To date, no other tumors have appeared in either series of animals.

Apparently, for the first time, a factor has been extracted from primary human cancer which is capable of producing tumors in an experimental animal. Further trials of the above experiment are now under way, in addition to the obvious control experiments that will be necessary to establish this finding. Also, an attempt is being made to isolate the active factor from the pooled extracts of several human cancers. These results will be reported when they are completed.

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INSECT LIFE WITHOUT VITAMIN A

IN a series of earlier studies[1] it was found that *Blattela germanica* L., the ordinary cockroach, could grow to maturity upon a synthetic diet of purified casein, starch, salt mixture and yeast or yeast extract. Since this diet was very low in vitamin A, this species must either have synthesized this factor or have had no need for it. Inasmuch as vitamin A seems essential for all the higher vertebrates that have been studied, it is interesting that it may play no part in the life of one or possibly many species of insects.

A new series of experiments was devised to check the earlier results showing no dietary need for this vitamin. The work was then extended still further to determine whether or not the cockroach could synthesize this factor within its body when fed diets devoid of vitamin A or its precursor carotene. The stock diet that has been in use for many years by us for producing cockroaches is a mixture of equal parts of whole wheat flour and dried skimmed milk. This diet was exposed to hot air for six hours at 115° C. to destroy any carotene. The young cockroaches, started two days after emerging, grew better upon this heat-treated diet than upon the original. The purified diet deficient in vitamin A and used in the usual assay procedure for vitamin A was then tested as a stock diet. All these studies indicated that the cockroach could thrive upon diets that are so deficient in vitamin A that they will not support the growth of rats.

The next step to determine if this insect could carry on its body functions without vitamin A consisted in producing large numbers of the insects upon an A-free diet, extracting the fat from these insects and testing this fat for this vitamin.

By the use of large cages 2.5 kilograms of live cockroaches were produced in the course of ten months. These were reared upon the vitamin A-free diet used in the U. S. P. method for the vitamin assay with rats. From these insects were extracted very carefully in the cold 150 grams of oil. This oil was tested colorimetrically for vitamin A but gave only a negative test. It was then fed to rats in accordance with the usual procedure for the assay of vitamin A. Levels of 0.1 and 0.01 grams were fed daily in this assay. Neither level gave any indication of containing vitamin A. In the same assay the reference cod liver oil gave the usual response in growth and prevention of eye symptoms.

From these results it is evident that the cockroach needs no vitamin A in its diet and that its body can function normally throughout its life cycle without this vitamin. Therefore vitamin A is not of universal importance in the life of animals.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A DIFFERENTIAL METAL BELLOWS MANOMETER FOR THE MEASUREMENT OF BLOOD FLOW

THE differential rubber membrane manometer described in an earlier report for the measurement of blood flow by differential manometry[1] has been replaced by a pair of metal bellows manometers, arranged to record mechanically the difference in their pressure readings. The calibration of the manometer couple in this arrangement has remained constant over a period of eight months in almost daily use.

The bellows is a deeply corrugated thin-walled cylinder, which elongates under application of internal pressure.[2] The most flexible small bellows obtainable has an outside diameter of 25 mm and a length of 30 mm. Without load, it responds to internal pressure with elongation at the rate of approximately 0.04 mm for 1 mm Hg in roughly linear fashion up to at least 200 mm Hg. To adapt the bellows for differential manometry, a pair of them was mounted on suitable bases (Fig. 1, *a*) and clamped in position with their movable faces apposed so that each bellows exerted its full thrust against the other. Magnified mechanical recording of the movement at the apposed faces was accomplished by inserting between the faces a short sleeve (Fig. 1, *b*) bearing a rod onto which the short arm of a recording lever was slotted (Fig. 1, *c*). The

[2] Finney-Howell fellow in cancer research.
[1] C. M. McCay, *Physiol. Zool.*, 11, 89, 1938.
[1] Hampden Lawson and J. P. Holt, *Jour. Lab. and Clin. Med.*, 24: 639, 1939.

[2] The courtesy of the Fulton Sylphon Company, Knoxville, Tenn., who supplied the bellows from special stock, is gratefully acknowledged.

sleeve was cut out as shown in the sketch, and fastened to the free face of each bellows with a small amount of solder. Maximum range is secured for the couple by mounting the bellows under minimum compression. The fulcrum which carries the recording lever is adjustable on the short rod *d*. The recording lever and its axle are shown only in the lateral view in Fig. 1.

When coupled in this fashion, the elongation of each bellows for a given rise in pressure is reduced by one half, pressure in the other member of the pair remaining constant. Thus, with the diameter and flexibility given above the volume change for a pressure rise of 100 mm Hg is approximately 0.87 cc. Under most conditions the time required for the displacement of

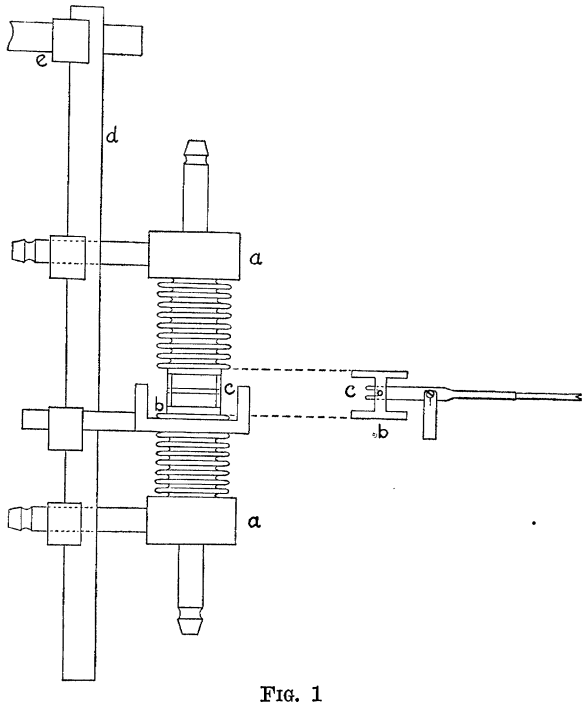

FIG. 1

this volume of fluid does not constitute a serious error. Unless pressures high enough to produce lateral deformation are employed, the behavior of the firmly joined apposed faces resembles that of a single elastic membrane, in response to pressure differences in the two members of the couple. Equal pressure increases in either member, pressure in the other remaining constant, will produce equal and opposite movements of the writing point from the zero line, regardless of differences in the separate flexibility of the two bellows. Furthermore, since fluid displacement for a given pressure change is equal in the two members, resistance to flow anywhere in the system has the same effect as resistance anywhere else.

The use of this type of manometer as a flow-meter for arterial blood flow was described in the earlier report. Water is used for filling the bellows and tubing, rather than citrate solution, as the latter corrodes the metal bellows. After cannulation and filling of the apparatus is complete, 5 per cent. chlorazol fast pink solution is injected into the cannulae and adjacent tubing as an anticoagulant. In filling the lower bellows, air is evacuated by rotating the couple on the rod *d* in the clamp *e* until the lower bellows is uppermost.

With arterial pressure acting on both bellows, there is usually a fairly wide swing of the writing point with each pulse wave, due to delayed arrival of the wave at the lower cannula. Up to a frequency of about 40 per min. in hydrostatic systems, equal but asynchronous pulsating pressures in the two bellows produce equal oscillations of the writing point about the true mean. With higher frequencies, such as occur in the arteries, there may be an error as great as 2 mm Hg in reading the true mean.

When the constricting clamp is placed on the artery between the two cannulae to permit the use of the apparatus as a flow-meter, the pulse wave as well as mean pressure in the lower bellows is reduced, and the now weakly opposed waves in the upper bellows produce large oscillations of the pointer. The legibility of the record may be improved by damping these with a screw clamp applied to the tubing leading to the upper bellows. The reading of the mean pressure difference is not affected by such damping.

The force acting at the apposed faces is approximately 5.85 gm for a pressure difference of 1 mm Hg. This permits the use of magnifying recording levers, giving 50–100 times magnification on the record. With a light lever giving a magnification of approximately 100 times, the apparatus in use has a period of 0.3 sec. Since this is of the same order as the natural period of most mercury manometers, the apparatus can indicate flow changes with such cyclic circulatory phenomena as can be recorded with a mercury manometer. The accuracy with which it records these is about the same as the accuracy of the usual laboratory mercury manometer in indicating pressure changes.

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