en the small increase in yield strength caused solute locking might be getting offset by e decrease in strength caused by dynamic covery.

Since stress relaxation in the plastic strain nge occurs by a process of thermally acti-ted motion of dislocations across the rriers,[12,13] it is possible to calculate one of e activation parameters, *viz.*, the activation olume from the relaxation curves. Activation olume, the product of the length of the dis-cation getting activated, the Burgers vector id the width of the barrier, characterises the stacle to dislocation motion. From the rela-on between creep and low temperature laxation, it has been shown[13,14] that the ope 'S' of the curve $\sigma_0 - \sigma$ *versus* ln t is ven by

$$S = kT/v \qquad (2)$$

here 'v' is the activation volume, k the oltzmann's constant and T the absolute tem-erature. The slopes of the straight lines rresponding to 3·9 and 4·8 kg./mm.^{2} are ilised to calculate the activation volume from quation (2). The estimated activation olume ($\simeq 2{\cdot}5 \times 10^{-21}$ cm.^{3}) is in good agree-ent with that reported earlier from creep xperiments.[1] While the estimated activation olume suggests that either intersection of ide and forest dislocations or the non-conser-ative motion of jogs is the rate-controlling echanism in Indian commercial aluminum, ur earlier results based on the combined data creep and tensile testing indicated that the on-conservative motion of jogs producing oint defects might be the most probable one.

Conclusions

Strain ageing experiments on Indian commercial aluminum showed the occurrence of sharp yield point associated with an yield drop. The increase or decrease in the yield strength after ageing depended on the stress level. The analysis of the relaxation curves yielded a value of $2{\cdot}5 \times 10^{-21}$ cm.^{3} for the activation volume.

Acknowledgements

We are thankful to Dr. S. Dhawan, Director and Prof. A. A. Krishnan for their interest in the work. We are also grateful to the authorities of N.A.L. for providing the Instron Testing Machine for conducting the experiments and to Mr. V. Sreenivasan, scientist, N.A.L. and Mr. M. V. J. R. Pantulu for their help during the experiments.

1. Prasad, Y. V. R. K., Sastry, D. H. and Vasu, K. I., To be published in *Trans. Ind. Inst. Metals.*
2. —, — and —, communicated to *J. Ind. Inst. Science.*
3. Mitra, S. K., Osborne, P. W. and Dorn, J. E., *Trans. AIME*, 1961, **221**, 1206.
4. — and Dorn, J. E., *Ibid.*, 1963, **227**, 1015.
5. Nunes, A. C., Rosen, A. and Dorn, J. E., *Trans. ASM*, 1965, **58**, 38.
6. Basinski, Z. S., *Phil. Mag.*, 1959, **4**, 393.
7. Cottrell, A. H., *Dislocations and Plastic Flow in Crystals*, Oxford, London, 1953, p. 139.
8. —, *Trans. AIME*, 1958, **212**, 192.
9. Johnston, W. G., *J. Appl. Phys.*, 1962, **10**, 727.
10. Hahn, G. T., *Acta Met.*, 1962, **10**, 727.
11. Cottrell, A. H., *Conf. on the Relation between the Structure and Mechanical Properties of Metals*, *H.M.S.O.*, 1963, **2**, 456.
12. Feltham, P., *J. Inst. Metals*, 1960-61, **89**, 210.
13. —, *Phil. Mag.* 1961, **6**, 259.
14. Sargent, G. A., *Acta Met.*, 1965, **13**, 663.

TEST-TUBE FERTILIZATION IN *DICRANOSTIGMA FRANCHETIANUM* (PRAIN) FEDDE

N. S. RANGASWAMY AND K. R. SHIVANNA

Department of Botany, University of Delhi, Delhi-7

THE technique of test-tube fertilization devised by Kanta *et al.*[1] helps to eliminate he path of pollen tubes through the stigma nd style. It is therefore promising in studies n plant breeding and genetics, and has been hus far applied to a few systems.[2-5] This aper reports our successful application of the echnique to *Dicranostigma franchetianum* (Papaveraceæ). Plants of this species were aised from seeds obtained from the Direktor, nstitute für Kulturepflanzenforschung, Gater-leben, East Germany.

As a prerequisite to our work, anthesis, dehiscence of anthers, pollination, fertilization, and seed development were studied from fresh material and from material fixed in formalin-acetic-alcohol (40% formaldehyde solution 5 ml + glacial acetic acid 5 ml + 70% ethyl alcohol 90 ml). The fixed material was embedded in paraffin following the customary method and microtomed (10–15 μ). The sections were stained in iron hæmatoxylin and erythrosin, and mounted in Canada balsam. Pollen germination and pollen tube growth

were studied also from whole mounts and free-hand sections prepared in 1% iron acetocarmine.

Under the climate of Delhi *Dicranostigma franchetianum* flowers during February-April. Anthesis occurs between 8 and 9 a.m. Anthers begin to dehisce toward the evening the day before anthesis and continue to shed pollen until two hours after anthesis by which time pollination is also accomplished. Pollen germination occurs nearly 30 minutes after pollination and fertilization 24–36 hours thereafter. Six days after pollination a 2- to 4-celled

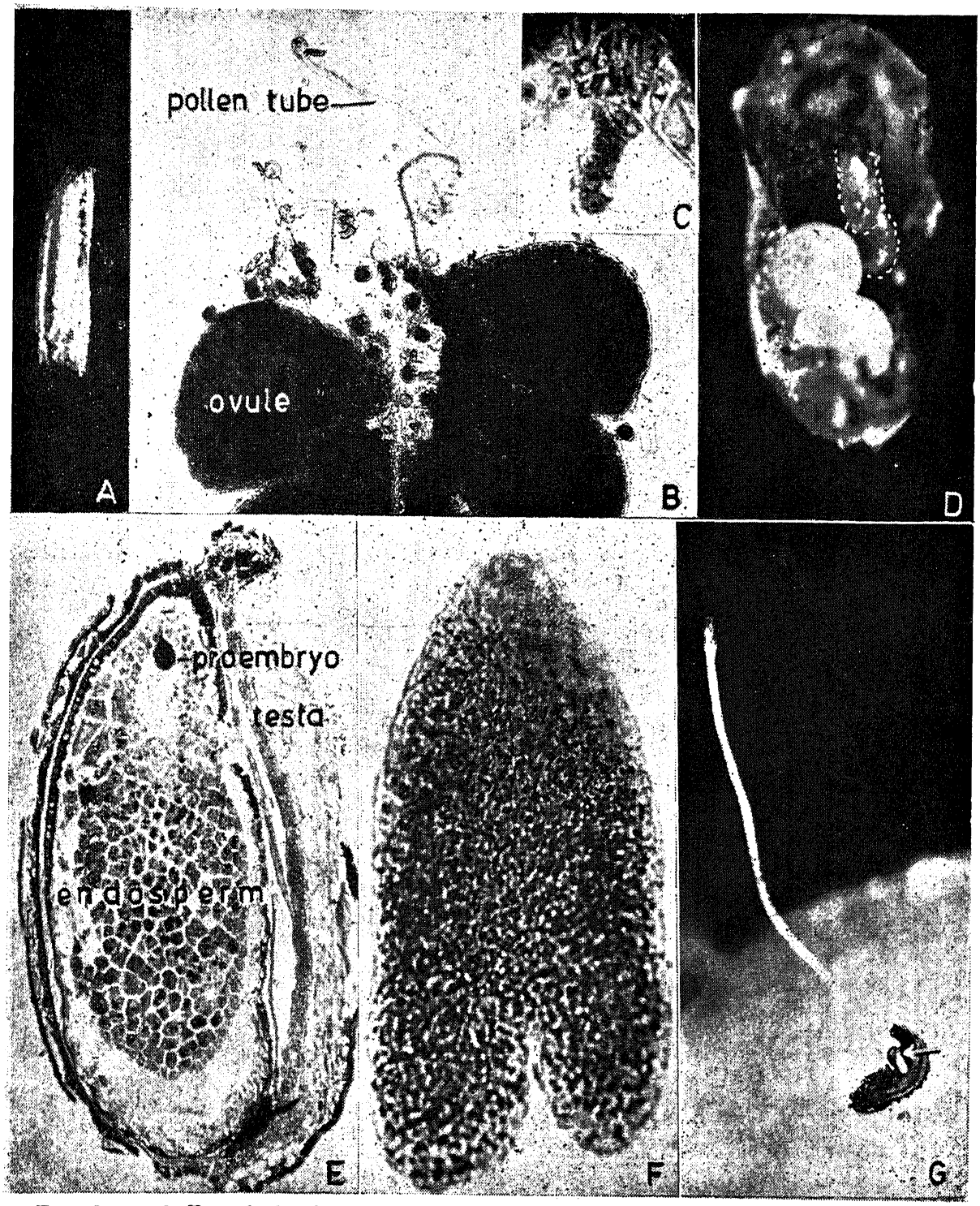

FIG. 1, A–G. Test tube fertilization in *Dicranostigma franchetianum*. A. An explant showing ovary wall, placenta, and ovules, × 6. B. Whole mount of a few ovules removed from a culture 24 hours after pollination; note pollen germination, × 121. C. Longisection of micropylar part of a fertilized ovule from a culture 4 days after pollination. The filamentous proembryo is obvious, × 102. D. 7-day-old pollinated culture showing 4 developing seeds; the 2 that are in profile are highlighted by broken lines; unfertilized ovules are not in focus, × 22. E. Longisection of a young seed collected from a culture 7 days after pollination. Globular embryo and massive endosperm are evident, × 110. F. Whole mount of embryo dissected from seed obtained from 18-day-old pollinated culture, × 345. G. 21-day-old pollinated culture showing seed germination *in situ*. In this view, the seedling does not show the root; the arrow-marked is a recently germinated seed which shows only the emergence of the radicle, × 4.