Bush, formerly vice-president and dean of engineering at the Massachusetts Institute of Technology, has presently available a large fund for research on devices and instruments of warfare. Members of the committee in charge of its four divisions are Dr. Frank B. Jewett (M. I. T., '03), Dr. Richard C. Tolman (M. I. T., '03), President James B. Conant, of Harvard University and myself. Among the committee's section chairmen are Dr. Alfred L. Loomis, of the corporation; Professor W. K. Lewis, department of chemical engineering, and Professor George R. Harrison, department of physics, and on the operating section committees are Professors Tenney L. Davis, chemistry department; Thomas K. Sherwood, chemical engineering department; Edward L. Bowles and Samuel H. Caldwell, both of the electrical engineering department.

These are only some of the present national defense activities of our staff. Many others also will undoubtedly arise in the near future.

Where we possess facilities of personnel or equipment which can contribute in especially significant ways to the national defense program, we should direct them to this effort, always guided by our best evaluation of the national importance of this effort in comparison with other ways in which these same personnel and facilities might be used. We should make this possible by postponing less urgent research projects, by internal rearrangement of teaching schedules and by carrying a more than normal per capita burden of work.

In addition to scientific and engineering research, special courses in various scientific fields have been given and others are expected to follow as the need arises. One of these was an intensive course for junior aeronautical engineers. Fifty-one graduates in civil, mechanical and other engineering subjects from engineering schools in northeastern United States were accepted for this ten weeks' course without tuition. The success of the program has led to requests by aircraft companies that the course be repeated and that similar training be offered in other fields. Congress has under consideration an appropriation of $9,000,000 for financing short intensive courses in engineering schools.

Technology is continuing to participate in the Civilian Pilot Training program and is planning to speed up the ground school program during the current academic year.

Weather forecasting is an essential feature of modern warfare. For a number of years the institute has been giving postgraduate training in meteorology to young men of the Army, Navy and the United States Weather Bureau. This summer a special intensive course was given to recruits for the meteorological service of the Army Air Corps. During the current academic year, training will be given to another group of approximately sixty-five special postgraduate students in this subject, mostly from the Army Air Corps and the Weather Bureau. With these additions we have had a threefold increase in the number of graduate students studying meteorology.

Realizing fully that present conditions make it more important than ever that it keep abreast of advances in science and engineering and that its officers must have the best possible technical training, the Navy Department is sending an increased number of officers for postgraduate study at the institute. At its request there has been established a new course which combines the separate courses in naval construction and naval engineering into a single coordinated program. Of the sixty officers detailed to technology, forty are taking this three-year program and the remainder are distributed among other courses.

As the need arises we are preparing to institute intensive new courses in naval construction and aircraft instruments for special groups of officers.

The Wright Brothers Memorial Wind Tunnel is in continuous and overtime use for the testing of design models of new types of airplanes. With funds provided by two aircraft companies, important new equipment is being added to this laboratory to permit tests on models with power applied to propellers, thus more closely simulating flight conditions.

SPECIAL ARTICLES

PROPERTIES OF THE ISOLATED EQUINE ENCEPHALOMYELITIS VIRUS (EASTERN STRAIN)[1]

REPORTS from this laboratory during the past two years have been concerned with the purification of the virus of equine encephalomyelitis and the study of its properties. Of chief interest has been the investigation of a specific material obtained by ultracentrifugal fractionation of extracts of chick embryos diseased with the virus (Eastern strain). With this material, first described by Wyckoff,[2] is associated the infectivity of the extracts from which it is derived. Continued study has provided increasing evidence that it is identical with the virus.

The process consistently yielding the purified virus

[1] This work was aided by grants from Lederle Laboratories, Pearl River, N. Y., and the Dorothy Beard Research Fund.

[2] R. W. G. Wyckoff, *Proc. Soc. Exp. Biol. and Med.*, 36: 771, 1937.

has already been described.[3] Obtained after three cycles of alternate low- and high-speed ultracentrifugation, the purified substance, dissolved in solution of 0.1 M or greater salt concentration, exhibits the homogeneity of a single molecular species[3] in the analytical ultracentrifuge. The sedimenting boundary is sharp, comparable with the boundaries seen with the papilloma virus[4] and reported for the tobacco ringspot virus[5] though not with those of certain other plant viruses such as that of tobacco mosaic. Unsedimentable light-absorbing substances are not present nor are more than traces of material sedimenting more rapidly than the virus. The sedimentation constant is $S_{20^\circ} = 253 \times 10^{-13}$ cm sec^{-1} dynes^{-1}.

Solutions containing 0.1 per cent. virus are opalescent and give the usual protein tests. The Molisch test is initially negative, but positive tests for pentose with orcinol and sulfuric acid and Bial's reagent are obtained. The Schiff test for aldehydes is strongly positive and so, too, is the acrolein test for fat. A sample containing 0.25 per cent. virus heated gradually (2° per minute) becomes opaque at 56.0 to 58.0° C. The denatured material is insoluble, its initial infectivity is lost, and the nitroprusside test is negative. Dialysis against distilled water leads to precipitation and partial inactivation of the virus, and the salt-free material frozen and dried *in vacuo* is further inactivated and insoluble in saline solutions.

The results of chemical fractionation and analysis are summarized in Table 1. For this about 300 mg of the homogeneous material with an initial infectivity of about 10^{14} mouse infectious units per gram was dialyzed against distilled water, frozen and dried *in vacuo* and then dried to constant weight over P_2O_5. The lipoid fraction was obtained by extraction in turn with acetone, alcohol-ether (1 – 1) and benzene. From a solution of the whole lipoid fraction in chloroform, phospholipids were precipitated with strontium chloride and acetone.[6] The precipitate was completely soluble in moist ether and contained practically all the nitrogen and phosphorus of the whole lipoid fraction. The weight of this phospholipid subfraction was calculated from the phosphorus value with the factor 26. Cholesterol was determined upon an aliquot of the acetone fraction and was completely precipitable with digitonin. Fatty acid was calculated as oleic acid. The presence of aldehydes in the lipoid fraction was indicated by a strongly positive test with Schiff's reagent.

The protein fraction remaining after lipoid extraction gave positive tests for pentoses and only a weakly positive Schiff test. From 57.5 mg of the protein fraction, 5.5 mg of material having the qualitative solubility and general properties of a ribose nucleic acid was obtained.[7] Practically all the phosphorus was removed from the protein in this subfraction. Samples weighing 0.25 to 0.3 mg gave positive orcinol and Bial tests, but were negative with the Feulgen test. Parallel tests and analyses were made with comparable weights of yeast and thymus nucleic acids. It is evident that the behavior and constitution of this virus nucleic acid are similar to those of yeast nucleic acid.

By pyknometer measurements on solutions of fully

TABLE 1

FRACTIONATION AND ANALYSIS OF THE EQUINE ENCEPHALOMYELITIS VIRUS (EASTERN STRAIN)

	Whole virus	Virus fractions							Yeast nucleic acid
		Lipoid				Carbohydrate†	Protein		
		Total	Phospholipid	Cholesterol	Fatty acid	Total	Total	Nucleic acid	
Per cent. of whole virus		54.1*	35	13.8	9.6	4.0	49.1*	4.4	
Per cent. of fraction			64	24.0	18.0			9.6	
C (per cent. dry weight)	62.2								
H " "	9.2								
N " "	7.7	1.5	2.0				14.1	14.1	13.3
P " "	2.2	2.4	2.5				1.2	7.3	7.9
Residue " "	2.8								
Carbohydrate† " "	4.0	1.6					7.2	33.6	33.2
N : P	3.6 : 1	1 : 1.6	1 : 1.2				1 : 11.7	1 : 1.9	1 : 1.7
Carbohydrate : P	1.8 : 1	1 : 1.5					6 : 1	4.6 : 1	4.3 : 1

* These values include the corresponding fraction of total carbohydrate.
† Carbohydrate as glucose.

[3] A. R. Taylor, D. G. Sharp, H. Finkelstein and J. W. Beard, *Proc. Soc. Exp. Biol. and Med.*, 43: 648, 1940.

[4] J. W. Beard, W. R. Bryan and R. W. G. Wyckoff, *Jour. Infect. Dis.*, 65: 43, 1939.

[5] W. M. Stanley, *Jour. Biol. Chem.*, 129: 405, 1939.

[6] R. J. Reiser, *Jour. Biol. Chem.*, 120: 625, 1937. We are greatly indebted to Dr. Reiser for his advice and aid in the analysis of the lipoid fraction.

[7] T. B. Johnson and H. Harkins, *Jour. Am. Chem. Soc.*, 51: 1770, 1929.

active virus the partial specific volume was 0.839, corresponding to a specific gravity of 1.19.

Molecular stability[8] is at a maximum between pH 7.0 and 8.5. When the pH is reduced below about 6.5, the virus precipitates, and its infectivity is rapidly lost.[9] Disintegration, occurring slowly in the optimum pH range and more rapidly above the optimum to about pH 10.5, takes place as a splitting off of relatively very small light-absorbing fragments. These fragments are evident in the sedimentation patterns above the still sharp boundary of the residual virus, which thus becomes progressively obscured. At pH levels above about 10.5, the sedimentation constant of the residual large component is greatly diminished. Exposure of the virus to ultraviolet light of 2537 Å results in inactivation at a rate of the same order of magnitude as that reported for certain bacteria.[10] Virus inactivated in this way to the extent of 7 decimal dilutions gives a slightly diffuse sedimentation boundary and the same sedimentation constant as that of the fully active material. The molecular stability of the inactive material is much less than that of the untreated virus, but the process of disintegration subsequent to irradiation appears similar to that of the intact virus. The nitroprusside test of the inactive material is negative.

The purified material studied is specific to the virus-diseased chick embryos. No trace of a similar or related component has been found in repeated studies of normal embryo tissue. The homogeneity of the product is clearly evident in the findings with the analytical ultracentrifuge and in the uniformity of its biological and chemical behavior. It would thus appear that the virus of equine encephalomyelitis (Eastern strain) is a complex of high molecular weight consisting of phospholipids, cholesterol, fatty acid and ribonucleoprotein.

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[8] A. R. Taylor, D. G. Sharp and J. W. Beard, *Jour. Infect. Dis.* In press.

[9] H. Finkelstein, W. Marx, D. Beard and J. W. Beard, *Jour. Infect. Dis.*, 66: 117, 1940.

[10] D. G. Sharp, *Jour. Bact.*, 37: 447, 1939; 39: 535, 1940.

HYPERFUNCTION OF ANTERIOR PITUITARY IN RATS. II. ESTRUS CYCLES[1]

IN previous papers[2, 3] the authors have reported the following as evidence of a hyperactivity of the anterior pituitary in their colony of the Yale strain of rats: (1) high fasting blood sugar, (2) low glucose tolerance, (3) an exaggerated hyperglycemic response to epinephrine, (4) an initial resistance to insulin, (5) a high percentage of body fat, (6) an exaggerated rate of growth and adult size, (7) large urine volume and (8) high incidence of sterility. If these characteristics result from a hyperfunction of the anterior pituitary, one might expect to find a reflection of this activity in the estrus cycle.

Observations on 122 rats revealed a significant difference between the cycles of the Yale strain and the normal strain, although quantitatively the difference was not as great as that observed by Evans[4] following the injection of anterior pituitary extracts. The procedure consisted of comparing under controlled conditions the estrus cycles of the Yale strain with those of the Wistar strain which we consider normal for reasons previously enumerated.[2, 3] Individuals from the two strains were matched according to age, type of cage, number per cage, degree of light exposure and diet. Smears were made each morning, and the first appearance of cornification was taken as the end-point.

In the first series of observations, 17 sexually mature rats ranging in age from 40 to 60 days at the inception of the experiment were selected from each strain and smeared daily for at least 3 cycles. The average cycle in days for the Yale strain was 5.8 P.E. $\pm$ 0.36 and for the Wistar strain 4.7 P.E. $\pm$ 0.36. There are 8 chances per 100 that the difference is not significant. Sixty-five per cent. of the Yales and 35 per cent. of the Wistars had average cycles of 5 days or more, and 35 per cent. of the Yales and 6 per cent. of the Wistars had average cycles of 6 days or more. The chances that these differences are not significant are 4 and 3 in 100, respectively.

The second series totaled 44 Wistars and 45 Yales ranging in age from 80 to 295 days. One Yale rat, 97 days of age, showed no cycle although smeared for 16 days. Table 1 shows that the cycles averaged 5.48 days for the Yales and 4.45 for the Wistars. The chance that this difference is not significant is less than 1 in 100. Thirty-four per cent. of the Yales but only 9 per cent. of the Wistars have cycles of 6 days or over. The chance that this difference is not significant is less than 1 in 10,000.

In view of the work of Blunn[5] on the relation of the genetic composition of rats to the time of opening of the vagina, it appears important to record that the Yale, more accurately called the Connecticut Agricul-

[1] This investigation was supported by a grant from the Committee on Research in Endocrinology, National Research Council.

[2] V. V. Cole and B. K. Harned, *Endocrinology*, 23: 318, 1938.

[3] B. K. Harned and V. V. Cole, *Endocrinology*, 25: 689, 1939.

[4] H. M. Evans, Harvey Lectures, 19: 212, 1924.

[5] C. T. Blunn, *Anat. Record*, 74: 199, 1939.