Those results are in perfect accord with the titration of the Venezuelan encephalomyelitis virus, which has in the mouse brain a titre oscillating between 10^{-6} and 10^{-8}, less frequently 10^{-10} to 10^{-12}. In the chick-embryo the average titre corresponds to the dilution 10^{-7} and is rarely higher or lower.

The immunological relation between the recently isolated virus from Trinidad and the Venezuelan encephalomyelitis strain virus (1938) has been studied in the protection test as follows: 72 Swiss mice have been immunized by means of 4 subcutaneous injections of 0.2 cc of the Venezuelan antiencephalomyelitis vaccine from chick-embryo cultured virus, one injection given every other day. The same vaccine has for many years been used with great success in combating encephalomyelitis in Venezuela. Three days after the last vaccination, the animals were divided into two batches for the challenge inoculation: the first group received intracerebrally 6 tenfold dilutions from 10^{-1} to 10^{-6} (using 6 mice for each dilution) of a mouse brain suspension containing Venezuelan encephalomyelitis virus, and the second one equal dilutions of the virus proceeding from Trinidad. Both viruses have been simultaneously titrated intracerebrally in non-immunized mice.

The vaccinated mice showed a solid protection against both viruses on test. The degree of immunity has been more or less equal against both of them, because the mice of each group withstood about 1,000,000 minimal lethal doses.

Summing up our findings, we believe we are entitled to draw the following conclusions:

(1) From 2 studied materials proceeding from a horse and a mule which died in Trinidad with clinical manifestations of encephalomyelitis, a neurotropic virus has been isolated.

(2) Inoculated into mice, guinea-pigs and chick-embryos, this virus showed the same properties as the Venezuelan equine encephalomyelitis strain virus.

(3) The vaccine prepared from Venezuelan chick-embryo cultured virus conferred on mice an equal protection against both viruses, the homologous as that of Trinidad.

(4) Therefore, an immunological identity between those two viruses is suspected.

Work on this theme is being continued.

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AN EXPERIMENTAL TEST OF THE THEORY THAT SOCIAL BEHAVIOR DETERMINES SOCIAL ORGANIZATION

IT appeared to the author that the fighting behavior of male mice of an inbred strain was suitable material for testing a fundamental theory of general sociology —that differences in social organization are caused by differences in social behavior. The strain used was subline 10 of the C–57 black, originally from the Jackson Laboratory at Bar Harbor. These mice have nearly identical heredity and can be depended upon to give similar reactions in similar environments.[1]

Preliminary experiments indicated that the males could be easily trained either to fight or not to fight. It was expected that if two fighting males were placed together they would develop some sort of social control or dominance based on fighting and that this organization would be absent between peaceful mice. This expectation was confirmed in the series of experiments described below, in which the mice were not only from the same inbred strain, but the same individuals were used for both fighting and non-fighting situations.

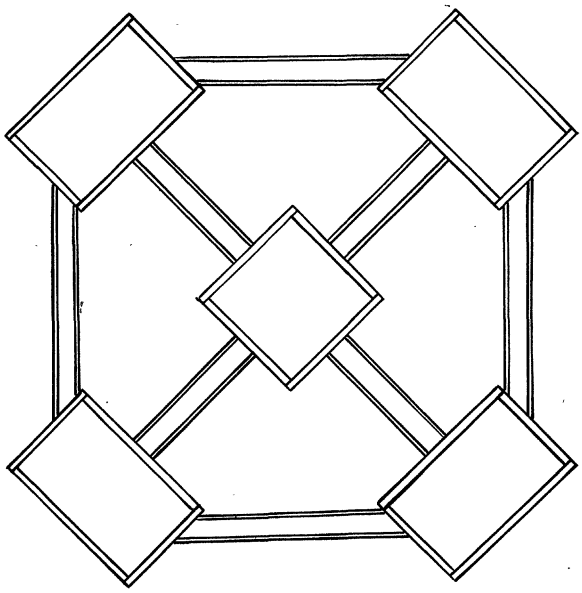

FIG. 1. Plan of multiple escape pen. The corner compartments are the same size as breeding boxes ($10 \times 15\frac{1}{2}''$), and the entire top is covered with hardware cloth.

The mice were trained not to fight by the following method. A male and female of the same litter were raised in the same pen with no handling after weaning. Young were removed as soon as they appeared. After sexual maturity, as shown by the birth of young, the animals on at least three successive days were lifted out of the pen with forceps, roughly stroked five times and replaced. When another male, similarly trained, was put in the pen, no fight took place. The same result was obtained with each of six different pairs. The peaceful situation lasted as long as observation was continued (up to nine days; longer in

[1] J. P. Scott, *Jour. Heredity*, 33: 11–15, 1942.

preliminary work) without any fighting at the period of observation or any traces of injury at other times.

The apparent explanation is that the males are already inhibited against fighting the females. Since no fighting takes place after handling, they quickly associate not fighting with handling and are inhibited by the latter. There being no fighting at the first meeting, the inhibition probably tends to become permanent.

The same pair of males was then transferred to separate parts of a large multiple escape pen (planned as in Fig. 1) and isolated for at least fourteen days. Following the lead of Ginsburg and Allee,[2] who found that animals fought best if successful in fighting, these males were trained to fight by introducing a belligerent animal of the same strain and removing it before either mouse was hurt. This was done on at least five successive days. Immediately after the last training period the mice were allowed to enter each other's pens, this time without handling. A fight soon started, usually after one male had made a sexual attempt on the other, or had found the path to his home pen blocked. The result was that one of the males soon became the victor and chased the other round and round the two pens. This, a clear case of temporary social dominance based on fighting, was seen with each of the six pairs used.

The development of this organization was watched over a longer period after all other passages in the multiple escape pen were opened; the losing mouse is soon killed if left in the same small area. Each compartment had at least three avenues of escape, and only one mouse was killed while in the large pen. If the mice met while the observer was present, the winning mouse chased the other through the passageways, sometimes making several rounds but finally losing contact. This semi-permanent type of dominance was seen to persist as long as 33 days but gradually tended to die out unless training was repeated from time to time. In one case where a day elapsed between training and the first fight, fighting and dominance could only be reobtained by further training.

Here the explanation appears to be that the mice become conditioned to fight any mouse which the observer puts into the pen. After the first unchecked fight the winning mouse is conditioned to chase and and the loser to run away. When these responses are not reinforced by the introduction of a fighting mouse, they tend to die out.

The probability of getting such consistent results by chance is very small. These and consistent preliminary data make it highly probable that the theory of determination of social organization by social behavior is correct in so far as social dominance based on the fighting of male mice is concerned.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A FLOWMETER FOR USE IN AIR SAMPLING PROCEDURES[1]

RECENTLY developed procedures for quantitative collection of air-borne bacteria and glycol vapors which utilize the Moulton atomizer sampler and the Folin aeration tube bubbler[2, 3, 4] depend upon accurate measurements of the air-flow. Most air flowmeters employ the Venturi or orifice principle by which the change in static pressure of an air stream during or after passage through a constriction is used as an index of the rate of air flow. The latter is defined in terms of unit volume of air per unit of time at standard conditions of atmospheric pressure and room temperature. The calibration of these flowmeters is usually carried out by connecting them in series with a standard instrument (wet gas-meter, spirometer bell, standard Venturi meter, etc.) so that these standard conditions are approximated.

It is not widely appreciated, however, that such flowmeters may give rise to erroneous air flow measurements when these standard conditions are not maintained. Flowmeters, connected downstream to a sampling device possessing high intrinsic resistance to the passage of air (*e.g.*, Moulton atomizer sampler) will give readings exceeding by as much as 70 per cent. the true rate of air-flow.[5] The actual value can be determined only by placing the flowmeter upstream to the sampling apparatus, where it will operate under conditions similar to those employed during calibration. Commercially available orifice flowmeters are usually unsuitable for use on the upstream side of air

[2] B. Ginsburg and W. C. Allee, *Phys. Zool.*, 15: 485–506, 1942.

[1] This investigation was aided in part through the Commission on Air-Borne Infections, Board for the Investigation and Control of Influenza and other Epidemic Diseases in the Army, Preventive Medicine Division, Office of the Surgeon General, U. S. Army.

[2] S. Moulton, T. T. Puck and H. M. Lemon, SCIENCE, 97: 51–52, 1943.

[3] H. Wise, T. T. Puck and H. M. Stral, *Jour. Biol. Chem.*, 150: 61, 1943.

[4] H. M. Lemon, *Proc. Soc. Exper. Biol. Med.* (in press).

[5] Downstream from a high resistance a considerable decrease in air pressure and therefore air density must occur; as a result a given mass of air will occupy a correspondingly increased volume. Compared with standard conditions, this air mass under diminished pressure must travel with increased velocity through the orifice if it is to pass through the meter in the same period of time, and hence an erroneously high static pressure difference will be observed.