the other hand, the precipitin dilution scale is uniformly logarithmic throughout.

Since none of the data were presented in numerical form it was very difficult to determine the infectivity data from the graphs, especially in the distorted portion. However, close estimates were obtained, and these together with the seric-reaction data were replotted on standard semi-logarithmic paper. In the tobacco mosaic and tobacco ringspot, it was found that the datum points for infectivity and seric reaction of the unheated viruses do not coincide, the points for the virus of tobacco mosaic showing an especially marked departure.

Chester calls especial attention to the fact that his curves for the seric inactivation and infectivity nearly coincide for each virus, but this curve proximity is accentuated through the use of the logarithmic scale which compresses increasingly as the data increase in magnitude. By plotting these data on plain graph paper this relationship is much less striking, especially in those curves in the upper portion of the figure.

For purposes of interpreting the antigenic nature of a virus it seems apparent that the infectivity and the seric-reaction end points are of much greater significance than the other points on these curves. These end points seem to be close in the case of each virus given the temperature treatments. It appears also that these end points were close when the viruses were treated with chemicals.

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CLEAVAGE WITHOUT NUCLEI

WHEN unfertilized *Arbacia* eggs are centrifuged for four minutes at 10,000 X gravity in a sucrose solution isosmotic and of the same density as the eggs, so as to keep them suspended, they break into two nearly equal parts.[1,2] One of these parts is nucleated, *i.e.*, contains the female pronucleus, and the other is non-nucleated. This distribution is invariable; the nucleus always lies in the light half, under the oil cap. By treating the non-nucleate halves, which contain only yolk and pigment granules and the matrix or ground substance, with parthenogenetic agents, such as concentrated sea water, they throw off fertilization membranes. When transferred to sea water, cytasters soon appear, and after two hours cleavage planes appear in many of them. These divide the enucleate half-eggs sometimes into two equal cells, sometimes into two unequal cells and sometimes into three or four cells, equal or unequal. By subsequent cleavages, the enucleate half-eggs develop into blastulae, sometimes quite normal in appearance. Blastulae of approximately a hundred cells have developed from these activated enucleate half-eggs, though as yet no swimmers. Cleavage can therefore occur in eggs without either maternal or paternal nucleus. A full account of these parthenogenetic merogones with photographs will be published shortly.

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[1] E. N. Harvey, *Biol. Bull.*, 61: 273, 1931.
[2] E. B. Harvey, *Biol. Bull.*, 62: 155, 1932.

THE HATCHING OF EGGS OF THE SOUTHERN BUFFALO GNAT

IN the spring of 1927 and in other years since that time considerable numbers of farm animals, chiefly mules, have been killed in the lower Mississippi Valley by outbreaks of the Southern buffalo gnat (*Eusimulium pecuarum* Riley) (Simuliidae: Diptera). In former times this insect caused enormous losses of live stock in this region, but for some forty years prior to the present series of outbreaks, little was recorded concerning its depredations. That the sudden appearance of swarms of this pest is in some way dependent on spring floods has long been known, but the available information on the life history of the insect has failed to explain satisfactorily the phenomenon of this relationship.

After an investigation of the buffalo gnats that infest the lower Mississippi Valley, with special reference to *Eusimulium pecuarum*, Webster[1] stated that, so far as observed, the eggs of all the species dealt with hatch within a few hours, and the larvae live in the streams nearly an entire year before changing to pupae. The writer has for several years past made a careful search for young larvae of *E. pecuarum* in the gnat-producing rivers of Mississippi and Arkansas immediately after the spring outbreaks and also later in the summer.[2] During neither of these periods has he been able to find young larvae, although very small ones, which appeared to be *E. pecuarum*, were collected on November 22 and 23, 1932.

In April, 1934, several lots of eggs were obtained by confining gravid females of this species in jars over water. These jars were brought to the laboratory at Orlando, Fla., and were divided into two lots; one, in which the water was kept agitated and aerated by a continuous stream of air produced by a suction pump in a manner similar to that described by McCutcheon[3];

[1] F. M. Webster, U. S. Dept. Agric., 4th and 5th Annual Reports of B. A. I. for the years 1887 ad 1888; 456–465. 1889.
[2] G. H. Bradley, "Notes on the Southern Buffalo Gnat." (Accepted for publication in Proc. Ent. Soc. Wash.), 1935.
[3] F. Harold McCutcheon, SCIENCE, 76: 1975, 416–417, November 4, 1932.

the other, in which the jars were left undisturbed in the laboratory. The eggs were examined under low magnification occasionally during the following months, and up until November 5 no sign of larval development had appeared. Owing to the stress of other work further examination was not made until the middle of December, at which time large numbers of eggs in both the still and aerated jars contained fully formed larvae and some in each series were hatching.

It is apparent, therefore, that the eggs of *E. pecuarum* will hatch after spending the summer in a quiescent stage undergoing an incubation period of several months in either still or moving water. This finding offers an explanation for the fact that, in addition to the numbers of adults which emerge every spring from certain rivers, enormous numbers are produced during spring floods from the many "cutoffs," "bays" and lakes which are to be found in the lowlands of Mississippi and Arkansas and in which the water is quiet, except when adjacent rivers overflow. Since all *Simulium* larvae, so far as is known, require running water for their development, it appears that the long period which *E. pecuarum* spends in the egg stage is an adaptation for passing the several months during which a large part of its breeding places are likely to be unsuited for larval life. It seems probable that adult gnats are not produced from larvae coming from eggs which hatch in these quiet waters except in the event that a spring overflow occurs and keeps the waters in motion for a period sufficient to permit larval maturity. When such an overflow occurs, myriads of larvae may develop more or less simultaneously and give rise to swarms of adults, which under weather conditions favorable for their survival and migration cause large losses of farm animals.

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BIOLOGICAL CONTROL OF AN INSECT PEST BY A TOAD

IT is generally appreciated that many of the most destructive insect pests of any crop, in any country, are of foreign origin, inasmuch as in their migrations some at least of their natural enemies are left behind. Biological control of such introduced insect pests is therefore much more to be expected than the control of native insect pests by foreign natural enemies. The practical control of the native white grubs, the most serious and generally destructive insect pest of agricultural crops in Puerto Rico, by means of an introduced toad is therefore somewhat more notable and is perhaps the first authentic record of a foreign predator successfully reducing the numbers of an insect pest which is native to the country in which it was destructive. The foregoing statements and the history of the white grubs which follows are from no less an authority than Dr. George N. Wolcott, entomologist of the Insular Experiment Station of Puerto Rico.

The white grubs of Puerto Rico are larvae of large beetles of several species of the genus *Phyllophaga* (*Lachnosterna*); these species are found nowhere else in the West Indies or continent. In the mainland United States related species are known as May beetles or June bugs.

The rapid expansion of the sugar industry, following the change in governmental status of Puerto Rico in 1898, provided a continually more abundant food supply for these white grubs and also tended to eliminate many of their natural enemies such as owls and other large insectivorous birds. In some of the richest and otherwise most productive regions of the island, all the cane fields were more or less affected and cane harvesting often became a race to see if the stalks could be gathered before the grubs had completely destroyed all the roots.

Attempting to control the pest, an expensive method of hand collecting the grubs and beetles was first used. On one property during six years approximately 12,000,000 beetles were collected and an equal number of grubs. Other methods of artificial control were tried, such as dynamiting the fields, maintaining a herd of pigs to follow the plow and eat the grubs and by applying various chemicals. Also attempts were made to introduce insect parasites of other species of grubs from other countries, but all resulted in failure.

The first importation of the Surinam toad, *Bufo marinus* L., from Barbados, was made in 1920 by the Puerto Rico Experiment Station of the U. S. Department of Agriculture to combat these white grubs. In the winter of 1923–24 R. Menéndez Ramos, director of the Insular Experiment Station, brought in 40 additional individuals from Jamaica.

Bufo marinus is comparatively large, averaging 6 inches in length and is more than double the size of the ordinary American toad. It is venomous, but thousands have been collected by children for distribution without the venom being noticed. However, a dog seizing one in the mouth may receive a fatal dose of poison.

The first introductions were released on the station grounds at Mayaguez. A few years later they were being collected at the station and distributed to all parts of the island. Hundreds and thousands were carried from the station to the cane fields of the southern coast, where May beetles were most abundant and the toad could be of greatest value in reducing