for embryos has a narrower range of heat stability than the virus hemagglutinin. The former ranged from 30 to 180 minutes, as compared to 5 to 360 minutes for the latter. The descending order of susceptibility to heat treatment obtained by the Henles for certain activities of influenza virus is not paralleled with Newcastle virus. With the latter either activity, the HA or the EI, may be destroyed first.

The ability of the virus to fix complement in the presence of immune serum is very stable under heat treatment, withstanding 100°C for at least an hour. Using only three strains, 0.01% formalin failed to increase the stability of the hemagglutinin. The possibility still remains that certain other Newcastle virus strains, like some of the influenza strains, may have hemagglutinins more stable to heat in the presence of traces of formalin.

Comparisons of heat resistance of the hemagglutinating activity of the strain with the locality from which it was isolated suggests that a survey, based on many strains, may show a close correlation between them, especially if the time of isolation is considered. All five strains obtained from the eastern seaboard of the United States were of low heat resistance, 4 having either very low or no stability at 15 minutes. All 8 Canadian strains were highly heat resistant, 7 of them having hemagglutinins persisting for 2 to 4 hours. The strains from the Middle West showed more variation in their stability. When the time of isolation of these strains is taken into consideration, it is noted that of 3 obtained in 1946, all were of medium resistance; of 2 obtained in 1947, 1 was of medium and 1 of high resistance; and of 3 obtained in 1948, 1 was of low and 2 were of high resistance. It is possible that a shift in the heat resistance of the midwest strains is occurring and that it might be related to mutation of existing strains or to the introduction of new strains. The existence of such a possibility merits further investigation by this and other methods of strain characterization.

Conclusion. The stability of the hemagglutinin of different Newcastle disease virus strains, when subjected to increased temperatures, has been found to vary over a wide range. The stability of the hemagglutinin of 1 isolate was destroyed at 56°C in a period as short as 5 minutes, and that of another was diminished only after 6 hours exposure. The stability of the hemagglutinin of Newcastle virus is discussed in relationship to influenza viruses. A relation of heat stability of strains to place and time of isolation is observed.

16900

Comparative Nutritive Value of Butter and Vegetable Fats Under Conditions of Low Environmental Temperature.*

B. H. ERSHOFF, J. N. PAGONES, AND H. J. DEUEL, JR.

From the Emory W. Thurston Laboratories, Los Angeles, and the Department of Biochemistry and Nutrition, University of Southern California School of Medicine, Los Angeles.

It has been generally accepted by nutritionists that, aside from differences in vitamin potencies, animal and vegetable fats have essentially the same nutritive value. On diets containing an adequate amount of B

* This paper reports research undertaken in cooperation with the Quartermaster Food and Container Institute for the Armed Forces, and has been assigned number 233 in the series of papers approved for publication. The views or conclusions contained in this report are those of the authors. They are not to be construed as necessarily reflecting the views or indorsement of the Department of the Army.

Contribution No. 208 from the Department of Biochemistry, University of Southern California.

TABLE I.
Comparative Effects of Butter and Vegetable Fats on the Gain in Body Weight of Immature Rats Maintained Under Cold Room and Room Temperature Conditions.

Dietary fat	No. of rats	Initial body wt., g	Gain in body wt 8 wk period,* g
		Cold room series	
Cottonseed oil	10	65.5	110.0 ± 3.8
Corn oil	10	65.1	100.4 ± 6.4
Margarine fat	10	65.3	94.7 ± 4.2
Butter fat	10	64.4	100.6 ± 4.6
		Room temperature series	
Cottonseed oil	6	64.3	129.7 ± 4.1
Corn oil	6	64.7	138.3 ± 7.9
Margarine fat	6	64.7	119.7 ± 6.5
Butter fat	6	64.2	139.8 ± 9.3

* Standard error of the mean $\sqrt{\frac{\Sigma d^2}{n-1}} / \sqrt{n}$

vitamins no significant difference in growth has been observed under room temperature conditions in immature rats fed diets containing butter fat or various vegetable oils.[1-3] Available data indicate, however, that requirements for essential nutrients may be significantly increased by exposure to cold and other conditions of "stress."[4] It was felt that if differences exist in the nutritive value of fats, these might be accentuated under the stress of low environmental temperature. In the present study immature female rats were raised to maturity on purified rations containing butter and vegetable fats and their rate of growth determined under conditions of low environmental temperature.

Procedure and Results. Four experimental rations were employed in the present experiment, differing only in the source of fat. These consisted of 53.5% sucrose, 22.0% casein,† 4.5% salt mixture,‡ and 20.0% of either cottonseed oil, corn oil, margarine fat or butter fat.§ To each kg of the above diets were added the following synthetic vitamins: thiamine hydrochloride 72 mg, riboflavin 9 mg, pyridoxine hydrochloride 15 mg, calcium pantothenate 67.2 mg, nicotinic acid 60 mg, 2-methyl-naphthoquinone 5 mg and choline chloride 1.2 g. Each rat also received once weekly a vitamin A-D concentrate‖ containing 150 U.S.P. units of vitamin A and 15 U.S.P. units of vitamin D together with 3 mg of alpha-tocopherol acetate. Seventy-two female rats of the Long-Evans strain were selected at 28 to 30 days of age and an average weight of 64.9 g for the present experiment. Animals were placed in individual metal cages with raised screen bottoms to prevent access to feces, and were fed the above diets *ad lib.* Feeding was continued for 8 weeks. Experiments were conducted (1) with animals kept continuously in a large walk-in refrigerator at a temperature of 2±1.5°C, and (2) under standard labora-

[1] Boutwell, R. K., Geyer, R. P., Elvehjem, C. A., and Hart, E. B., *Arch. Biochem.*, 1945, **7**, 143.

[2] Deuel, H. J., Jr., Movitt, E., Hallman, L. F., and Mattson, F., *J. Nutrition*, 1944, **27**, 107.

[3] Deuel, H. J., Jr., Greenberg, S. M., Savage, E., and Fukui, T., unpublished data.

[4] Ershoff, B. H., *Physiol. Rev.*, 1948, **28**, 107.

† Vitamin Test Casein, General Biochemicals, Inc., Chagrin Falls, Ohio.

‡ Sure's Salt Mixture No. 1,[5].

[5] Sure, B., *J. Nutrition*, 1941, **22**, 499.

§ The fats were obtained from the following sources: Cottonseed oil, Wesson Oil, and Snowdrift Sales Co., New Orleans, La., corn oil, Corn Products Refining Co., Argo, Ill.; margarine fat, Best Foods, Inc., New York, N. Y.; butter fat, Knudsen Creamery Co., Los Angeles, Calif. The butter and margarine were melted, and the water and protein separated by centrifugation. The fat was poured off and mixed to give a homogenous sample.

‖ Nopco Fish Oil Concentrate, assaying 800,000 U.S.P. units of vitamin A and 80,000 U.S.P. units of vitamin D per gram.

TABLE II. Summary Table Showing Average Gain in Weight, Average Food Consumption and Ratio of Increase in Weight to Calories Consumed for the First 4 Weeks of Feeding.

Dietary fat	Avg gain in body wt,* g	Food consumption (g/day) on following wks of experiment 1st	2nd	3rd	4th	Avg total food intake per rat for first 4 wks of feeding*† g	Calories	Efficiency‡
		Cold room series (10 animals per group).						
Cottonseed oil	62.4 ± 2.9	11.7	13.2	13.4	14.8	371.7 ± 9.3	1784.2 ± 44.6	3.50 ± .10
Corn oil	62.4 ± 4.3	11.4	13.0	13.0	15.2	368.2 ± 9.7	1767.4 ± 45.0	3.54 ± .18
Margarine fat	58.9 ± 3.4	11.3	13.1	13.6	14.2	365.4 ± 11.0	1753.9 ± 50.0	3.36 ± .05
Butter fat	63.0 ± 3.1	11.3	13.6	14.2	15.1	379.4 ± 10.0	1821.1 ± 49.8	3.46 ± .13
		Room temperature series (6 animals per group).						
Cottonseed oil	86.3 ± 2.6	9.6	10.5	11.3	11.6	301.0 ± 6.9	1444.8 ± 33.0	5.97 ± .19
Corn oil	91.5 ± 5.8	8.9	11.4	11.4	12.3	308.0 ± 14.7	1478.4 ± 70.4	6.19 ± .16
Margarine fat	83.7 ± 2.9	10.0	12.3	13.0	12.8	336.7 ± 11.9	1616.2 ± 57.2	5.18 ± .15
Butter fat	93.3 ± 8.7	9.4	11.0	12.0	10.8	302.4 ± 21.0	1451.5 ± 100.8	6.42 ± .28

* Standard error of the mean; see footnote to Table I.
† The caloric value of these rations was approximately 4.8 calories per gram of diet.
‡ $\frac{\text{G increase in weight}}{\text{Calories consumed}} \times 100$

tory conditions at an average temperature of approximately 21±2°C. The cold room groups consisted of 12 rats each; the room temperature groups of 6. Food consumption was determined for each rat during the first 4 weeks of feeding. All diets were prepared weekly and kept under refrigeration when not in use.

The findings are summarized in Table I. Data for the cold room series were computed on the basis of the top 10 animals in each group to minimize variations in averages due to early deaths, infection, and atypical responses on the part of individual rats. Growth was markedly reduced in all rats under cold room conditions. Gain in body weight was most marked on the cottonseed oil diet and least on the ration containing margarine fat. In the room temperature series gain in body weight was most pronounced on the butter fat diet and least for margarine fat. The differences in growth on the various rations, however, either under cold room or room temperature conditions, were not sufficiently marked to be statistically significant.

Data on food consumption and the relative efficiency of the various diets for the building of body tissues are summarized in Table II. The findings indicate that for the first 4 weeks of feeding both under cold room and room temperature conditions virtually no difference in relative efficiency as measured by the ratio of gain in weight × 100 to the calories consumed was obtained for diets containing cottonsed oil, corn oil, or butter fat. Values were somewhat lower in the case of margarine fat, but in view of the small number of animals employed it is questionable whether these differences are significant. Values for the cold room series were less than for the room temperature series, a finding due, at least in part, to the increased metabolism of animals maintained under cold room conditions.

The findings indicate that butter fat, margarine fat, cottonseed oil, and corn oil have substantially the same nutritive value as judged by gain in body weight and efficiency of food utilization of young rats maintained at low environmental temperatures and fed diets differing only in the source of dietary fat.

Summary. Immature female rats were

raised to maturity under cold room and room temperature conditions on purified rations differing only in the source of fat. The fats employed were cottonseed oil, corn oil, margarine fat, and butter fat. Gain in body weight was significantly reduced in all rats under cold room conditions. No significant difference was observed, however, either under cold room or room temperature conditions, in gain in body weight on the various diets employed.

16901

Central Inhibitory Effects of Carbon Dioxide. II. *Macacus rhesus*.

S. N. STEIN AND G. H. POLLOCK. (Introduced by W. S. McCulloch.)

From the Department of Psychiatry, University of Illinois, Illinois Neuropsychiatric Institute.

Pollock's observation that carbon dioxide prevents electrically induced cortical seizures in cats suggested further study on primates.[1] Since the normal electroencephalograph of the *Macacus rhesus* is so well known, and it is not difficult to extrapolate from it to the human, this animal was chosen for the primate study.

Tracheal intubation, exposure of both femoral veins and of the calvarium were performed under ethyl ether anesthesia. Artificial respiration was started after an initial intravenous injection of 20 mg of dihydro-B-erythroidin hydrobromide and was maintained at 45 cc per stroke, 30 strokes per minute. 180 mg of dihydro-B-erythroidin hydrobromide in 300 cc of normal saline was administered as a slow drip throughout the experiment. Bilateral screw-in electrodes were placed 4 mm posterior to the coronal suture and 6 mm lateral to the sagittal suture. These electrodes were connected to a double-pole-double-throw switch allowing alternate connections to the input of a Goodwin non-blocking EEG amplifier with ink-writing oscillograph or to the output of a Lab-Tronics Stimulator (Model 3). The EEG was recorded concurrently with the EKG picked up from the right fore and left hind limbs.

Routinely the animals were ventilated with various concentrations of carbon dioxide in oxygen for intervals of 1 to 9 minutes and, on termination of each period of respiring carbon dioxide, stimulated with threshold and superthreshold voltages. A "saw-tooth" stimulating frequency of 60 impulses per second and a falling phase of 10 sigma were used throughout the experiment. It was found that concentrations of carbon dioxide below 15%, when administered for 3 minutes, would not prevent electrically-induced cortical seizures. When these concentrations were given for periods longer than 3 minutes, suppression of seizures occurred, which was more marked as the concentration of carbon dioxide approached 15%. Concentrations of carbon dioxide over 20% prevented the seizure response. Duration and intensity of the stimuli did not markedly affect the result. It appears that in *Rhesus macacus* the anticonvulsive level of carbon dioxide lies somewhere between 15% and 20%. The changes in the EEG and EKG found with carbon dioxide were similar to those found in cats by Pollock.[1]

Lorente de No' found that the rise of the membrane potential due to carbon dioxide is roughly proportional to the logarithm of its concentration, and this was accompanied not only by a decrease in fatiguability but also by a rise in threshold.[2] It is also known that carbon dioxide alters the pH, oxygen tension and blood flow of the brain.[3] Hence it is to be

[1] Pollock, G. H., Thesis, Univ. of Ill., College of Medicine, 1948.

[2] Lorente de No', R., Studies from the Rockefeller Institute for Medical Research, Vol. 131.

[3] Roseman, E., Goodwin, C. W., and McCulloch, W. S., unpublished data.