THE TRANSPLANTATION OF TUMORS TO FOREIGN SPECIES.*

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PLATE 51.

It is known that when a mouse tumor is implanted into rats growth goes on for seven to ten days, but then resorption takes place. The failure of tumors to grow in animals of foreign species seems to be a general rule to which few exceptions are known. Ehrlich explains the temporary growth of mouse tumors in rats on the theory, the so called athreptic theory, that the foreign organism is lacking in specific foods, which exist only in animals of the sort from which the tumor came.

The recent work on the influence of diet on tumor growth has shown the importance of this hitherto undervalued factor. It seems advisable to investigate the influence of feeding to animals in which a tumor of a foreign species is growing, the tissue of that species, more especially tumor tissue itself. In this way the substance which the tumor needs might be supplied. Some time ago I tried to render rats more susceptible to mouse tumor by injections of alcoholic extracts of mouse tumor, but though some success was obtained the study had to be abandoned as the injections proved toxic.

The experiments here to be reported were arranged as follows: The tumor chosen was Ehrlich's mouse chondroma, which "takes" in a very high percentage of the mice to which it is transplanted. Before the experiments were started, many mice were inoculated with the growth to supply the tumor material used for feeding. Then a

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1 Among the reported cases of successful transplantation of human tumors to animals, or of animal tumors to other species, few will stand criticism. In very few cases indeed (Dagonet-Mauclaire, Carl Lewin) were the growths successfully reinoculated.

large number of rats were inoculated,—also with the chondroma,—
and these were divided into two batches, one batch being fed on ordi-

nary food, the other on ordinary food with the twice daily addition
of freshly excised chondroma from the mice. The rats ate the
tumor material with avidity.

The results were striking: In rats fed the tissue of the chon-
droma, this growth succeeded on inoculation much better than in
those receiving ordinary diet.

Experiment I. First Generation.—Two batches, each of thirty young rats,
were employed. One batch was fed, besides ordinary food, the mouse chon-
droma twice each day. After a week of the feeding both batches were inoculated
with material of the mouse chondroma. The same tumor was used for all the
inoculations. In the controls fed on ordinary food but one small tumor ap-
peared. This was noticed after ten days and was completely absorbed after
fifteen days. Of the rats fed the chondroma, six developed tumors, and in one
instance the growth after sixteen days was about 12 by 18 mm. in size. It was
disc-shaped and only 3 to 4 mm. thick. This tumor was examined micro-
scopically and showed the histological characters of the original tumor (figure 1),
but in distinction from the latter, which was soft and hemorrhagic, it was firm,
and consisted, as the drawing shows, practically entirely of the chondroma cap-
sules with very little homogeneous, intracellular substance (figure 2). Bits of it
were transplanted to twenty rats and six mice. A chondroma developed in all
of the latter, but much later than usual, showing that the transplantation into
rats had in some way rendered the tumor unfit for mice. The results of the
transplantation into rats is recorded below.

In another rat of this experiment the tumor reached, after five weeks, the
size of a pea and was reinoculated into six mice with success in all cases.

Second Generation.—Twenty rats were inoculated with bits of the large tumor
just described. All were fed the mouse chondroma. In one of the eighteen
which survived seventeen days there was noted a tumor measuring 1 by 0.5 cm.
Two other rats showed after twenty-four days tumors of the size of a small pea;
and six had very small tumors which finally disappeared. The largest growth
was examined microscopically and proved to be the chondroma. It was trans-
planted to eight rats and four mice,—to all of the latter successfully. The result
in the rats was as follows:

Third Generation.—The eight rats inoculated with the tumor of the second
generation were all fed the mouse chondroma. After eleven days one had a
tumor the size of a big pea and five had smaller nodules, which finally disap-
ppeared. The largest tumor in this case was found microscopically to be a
chondroma.

Further transplantations were abandoned because there was not sufficient
material for inoculation.

Experiment II.—Twenty rats were inoculated with the mouse chondroma
from a mouse of experiment I, which had been inoculated with a tumor from
FIG. 1.

FIG. 2.

(Funk: Transplantation of Tumors to Foreign Species.)
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a rat of the first generation. The animals were divided into two batches, one fed on ordinary food, the other on the same diet with the addition of tumor tissue. In the latter batch two tumors developed which still persisted after twenty-four days. One was the size of a large pea. In the controls no tumors were observed.

The experiments show that by feeding tumor tissue to animals of alien species they may be rendered more favorable to the growth of this tumor. The tumor employed, the mouse chondroma, was successfully transplanted in three successive series of rats, and kept alive for five weeks in all. But with every transplantation the tumors obtained were smaller, until the material was not sufficient for inoculation purposes. The results might have been more successful if a larger number of animals had been used, since only a very small percentage of the rats furnished tumors sufficiently large to be useful for transplantation. The method is promising enough for further experiments on other perhaps more suitable tumors and on other animals.3

SUMMARY.

By feeding to rats the tissue of the mouse chondroma they are rendered more suitable as hosts for the growth. Using this method rats have been inoculated successfully with the mouse tumor and it has been transferred to three successive series of these animals.

EXPLANATION OF PLATE 51.

Fig. 1. Mouse tumor (chondroma). Leitz ocular 2, objective 8.
Fig. 2. Mouse tumor (chondroma) in a rat of experiment I, generation I. Leitz ocular 2, objective 8.

8 Following the work of Murphy (Murphy, Jas. B., Jour. Exper. Med., 1913, xvii, 482) on heterogeneous transplantation in embryos, Bashford has shown that newly born animals are favorable hosts for the tumors of other species (Bashford, E. F., Twelfth Annual Report of the Imperial Cancer Research Fund, 1913-14. 9). The animals used in the present experiments were one-half to three-quarters grown.