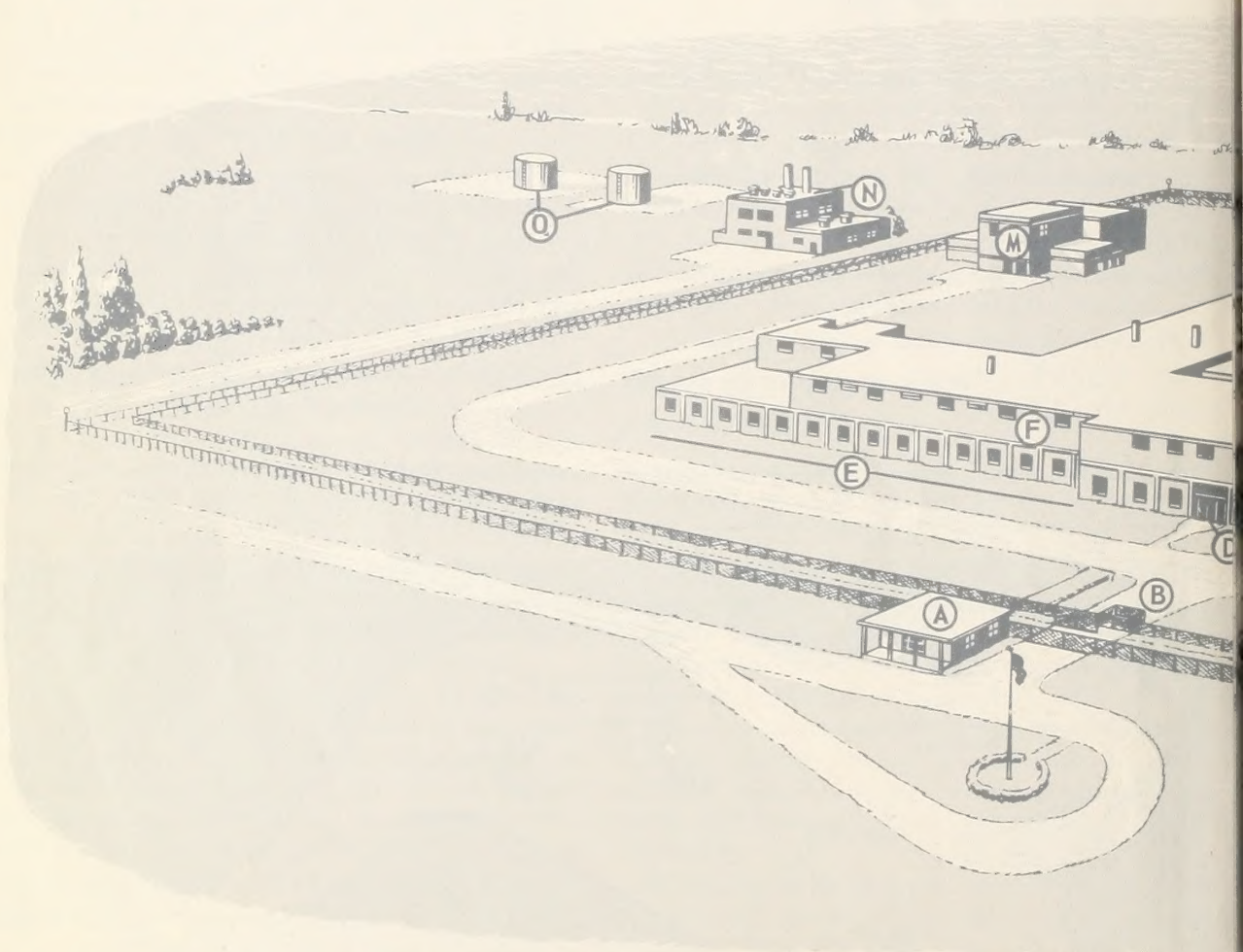
cipal research building, opened in 1956, is at upper left. Smaller research building, where work was started in 1954, is at lower left.





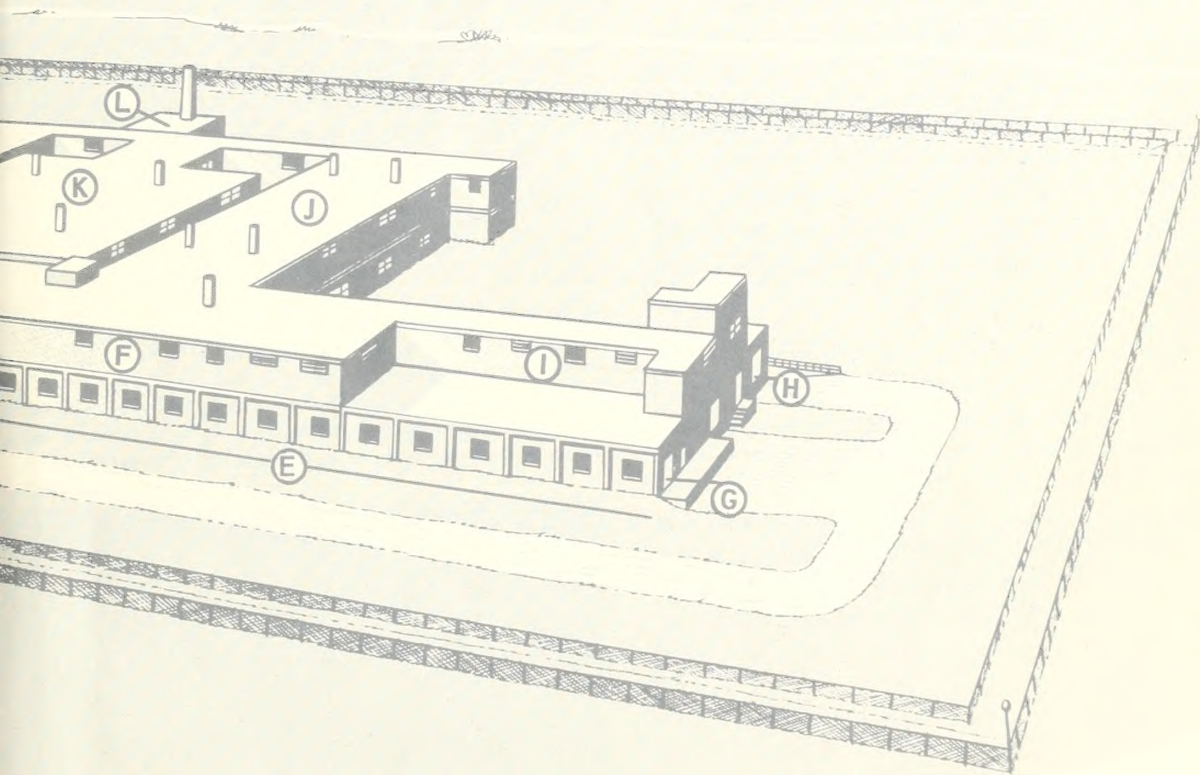
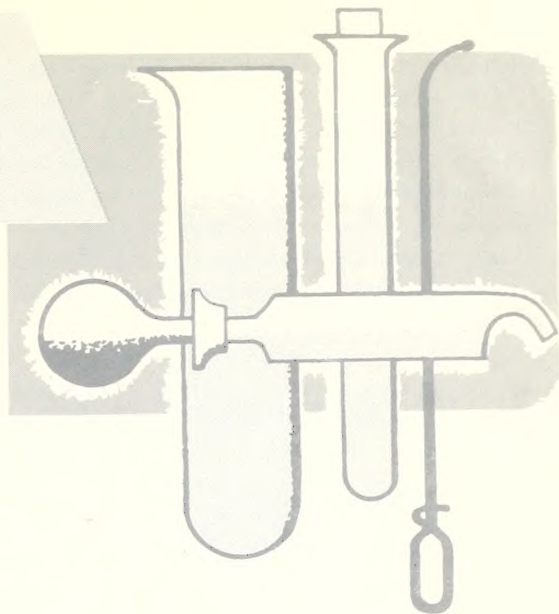
Principal Re The Plum Island Ani

- A. Guardhouse and personnel gate.
- B. Service gate and unloading platform.
- C. Double chain-link fence.
- D. Personnel entrance.
- E. Service area.
- F. Machinery space.
- G. Animal entrance.
- H. Feed entrance.
- I. Feed corridor.
- J. First floor—Animal isolation units.
Second floor—Feed corridor and machinery space.

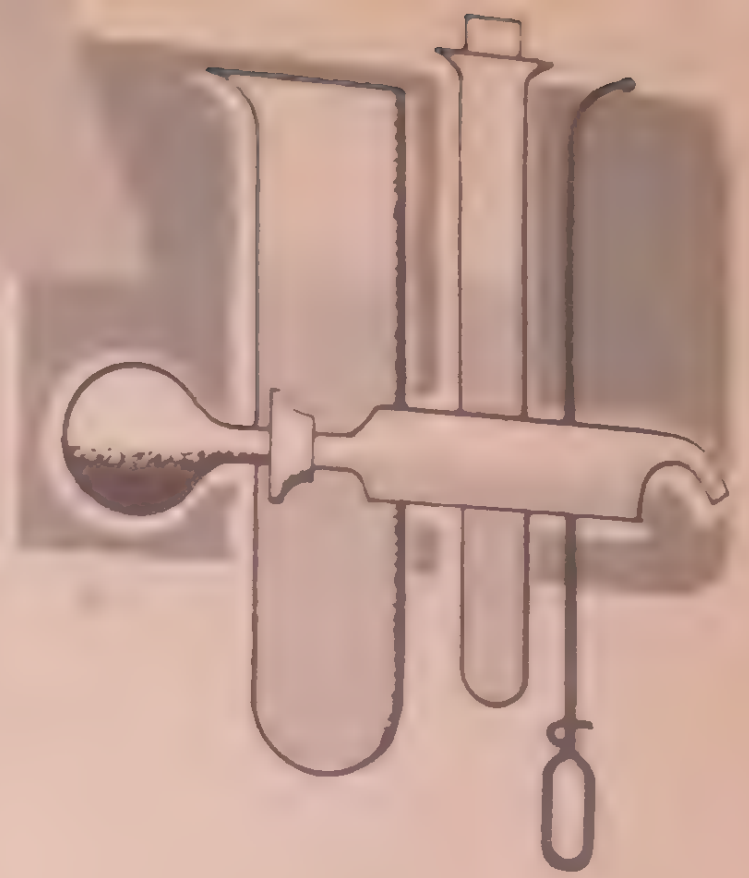


ch Building Disease Laboratory

- K. First floor—Laboratory work units.
- L. Incinerator.
- M. Sewage decontamination.
- N. Steam and emergency electric powerplant.
- O. Fuel oil storage tanks.



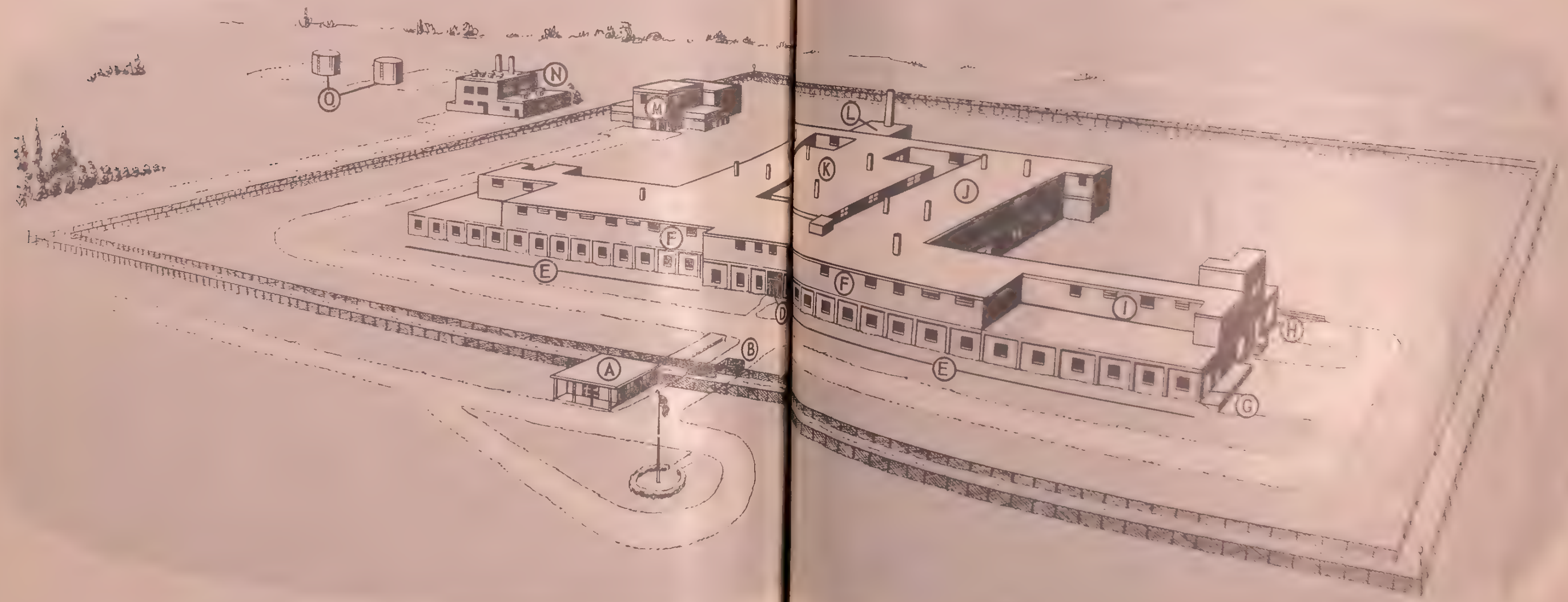
Principal Research Building The Plum Island Animal Disease Laboratory



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FACTS ABOUT FOOT-AND-MOUTH DISEASE

Foot-and-mouth disease is a highly contagious vesicular disease (characterized by vesicles or blisters) affecting cloven-footed animals almost exclusively. These include, among farm animals, cattle, swine, sheep, and goats; and, among wild animals, deer, buffalo, antelope, etc. It is caused by a virus of which there are at least 7 recognized types and variants within types.

Visible symptoms of the disease appear first as blisters on such tissues as the tongue, lining of the mouth, and between and around the top of the claws. In milk cows, the blisters may appear on the teats and udder. The blisters soon break, leaving a raw eroded surface. In cattle there is excessive salivation, causing the animal to drool. When the feet are affected, the animal limps painfully or lies down.

Mortality varies widely. Generally it is less than 5 percent, occurring especially in young animals. More virulent forms have caused death losses of 30 to 50 percent.

Greatest damage to herds, however, comes from loss in condition and permanent impairment such as loss of fertility. Recovered animals seldom regain production efficiency. Meat animals lose weight. Dairy stock lose condition rapidly and milk production often drops to almost nothing. It has been estimated that if the disease ever became firmly established in the United States, the combination of death losses and damage to affected animals could cost this country up to one-fourth of its production of meat, milk, and other animal products.

Nine outbreaks of foot-and-mouth disease have occurred in this country—from 1870 to 1929. The United States Government worked closely with Mexico to eradicate the disease there during the years 1947-52 and 1953-54. Specialists from this country were

invited to observe the eradication program in Canada in 1952.

SAFETY PRECAUTIONS

The safety precautions enforced at the Plum Island Laboratory are geared to control the highly contagious foot-and-mouth disease virus. The two research structures, with similar safety features, are considered the safest in the world for work on animal viruses.

Among the safety precautions are the following:

1. *Isolation on an off-shore island as required by law.*—The location—on an island controlled by the Federal Government and with no normal traffic facilities connecting with the mainland—makes it possible to control movement to and from the island and on it.

2. *Controlled movement of vehicles.*—Vehicles moving to and from Plum Island (by water transport) are restricted to a few Government-owned trucks, allowed only as far as the fenced-in dock area. Government vehicles operated beyond the fenced dock area are restricted to the island. Personally owned automobiles are not permitted on Plum Island.

3. *Careful introduction of experimental animals.*—Only healthy animals are selected for experiments. On the way to Plum Island they are kept in strict isolation. The animals are transferred to Government trucks at an isolated point on Long Island. These trucks are then allowed to proceed only as far as the fenced-in area at the Plum Island dock. Here the animals are transferred to island trucks on the other side of the dock-area fence by means of unloading and loading ramps that are disinfected after each transfer.

Beef kidney is used in one method for tissue culture of foot-and-mouth disease virus developed at the Plum Island Laboratory. This method is a major contribution in providing an efficient and inexpensive means of producing large quantities of virus for continuing studies of the disease and methods of combating it.



The animals are kept in quarantine on Plum Island long enough to insure that no disease is in the incubation period before they are taken into the Laboratory. While in quarantine, they are treated to eliminate external parasites, such as ticks and lice.

Animals are introduced into the research buildings through double-doored air locks. (The inside door is closed before the outside door is opened to permit entry.) Animals that enter the research buildings never come out, and none that land on Plum Island are ever permitted to leave the island. No virus studies are conducted except in the enclosed laboratory buildings, and there no contact is possible with other livestock or with birds and insects.

4. *Controlled introduction of all materials.*—All equipment, supplies, feed, and other materials arriving at the island are received under rigid controls. Transactions, particularly at the Plum Island dock-area platform, are so regulated that persons making delivery do not contact or receive aid from those accepting delivery. The transfer platform is thoroughly cleaned and disinfected between such transactions. Equipment and supplies moving into the research buildings must pass over similar transfer platforms and must pass through autoclaves and the same type of double-doored air locks that are used to introduce animals.

Feeds are processed to kill insects, rodents, and other vermin before being taken into the research buildings. In the principal research building, feed is introduced from an outside opening where it is dropped through trap doors to the basement below. Here it is hammer milled and then blown into feed hoppers on the second floor area. From these hoppers, it is taken through a feed corridor to chutes directly over the mangers in

each of the animal rooms. There is a double gate system on each feed chute, and one gate is closed at all times. This feed corridor on the second floor is entirely independent of the rest of the building.

5. *Written permit required for entry.*—Only authorized persons are permitted on Plum Island. All persons must have an approved pass and must be prepared to show it to any guard or safety representative upon request while they are on the island. They are required to read the printed safety regulations and to sign a certified statement that they will comply with them. Laboratory employees may be discharged for violation of these regulations.

6. *Protection of large compound and double fence.*—Upon approaching the Laboratory buildings, Laboratory personnel pass a guard and proceed through gates of a double fence. The inner fence, about 20 feet from the outer fence, is set in concrete extending 3 feet underground to prevent burrowing animals from digging their way inside. Between the fence and the research building is a large open compound; it is without vegetation so as to discourage birds, rodents, and other animals.

7. *Regulated movement of persons entering the research buildings.*—A person entering a research building must leave street clothing and personal belongings—even jewelry and eyeglasses—in an outer locker room and put on laboratory clothing. He may then pass through a one-way turnstile to his assigned work area.

If he enters such areas as the animal isolation or laboratory areas, he must leave the laboratory clothing behind and change into different laboratory clothing. When he comes out of the animal isolation or laboratory

Tissue-culture flasks and test tubes are inoculated with foot-and-mouth disease virus. Quart-sized flasks are used for production of virus needed in the laboratory research.

Eroded areas on the gums of this steer are typical lesions of foot-and-mouth disease. The animal was experimentally infected as part of the laboratory research.



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area, or if he moves from one to another of the units of each, he must leave the clothing worn in the highly contaminated area, take a soap shower, and again change laboratory clothing.

Laboratory clothing worn in the various areas of the research buildings is marked so that it is apparent immediately to safety technicians if an employee or visitor should attempt to move from one area to another without changing clothing. All laundering for the laboratory, as well as the sewing required in mending and repair of laboratory clothing and other supplies, is done within the building.

8. *Isolation of animals.*—Animals are kept in windowless, separately ventilated isolation areas, sealed away from the rest of the world. The isolation units are separated by air locks and other decontamination facilities so that different viruses or strains of viruses can be studied at the same time without spreading from one unit to another. The laboratory work units are similarly divided.

9. *Decontamination and sterilization of research buildings.*—All rooms, corridors, and other areas of the research buildings are cleaned and disinfected at frequent intervals and after the conclusion of experiments, in accordance with strict specifications.

10. *Decontamination of air.*—There are no openings in the research buildings except as required for intake and exhaust of air, entrance of personnel, animals, and materials, all of which are controlled. Air flowing out of the research buildings is decontaminated by a system of filters. Within the research buildings no air is allowed to move from one contaminated area to another. A system of different pressures insures that air moves in an outside-to-inside direction whenever per-

sons, animals, or materials enter the building.

All air entering the principal research building is filtered and then either heated, cooled, dehumidified, or humidity added as may be required. All air exhausted from the building is filtered through deep bed filters located in each room and then through welded exhaust ducts extending through the roof. All filter boxes at each room are provided with a damper and steam connection. When it is necessary to replace filters, the damper is closed and the steam jet opened to decontaminate the filters and ducts. After this decontamination, the filter is removed and replaced before the damper is opened. This system permits decontamination of any individual room and change of filters without disturbing operations in any other room in the building and leaves the ducts in the machinery space clean and uncontaminated.

11. *Sterilization of liquid wastes.*—All liquid wastes are sterilized by heat before they are discharged as sewage from the research buildings.

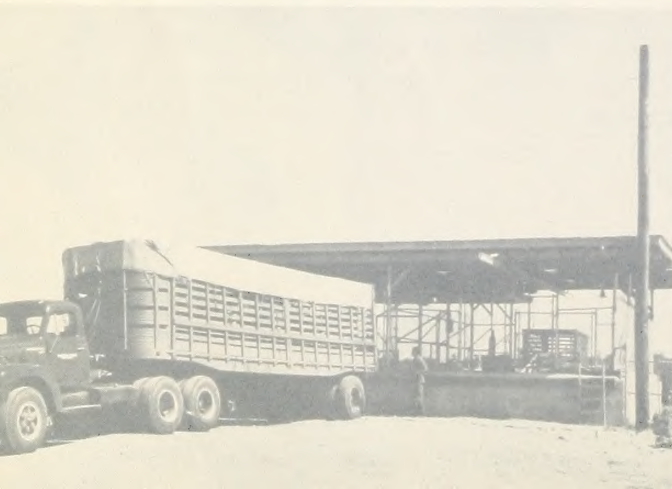
All waste liquids within the principal laboratory building pass through welded lines to the sewage decontamination building, which is a separate structure within the compound. Inside the decontamination building, the sewage passes into 3 large holding tanks and then into a heating system that raises the temperature to a minimum of 180° F. and maintains that level for a minimum period of 20 minutes before the sewage is discharged into the sea.

Two identical sewage systems are provided: They can be operated independently in case of breakdown or repairs or can be operated simultaneously.

12. *Destruction of solid wastes.*—All solid waste materials, including animal carcasses, are destroyed by

Cattle are unloaded at the Plum Island receiving dock. Animals received at the island are never permitted to leave.

Materials received into research buildings pass through autoclaves, like the one shown here, or through air locks. Before re-use, autoclaves and air locks are sterilized.



incineration within the research buildings. The principal research building is equipped with 2 incinerators, each with a capacity of burning 2,000 pounds per hour.

13. *Disinfection of equipment leaving the research buildings.*—Equipment may be removed from the research buildings only after supervised disinfection, usually by autoclaving (sterilization by superheated steam).

14. *Regulations affecting persons leaving the research buildings.*—All persons leaving the research buildings are required to take decontaminating showers before they change again to their street clothing and exit through an uncontaminated area.

In the principal laboratory building each person,

after removing work clothing and taking a soap shower, must pass through a bar gate into a deluge shower 6 feet long. When the bar gate is opened, water automatically emerges from multiple spray nozzles directed so that all areas of the shower room are sprayed. The water remains on for a period of 20 seconds after the bar gate has been closed. All means of exit are equipped with this automatic system so that it is physically impossible to leave the building without a shower.

Everyone leaving the island is required to agree not to come in contact with animals susceptible to the diseases under study, or areas where they are kept, for a specified period of as long as 1 week.

Animal rooms inside the research buildings are cleaned and disinfected after use in virus-disease studies. The usual disinfectant solution used contains lye and will kill foot-and-mouth disease virus that might be left on the walls, floor, and ceiling.

Incinerators inside the research buildings are used to burn all refuse and carcasses of animals used in research studies. Contaminated wastes never leave the buildings.



Outlook for the 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 can 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 first 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.

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