

parallel to the length. The lineation is therefore down dip, parallel to a . Figure 2 represents the orientation diagram of 300 quartz axes of this quartzite. The maximum represents a concentration of points upto 13% in 1% area, the contours having been drawn at intervals of 2%. The near parallelism of the quartz axes to the fabric axis a is evident as in Fig. 1. This suggests that the S-tectonite fabric with the maximum I in a is also produced by the slipping or movement of rock bodies along the bedding plane during the process of folding. The specimen is taken from the middle of the quartzite band, so the movement has affected the grains throughout the main body. It is to be noted that the maximum and the contours are spread along ac plane, indicating the dispersal of the quartz axes in the ac plane and a tendency for a girdle development. The incomplete girdle along the ac plane shows the transition towards a B-tectonite. The spread of contours towards a girdle pattern suggests a bending or rotational movement along ac plane around b axis, as often happens when a rock is undergoing folding.

A specimen from another quartzite band away from the folded series was selected. There is no evidence of this quartzite forming part of the folded series, but it dips at a high angle. As in the previous example, the section was taken perpendicular to b , the direction of strike. The grains are large, inequidimensional; and the ratio of length to breadth is very high. The lineation is down dip, parallel to a . Figure 3 is the orientation diagram of 300 quartz axes. Here also the maximum is of a high degree with 20% pole concen-

tration in 1% area (contours are drawn at intervals of 4%). This bears similarity both to Fig. 1 and Fig. 2. The girdle is poor but shows tendency for development along ac plane. Movement by slipping along single S-plane, i.e., the bedding plane, rather than the bending movement, is dominant.

CONCLUSION

The similarity of the fabric pattern between the crushed quartzite and the other two that form part of the bedded series suggests that the sedimentary metamorphosed sequences in the Closepet-Satnur area of Bangalore District have undergone slipping movement along the bedding planes, whether they have been folded or not, during the regional deformation of the rocks of this area. The lack of girdle development in Fig. 3 points to the fact that the quartzite which this diagram represents forms, in all likelihood, the middle part of a limb of a regional fold.

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MUTATIONAL ANALYSIS OF A LOCUS GOVERNING BRITTLENESS IN *ORYZA SATIVA*

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STUDIES on complex loci have given much insight into the functional, mutational and recombinational aspects of the gene. More than forty years ago, Dubinin, Seribrovsky and others suggested that "achaete scute" alleles in *Drosophila* can be arranged in a definite series. This view was later developed and subsequently it was concluded that this locus comprised separate, regularly-spaced and lineally-arranged functional units.¹ Seven years later, another complex locus called "lozenge" was discovered² and based on interallelic or intragenic recombination, the theory of "pseudo-

allelism" was put forth.³ More recently, using both recombinational and mutational analyses, the genetic fine structure has been investigated in a considerable detail at several gene loci in a variety of organisms. The work with micro-organism in general and *Neurospora* in particular has changed our earlier concept of gene structure. However, the final breakthrough that gave the first indisputable evidence of complexity of genes was obtained in research with bacteriophages⁴ and bacteria.⁵ These studies indicated that genes are complex in nature, in which changes could occur

at different sites, giving rise to different alleles.

Unlike in *Drosophila* and micro-organisms, the resolving power of genetic analysis is low in higher organisms due to limitations in handling a large population, thereby reducing the chances of recovering rare recombinants. During the present study, several mutants characterized either by fragile culms, leaves or both were isolated from the M_2 generation of non-brittle *japonica* variety, of rice (*Oryza sativa* L.), Tainan-3, which had been treated with physical (gamma-rays) as well as chemical (ethylmethane sulphonate, nitroso methyl urea) mutagens. The complete brittle mutant had brittle rachis in addition to brittle culm and leaves. Mutants with brittle rachis alone were not observed. The frequency of occurrence of each type is presented in Table I.

TABLE I

Frequency of different type of brittle mutations

Product of mutation	Mechanism	Frequency (Mutants in No. of M_2 plants)
1. Complete Brittle ..	$s \rightarrow S$	1/50,000
2. Brittle culm ..	$BC \rightarrow bc$	7/50,000
3. Brittle leaf ..	$BL \rightarrow bl$	10/50,000
4. Brittle rachis ..	$BR \rightarrow br$	Not studied

As far as the genetics of brittle character is concerned, the earlier reports suggest that brittle culm is controlled by a single recessive gene, *bcc*.^{6,7} Jodon⁸ reported that the fragile nature develops more in older seedlings, while Siddiq⁹ obtained a completely brittle mutant in the M_2 generation of Taichung-65 where he observed a brittle tendency even at the young stage of seedlings.

From the present findings, it appears that the genetic control of brittle character is complex. Based on a study of the different types of induced mutations and their frequency the brittle locus has probably three different mutational sites, BC, BL and BR (for culm, leaves and rachis respectively) and in addition there is a suppressor gene, S. Non-brittle rice varieties may, therefore, have the genotype, BC BL BR / BC BL BR and an inactive suppressor gene *s*. Rare mutations at the inactive suppressor locus *s* result in active suppressor gene *S* which gives rise to a complete brittle plant. Mutations involving different sites occur independently of each other resulting in brittle culm, brittle leaves or brittle rachis more frequently. The order and size of these sites are still unknown due to lack of recombina-

tional analyses. However, a hypothetical model is presented in Fig. 1.

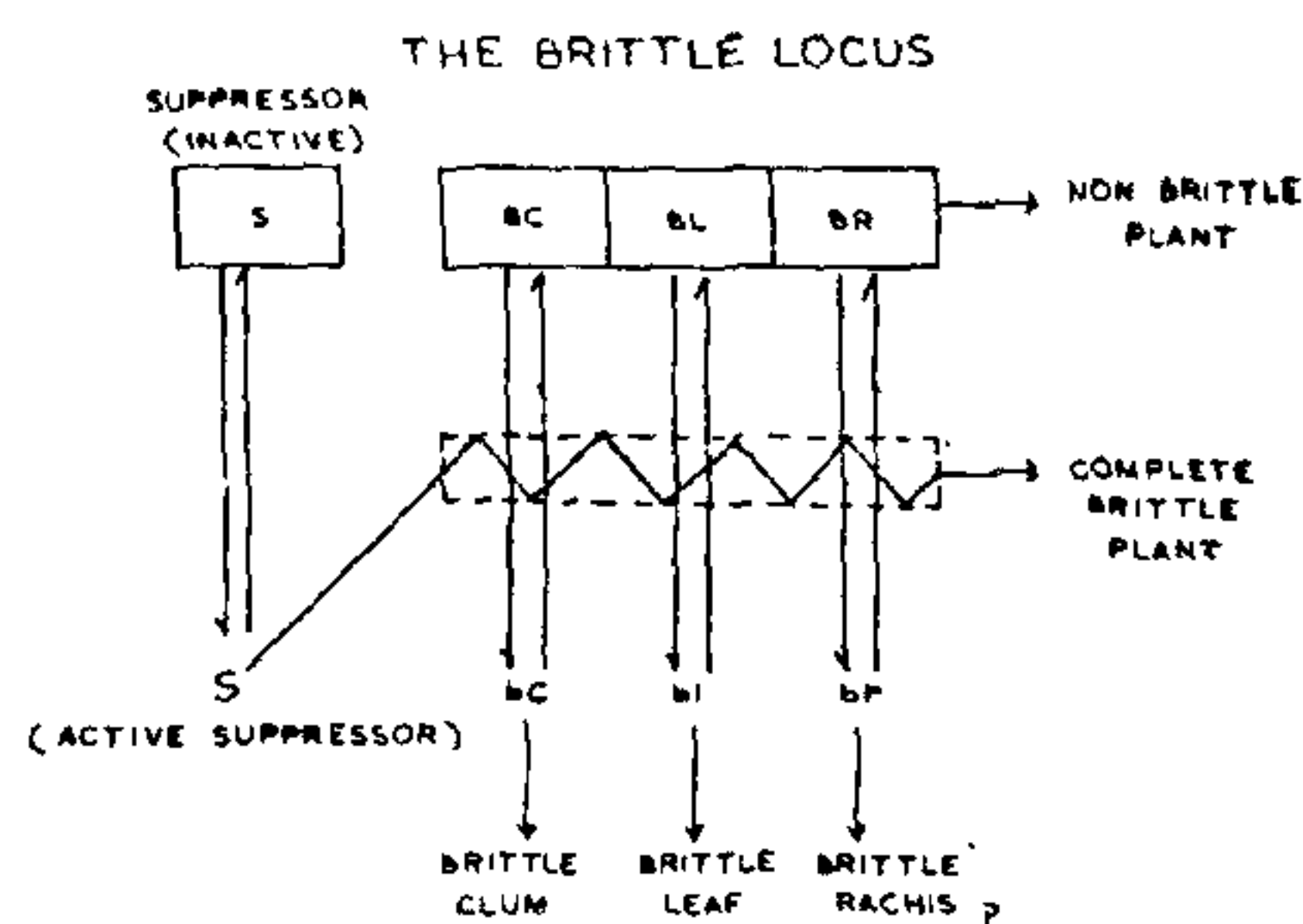


FIG. 1

The chemical nature of the fragile character has not been worked out. The only report in this context is by Takahasi¹⁰ which indicates that the brittle character develops due to a reduction in the α -cellulose content. Mutations at the brittle locus might alter the α -cellulose content of total carbohydrate present in the cell-walls in similar ways, as the *indica* and *japonica* grain mutations have been found to change the amylose/amylopectin fractions of starch content in rice.^{11,12} The suppressor gene mechanism involved in this system might disturb the normal functioning of brittle genes through its end product interaction. Further studies are, however, necessary on interallelic complementation in order to test the validity of the present hypothesis.

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