of contact metamorphism in this region. Pilgrim and West[2] observed the occurrence of xenoliths in the eastern parts of the granite but have not given the textural or mineralogical details of the xenoliths indicating contact metamorphism. Dixit[3] has also reported the occurrence of kyanite-bearing xenolith in the massive granite but the mineral assemblage of his xenoliths does not indicate any facies or subfacies of contact metamorphism. According to Pilgrim and West[2] the older rocks about the granite show essentially metamorphism of the regional type and not purely thermal as evidenced by the development of staurolite, chloritoid and chlorite. The increase in the grade of metamorphism has been ascribed by them to be due to increase of temperature consequent upon granite intrusion. Most of the later workers have followed the same view but expressed it in different ways.

The present authors while working in the Chor area have encountered, for the first time, the outcrop of typical hornfels in the proximity of Chor granites exposed at an altitude of about 3000 m along the south-western slope of the hill. The associated granite is dirty greyish white, medium to coarse grained with typical granitoid texture and almost completely devoid of foliation. The grey coloured porphyroblasts of plagioclase are embedded in the medium grained quartzo-feldspathic groundmass which contains specks of biotite scattered in it. Sometimes fine grained micro-granites and pegmatites are also associated with it.

At the contact with granite, the psammo-pelitic and pelitic country rocks (Jutogh) exhibit distinct contact metamorphism. The psammo-pelitic hornfels is fine grained, light to dark greyish coloured, very hard and compact, with spotted appearance. Under the microscope it exhibits typical hornfelsic texture which is marked essentially by deep brown scaly biotite and needles and prisms of sillimanite disposed in bands perhaps representing the bedding, or in patches in the granoblastic quartzose matrix. Small twinned or untwinned grains of plagioclase, potassium feldspar, and anhedral cordierite usually surrounded by biotite, occur in the matrix. The cordierites contain tiny inclusions of biotite, quartz and tourmaline, sometimes showing sector twinning; the mineral is biaxial negative. Poikiloblastic spongy garnet crystals occur here and there in the rock and contain inclusion of lenticles of opaques, quartz and fine needles of sillimanite in it. Sillimanite contains streak of biotite in it, indicating that it may have formed due to dissociation of the latter. Some quartz grains in the groundmass show polygonal outline and the straight grain boundaries meet in triple-point indicating a process somewhat analogous to primary recrystallization in a annealing (Spry[4]). The main assemblage of the hornfels is quartz-biotite-sillimanite-plagioclase-garnet K. feldspar (± cordierite). The rock is almost completely devoid of muscovite or contains a few flakes of it.

The pelitic schists in the contact, on the other hand, show relict foliation or bedding marked by bands of short prisms of muscovite and biotite exhibiting decussate texture. The muscovite of later phase is superimposed over the foliation or banding. Xenoblastic garnet is spongy and often stretched in the foliation plane containing inclusions of opaques, quartz, etc. The psammitic band is however devoid of muscovite and shows hornfelsic texture. The schist essentially consists of quartz, biotite, muscovite, garnet and plagioclase.

The mineral assemblage of the hornfels represents hornblende-hornfels or pyroxene-hornfels facies condition of metamorphism. The abundance of sillimanite instead of andalusite is due to high temperature condition of metamorphism in the immediate vicinity of the granitic body (Turner and Verhoogen[5], Turner[6]).

The authors are thankful to Professor B. S. Tewari for providing facilities for field and laboratory investigation.

Centre of Advance Study in Geology,
Panjab University,
Chandigarh 160 014,
June 26, 1978.

Brijraj K. Das.
Rakesh Rastogi.

1. McMahon, C. A., *Rec. Geol. Surv. Ind.*, 1882, **15**, 34.
2. Pilgrim, G. E. and West, W. D., *Mem. Geol. Surv. Ind.*, 1928, **53**, 1.
3. Dixit, A. K., *Him. Geol. Seminar*, New Delhi, Section 1, 1976, p. 1.
4. Alan Spry, *Metamorphic Textures*, Pergamon Press, 1969.
5. Turner, F. J. and Verhoogen, J., *Igneous and Metamorphic Petrology*, Indian edition, Allied Pacific Pvt. Ltd., 1962.
6. —, *Metamorphic Petrology*, McGraw-Hill Book Co., 1968.

IRREGULAR MEIOSIS IN STRAINS OF TRITICALE

Triticale, although having many advantages over cultivated wheat[1], could not make a commercial impact mainly due to irregularities in cell division and some degree of sterility. So far no strain exists having meiotic stability and fertility comparable to that of wheat. It requires constant cytological evaluation for developing stable strains[2, 3]. Meiotic behaviour in some triticale strains is reported in this communication.

TABLE I

Meiosis in some hexaploid triticale strians

Strain	Metaphase I		Anaphase I		Telophase II	
	% irregular cells	univalents/ pmc	% irregular cells	laggards/ pmc	% irregular cells	micronuclei/ pmc
JNK 6T002	46·0	1·1 (0–6)*	57·3	1·1 (0–7)	52·0	0·8 (0–4)
JNK 6T007	42·7	1·3 (0–8)	43·3	1·2 (0–8)	84·0	3·2 (0–8)
JNK 6T012	45·8	1·1 (0–6)	56·7	1·7 (0–6)	61·1	1·5 (0–6)
JNK 6T039	42·2	1·1 (0–6)	76·7	1·4 (0–6)	55·6	1·8 (0–5)
JNK 6T059	24·0	0·5 (0–6)	25·5	0·4 (0–3)	47·8	0·9 (0–4)
JNK 6T090	29·3	0·8 (0–6)	23·3	0·3 (0–4)	61·3	1·4 (0–5)
BRONC090	46·0	1·2 (0–8)	78·9	1·8 (0–9)	47·3	0·9 (0–4)

* Values in parenthesis indicate range of irregularity.

Hexaploid triticale strains ($2n = 6x = 42$) namely, JNK 6T002, JNK 6T007, JNK 6T012, JNK 6T059, JNK 6T090 and Bronce 90 were examined for meiotic stability. The floral buds were fixed in Cornoy's fluid (6 parts absolute alcohol : 3 parts chloroform : 1 part acetic acid) at appropriate stage and were subsequently squashed in 2% acetocarmine. Thirty cells were analysed from each plant and five plants were screned from each strain. Meiotic abnormalities such as univalents at metaphase I, lagging chromosomes at anaphase I and micronuclei at telophase II were recorded and are presented in Table I.

Meiosis in all the strains studied is irregular. In some cases the frequency of lagging chromosomes at anaphase I is higher than that of univalents at metaphase I. Sometimes univalents at anaphase I are also seen dividing into chromatids. This may result in the increased frequency of micronuclei as is observed in some cases.

The irregular cell division is supposed to be due to lack of compatibility in parental genomes of triticale[4, 5] due to different cell cycles[6-8] or due to heterochromatin associated with rye chromosomes[9-10] and is polygenically controlled[3]. The per cent irregular cells can be taken as a measure of instability. As its value shows variation, different triticale strains have achieved varying degrees of stability.

Thanks are due to Prof. P. K. Gupta, Department of Agricultural Sciences, Meerut University, for helpful discussions and to Council of Scientific and Industrial Research, New Delhi, for financial assistance.

Cytogenetics Laboratory, N. C. SHARMA.*
Meerut University,
Meerut 250 001, *January* 28, 1978.

* Present address : Department of Botany, Bareilly College, (Rohilkhand University), Barelly 243 001,

1. Hulse, J. H. and Spurgeon, D., *Scientific American*, 1974, **231**, 72.
2. Tsuchiya, T. and Larther, E. N., *Euphytica*, 1971, **20**, 591.
3. Merker, A., *Hereditas*, 1973, **73**, 285.
4. Yashvir and Gupta, P. K., *Biology and Plants*, 1972, p. 259.
5. Kempanna, C. and Seetharam, A., *Cytologia*, 1972, **37**, 327.
6. Bennett, M. D., Chapman, V. and Riley, R., *Proc. Roy. Soc. Lond.*, 1971, p. 259.
7. — and Kaltsikes, P. K., *Can. J. Genet. Cytol.*, 1973, **15**, 671.
8. Shkutina, F. M. and Khvostova, V. V., *Theoret. Appl. Genet.*, 1971, **41**, 109.
9. Merker, A., *Hereditas*, 1976, **63**, 215.
10. Roupkias, D. G. and Kalsikes, P. J., *Can. J. Genet. Cytol.*, 1977, **19**, 543.

TRANSFORMATION OF STREPTOMYCIN RESISTANCE IN *RHIZOBIUM* AND *AZOTOBACTER*

THOUGH there have been many reports on the intraspecific and interspecific genetic transformation in *Rhizobium*[1-3], reports on the intergeneric transformation between *Rhizobium* and *Azotobacter* are scarce[4] and require further confirmation[5]. The present communication deals with the transfer of streptomycin resistance in *Rhizobium cowpea*, transformation between *Rhizobium cowpea* and *Rhizobium japonicum* and between *Rhizobium cowpea* and *Azotobacter chroococcum*.