$$E + ATP \rightleftharpoons E(AMP—PP)$$
$$E(AMP—PP) + AA \rightleftharpoons E(AMP—AA) + PP$$
$$E(AMP—AA) + NH_2OH \rightleftharpoons E + AMP + AA—NH.OH$$

If the activation of amino-acids prior to incorporation into protein takes place by a general mechanism such as the above, then a function for the intracellular pyrophosphatase is apparent : to split the inorganic pyrophosphate formed, thus providing free orthophosphate for utilization in the regeneration of adenosine triphosphate (presumably through a concomitant glycolytic process). The higher inorganic pyrophosphatase activity in reticulocytes could be related in this way to the protein-synthesizing capacity of these cells.

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Polyembryony in *Cassia*

DURING an investigation into a presumed hybrid swarm among *Cassias*[1], seeds with twin embryos were found. An examination of the seeds of different species of *Cassia* that were available has shown the occurrence of polyembryony to be geographically widespread and remarkably common within several species. Table 1 gives the percentage of twins and triplets (in brackets) found in different collections of fifty to a hundred seeds.

Table 1. PERCENTAGE OF TWINS AND TRIPLETS (IN BRACKETS) IN DIFFERENT COLLECTIONS OF SEED

Australian species of *Cassia*	1	2	3	4	5
C. artemisioides Gaud.	10 (1)	25	10 (1)	23 (3)	8
C. australis var. *revoluta* Benth.	0				
C. desolata var. *involucrata* J. M. Black	16 (1)				
C. eremophila A. Cunn	40 (2)	20 (2)	5	24	
C. phyllodinea R. Br.	14 (1)				
C. sturtii R. Br.	3	21	9	40 (4)	14 (2)

The exotic species *C. bicapsularis*, *C. cana*, *C. corymbosa*, *C. fistula* and *C. leptophylla* contained no twins in single samples of fifteen to fifty seeds.

Among the twins and triplets the embryos varied from equality in size to one large and one small, and one large and two small respectively, gross inequality being the general case. Fused embryos and others with extra or reduced cotyledons were also frequent. The pairs of large twins at least were viable.

These extra embryos could arise from several sources. The occurrence of cleavage polyembryony or of several embryo sacs would not be apomictic in nature, but the first case would lead to the production of identical twins as would apomictic embryos. The latter could have developed from cells of the nucellus and integuments, or in some cases from the synergids. Twins arising from several embryo sacs would not be identical. However, many genera are facultative apomicts, and both sexual and apomictic reproduction may occur simultaneously[2]. Evidence for this in *Cassia* was indicated when one plant, presumed to be a hybrid on morphological characters, failed to segregate but produced twins and other abnormal seedlings, while a second plant produced morphologically different seedlings from each of two pairs of twins.

All the Australian species listed belong to the section *Psilorhegma*, which is well developed in Australia, but the varied biotypes of which have resulted in taxonomic confusion, particularly in the species complex centred about *C. sturtii*. The preservation of the intermediates could be the result of both apomixis and of sexual reproduction.

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A Feature of the Root Nodules of *Casuarina*

IN the course of an investigation into the development and physiological activity of the root nodules of *Casuarina*, considerable numbers of nodulated plants of *C. cunninghamiana* and *C. equisetifolia* are being grown in water culture. Nodulation was secured by inoculating the roots of young plants with a suspension of crushed *Casuarina* nodules obtained from abroad through the assistance of Dr. H. R. Fletcher, of the Royal Botanic Garden, Edinburgh, and commenced three to four weeks after such inoculation. McLuckie[1] noted a resemblance between *Casuarina* and *Myrica* root nodules in that both show a lobed structure as the result of repeated branching (actually this is true of most non-legume and some legume nodules) and in that a root grows out from each nodule lobe.

An interesting feature which has emerged from the present study is that these nodule roots show strongly upward growth, as illustrated in Figs. 1–4. In some cases the roots (which bear few or no root hairs) have attained a length of 10 cm. and may project from the surface of the culture solution even when originating from quite deeply set nodules. Precisely similar features have been recorded previously for *Myrica gale*[2] growing under a variety of cultural and under field conditions. In that species the upward growth of the nodule roots was shown to be the result of negative geotropism (not of ageotropism, as stated in a recent review[3]), and was thought to be possibly of significance in the ventilation of the nodules, which are otherwise enclosed in a layer of cork tissue. The general position seems to be much the same in *Casuarina*.

It is somewhat surprising that this unusual pattern of root behaviour should be repeated in such unrelated plants as *Casuarina* and *Myrica*, resulting in the nodulated root systems of young plants being virtually indistinguishable from each other externally. A further resemblance is that the nodules of *Casuarina* also are frequently pink in colour. I have no oppor-