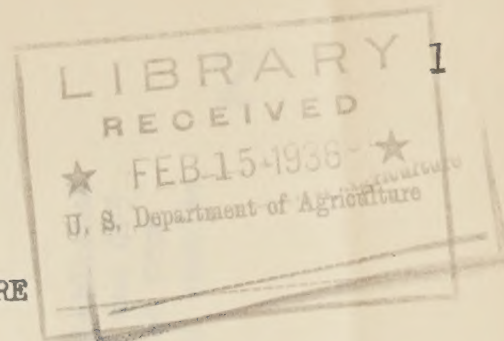


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UNITED STATES DEPARTMENT OF AGRICULTURE  
Bureau of Entomology and Plant Quarantine  
Washington, D. C.

NOT FOR PUBLICATION

January 15, 1936.

International Movement of Insect Parasites and Predators.

There is presented herewith in chart form the following information:

Fig. 1. The countries of origin of the 73 species of parasites and predators imported and established in the continental United States.

Fig. 2. The countries of origin of the 94 species imported and established in Hawaii.

Fig. 3. The number of species imported into the continental United States, Hawaii and all other countries combined, in five-year periods, from 1870-1934.

Fig. 4. The world movement of Rodolia cardinalis Muls., a predator of the cottony cushion scale, Icerya purchasi Mask.

Fig. 5. The world movement of Cryptolaemus montrouzieri Muls., a predator of mealybugs, Pseudococcus spp.

Fig. 6. The world movement of Aphelinus mali Hald., an internal parasite of the woolly apple aphid, Eriosoma lanigerum Hausm.

These charts illustrate the extent of the international movement of insect parasites and predators, the expansion of this type of work in recent years, and the world-wide distribution of three well-known species.

C. P. Clausen  
In Charge  
Foreign Parasite Introduction.



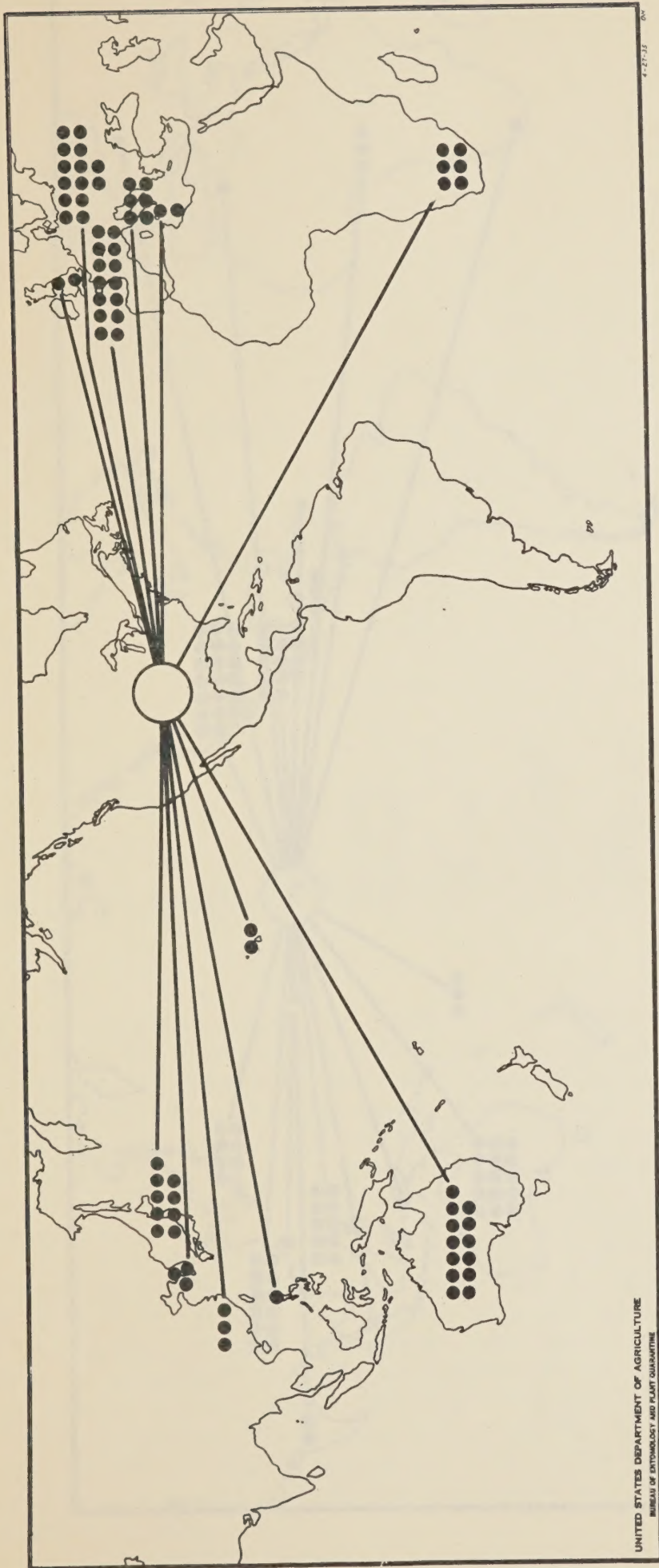


Fig. 1. - The countries of origin of the 73 species of parasites and predators imported and established in the United States between 1883 and 1934. The total number of importations during this period was 403 species. Each dot represents a single species. These are duplicated where a species was imported from widely separated regions. All establishments from the Tropics and the Southern Hemisphere are of enemies of aphids and scale insects.



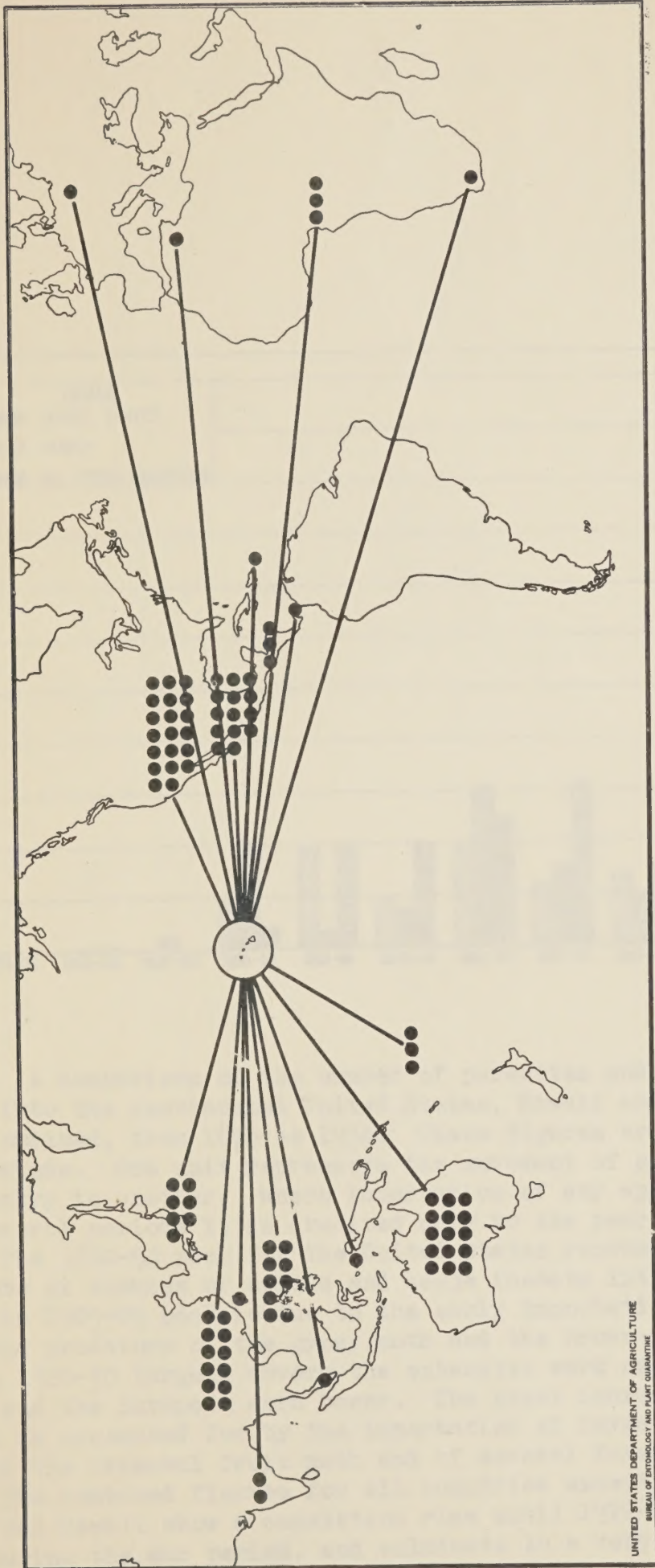


Fig. 2. - The countries of origin of the 94 species of insect parasites and predators imported and established in Hawaii from 1890-1934. During this period a total of 278 species were imported. The exceptionally wide geographic distribution covered by these importations is noteworthy.





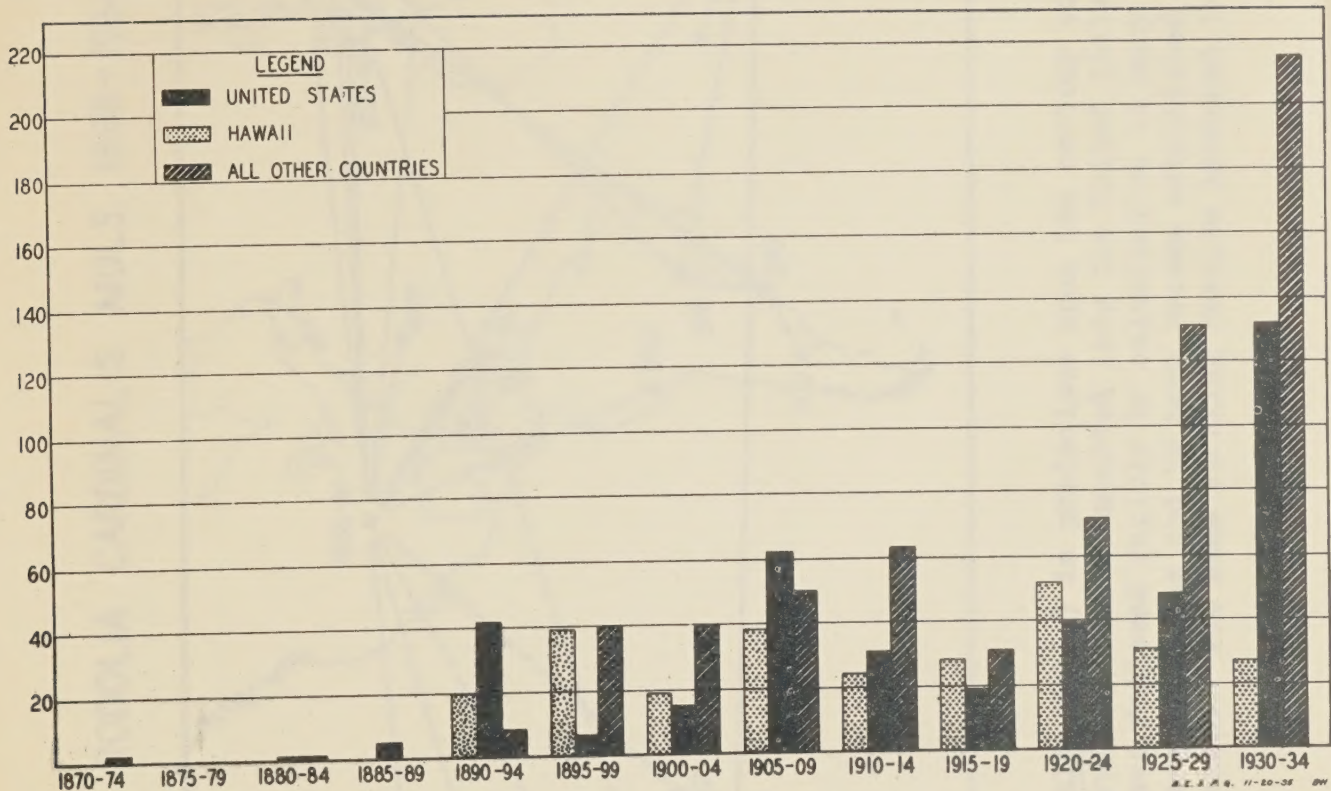


Fig. 3. A comparison of the number of parasites and predators imported into the continental United States, Hawaii and all other countries combined, from 1870 to 1934. These figures are given for five-year periods. One unit represents the movement of one species from one country to another. Where importation of any species extends over several periods it is credited only to the year of first shipment. The 1890-94 peak for the United States represents Koebele's shipments of enemies of aphids and scale insects into California, while the 1905-09 peak is due to the early importations of parasites and predators of the gypsy moth and the brown-tail moth. The rise in 1920-30 largely covers the extensive work on the Japanese beetle and the European corn borer. The great increase shown in 1930-34 is accounted for by the importation of large series of parasites of the Oriental fruit moth and of several forest insects.

The combined figures for all countries except the United States and Hawaii show a consistent rise until 1910-14, then a decline during the war period, and culminate in a very rapid increase from 1920 onwards.

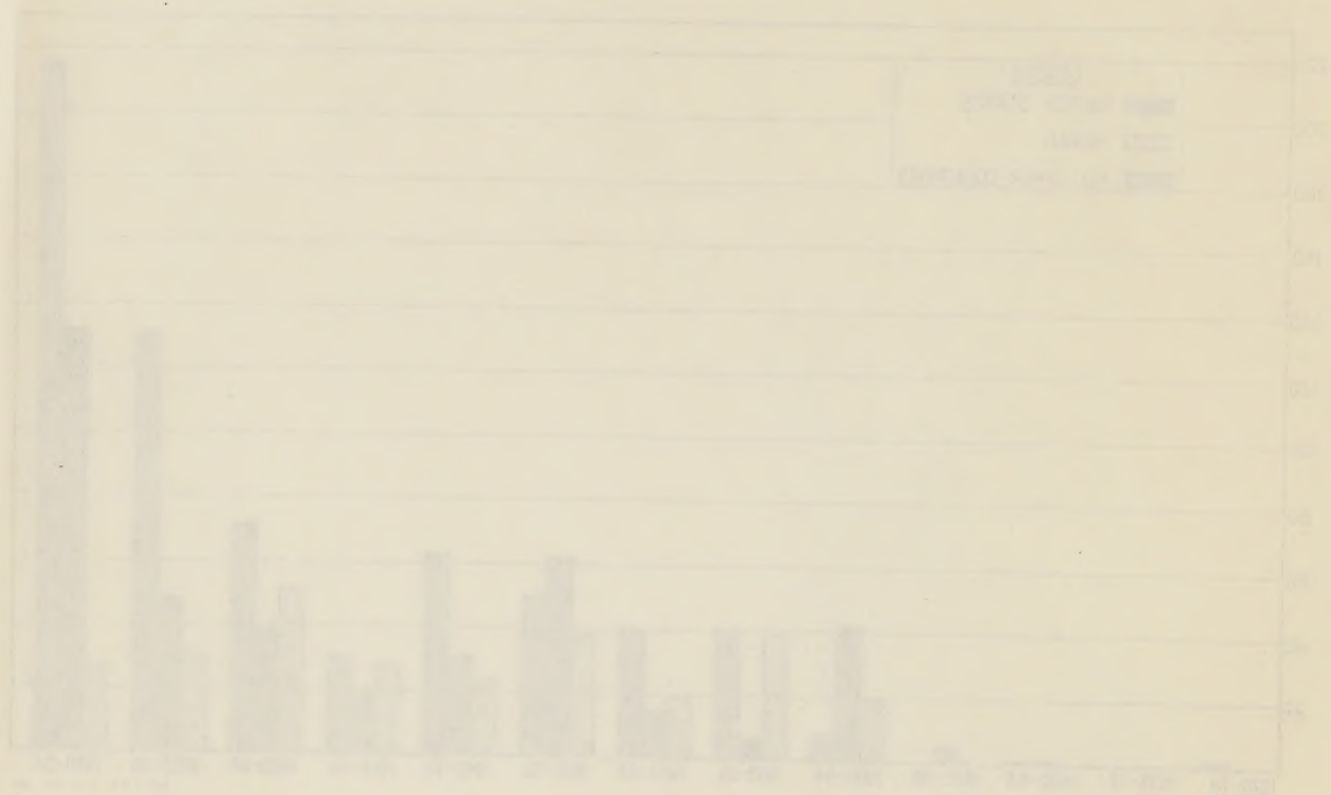


Fig. 2. A comparison of the number of passenger and freight cars in the United States from 1900 to 1920. The chart shows a general upward trend in the number of cars over the period, with a notable increase in the early 1910s. The number of passenger cars increased from approximately 10 in 1900 to 60 in 1920. The number of freight cars increased from approximately 15 in 1900 to 68 in 1920. The total number of cars increased from approximately 25 in 1900 to 128 in 1920. The increase in the number of cars was due to the expansion of the railroad network and the growth of the automobile industry.

## INTERNATIONAL MOVEMENT OF *RODOLIA CARDINALIS* MULS. 1888-1934 INC.

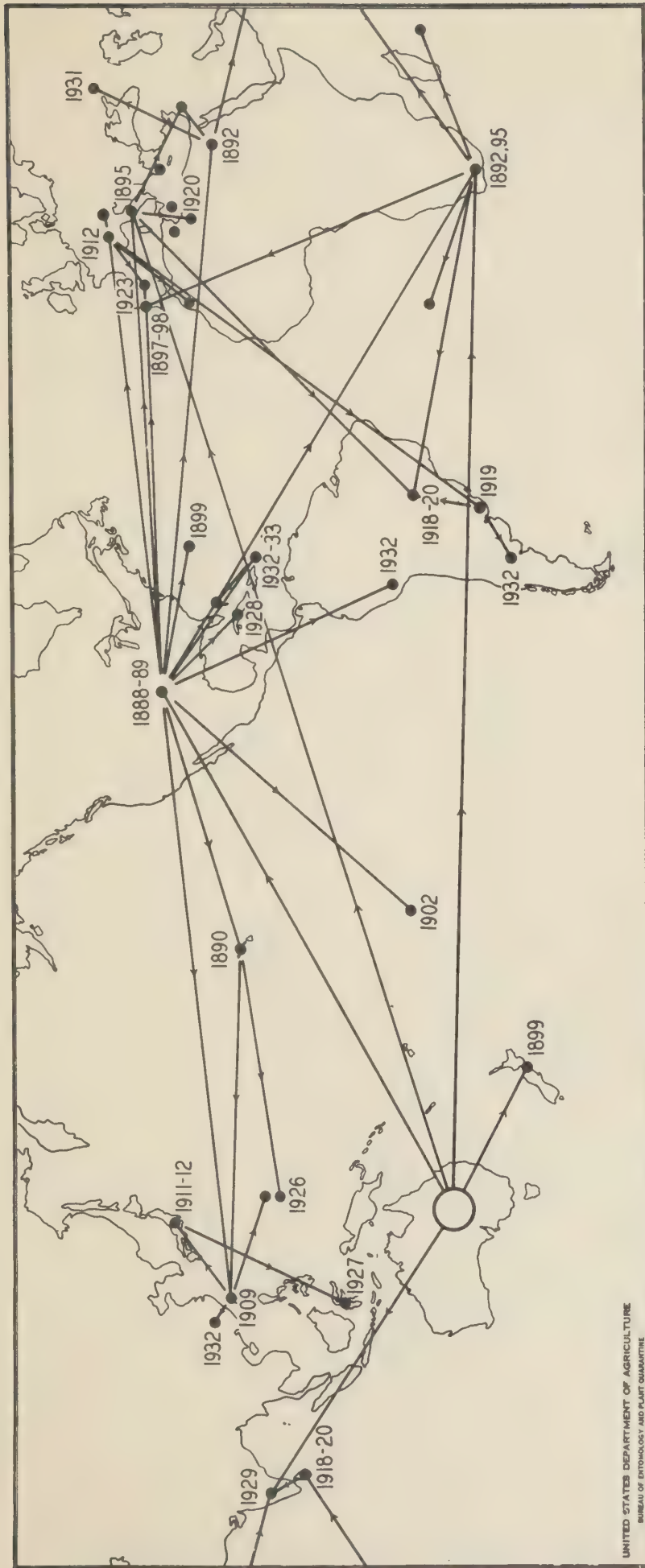


Fig. 4. - The *Vedalia* beetle (*Rodolia cardinalis* Muls.) is predacious upon the cottony cushion scale (*Icerya purchasi* Mask.) and is native to Australia. It was imported into the United States in 1888-89. The spectacular success of this introduction was followed rapidly by colonization in many other countries. It is known to have been shipped to 45 different countries and to have become established in 31 of them. The dates of a number of these movements are shown. The same striking results produced in California were duplicated in many other sections.



INTERNATIONAL MOVEMENT OF *CRYPTOLAEMUS MONTROUZIERI* MULS. 1891-1934 INC.

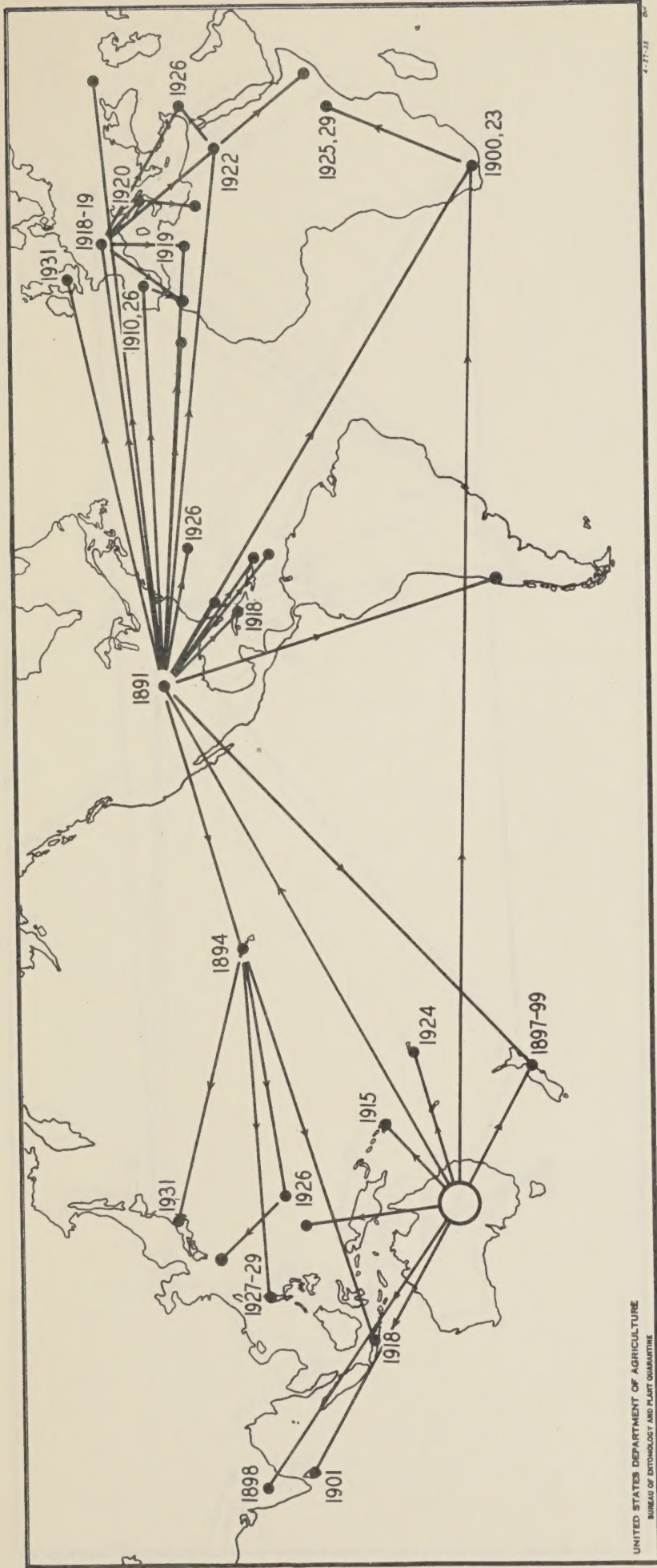


Fig. 5. - The Australian beetle (*Cryptolaemus montrouzieri* Muls.) is predacious upon various species of mealybugs, and is native to Australia. It was imported into California in 1891, and since that date has been distributed to 33 different countries. The dates of many of these movements are shown on the chart. Establishment is known to have occurred in 15 countries. In many temperate or subtropical sections recolonization is necessary each spring to secure effective results.



INTERNATIONAL MOVEMENT OF APHELINUS MALI HALD. 1920-34 INC.

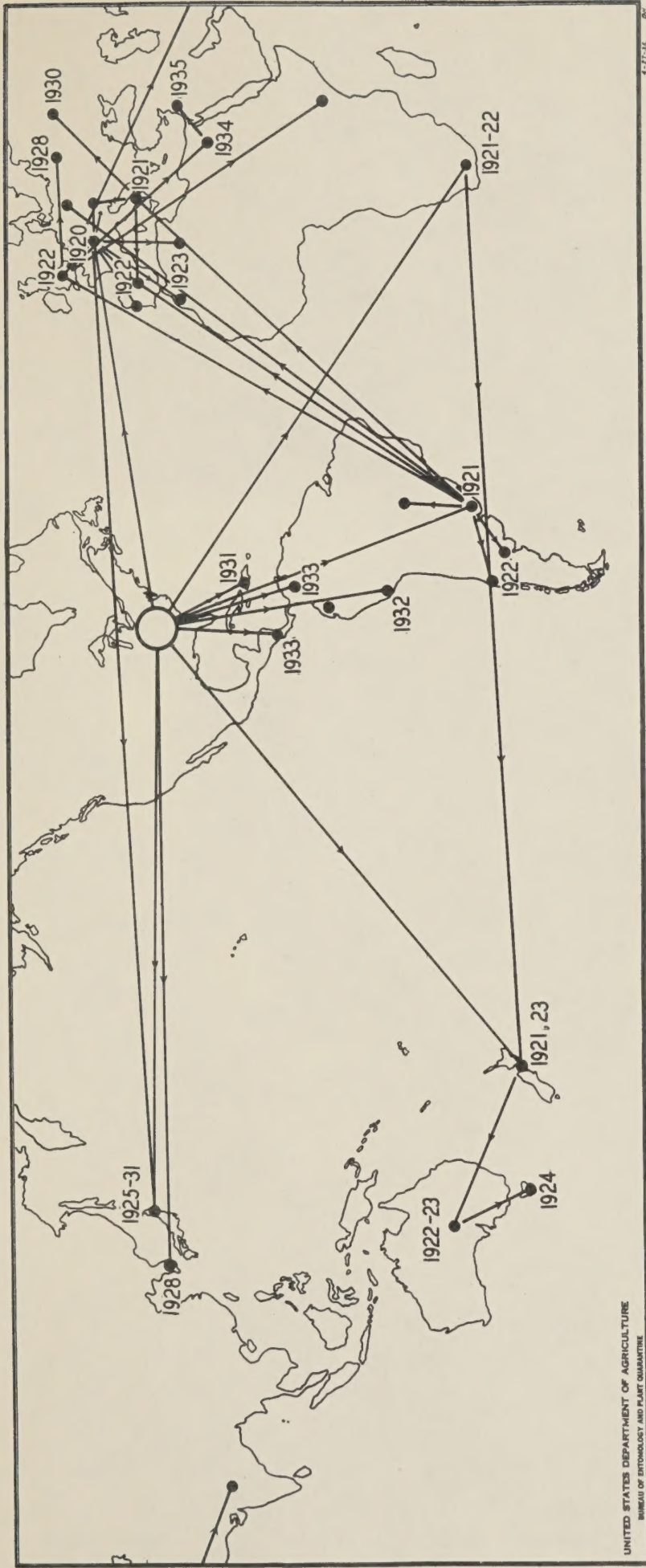


Fig. 6. - Aphelinus mali Hald., an internal parasite of the woolly apple aphid (Eriosoma lanigerum Hausm.) is native to North America. Following its shipment to France in 1920 it has been colonized in 38 different countries, and records of establishment are available for 26 of these. The dates of importation into a number of countries are shown. Effective control has followed in a number of instances. An account of the early travels of this parasite is given by Dr. L. O. Howard in the Annals of the Entomological Society of America, Vol. 22, No. 3, 1929.

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