The polysomes from the 200*S* region of the gradient (Fig. 3) are predominantly strung out in chains. Most of the ribosome units sedimenting at 158*S* are arranged in symmetrical tight squares with only some being strung out in chains, and the number strung out is consistent with the number in this peak which are sensitive to ribonuclease.

Polysomes from the 158*S* peak, from 12-day feathers, after treatment with ribonuclease (Fig. 4) are mostly tight squares. Electron micrographs of samples from the 158*S* region of a gradient of 14-day-feather extract reveal that the four-ribosome polysomes are no longer mainly tight symmetrical squares but are now largely open figures (Fig. 5). A sample from the 158*S* peak of a gradient of cytoplasmic extract from 3-day whole embryos also shows polysomes of principally open configuration (Fig. 6).

Another comparison of inactive with active polysomes can be made by examining samples from gradients of 12- and 14-day extracts from feathers treated with actinomycin D. Whereas both resulting profiles show that the material in the peaks (O.D.$_{260m\mu}$) sediments at 158*S*, only the four-ribosome polysomes of the 14-day extract have nascent protein as judged by counts of radioactivity associated with them. Study of electronmicrographs of samples from sucrose density gradients (Fig. 1, *C* and *F*) make it clear that inactive polysomes are arranged in tight symmetrical squares whereas active ones are not. All of the foregoing results illustrated with micrographs of negatively stained preparations were also confirmed in positively stained preparations.

Thus the inactive polysomes which are "stockpiled" to be activated when the feather begins to keratinize and convert its substance into a hard insoluble proteinaceous complex have a unique symmetrical structure. How this configuration is related to their nonfunctional state or their resistance to ribonuclease is not clear. It was suggested earlier (*1*) that the messenger RNA (mRNA) of these nonfunctional four-ribosome aggregates was specifically protected from ribonuclease. Protection may be bestowed by the tight-clustered arrangement of ribosomes. Calculations (*7*) suggest that normally the configuration of polysomal ribosomes is helical. Departure from the helix might result in a polysome whose mRNA is inaccessible for translation. It remains to be determined exactly how the configuration of the square polysome is related to its failure to make protein. It is clear, however, that as translation begins the square unfolds.

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Growth of Rats Fed on Opaque-2 Maize

Abstract. *Six weanling male rats were fed a diet containing 90 percent* opaque-2 *maize for 28 days. The average gain in weight was 97 grams. In control rats fed on a standard hybrid maize the average gain was 27 grams. This confirms results of a previous feeding test on rats and demonstrates the superior quality of the proteins in* opaque-2 *mutant endosperm.*

We reported in 1964 that the *opaque-2* mutant gene markedly changes the protein and amino acid composition of maize endosperm (*1*). Similar changes are not observed in the embryo (*2*). Based on chemical composition, the proteins of *opaque-2* endosperms should be of greater food value than those of normal endosperms. Sufficient amounts of *opaque-2* maize were harvested in the fall of 1964 to permit two feeding tests with rats. Results of the first test are described elsewhere (*3*); the results of the second test are reported here.

The *opaque-2* maize was from a back-cross progeny and the whole seed contained 1.69 percent nitrogen. The plants were self-pollinated in order to exclude pollen from normal plants, since *opaque-2* is a recessive gene. The normal or nonopaque maize was a standard hybrid, Indiana 453, grown in a yield trial in which pollination was not controlled. The whole seed contained 1.68 percent nitrogen. Both types of maize were ground in a Labconco burr mill at the finest setting before they were analyzed or incorporated in diets. Amino acid analyses (*1*) were made on ground samples of whole seed which had been defatted (*4*). For each 16 g of nitrogen, the defatted *opaque-2* maize contained 4.7 g of lysine and the standard hybrid, 2.8 g of lysine (Table 1). The lysine values, which were higher than those reported previously (*1*), reflect the presence of the embryo, which contains approximately 6 g of lysine for each 16 g of nitrogen. With the exception of histidine, the differences in amino acid composition were similar to those observed previously (*1*) in mutant and normal endosperms from the same ear of maize.

Groups of six weanling male rats (Wistar strain), each weighing 40 to 57 g, were kept in individual wire-mesh cages, and given unrestricted access to one of the following diets: diet A, 90 percent *opaque-2* maize, 5 percent corn oil, 4 percent Hawk-Oser salt mixture No. 3 (*5*), and 1 percent Vitamin Fortification Mixture (*6*); diet B, the same as diet A except that Indiana hybrid 453 replaced *opaque-2* maize; diet C, 10 percent casein, domestic (*7*), 75 percent corn starch, 10 percent corn oil, 4 percent Hawk-Oser salt mixture No. 3, and 1 percent Vitamin

Table 1. Amino acids in *opaque-2* and normal defatted corn (expressed as grams per 100 g of protein). Values for tryptophan were not available.

Amino acid	*Opaque-2*	Normal corn
Lysine	4.7	2.8
Histidine	3.0	3.0
Ammonia	2.7	3.4
Arginine	6.5	4.8
Aspartic acid	10.6	6.7
Glutamic acid	17.9	20.8
Threonine	3.9	3.6
Serine	4.9	4.8
Proline	8.1	10.0
Glycine	4.8	3.8
Alanine	6.9	7.9
Valine	5.5	5.0
Cystine	1.4	1.2
Methionine	1.9	2.0
Isoleucine	3.8	4.0
Leucine	9.8	13.9
Tyrosine	3.6	4.0
Phenylalanine	4.8	5.2

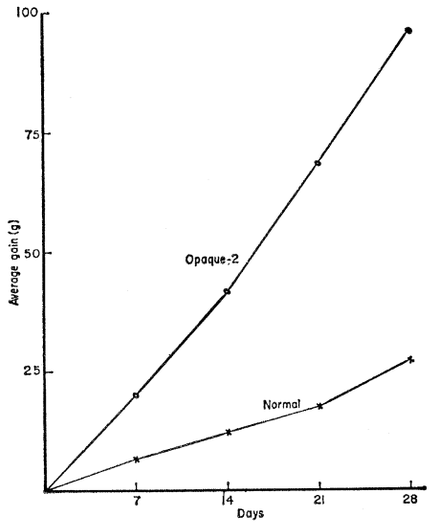

Fig. 1. Curves showing average weekly gains of rats fed on *opaque-2* maize and Indiana hybrid 453.

Fortification Mixture; diet D, the same as diet C except containing 20 percent soybean meal (*8*), no casein, and 65 percent corn starch.

The results of feeding the rats on these diets are summarized in Table 2. In spite of special feed cups, scattering was a problem in all groups, with greatest incidence in the group fed on hybrid maize (diet B). Protein efficiency ratios (PER) were calculated for all animals, but the average PER values include only animals which did not scatter food, or scattered only slightly. Howe *et al.* (*9*) surveyed the PER values of nine unsupplemented, ground, whole cereal grains fed to rats on diets containing 7.8 to 10 percent protein, and found oats to have the highest value (1.8) when compared with casein (2.5). Barley, rice, maize, bulgar, rye, wheat, sorghum, and millet were below oats in PER. Our data indicate that in young rats *opaque-2* maize proteins have a food value equal to that of heat-treated soybean meal, and superior to any cultivated cereal grain.

Table 2. Gains in weight, protein consumption, and protein efficiency ratios (28 days).

Animal No.	Gain (g)	Protein eaten (g)	PER*
Diet containing casein			
C-1	70	20.3	3.4
C-2	54	17.2	3.1
C-3	72	31.6†	2.3†
C-4	73	21.0	3.5
C-5	43	17.4‡	2.5‡
C-6	85	26.7	3.2
Average	66		3.1
Diet containing opaque-2 *maize*			
A-7	86	30.0	2.9
A-8	102	38.0†	2.7†
A-9	134	41.6	3.2
A-10	81	30.7	2.6
A-11	96	37.0	2.6
A-12	85	38.2†	2.2†
Average	97		2.8
Diet containing Indiana hybrid 453			
B-13	32	38.6†	0.8†
B-14	33	19.8	1.7
B-15	23	21.5†	1.1†
B-16	23	14.3	1.6
B-17	23	19.7†	1.2†
B-18	30	19.5	1.5
Average	27		1.6
Diet containing soybean meal			
D-19	67	35.6†	1.9†
D-20	95	34.0	2.8
D-21	95	36.0	2.6
D-22	101	37.2‡	2.7‡
D-23	78	28.7	2.7
D-24	105	37.3	2.8
Average	90		2.7

* Protein efficiency ratio (grams gained divided by grams protein eaten). The percentage of protein (N × 6.25) in the diets was as follows: diet C, 8.1; diets A and B, 9.5; and diet D, 10.0. † Value not included in average because of food scattering. ‡ Rat scattered the food slightly, but value was included in average.

Diets A and B were labeled with 1 percent metallic oxide, and the digestibility of the proteins was measured as described by Mertz *et al.* (*10*). White rats weighing approximately 100 g were used, four animals being fed on each diet. Protein digestibility values of 80, 83, 86, and 87 percent, respectively, were obtained with the rats on diet A (*opaque-2*) and values of 84, 84, 87, and 87 percent, respectively, were obtained with the rats on diet B (Indiana hybrid 453). Better digestibility of proteins therefore does not appear to be a factor contributing to the growth-promoting properties of *opaque-2* maize.

In a previous feeding test with the same number of rats (*3*), the average gain in weight for 28 days was 86 g for rats fed a different strain of *opaque-2* maize and 23 g for rats fed Indiana hybrid 257, a 3.7-fold difference. In the present test, a 3.6-fold difference was observed. Figure 1 shows average weekly gains of the animals on diets A and B. Similar curves were obtained in the previous feeding test.

The greater efficiency of *opaque-2* proteins in rats provides a basis for assuming that *opaque-2* proteins would also be superior to ordinary maize proteins in the diet of man and domestic animals. Loci homologous to *opaque-2* probably exist in other cereals, and methods for detection and use of mutants should be developed.

Note added in proof: Opaque kernels in high protein background gave endosperms containing 19.2 percent protein, of which 2.7 percent was lysine. Nonopaque kernels on the same ear yielded endosperms with 19.6 percent protein, of which 1.3 percent was lysine. Thus, the opaque gene exerts its effect in a high protein background, and selection is feasible for lines that are high in both lysine and protein. Such lines would provide more lysine per gram of corn than diet A.

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Isoantigens of Gamma Globulin in Pigs

Abstract. *Two gamma globulin isoantigens in pigs have been identified by hemagglutination-inhibition tests. Two codominant autosomal alleles,* Gl^a *and* Gl^b, *determine three phenotypes,* $Gl(a+b-)$, $Gl(a+b+)$, *and* $Gl(a-b+)$.

Genetic differences in types of γ-globulins have been described for a number of mammalian species (*1–3*). The hemagglutination-inhibition system used to identify isoantigens of γ-globulins in pigs is modeled after that used for typing Gm and Inv, the hereditary antigenic determinants of γ-globulin in man (*2*).

Antibodies against the serum factor designated Gl_a were first produced by isoimmunization of pigs according to a procedure similar to that described for rabbits (*3*), but repeated immunizations were required to produce antibodies, and inhibition of agglutination was not easily interpreted. Wilson and Steinberg