drinking glass will crack if doused with cold water does not depend greatly upon the content of crystalline material in the glass. The development of cracks in materials by thermal shock is more a matter of temperature gradients, coefficients of thermal expansion, internal strains, and strengths of materials. Incidently, glass or bone china are not strictly homogeneous structures. For example, bone china may be comprised of about 50 percent of crystalline material and 50 percent of amorphous. Ordinary glass frequently contains some 0.1 to 1.0 percent of crystalline material.

Contrary to Kamrin's statement, we did not equate the smashing action of a weight to the normal biting action experienced by teeth. Our purpose, as is abundantly clear from the communication, was to find a test, of whatever character, that would distinguish between teeth bearing high or low levels of strains and cracks.

His comments on the statistics of caries incidence in various locations of the mouth are interesting and we agree that this type of information will help us in properly assessing the problem; provided one takes into account such factors as our normal tendency to flip bites of hot food from the front teeth to between the molars with the tongue.

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Isomerization of β-Carotene with Sunlight

Zechmeister and his associates have studied the isomerization of β-carotene by various methods, including fusion, refluxing its solution, use of iodine catalysis, shaking its solution with hydrochloric acid, and insolation (exposure to sunshine in the absence of catalyst) (*1, 2*). They obtained, by insolation, besides 98-percent recovery of all-*trans* β-carotene, 1 percent each of neo-β-carotene-U and neo-β-carotene-B (*2*).

In my work (*3*), in addition to neo-β-carotene-U and neo-β-carotene-B, the formation of neo-β-carotene-E was confirmed. A solution of chromatographically pure β-carotene (16 mg) in hexane (150 ml) was placed in a Pyrex measuring flask irradiated with direct noontime sunlight for 1.5 hr, and then chromatographed on lime-Celite (2:1). The appearance of the developed chromatogram is described in Table 1.

Table 1. Appearance of developed chromatogram. The numbers in parentheses in column 3 are the light absorption maxima in millimicrons used to characterize the zone materials.

Zone width (mm)	Zone color	Zone identification
2	Orange	Irreversible layer (heterogeneous)
15	Almost colorless	
25	Reddish orange	Neo-β-carotene-U (480, 450)
5	Almost colorless	
62	Dark orange	β-Carotene (486, 454)
28	Dark yellow	Neo-β-carotene-B (476, 444)
2	Almost colorless	
12	Pale reddish	Neo-β-carotene-E (480, 447)

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3. I wish to thank L. Zechmeister for his kind advice.

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Note on the Al and Si Positions in Ordered Na and K Feldspars

The condition of disorder among the Al and Si positions in Na and K feldspars is well known, and the degree of disorder is measurable (*1*). To date, x-ray analysis has not been successful in determining the Si and Al positions in the ordered minerals. However, it is theoretically possible to predict the structural positions of Al and Si in the ordered mineral and to substantiate the prediction by observations of certain features that are described here.

The ordered or lowest energy level for the mineral would be expressed on the atomic level by having the highest polarizing power cations (Si) form the largest number of bonds with the most polarizable anions (bonded to Al). This condition would be realized if one-third of the Si cations shared two of their four anions with two Al cations and shared the other two anions with two other Si cations; two-thirds of the Si cations would share anions with one Al cation and three Si cations. This association results in polymerized Si—O—Si—O—Si—O—Si—O chains alternating with (but bonded to) chains of Si—O—Al—O—Si—O—Al—O that pass through the feldspar so as to produce periodically uniform bond conditions. "Partially disordered" feldspars could have the same cation associations, but the periodic uniformity would be lacking. Disordered feldspars could have some Si cations sharing anions with three Al cations and other Si cations sharing anions with four Si cations. One Al sharing an anion with another Al is unlikely, as is evidenced by the lack of Al-Si disorder in anorthite (*2*).

If the orientation of the chains in the mineral could be determined, the ordered configuration of the Na and K feldspars would be known. Three possibilities are present: the chains may parallel either the *a*, the *b*, or the *c* crystallographic axis. Chains parallel to the *c*-axis are such that two Al, Si positions per unit cell are not included in the chains. These two positions are included if the chains spiral along their length, but such chains would not occur because this results in some improbable bond combinations, such as

Al—O—Al, and in Si sharing anions with three Al or four Si cations. Chains parallel to either the *a*- or the *b*-axis include all the Al, Si positions in the chains. Chains parallel to the *a*- and *c*-axes are the straightest and contain relatively uniform bond angles throughout their length. Chains parallel to the *c*-axis traverse the unit cell with three Si—O_4 or Al—O_4 tetrahedrons, and chains parallel to the *a*-axis traverse the unit cell with four tetrahedrons. A chain of six tetrahedrons is necessary to traverse the unit cell parallel to the *b*-axis, and this chain must wind along its length with nonuniform bond angles. Because of its greater length and its distortion around the alkali ion positions, it is suggested that the *b*-axis chains would not be produced in feldspar crystallization.

In polymerized compounds, the direction of greatest polymerization is the direction of elongation in the habit of the crystal. Inasmuch as the chains in feldspar represent the direction of principal polymerization in the mineral, the orientation of the chains should be manifested in an elongation of the crystal in the direction of the chains. The habit of K feldspar often displays a longer length parallel to the *c*-axis than is parallel to the *a*- or *b*-axis. Some crystals show a relatively elongated *a*-axis, but I have not seen an elongated *b*-axis. The Na feldspars are similar to the K feldspars except that an elongated *b*-axis is present in the pericline variety of albite. If the crystal elongation is related to the chains and if the three possible orientations of the chains are energetically equivalent, there should be an equal number of crystals in any rock with each of the possible orientations. In the specimens examined, all crystals showed either *a*-, *b*-, or *c*-axis elongation with no mixtures of the different elongated forms. Consequently, the chain orientation of the crystals is not an accident of nucleation but is primarily controlled by the environment of crystallization.

Prior to crystallization, polymerized groups of Al and Si tetrahedrons form, as is evidenced by the high viscosity of their melts. If the alkali ions can form more or less stable bond associations with these Al, Si groups, the Al—O—Si—O—Al—O—Si and Si—O—Si—O—Si—O—Si chains parallel to the *a*-axis would be favored over other orientations, because the alkali ion density is greater parallel to the *a*-axis than in other directions and because chains parallel to these alkali ions rows would reduce the bond energy of the group. High temperatures and/or low alkali ion concentrations would tend to decrease the amount or the importance of the alkali ion association with the Al, Si groups and, therefore, reduce the alkali ion influence on the chain orientation. Hence, at high temperatures and/or low alkali ion concentrations, the orientation of the chains or partial chains would be predominantly controlled by the kinetic energy of the Al, Si, group and, thus, the shorter *c*-axis chains would be favored. Also, under high alkali ion concentrations, the (010) "faces" of these Al, Si groups would tend to have a high alkali ion association that would establish the *a*-axis orientation but would also increase the rate of growth parallel to the *b*-axis. In other words, the growth parallel to the *b*-axis might not be as interrupted by the positioning of the alkali ions as it would be if the alkali ion concentration were lower, and this effect would be more pronounced in the relatively strongly bonded Na feldspars (pericline) than in the relatively weakly bonded K feldspars.

Additional evidence for the presence and orientation of the predicted chains is found in the crystallographic orientation of the quartz grains intergrown with feldspars, such as in graphic intergrowths and myrmekite. Drescher-Kaden (*3*) has discussed the relationships of quartz to feldspar and has pointed out that the *c*-axes of the quartz grains are commonly inclined 42° to the *c*-axis of the related K feldspar and are inclined about the same amount for the Na feldspars. The quartz *c*-axes are roughly concentrated into six fields about the feldspar *c*-axis with different specimens forming the different fields. Drescher-Kaden illustrates other quartz *c*-axis orientations inclined in zones roughly 70° and 20° to the feldspar *c*-axis. This orientation of quartz intergrown with feldspar is readily expected if the Si—O—Si—O—Si-type chains are present in the ordered or partially ordered feldspar, because chains of identical configuration are present in the quartz crystal and are inclined 42° to the quartz *c*-axis. If quartz nucleates on the Si—O—Si—O—Si chains in the feldspar, the quartz *c*-axis would be inclined 42° to the direction of the feldspar chain which, if the chains are parallel to the feldspar *c*-axis, would also be inclined 42° to the feldspar *c*-axis. If the chains are parallel to the *a*-axis, the *c*-axes of the quartz would be inclined either 18° or 72° to the *c*-axis of the feldspar. The baveno feldspars, which are elongated parallel to the *a*-axis, have the associated quartz *c*-axes inclined roughly 70° to the feldspar *c*-axis (*3*). These feldsparlike chains are present in six directions in the quartz crystal, all inclined 42° to the quartz *c*-axis, and this accounts for the six fields of points for the quartz *c*-axes around 42° and 70° zones. Short-range order but long-range disorder in feldspar could account for the scattering of the quartz *c*-axes that is found in some of the specimens.

It is concluded on the basis of crystal habit, quartz orientation, and bond energy considerations that the ordered Na and K feldspars contain Si—O—Si—O—Si and Al—O—Si—O—Al—O—Si-type chains oriented either parallel to the *a* or *c* crystallographic axes of the feldspar.

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