The study of *Frankia* and its nitrogen-fixing symbioses with woody dicots has attracted an increasing number of investigators because of the importance of actinorhizal plants for forestry, land reclamation and natural ecosystems and as a model for the genetic engineering of new symbioses. Since the first successful isolation and culture of the root-nodule microorganism from actinorhizal plants in 1978, sufficient progress has been made on the biology of the actinomycete *Frankia* to convene a 3-day international conference on the subject. On August 4–6, 1982, approximately 60 scientists from North America and scattered places from around the world met at Madison, WI. Thirty-two papers on the general subject of *The Biology of Frankia* were presented. The program was planned by John G. Torrey and John D. Tjepkema of Harvard University and was hosted by Jerry Ensign of the University of Wisconsin. Twenty-seven of the papers have been brought together for publication in this issue.

Notable progress has been made on many fronts and the participants had the stimulation of exchanging much new information on the nature of the filamentous soil bacterium which invades roots of a wide range of hosts, forming highly effective symbioses. The list of actinorhizal host plants has now been increased to 22 genera distributed among eight families of dicotyledonous woody species and including in excess of 170 species. The number of separate discrete isolations of *Frankia* from an increasing proportion of these hosts has now reached the hundreds. Host genera from which *Frankia* isolates have been cultured which are known to be infective and effective (in forming nitrogenase) include *Alnus, Casuarina, Comptonia, Elaeagnus, Hippophaë, Myrica*, and *Purshia*. Included in this series of papers are the first reports of successful isolation of an effective strain of *Frankia* from the important tropical and subtropical tree *Casuarina*, opening the possibility of distributing endophyte for inoculation of a genus of worldwide distribution which is increasingly one of the most important fuel trees in the world.

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Des progrès remarquables ont été accomplis sur plusieurs fronts et les participants ont eu la stimulante initiative d'échanger beaucoup d'information nouvelles sur la nature de la bactérie terricole filamentueuse qui envahit les racines d'une grande variété d'hôtes, formant des symbioses très actives. La liste des plantes actinorhizées hôtes est maintenant passée à 22 genres à partir desquels les huit familles d'espèces dicotylédones ligneuses qui comprennent plus de 170 espèces. Le nombre d'isoles peu de caractères discrets de *Frankia*, à partir d'une proportion croissante de ces hôtes, a maintenant atteint les centaines. Les genres d'hôtes à partir desquels les isoles de *Frankia* ont été cultivés, qui ont la réputation d'être infectieux et actifs (en formant de la nitrégénase) comprennent les *Alnus, Casuarina, Comptonia, Elaeagnus, Hippophaë, Myrica* et *Purshia*. Cette série de communications comprend les premiers rapports d'isolement réussi.
An area of active research dealt with in a number of contributions in this symposium concerns improved methods of cultivation of *Frankia in vitro*. The early isolations were established on complex media containing yeast extract. Now many strains can be grown on defined media. Under these conditions one can induce morphological differentiation of specialized structures: sporangia and thick-walled spores in abundance, or purely filamentous growth, or filaments bearing specialized terminal swellings called vesicles within which the N₂-fixing enzyme nitrogenase is formed. Thus, free-living *Frankia* can be induced to fix atmospheric N₂ using as energy and carbon source such compounds as propionate or succinate in a defined inorganic medium.

Important advances were also evident in nodule physiology and the ecology of actinorhizal plants. The presence of hemoglobins was demonstrated in several species with relatively high concentrations being found in nodules of *Casuarina cunninghamiana* and *Myrica gale*. New aspects of the mechanism of protection of nitrogenase from oxygen and the first measurements of annual energy usage in nitrogen fixation by an actinorhizal species were reported. There was also progress on photosynthetic partitioning, nodule carbon metabolism, and soil factors affecting nodulation and nitrogen fixation.

Other firsts reported at the meeting included detailed comparisons of a large number of strain isolates from a common host species, which indicate the diversity of strain types associated with a given host. New also were the first reports of the occurrence of plasmids in *Frankia* (to be published elsewhere). Progress is reported here on a better understanding of the infection process whereby *Frankia* enters the root hairs of susceptible host plants and on some of the subtleties of interactions between host and endophyte leading to successful symbioses or to failed associations.

Although emphasis was placed at the meeting and in this published report on the basic biology of *Frankia*, the implications for the improvement of host--bacterial symbiotic associations were evident as well as the importance of the symbioses to host plant growth and development and success in its natural or plantation site.

During discussions at the meeting, much attention was given to the increasing difficulties of identifying strains because of the lack of a uniform method of strain designation. A committee chaired by M. P. Lechevalier agreed to prepare a statement on a method of uniform strain designation for future use with *Frankia* isolates. The results of their deliberations combined from more general discussions are presented in this series.

Plans for another meeting to be held 2 years hence were formulated. At that time it is hoped that emphasis will be placed not only on progress in understanding the biology of the cultured organism but also on the practical
application of this knowledge to the inoculation of forest

tree species and the improvement of tree production with
symbiotic nitrogen fixation from *Frankia* – actinorhizal
plant associations.

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