acid does not produce electrophysiological effects. Following destruction of the blood-brain barrier the synaptic actions are similar to those produced by topical application. In regions of increased barrier-permeability, intravenous GABA abolishes or reduces the frequency of spontaneous paroxysmal discharges arising from such areas. Therefore systemically administered GABA produces no synaptic effects because of failure to penetrate the blood-brain barrier. By permitting rapid exchanges of GABA between blood and brain during electrophysiological studies following barrier lesions, information was obtained relating to the role of γ-amino butyric acid in the central nervous system not attainable by the method of topical application. Production of experimental, localized regions of blood-brain barrier loss may have applications for the study of substances that are otherwise denied access to the cells of the central nervous system.

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Calory and Protein Intake as Related to Growth. (23741)

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Numerous recent papers on calory and protein nutrition of fowls have been concerned with the "Calory-Protein Ratio." This ratio is the nutritional caloric value of the diet divided by the percentage of protein. There has appeared no consistent relation of this ratio to biological results unless either protein or caloric value of the diet has been relatively constant.

Exp. In an experiment on protein and caloric needs, B. B. Bronze hens on range were provided definite intakes of practical formula feeds and grain per day (Table I). Protein intake was calculated from analyses. Caloric intake was expressed as "Productive Energy Values" of Fraps, revised by Titus(1). Most of the reports referred to have also employed such values. These have been expressed as calories per lb. of feedstuff. Correlation of calory-protein ratio to growth results was found to be negligible. It was observed that the *product* of the caloric and protein intakes showed a good correlation with body weights (coefficient 0.83).

Discussion. The ratio remains the same whether calculated from composition of diet or from intakes, and is independent of the magnitude of intakes. Hence such anomalous findings appear as a decrease in growth when the ratio is increased, due to decreased total feed or decreased protein intake or both(2,3). Protein is represented in the numerator of the ratio as protein calories and in the denominator as percent protein. This implies that all protein simultaneously is consumed to produce calories, and also is utilized for growth purposes, which, obviously, is impossible. Since the ratio includes all the protein calculated both as calories and as percentages of protein the ratio may be expressed:

$$\text{Calory-protein ratio} = \frac{\text{Protein calories}}{\text{Percent protein}} + \frac{\text{Non-protein calories}}{\text{Percent protein}}$$

TABLE I. Protein and Caloric Intakes of B. B. Bronze Turkey Hens in Relation to Growth.

Group No.*	Total calories/hen/day†	Protein/hen /day, g	Avg wt at 26 wk, kg‡	Calory-protein ratio	Non-protein calory-protein product
1	450	39.5	7.02	51.7	29.7
2	429	40.9	7.24	47.7	28.5
3	378	39.5	6.73	43.8	23.4
4	449	43.6	7.36	46.7	31.6
5	413	43.6	7.11	43.0	28.1
6	377	43.6	6.87	39.2	24.7
7	411	44.0	7.18	42.4	28.1
8	413	38.6	6.95	48.6	26.1
9	416	36.8	6.64	51.3	25.5
10	448	37.2	7.02	53.3	28.8
11	445	40.4	7.24	50.0	29.7
12	537	41.8	7.70	58.4	38.8

* Approx. 180 hens started/group. † Productive energy (Fraps) revised by Titus(1).
‡ Exp. started at 18 wk of age with pens of equivalent avg wt.

The first term is a constant. The variability resides entirely in the ratio of non-protein calories to percentage protein. A change in percentage protein involves a change in the numerator of the second term by affecting the percentage of non-protein and an opposite change in the denominator, thereby, causing a large change in the ratio. A wide series of diets containing adequate protein, or more, can have a wide series of ratios and yet yield equivalent biological results, because the protein used for caloric production is nearly equivalent to the carbohydrate displaced by protein. When the products are employed the loss of protein to produce energy is approximately balanced by the gain in calories.

To avoid the ambiguous use of protein an attempt was made to remove the protein calories from the productive energy, leaving only the total non-protein calories. This may amount to an over correction, in variable degree, since some protein is always converted to energy.

From productive energy values for blood meal, fish meal, meat scrap, casein, fat and representative analyses the following productive energy values for the protein component were calculated.

	Productive energy of protein (cal/lb)
Blood meal	1270
Casein	1300
Fish meal	1240
Meat scrap	1200

Sucrose is listed at 1334 calories and it is stated that protein has .914 the energy of carbohydrate(1). This leads to a value of 1220 calories. An average of all 5 values was taken at 1250 (2750 cal./kg).

Since quality of protein of a well-balanced diet is indistinguishable as to origin, because of mutual supplementary actions, a single factor may be used to express the caloric equivalent of such protein of a good mixed diet. Using the 2750 factor the total non-protein caloric intake of the turkey hens was calculated. The ratio of non-protein calory intake to protein intake showed a very low correlation with body weights. On the other hand, the non-protein calory intake was multiplied by the protein intake and correlation of the product with hen weights was obtained as a coefficient of 0.92, representing an improvement over the 0.83 first obtained. Such improvement indicates that a more correct manner of relating the data has been employed.

The above observations were applied to other recent data embodying a range of variation of both protein and caloric intakes. For example, data provided by Ferguson *et al.*(2) were calculated to the basis of protein and caloric intake in cases of the most complete diets fed to B. B. Bronze poults. Correlation of calory-protein product and growth was 0.70 and was improved to 0.87 when the caloric term was corrected to non-protein calories. Data of Donaldson *et al.*(3) for young chicks show a correlation coefficient of growth and calory-protein product of 0.74, which was improved to 0.94 when corrected to a non-pro-

tein caloric basis. Sunde(4) has provided data from chick tests which yield little or no correlation of growth with calory-protein ratio, a low correlation with calory-protein product and a good correlation, of about 0.8, of growth with the non-protein calory-protein product. Data with rats have been provided by Sibbald *et al.*(5). While the weights reported are averages of initial and final weights, the growth results are highly correlated with the product of digestible nonprotein calories and digestible protein intakes, (coefficient 0.92). Other examples have been studied with similar results. The relations discussed above no longer apply when the genetic or physiologic capacities of the animal have been exceeded.

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Comparative Behavior of 16 ECHO Virus Types in Fibroblast-like and Epithelial-Like Human Cell Strains.* (23742)

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One of the characteristics of the ECHO viruses as a group is their ability to proliferate in tissue cultures of rhesus (*Macaca mulatta*) monkey kidney cells(1). Neither cultured kidney cells from other species of monkeys, nor cultured strains of human cells have appeared to be uniformly susceptible to all of the ECHO viruses(1,2,3). This communication reports a systematic study of the ability of 16 ECHO virus types to proliferate in human cell strains of different morphology as well as from different malignant and non-malignant sources.

Materials and methods. Cell strains. One fibroblast-like (Fb-L) and 6 epithelial-like (Ep-L) human cell strains have been investigated. Four of the Ep-L strains have been previously described(4). Of these, Detroit-30A was derived from carcinomatous ascitic fluid, Detroit-32 from bone marrow of a patient with carcinoma, Detroit-98 from normal bone marrow, and Detroit-116P from lymphomatous pleural fluid. Although some of the ECHO viruses appear to proliferate in HeLa cells(1), especially after adaptation(3), the HeLa strain was included in this study for purposes of comparison. The 2 additional cell strains, Detroit-196 Fb-L and Detroit-196 Ep-L were established as follows. A skin biopsy from a patient with urticaria pigmentosa was minced, washed with basal medium, Eagle (5) (BME), and incubated in 0.25% trypsin solution (Difco, 1:250). The resulting cell suspension was again washed and approximately 10^5 cells were suspended in 8 ml of growth medium (BME 80%, human serum 20%) and deposited into a 3-ounce prescription bottle. After incubation at 36°C for 40 days, fibroblast-like cells were distinguishable among the cellular debris and within the next 10 days a network of Fb-L cells covered the wall of the bottle. These were subcultured according to procedures previously described (4). An inoculum of 4×10^5 cells in 3-ounce bottles yielded averages of 2×10^6 cells in 8 days. After the Detroit-196 Fb-L cells had undergone 6 serial subcultures over a period of 2½ months, islands of polygonal cells appeared in several bottles of the 6th passage. These polygonal cells outgrew the fibroblasts and thus a substrain of epithelial-like cells emerged which has been continuously main-

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