45°, so the mean *ground* components and total field for $t = 1958$ would be:

$$\overline{H}_{\mathrm{H}} = 0.304(4/\pi)\int_0^{\frac{\pi}{4}} \cos\phi_m d\phi_m$$

$$= 0.274 \text{ gauss}$$

$$\overline{H}_{\mathrm{v}} = 0.304(8/\pi)\int_0^{\frac{\pi}{4}} \sin\phi_m d\phi_m$$

$$= 0.227 \text{ gauss} \quad (14)$$

$$\overline{H}_0 = \sqrt{\overline{H}_{\mathrm{H}}^2 + \overline{H}_{\mathrm{v}}^2} = 0.356 \text{ gauss}$$

The mean field $\overline{H}$ varies as the inverse cube of geocentric distance, which, for the present satellite, ranges between 1.10 and 1.62 earth radii. Using as first approximation to its orbit

$$r = a(1 - e\cos M)$$

where $a = 1.36$ earth radii, $e = 0.19$, and M is the mean anomaly of the satellite, the time mean field, according to Bauer's theory, surrounding Vanguard I is:

$$\overline{H} = (0.356/2.52\pi)\int_0^{\pi} \frac{dM}{(1 - 0.19\cos M)^3}$$

$$= 0.142 \text{ gauss} \quad (15)$$

evaluated by numerical integration.

Now, to obtain for comparison the total mean field implied by the measured effective field of Eq. 9, we assume the mean ratio (invariant with radius in a dipole field):

$$\overline{H}_{\mathrm{v}}/\overline{H}_{\mathrm{H}} = 227/274 = 0.8286 \quad (16)$$

given by Bauer's theory. Solving Eq. 9 approximately for the mean total field gives:

$$\overline{H} = \overline{H}_{\perp}\sqrt{\frac{1 + (0.8286)^2}{(0.8286)^2\,\overline{\sin^2\alpha} + \overline{\sin^2\theta}}} \quad (17)$$

where, inserting the values found above, $\overline{\sin\alpha} = 0.637$, $\overline{\sin\theta} = 0.941$, and $\overline{H}_{\perp} = 0.115 \pm 0.001$ gauss, we find:

$$\overline{H} = 0.138 \pm 0.001 \text{ gauss} \quad (18)$$

as the mean total field implied by rotational damping. The agreement with the theoretical value given by Eq. 15 is satisfactory.

Perturbations in the mean effective couple on Vanguard I are to be expected to result from the regression of orbital nodes (3.019° per day), the advance of perigee (4.408° per day), the space-wandering of the spin axis, and the temperature variation of satellite resistivity. There seems to be perceptible evidence of such perturbations in the slightly wavy track of the radio-observed points in Fig. 1, but a precise study of such small effects would seem to await (i) frequent optical observation of reflections from some more efficiently designed satellite shape, such as a specular polyhedron (*6*), (ii) axis-orientation data, and (iii), experimental determination of satellite electrical and magnetic properties. The optical spin rate for Vanguard I on 10 January 1959 of 0.673 rotations per second, obtained from a Smithsonian Astrophysical Observatory photograph (*7*), which fits closely to the empirical curve of Fig. 1, would seem to be a first step toward more precise rotational studies.

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6 July 1959

Simplified Way to Cultivate Chick Kidney Cells and Maintain the Culture without Serum

Abstract. Chick kidney fragments were easily dispersed after incubation in trypsin solution for 1 hour at room temperature. The centrifuged cells were resuspended in Melnick's growth medium, diluted to 100 ml for each pair of kidneys, and seeded at 1 ml per tube. The cultures were maintained for 7 days or longer in the medium modified by replacing the serum with tryptose.

The methods of preparing cell suspensions by means of treating minced tissue with 0.25-percent trypsin solution reported by Youngner (*1*) and Bodian (*2*) required the use of a magnetic stirrer and took considerable time. In the course of a study of propagating avian viruses in chick kidney cell culture, a simplified technique for the preparation of the culture was sought (*3*). It was felt that, in order to avoid virus inhibitors or specific antibodies in animal serum in the culture system, development of a nonserum-containing maintenance medium which would maintain the culture for a period of a week would be desirable.

The cell culture was prepared from the kidneys of 1-week-old chicks. Kidney fragments were incubated at room temperature for 1 hour in 0.25-percent trypsin solution, prewarmed to room temperature, 10 ml being used for each pair of kidneys. The mixture was shaken vigorously by hand for 3 to 5 minutes until the pink tissue fragments disappeared. After the cell suspension had been centrifuged at 800 rev/min for 10 minutes, the sediment was resuspended in growth medium and filtered through four layers of gauze. The filtrate was further diluted with medium to a total volume of 100 ml for each pair of kidneys used. One milliliter of the cell suspension was seeded into each tube. A dense, full, cell sheet developed in 5 days. Melnick's growth medium was used; it contained 0.5 percent lactalbumin hydrolyzate (*4*), 10 percent calf serum, and 100 units of penicillin, 100 μg of streptomycin, and 100 units of mycostatin, respectively, per milliliter, in Hanks' (*5*) salt solution.

The culture was changed to maintenance medium as soon as a full cell sheet formed. The maintenance medium contained 0.5 percent lactalbumin hydrolyzate, 0.5 percent tryptose (Difco), and antibiotics, in Hanks' salt solution with 0.07 percent sodium bicarbonate. The culture remained in good condition for 7 days or longer. This maintenance medium has been used with satisfactory results for avian encephalomyelitis virus titration and neutralization tests which usually require 5 to 7 days' incubation.

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5 June 1959

A Nomenclature for Conformations of Pyranoid Sugars and Derivatives

Abstract. A system is presented for designating, with symbols, all chair and boat conformations of all pyranoid sugars and derivatives. For chairs, these symbols are *CA* and *CE*: for boats: B_1A, B_1E, B_2A, B_2E, B_3A, and B_3E. Symbols *A* and *E* describe an axial or equatorial "glycosidic" group of the α-anomers (D and L series).

A recent note by Guthrie (*1*) on a system of nomenclature for sugar conformers prompts us to describe one that we have devised. The two systems are much alike, but ours appears to be more concise. Features common to the two are: (i) use of carbon atom 1 as the point of

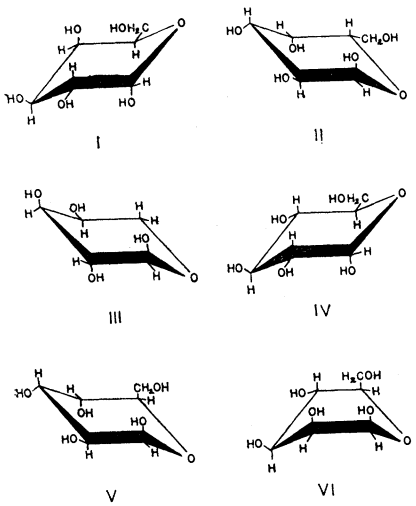

Fig. 1. Some conformations of pyranoid sugars.

reference and (ii) specification of conformations in terms which refer to the α-anomers only. Both systems are, we believe, preferable to two previously suggested (*2, 3*). By Reeves' system (*2*), enantiomorphs received different symbols. This situation was avoided by Isbell (*3*), but his system applies only to chair forms of aldohexopyranoses, ketoheptopyranoses, and the higher sugars.

In our system, a symbol describing the kind of pyranoid ring is used; thus, *C* denotes the chair, and B_1, B_2, and B_3 specify the three boats (*4*). If the reference group (*5*) at carbon atom 1 of the α-anomer (D or L series) is axial, the symbol *A* is added to the ring symbol; if the reference group is equatorial, the symbol *E* is added. Thus, eight symbols (*CA*, B_1A, B_2A, B_3A, *CE*, B_1E, B_2E, and B_3E) are obtained which, appended to the systematic names, unambiguously describe all the chair and boat conformations of all the pyranoid sugars and their derivatives (*6*).

Table 1. Names of conformations of pyranoid sugars IV, V, and VI by the previous and the present systems.

Formula	Name	Reference
IV	α-D-Glucose-C1	(*2*)
	α-D-Glucose-C′1	(*3*)
	α(C*a*)-D-Glucose [α(C*a*) conformation]	(*1*)
	α-D-Glucose-*CA*	*
V	β-D-Altrose-1C	(*2*)
	β-D-Altrose-C′2	(*3*)
	β(C*a*)-D-Altrose [α(C*e*) conformation]	(*1*)
	β-D-Altrose-*CE*	*
VI	β-D-Mannose-3B	(*2*) (*3*)
	β(B_3a)-D-Mannose [α(B_3e) conformation]	*1*
	β-D-Mannose-B_3E	*

* Present authors.

The compounds having formulas I, II, and III are thus named α-D-galactopyranose-*CA*, α-L-galactopyranose-*CA*, and α-L-arabinopyranose-*CA* (Fig. 1). Table 1 gives the names for compounds IV, V, and VI by the previous systems and the present one (*7*).

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4. The three boats are those in which carbon atoms 1 (and 4), 2 (and 5), and 3 (and the oxygen atom), respectively, lie (*cis*) outside the plane of four other atoms of the ring.
5. A reference group at asymmetric carbon atom 1 (the "glycosidic" or anomeric carbon atom) is regarded as being any *atom* other than a hydrogen atom, or any *group* other than an alkyl or polyhydroxyalkyl (including hydroxymethyl) group.
6. This system is applicable, in conjunction with suitable symbols for the respective rings, to all pyranoid conformations having an axial-equatorial arrangement of exocyclic bonds at carbon atom 1.
7. For added clarity, the appropriate symbol (*a* or *e*) may, if desired, be inserted in parentheses after the anomeric symbol. Thus, II is α(*a*)-L-galactopyranose-*CA*; V is β(*a*)-D-altropyranose-*CE*; and VI is β(*a*)-D-mannopyranose-B_3E.

26 March 1959

Intracistron Recombination in the Wx/wx Region in Maize

Abstract. Five independently occurring *waxy* (*wx*) mutants produce low frequencies of standard type (*Wx*) pollen grains (0.3 to 3.8×10^{-5}). In crosses between these mutants, frequencies of *Wx* pollen grains range from 1.4 to 88×10^{-5}, depending on the cross. Data from the crosses allow the ordering of the mutants within the region. Functional complementation between the different mutants does not occur.

Genetic resolution can be enhanced greatly by using microorganisms and selective techniques for the detection of recombinants. The results obtained by Benzer with phage (*1*) and Pritchard with *Aspergillus* (*2*) have profound genetic implications, pointing as they do to the delineation of different mutational sites within a single functional region. Pontecorvo (*3*) has discussed the impact of these findings on modern genetical theory. It would be most desirable to be able to make similar studies in higher organisms, but it is difficult to handle populations of sufficient size to do more than hint at the existence of such a phenomenon.

A system in maize has been described (*4*) which makes it possible to deal easily with numbers giving a resolving power comparable to that obtained with some microorganisms. The technique uses the haploid pollen grain as the unit of observation and relies on the fact that the staining reaction of a pollen grain with a KI and I_2 solution depends on its genotype at the *Wx/wx* region. The standard type (*Wx*) pollen grains stain black, owing to the presence of amylose with amylopectin in the starch granules. The *waxy* mutant (*wx*) pollen grains, which contain only amylopectin, stain light brown. Thus the millions of microspores produced by a maize plant are available for analysis. Standard preparations containing about 50,000 pollen grains can be made and scored within a relatively short time.

If two independently occurring *wx* mutants are crossed, recombination may be detected in the pollen grains produced by the F_1 cross between the two mutants. One product of recombination would be a functional (*Wx*) region, and pollen grains carrying such regions would stain black in contrast to the brown-staining pollen grains of either of the parental types. Then, if the frequency of black-staining (*Wx*) pollen grains in the population from an F_1 cross between two mutants is significantly higher than the frequency in either parental stock this would indicate that the two mutations occupy different sites within the region.

To make such tests, five independently occurring, spontaneous *wx* mutants were crossed in all possible combinations (*5*). These mutants were *a, B, C, H21,* and *90*. All occurred in stocks of different genetic background. Only the *a* mutant allows the formation of measurable quantities of amylose. Plants homozygous for *a* have 2 to 5 percent amylose in the starch of the endosperm, in contrast to *Wx/Wx* plants, which have about 25 percent amylose. Tassel samples were collected just before pollen shedding and stored in 70-percent alcohol. Subsequently, each type was scored for the frequency of black-staining (*Wx*) pollen grains. The plants sampled were grown in the field in 1958, except for the *a* crosses, which were grown in 1957. The results are presented in Table 1.

Table 1 shows that for the parental stocks there are low but measurable frequencies of *Wx* pollen grains. The figure for any mutant would include back-mutations, suppressor mutations, and contamination arising from a wind-blown pollen grain lodging in one of the glumes to be sampled. For the crosses it may be seen that the frequencies range from no higher than the parental stocks to many-fold higher.

The data in Table 1 are derived from preparations in which 24 anthers (three anthers from each of eight glumes) were combined. For most crosses with a high