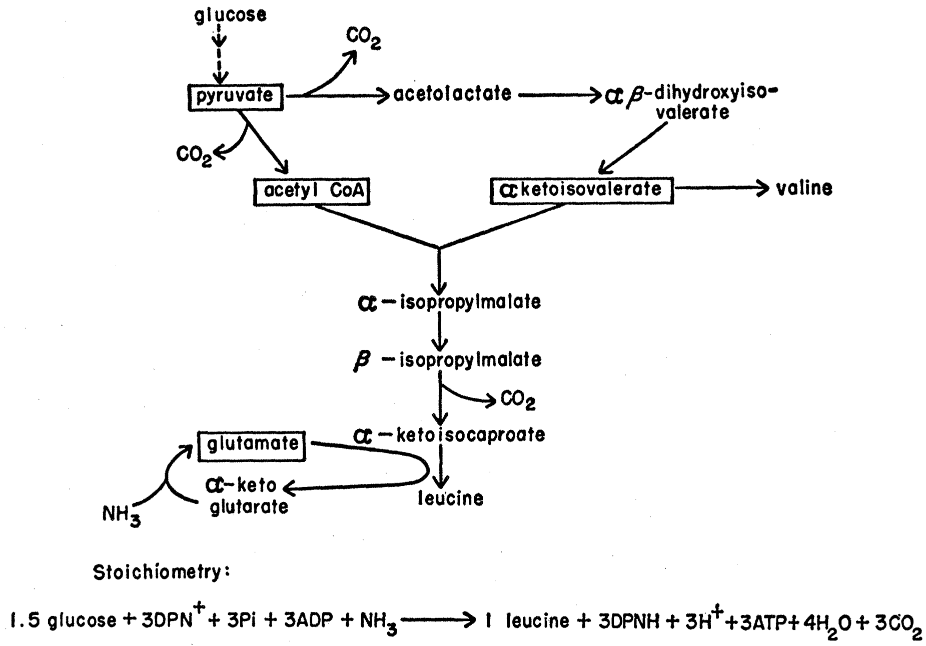

Fig. 3. Pathway from glucose to leucine (*10*).

1) The high rate of leucine biosynthesis might directly affect the growth rate by causing a limitation of an intermediate which is common to both leucine biosynthesis and to some other essential pathway. The most important leucine intermediates that are branchpoints in metabolism are circled in Fig. 3. In addition, it is conceivable that other components, such as oxidized or reduced cofactors, might become rate limiting.

2) As a result of uncontrolled biosynthesis, some intermediate in the leucine pathway might accumulate to the point where it was inhibitory to growth.

We initially suspected that the availability of valine was limiting growth because the generation times of LT-2 and CV241 in nutrient broth were identical. Consistent with this idea was the later finding that CV241 and the parental strain grew at the same rate in minimal medium supplemented with 10 μg of L-valine per milliliter.

However, an equally plausible interpretation of the effect of exogenous valine is that it inhibits acetolactate synthetase (*8*), thus cutting down the flow of intermediates for leucine biosynthesis. In this case it is obvious that a faster growth rate might result from either the exogenous supplementation of a necessary intermediate or the attenuation of a condition which is producing a limitation or a toxic product. Further work is necessary to establish the reason for the slower growth rate of CV241.

The importance of repression mechanisms in conserving protein synthesis in bacteria is widely recognized. Indeed, there are several reports of derepressed strains which synthesize as much as 6 percent of their total protein as a single enzyme (*9*). The work presented here quite clearly points out two other important functions of control mechanisms, namely, the conservation of nutrients and the preservation of balanced metabolism necessary for a maximum growth rate.

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Platyzoma: A New Look at an Old Link in Ferns

Abstract. *Record of a chromosome number of* 2n = *76, unusual for pteridophytes, in* Platyzoma microphyllum *R. Br. emphasizes other unique features of this monotypic Queensland fern and provides new evidence of its possible relationships. Other characteristics of this plant, which are not known among terrestrial ferns, are incipient heterospory—having two sizes of spores and a dioecious condition of the gametophytes. These and other morphological features show relationships of* Platyzoma *to members of the Schizaeaceae and Marsileaceae and relationships of these families to the Polypodiaceae, in which it is treated under the subfamily Platyzomatoideae.*

This report of the chromosome number of the fern *Platyzoma* is based on meiotic chromosome counts from the apex of young leaves treated with snail cytase (Figs. 1 and 2). Plants were grown at the Gray Herbarium, Harvard University, from spores of a plant collected near Mareeba, Queensland, Australia, by G. D. Keefer (*1*). Young sporophyte plants produced erect filiform leaves that were not circinate as in most ferns. Over a period of 3 years the plants produced these in tufts, and only one developed mature pinna-bearing leaves. Material for this study was brought to Leeds University by Irene Manton and the cytological work was done there by the junior author.

The haploid chromosome number of $n = 38$ is known in relatively few ferns. This or multiples of it are reported for members of the Schizaeaceae, Marsileaceae, and in the Polypodiaceae in *Woodsia* (*2*) and in four species of an African group *Blotiella* (reported as *Lonchitis*) (*3*). With regard to other characters, these genera are clearly distinct from *Platyzoma*. However, there are similarities to certain groups in the Schizaeaceae and Marsileaceae which are of interest in light of this new cytological record. In *Anemia* the base number was interpreted as $x = 19$ by Mickel (*4*), although there is no direct evidence of this, since the actual numbers encountered ($n = 38$, 76, 114, 152, and 228) are all multiples of 38, which is itself the lowest number of the series so far encountered in the Schizaeaceae. Another schizaeaceous genus, *Mohria*, has $n = 76$ (*5*). In only

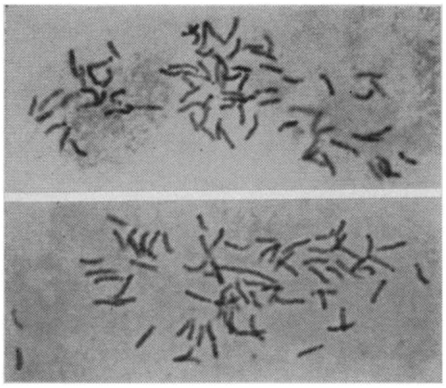

Fig. 1. Two different cells, from a young leaf of *Platyzoma*, in mitosis showing $2n = 76$. ($\times$ 750)

one genus of the Marsileaceae, namely *Regnellidium*, is it safe to infer $n = 19$ from a somatic count of $2n = 38$ (*6*). This exhausts the present known incidence of ferns with 38 chromosomes either as haploid or diploid. *Platyzoma* was recently placed in a separate subfamily of the Platyzomatoideae of the Polypodiaceae by Tryon (*7*) on the basis of similarities to members of both the Schizaeaceae and Polypodiaceae. Its position in the Polypodiaceae is based mainly on features of the sporangium, which is considered one of the major characters in the classification of the families of ferns. The sporangium in *Platyzoma* has the general form as in the Polypodiaceae with a nearly erect annulus which is interrupted by a two- or three-tiered stalk. In the spherical shape of the capsule there is a similarity to sporangia of *Mohria* and *Anemia* in the Schizaeaceae. In the deeply undulating cell walls of the capsule faces there is a similarity to the sporangia of *Schizaea melanesica* Sell. and *S. confusa* Sell. Sporangia of the Marsileaceae differ from those of most ferns in lacking a well differentiated annulus, and they are contained in special sporocarps.

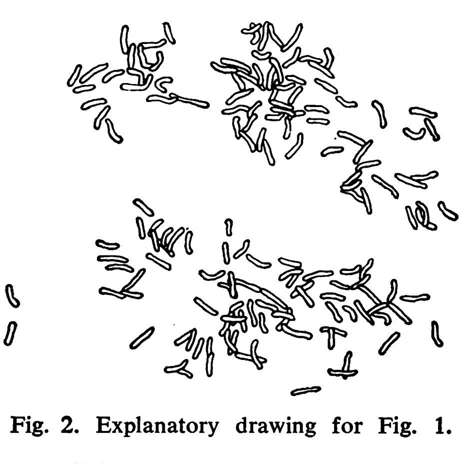

Fig. 2. Explanatory drawing for Fig. 1.

The indument in *Platyzoma* is of simple multiseriate trichomes and glands. The long, lustrous, rust-colored trichomes on the rhizome are similar to those in *Anemia*. Two- or three-celled capitate glands are especially abundant on the lower surface of the leaves, and these secrete a yellow wax-like substance. Such secretions occur in several genera of ferns but are best developed in species of *Pityrogramma* and *Notholaena* of the Polypodiaceae. Glands occur in *Schizaea* and in sections Anemia and Coptophyllum of *Anemia*, but a waxy secretion is not reported for any of the Schizaeaceae. In the Marsileaceae, multiseriate trichomes occur on the rhizome and on the lower surface of the leaves, and they are most conspicuous when they form a dense tomentum on the sporocarps in all of the genera.

The leaves in *Platyzoma* are strongly dimorphic. In juvenile plants and in zones along the rhizome of mature plants, they are filiform and erect. Such simple bladeless leaves are rare in the ferns but occur in several species of *Schizaea*, including the North American *S. pusilla* Pursh. In the Marsileaceae, these are found in *Pilularia* and in the juvenile leaves of *Marsilea*. Leaves of the mature form in *Platyzoma* are as unusual as the filiform ones. They are slender and elongate with numerous pouchlike pinnae on each side of the rachis. Somewhat larger fertile pinnae occur in zones in the upper portion of the leaves. The sporocarp in the Marsileaceae is considered to be a modified pinna (*8*), and the pouchlike form of the pinnae in *Platyzoma* could represent an intermediate stage toward the development of the sporocarp. The homology is most readily seen in such species as *Marsilea polycarpa* Hook. & Grev. in which several sporocarps are borne in a series along the rachis. *Jamesonia* in the Polypodiaceae has reduced leaves of this pinnate form, but this is a specialized genus mainly of the Andean paramos and quite unrelated to *Platyzoma*.

The spores of *Platyzoma* are remarkable among terrestrial ferns because they are of two size classes, generally with 32 small spores that develop in small sporangia and from 1 to 16 large ones in large sporangia. Strict heterospory in the Filicopsida is known only in the aquatic ferns Salviniaceae and Marsileaceae. Details of sporogenesis are not fully reported for the latter family, but the spore output is given as 64 microspores and usually a single megaspore per sporangia, although from 8 to 16 spore mother cells may be produced. It appears that in these plants irregularities in the development of both spore mother cells and the spore initials may produce variation in the numbers and in the sizes of the spores, as in *Platyzoma*.

The shape of the spores of *Platyzoma* is tetrahedral-globose with a triradiate scar, and the sculpture is mainly rugose. On the distal face the rugae branch or anastomose, and near the equatorial region they form a series of parallel bands. In the radial symmetry, trilete scar, and particularly in the parallel banding of the spores, there is a resemblance to spores of *Anemia* in the Schizaeaceae.

The rhizome of *Platyzoma* was described by Thompson (*9*) as a medullated protostele with a discontinuous inner endodermis and lacking leaf gaps. Similar rhizome structure is reported for species of *Schizaea* and *Anemia*. The rhizome in the Marsileaceae is a more complex solenostele, and the most reduced forms lack an inner endodermis.

The unusual chromosome number reported for *Platyzoma* emphasizes the uniqueness of the plant and its position apart from other groups in the Polypodiaceae. This new information, in addition to other morphological characters, lends support to the treatment of *Platyzoma* as a separate subfamily in the Polypodiaceae. Its similarities with groups in the Schizaeaceae and in the Marsileaceae strengthen the generally accepted relationships between these families.

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