(2) In addition to the receptors postulated by the above theory, there are either yellow receptors, white receptors, or both. In this respect the results so far obtained agree with the results obtained by Prof. Ragnar Granit who, as stated above, used the micro-electrode technique on the eyes of animals.

(3) Fixation can be extremely precise, since the effects of eye-movements do not show themselves.

(4) It is possible to stimulate by light, either single cones, or very small groups of cones indeed.

(5) It has been possible to identify, with the precision of at least half 'the cone intercentre distance', the position of some of the receptors which possess specific colour properties.

No evidence has so far been obtained that the green and blue sensations of human vision are due to the combined responses of several different kinds of receptor operating in narrow regions of the spectrum. It is hoped that further research with the microstimulator will help to elucidate this point.

I should like to thank Dr. John D'Silva, who acted as recorder for many of the above observations.

H. HARTRIDGE

Physiological Department,
Medical College of St. Bartholomew's Hospital,
London, E.C.1.
June 21.

Carcinogenic Substance from Human Cancer

J. F. MENKE[1] obtained lipid extracts from human breast cancer which, when injected into white mice, induced, in seven of thirty-six animals so treated, the development of sarcomas at the site of injection. In our experiments analogous extracts were prepared from various human cancers. Two extracts were prepared from gastric carcinoma, three extracts from breast carcinoma, and two extracts from fibrosarcoma. Each of the extracts was tested separately.

Four-months-old white mice of our own breeding were used in the experiments. Our strain of mice has a negligible incidence (less than 2 *pro mille*) of spontaneous tumours. The animals received 10, 20 or 30 mgm. of the lipid extract suspended in sweet almond oil, as a single subcutaneous injection. No differences were noted in the effect with variation of the doses within these limits. Of ninety-four mice injected with the extracts, twenty died within the first four months of the experiment. Of the remaining seventy-four mice, twenty-one animals (28·4 per cent) developed malignant tumours.

The tumours developed chiefly in organs at a distance from the site of injection, and exhibited various histological types including carcinoma and sarcoma. Gastric carcinoma extracts provoked two breast carcinomas (in two females), two lung lymphosarcomas (in one male and one female), and one lymphosarcoma at the site of injection (in one female). Breast carcinoma extracts provoked four breast carcinomas (in four females), one lung lymphosarcoma (in one female), one liver carcinoma (in one male) and two lymphosarcomas at the site of injection (in two females). Fibrosarcoma extracts provoked four breast carcinomas (in four females), one lung lymphosarcoma (in one female), one lung carcinoma (in one male), one kidney carcinoma (in one male), and one lymphosarcoma at the site of injection (in one female).

All seven extracts tested induced approximately the same percentage of tumours in the animals treated. The average period of time necessary for the development of tumours was 6 months for the gastric carcinoma extracts, 11 months for the breast carcinoma extracts, and 7·6 months for the fibrosarcoma extracts.

Of the fifty-three animals which died without developing tumours, the individuals survived as follows: four for 5 months, eight for 6 months, five for 7 months, seven for 8 months, four for 9 months, two for 10 months, two for 11 months, three for 12 months, and eighteen longer than 12 months.

Attempts undertaken with the aim of separating the active factor from the extracts resulted in a marked diminution of the number of malignant tumours provoked. Of fifty-seven mice injected with the chemically modified extracts, only six animals developed cancer. The average time for the development of the tumour after the single injection was approximately twice the time observed with the non-modified extracts.

Lipid carcinogenic extracts have been obtained from human livers[2–8] and from beef pituitary glands[9]. These experimental findings indicate that a lipid carcinogenic substance, probably of hormonal character, can be extracted from certain organs. Our experiments demonstrate that an analogous substance is present in human cancers. For this substance we propose the name 'boardin', which is accepted in our laboratories. Attempts are in progress to separate boardin from the extracts.

The histological diagnosis of the tumours was verified by Dr. Francis Carter Wood, to whom we are indebted for his co-operation.

HENRY K. WACHTEL

Cancer Research Laboratories,
Fordham University,
New York.
June 18.

[1] Menke, J. F., *Science*, **92**, 290 (1940); *Cancer Res.*, **2**, 786 (1942).
[2] Des Ligneris, M. J. A., *Amer. J. Cancer*, **39**, 489 (1940).
[3] Higier, I., *Amer. J. Cancer*, **39**, 496 (1940); *Science*, **93**, 262 (1941).
[4] Kleinenberg, H. E., Neufach, S. A., and Schabad, L. M., *Amer. J. Cancer*, **39**, 463 (1940); *Cancer Res.*, **1**, 853 (1941).
[5] Neufach, S. A., *C.R. Soc. Biol. Paris*, **124**, 616 (1937).
[6] Sannié, Ch., Truhaut, R., and Guerin, P., *Bull. Assoc. l'Étude Cancer*, **29**, 106 (1941).
[7] Schabad, L. M., *C.R. Soc. Biol. Paris*, **124**, 213 (1937); **126**, 1180 (1937).
[8] Steiner, P. E., *Science*, **92**, 431 (1940); *Amer. J. Path.*, **17**, 667 (1941); *Cancer Res.*, **2**, 425 (1942); **3**, 385 (1943).
[9] Wachtel, H. K., *Science*, **103**, 556 (1946).

Transmission of *Litomosoides carinii* to Mice and Hamsters

Litomosoides carinii is a filariid parasite of the cotton rat, *Sigmodon hispidus*. It has been used extensively in the United States to investigate the chemotherapy of filarial infections. R. W. Williams and H. W. Brown[1] and J. A. Scott (private communication) have recently shown that infection was transmitted from one animal to another by means of the tropical rat mite *Liponyssus bacoti*. These workers kindly showed their results and methods to one of us and provided us with a colony of the mites and some infected cotton rats. Further infected cotton rats were kindly lent us by Prof. R. M. Gordon.

The transmission of *Litomosoides* to clean cotton rats and to laboratory (piebald) rats has been confirmed in this Institute, microfilariæ being found in the blood of the rats 63 days after the first exposure to infected mites. The blood of some of these rats has contained as many as 450,000 microfilariæ per c.c.

In addition, the attempt was made to transmit the infection to other laboratory animals. Nine albino mice were exposed to infected mites for 40–70 days. After 42 days, one mouse was killed and nine worms, measuring 5–14 mm. long, were found in the pleural cavity. The blood of the other mice was examined at somewhat irregular intervals. Microfilariæ were found in the blood of two mice, each on a single occasion, on the eighty-second and ninety-first days respectively after the beginning of the exposure to infection. No microfilariæ have been seen in the blood of the other six mice up to the ninetieth day. Three hamsters (*Cricetus* (*Mesocricetus*) *auratus*) were exposed to infection for periods of 26–44 days. One hamster died after 39 days; five worms, measuring 1–3·2 cm. long, both sexes being present, were found in the pleural cavities. Another hamster was killed after 44 days; the pleural cavities contained thirty-four worms, 1–3 cm. long, both sexes being present. In the case of the third hamster, microfilariæ were found at the first examination of the blood made on the seventieth day and on subsequent occasions, the number present being small.

FRANK HAWKING
ANN M. BURROUGHS

National Institute for Medical Research,
London, N.W.3. June 22.

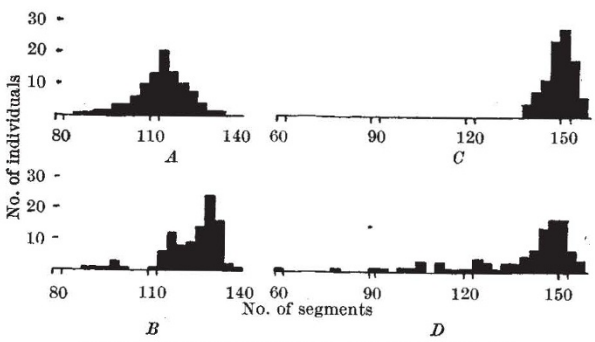
[1] Williams, R. W., and Brown, H. W., *Science*, **102**, 482 (1945); **103**, 224 (1946).

Distribution of Number of Segments in Earthworms and its Significance

DURING the course of an investigation into the relations between earthworms and the fertility of the soil, it has been found necessary to study the biology of the several species found in grassland in some detail since, in spite of their natural abundance, possible importance and extreme commonness as a type in zoological classes, very little is known about their biology, distribution on different types of soil, seasonal activities, etc. One of the factors making such a study difficult has been the fact that the specific characters are largely based on the position of the clitellum and tubercula pubertatis, which only appear at the onset of sexual maturity. Thus in a representative sample of worms only a small proportion are identifiable.

It has been the custom of systematists when describing species of earthworms to state the approximate number of segments, but little emphasis has ever been placed on this character. In an attempt to identify the numerous immature specimens collected during the past year, a detailed study has been made of the variation in the number of segments for a number of species. The results show that each species has a typical number often differing widely between nearly related members of the same genus, so that, taken in conjunction with other somewhat vague characteristics, about 95 per cent of the immature specimens in a collection can be identified. The departure of the distribution of the number of segments of adults from the normal distribution of the number for individuals just hatched can lead to interesting conclusions regarding the amount of predatism to which a species is subject, the presence or absence of regeneration in a species or genus, and finally an answer to a very old question, Do earthworms grow by adding segments?

The type of distribution of the number of segments varies considerably for the adults, from normal to an extremely left-skew distribution; that of individuals just hatched is, in general, normal or only slightly left-skew. As a result of predatism by birds and soil predators, a varying degree of left-skewness is introduced into the distribution, depending on the size of the species and on the possibility of regenera-



DISTRIBUTION OF THE NUMBER OF SEGMENTS OF 100 INDIVIDUALS

A, *A. chlorotica*, adult; *B*, *E. rosea*, adult; *C*, *L. terrestris*, recently hatched; *D*, *L. terrestris*, adult.