of the three estrogens. The partition column is of small size and is simple, rapid, and uncomplicated in operation. The application of this method to the determination of the microquantities of estrogens present in blood is now in progress.

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Induced Emigrations Among Small Mammals

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This study of the effect of intensive trapping over a large area upon the members of the surrounding population consists of two experiments. One of them was conducted on Mount Desert Island, Me., during the summer of 1950; the second, in the Huntington Wildlife Forest near Newcombe, N. Y., during the summer and fall of 1951. The predominant genera of mammals inhabiting these forested areas are *Peromyscus, Clethrionomys, Blarina,* and *Sorex,* which may be considered as a biological unit designated as "small mammals."

The population was reduced by the rapid removal of individual animals from the study areas by operating groups of trap lines. Each trap line consisted of 20 stations 50 feet apart, with 3 traps at each station. The several trap lines in each location were distributed so that they formed a rough rectangle. In each case the distribution was such that the population resident on 40–80 acres was reduced nearly 60% during the first 3 days of trapping. On the Maine location, 8 trap lines were used, making a total of 480 traps set each night. The term "trap night" will be used to indicate one trap set one night. On the Maine location trapping was run for 15 consecutive days with a terminal 3-day period of trapping following a 5-day interval. On the New York location, four trap lines were set during the first 10 days. Two were placed in the form of a cross on each of the opposite corners of a quarter-section. From the 11th through the 33rd day, 5.3 trap lines within and at the other two corners of the quarter-section were added. Although this procedure increased the area of sampling, it did not appear to alter the trend of the results.

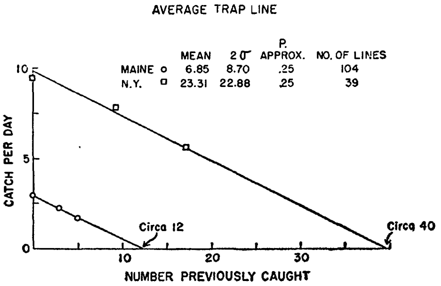

FIG. 1. Average trap lines for Maine and New York. Data for Maine cover 104 trap lines run during 1949, 1950, and 1951. Data for New York cover 39 trap lines run during 1951. Were the approximate probability of capture ($P = .25$) to continue on later days without invasion, the resident population exposed to an average trap line would be indicated by the intersection of the abscissa by the lines drawn through the first 3 days' captures.

The study on the Maine location was conducted by A. Dexter Hinckley under the supervision of John B. Calhoun. The study on the New York location was conducted by William L. Webb and Earl F. Patric.

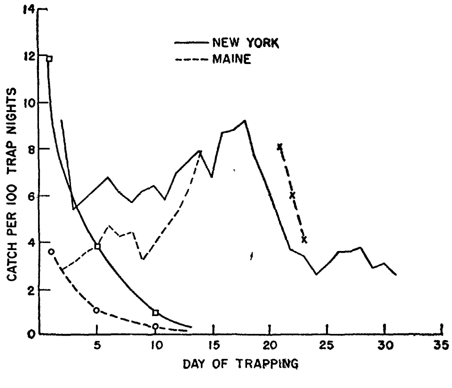

FIG. 2. Observed and expected sequences of captures in Maine and New York arising from continuous trapping beyond 3 days. The left-hand exponential curves are approximated expected curves had there been no invasion of the trapped area, where the catch for the first 3 days is 58% of the residents, and where the probability of capture is 0.25. The observed curves are 3-day moving averages, with the exception of the last 3 days for Maine, which are the observed captures. There was no trapping in Maine on days 16 through 20. The 425 animals taken in Maine and the 855 taken in New York are shown in terms of catch per 100 trap nights for the sake of a better comparison.

In both locations large numbers of trap lines have been run at other sites within the same general habitat, and the resultant data (Fig. 1) reveal the general effect that this method of trapping has upon the resident population. The population at the Maine location was less than one third that in New York. The *t* test of the significance of the difference between the mean population densities of the two areas has a probability of less than .001. In both areas, the trend of decrease through the first 3 days was such as to indicate an approximate probability of capture of 0.25—i.e., on the initial day 25% of the population is removed, and on each succeeding day 25% of those remaining is removed. Were there no invasion from surrounding areas, the resident population would be essentially removed at the end of 10 days. Data showing similar results to those of Fig. 1 are available for approximately 1000 of these standardized trap lines (*1*).

In contrast with the hypothetical trends in the removal of resident populations, shown in the two left-hand exponential curves in Fig. 2, the observed trends show that there was a marked invasion accompanying the continuous trapping in each of the two locations. The number of invaders in Maine during the first 23 days was five times that of the calculated original resident population. Similarly, on the New York location the number of invaders during the period of 23 days was 2.3 times the calculated resident population. It will be noted that in the New York location, which had the higher relative density, the rate of invasion was lower than in Maine. In both places invasion appears to have stopped sometime after the 16th–18th day. In New York there was a period of 6 days in which the captures seem to have been merely a removal of those animals that had arrived by the 18th day. Later there was a slight secondary invasion.

Several concepts may provide the basis for a tentative hypothesis to explain this invasion. The first point of consideration is the extent of the area depleted by continuous trapping. In each case the minimum distance across the trapping area slightly exceeded 1000 feet. We assume that this distance is sufficient to insure that untrapped animals living to one side of the trapping area are unable to detect the presence of other untrapped individuals on the opposite side. In other words, there was produced through the initial 3 days of trapping a "biological vacuum" insofar as the frequency and intensity of perception of neighbors were concerned.

Since small mammals move into the denuded area so rapidly, it is suspected that shifting the place of habitation is a response directly related to the relative intensity, frequency, or both, of perceiving neighbors at a distance. There are at least two alternative hypotheses to explain movement into the biological vacuum. First, as each animal moves about its home range, it must from time to time perceive its neighbors. If an avoidance response were to result from these perceptions, each individual would tend to concentrate its activities at some distance from any neighbors. In the case of the artificially produced biological vacuum, the center of activity of those individuals living on the periphery will shift away from the higher concentration of neighbors and toward the depleted area. Second, each individual may become conditioned to a certain pattern of perception of neighbors about its home range. This pattern may be one of unequal intensity, or unequal frequency of perception in various directions. This is an anticipated situation where irregularities in the physical environment affect density of distribution. Where there is an alteration in the pattern in any direction, the animal affected will shift its home range in such a way that the pattern or ratio of frequency of perceiving its neighbors will remain the same, although the absolute level of intensity of the stimuli in question may be altered. Thus, when a biological vacuum suddenly appears at one side of an animal's home range, it will move in the direction of this depleted area as if in an attempt to encounter again the stimuli produced by neighbors. It may well be that both intensity and pattern alterations in perception are simultaneously involved.

Whatever the exact mechanism underlying the response, those animals living just peripheral to the area subject to continuous trapping do move into it. As soon as the shift occurs, the next group living still farther away must move into the area just vacated by the previous group. Through this process a biological chain response is established whereby a simultaneous movement toward the central depleted area extends for a considerable distance away from the periphery of the trapping area.

If the inward movement covers a constant distance per day, one would expect that the number of invaders captured in the central area would increase daily, because consecutive bands of equivalent width (w) but lying at even greater distances from the periphery of the depleted locality increase in area at a constant rate of $2\pi w^2$. Thus, where density is proportional to area, an increasing catch per day might be anticipated. These generalizations are based upon the hypothetical use of a circular depleted area.

A trend toward an increasing catch on successive days is evident in the data from both locations (Fig. 2). At least this applies from the third day approximately through the 15th–18th. The fluctuations in the trend may well be dependent upon fluctuations in density through the habitat, as well as upon the effect of variations in the weather on the movement of the animals with reference to the traps.

Fig. 2 shows that the increase in catch per day was greater in Maine than in New York. Just the reverse might have been anticipated upon the basis of the greater density in New York, had all other factors affecting the invasion been the same. Our present data are inadequate to offer any explanation for the possible existence of an inverse relationship between density and rate of invasion. The causes of difference in rate of invasion most probably must be sought among factors that alter the distance (w) moved per day during invasion, or that affect the proportion of the population set in motion.

Many other studies (*2, 3*) have reported data concerning the capture of small mammals from a central area exposed to continuous trapping. These studies differ from ours in that the diameters of the areas were much more limited, ranging in general from 1 to 10 acres. In the case of smaller tracts there is only a gradual drifting in of nonresidents, in contrast to the more marked invasion observed in the present studies. The absence of any marked invasion, we believe, is attributable to the ability of the animals to detect others across the smaller depleted area. We have under way several more extensive and refined experiments designed to elucidate the above hypotheses, as well as to provide data on some variables not discussed here.

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Heterotransplantation of Human Tumors Into Cortisone-treated Rats

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Ever since the experiments of Murphy, starting in 1914 (*1*), the role of the lymphocytes of the host in the resistance to heterotransplantation has been the subject for intensive investigations. The production of antibodies by lymphocytes has been established (*2*), and the release of immune γ-globulin from lymphocytes demonstrated (*3, 4*). Murphy observed the persistence of transplanted mice tumors in x-irradiated rats (*5*). Recently it has been shown (*6*) that large doses of x-ray to rats and mice make these animals receptive to heterotransplantation of human tumors, and successive transplantations were carried out. The success of this experiment, as of those of Murphy, was related to the reduced lymphocyte counts of the irradiated animals. Prior to this experiment, transplantation of human tumors was successful only when it was carried out in the anterior chamber of the rabbit eye (*7, 8*).

As the administration of cortisone results in a greatly reduced lymphocyte count, heterotransplantation of human tumors in cortisone-treated rats was attempted. It was found previously by Foley and Silverstein (*9*) and by Howes (*10*) that the strain-specific resistance to transplantation of tumors in mice is greatly impaired by treatment with cortisone.

Biopsy material of human tumors was transplanted. Generally no more than 10–15 min elapsed between the removal of the tumor, establishing of the diagnosis by frozen section, and transplantation of the tissue into cortisone-treated rats. The tumor was cut into small fragments and transplanted, by the use of a trochar (1–2 mm diam), subcutaneously into the left inguinal region of 3 or 4 treated rats. The pretreatment of the rats varied because of the irregularity of the receipt of suitable material from the operating theatre. As rats had to be kept prepared, the number of injections before the transplantation varied between one and four. Young Wistar rats, mostly females, at the age of 4–6 weeks. were used. The rats received 25 or 12.5 mg of aqueous suspension of cortisone acetate subcutaneously at 2- or 3-day intervals. No untoward effects were manifest in the rats except for retardation in growth. Nine tumors were transplanted. Table 1 shows the origin of tumors transplanted and the results. Photomicrograms of tumors are given in Figs. 1 and 2. Rats were killed 4–21 days after transplantation, but as a rule after 8 days. The skin and muscle around the transplant were examined, and any nodules found were studied histologically. With the exception of one rat, killed 4 days after transplantation, no inflammatory reaction was found around the transplant. The survival of the transplanted tissue was judged by the size of the transplant, by the healthy occurrence of the tumor cells, and by the presence of mitoses in the sections. Reliable evidence for growth are the mitoses found several days after transplantation. The size of the transplants increased during the days following transplantation and was 4–5 times that of the original size after 10–14 days. The increase in size alone, however, cannot be taken as a measure of the growth of a transplant, since fibroblastic proliferation of the host tissues may also participate. No serial transplantation was attempted. Out of 9 tumors transplanted into 28 rats, positive results were obtained with 8 tumors in 14 rats. A carcinoma of the kidney was the only tumor not transplantable to any of the rats. This tumor was heavily infected. None of the tumors grew in all rats to which they were transplanted; the highest take was 3 out of

TABLE 1

Tumor transplanted	No. of rats	No. injections before transplantation	No. injections after transplantation	No. of successful transplants
Cancer of bronchus	4	2	3	1(4)* 1(12) 1(16)
Cancer of breast	3	4	2	1(8)
Metastasized lymphnode cancer of bronchus	3	2	2	2(13)
Cancer of breast	3	3	3	1(10)
Juvenile melanoma	3	4	3	2(8)
Cancer of breast	3	1	4	1(12)
Cancer of esophagus	3	3	3	2(8)
Cancer of kidney	3	2	3	0(7)
Ependymoblastoma	3	3	3	2(12)

* Figures in parenthesis represent the days after transplantation at which the rats were killed.