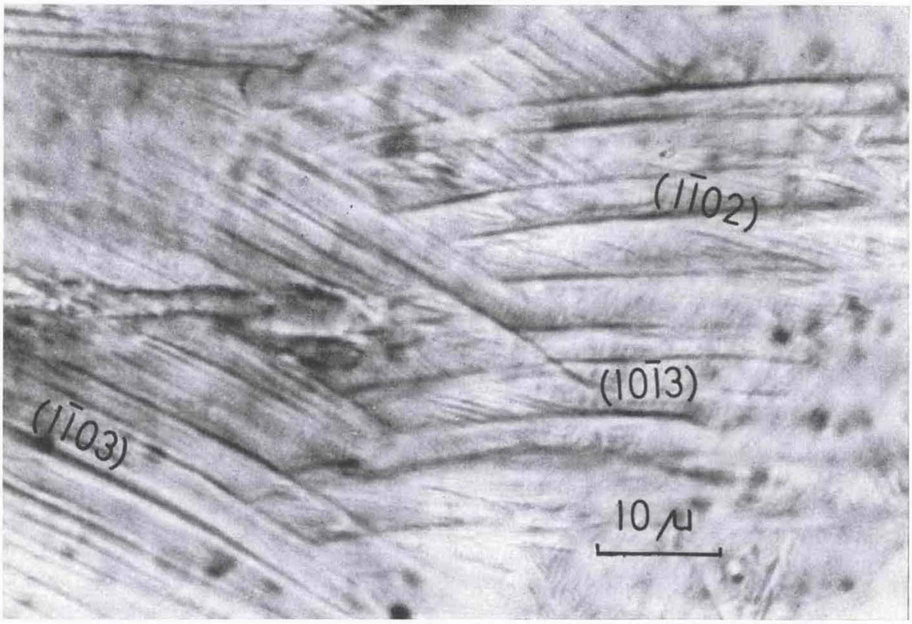

Fig. 16. Bending of non-decorated planar elements. Quartz from sample B 9. Plane polarized light

Table 8. *Refractive indices, birefringence and density of quartzes with planar deformation structures and of diaplectic quartz glasses (B 41, B 75)*

Sample	n_o		n_e (approx.)		n_e-n_o (approx.)	Density	
	range	mean	range	mean		range	mean
B 10	1.544—1.541	1.543	1.552—1.550	1.551	0.007	2.640—2.656	2.648
B 51	1.544—1.541	1.543	1.552—1.550	1.551	0.007	2.639—2.655	2.647
S 289	1.542—1.540	1.541	1.549—1.547	1.548	0.007	2.622—2.652	2.637
B 151	1.534—1.532	1.533	1.541—1.538	1.540	0.007	2.570—2.626	2.598
S 350	1.532—1.528	1.530	1.539—1.535	1.537	0.007	2.570—2.596	2.583
B 1	1.533—1.530	1.532	1.539—1.535	1.537	0.005	2.559—2.592	2.577
B 7[a]	1.480—1.475	1.478	1.485—1.480	1.483	0.005	2.256—2.296	2.276
B 9[a]	1.478—1.474	1.476	1.483—1.478	1.481	0.005	2.243—2.282	2.263
B 41	1.466—1.465	1.466	—	—	—	2.216—2.251	2.234
B 75	1.460	1.460	—	—	—	2.206—2.236	2.222

[a] The values of density and refractive indices are probably influenced by a small content of secondary recrystallisation products (clay mineral).

According to refractive index and density, the investigated quartz samples form a sequence, ranging from normal quartz down to diaplectic quartz glass: quartz from B 10 and B 51 is still very close to normal quartz ($d = 2.65$; $n_o = 1.544$; $n_e = 1.553$). On the other hand, quartz from B 7 and B 9 closely resembles the completely isotropic glasses from B 41 and B 75.

X-ray powder diagrams show in all optically anisotropic samples quartz lines with only minor deviations from the normal values of lattice constants[1]. It must consequently be assumed that all quartz samples of low densities and refractive indices are actually mixtures of crystalline quartz with an amorphous phase. The measured densities and indices are bulk values of truly heterogeneous grains, the heterogeneity being in a microscopical or submicroscopical scale. The presence of planar structures under the microscope does not contradict this assumption. In fact we assume, that all planar structures — but the genuine planar fractures — have to be interpreted as fine lamellae of amorphous SiO_2 embedded in a matrix of crystalline quartz. Thus they are actually responsible for the heterogeneity.

The higher the frequency of planar structures in a quartz grain, the larger is the amount of quartz transformed into an amorphous phase and the lower are bulk density and refractive index, finally resulting in a X-ray amorphous and optically isotropic diaplectic quartz glass. As shown in a previous paper (ENGELHARDT et al., 1967) these diaplectic quartz glasses are different from normal quartz glass: in general their indices of refraction and densities are higher. The observed range of densities was between 2.219 and 2.261 and that of refractive indices between 1.460 and 1.464 (normal quartz glass: $d=2.20$, $n=1.459$).

For reason of simplicity the amorphous phase in quartz with planar structures is assumed to have the properties of normal SiO_2-glass and the crystalline phase to be identical with normal quartz. The amount of glass present can then be calculated on the basis of the measured densities and refractive indices: Using the measured density d one obtains the volume percentage x_d of quartz glass as follows:

$$x_d = \frac{2.65 - d}{0.45} \cdot 100.$$

From the measured refractive index n_0 one obtains

$$x_n = \frac{1.544 - n_0}{0.085} \cdot 100.$$

Calculated values are recorded in Table 9. The agreement between x_d and x_n is good. Therefore it is reasonable to calculate an average value $\bar{x}$ for the percentage of amorphous SiO_2 enclosed in the individual "quartz". These values are lower limits because the amorphous SiO_2 is a diaplectic glass having higher density and indices of refraction than the values used for these calculations.

Table 9. *Content of amorphous SiO_2 in quartzes with planar structures. Volume percentages as calculated from density (x_d) and index of refraction (x_n)*

Sample	x_d (%)	x_n (%)	Average $\bar{x}$ (%)
B 10	0.6	1.2	0.9
B 51	0.7	1.2	0.9
S 289	3	3	3
B 151	12	13	12
S 350	15	18	16
B 1	16	14	15
B 7[a]	82	78	80
B 9[a]	86	80	83

[a] See note, Table 8.

4. Comparison with Other Planar Deformation Structures

4.1. Böhm lamellae as Traces of Tectonic Quartz Deformation

Planar structures in quartz have been frequently observed in tectonites. For the purpose of this synopsis all may be called Böhm lamellae, although BÖHM (1883),

1. BUNCH (1968), CHAO (1968) and HÖRZ (personal communication 1968) report differences between shocked and normal quartz in lattice dimensions (larger cell) and X-ray intensities.