less than sixty-five. These substantial differences in taxonomic concepts are particularly unfortunate in a genus such as *Fusarium* which contains so many pathogens of crop plants which are of great significance in both temperate and tropical countries.

In their elegantly produced guide to the species of *Fusarium*, Toussoun and Nelson accept the species concept of Snyder and Hansen. A simple key to the species based on the shape of microconidia, occurrence of chlamydospores and shape of the basal cell of macroconidia is given. In six pages of text there is useful information on methods by which species can be cultured and examined. Fifteen plates of particularly high quality show the spore morphology of each species, but no attempt has been made to show the complete variation in spore shape which exists in each species. No reference is made to *formae speciales*, races or cultivars. A printer's error occurs in Plate 16.

Plant pathologists, in particular, will regret the absence of reference to cultivars. It is generally accepted that many of the pathogenic cultivars of *F. roseum* as defined by Snyder and Hansen can be regarded biologically as separate entities. Importance must be attached to the precise identification of pathogenic isolates in communications involving taxa of the *F. roseum* (sensu) Snyder and Hansen complex. While the very great variability in shape of macroconidia in the *F. roseum* complex is well illustrated in three plates, research workers will have to look beyond this guide for assistance in attaching more precise labels to isolates. JOHN COLHOUN

BUILDING HIGH

The Stanford Two-Mile Accelerator

Edited by R. B. Neal. Pp. xiii + 1169. (Benjamin: New York and Amsterdam, 1968.) $35.

THE Stanford Two-Mile Accelerator is the largest of its kind in the world. The central feature of the accelerator consists of 960 10-feet sections of disk-loaded waveguide fed by 245 high-power microwave pulsed klystrons. Because of the unprecedented size, complexity and importance of this project—to quote its director, Dr Panofsky—members of Stanford Linear Accelerator Center (SLAC) felt a real responsibility to publish in full the technical features of the installation. With the assistance of ninety co-authors, the editorial committee headed by Dr Neal, associate director of SLAC, has compiled a complete factual record of the project up to mid-1967.

Preliminary studies for a multi-GeV electron accelerator first took place in 1955, but it was not until 1961 that authorization to construct the accelerator—known as "Project-M" or the "Monster"—was finally obtained. Several factors contributed to this choice of machine. Electron energies above 10 to 12 GeV are difficult and expensive to obtain with circular machines because of energy loss by radiation. The maximum energy so far produced in an electron synchrotron is 10 GeV. It is likely, therefore, that the SLAC accelerator will be unique because electron energies of 20 GeV and more will be obtained only with linear machines. Although there has usually been a strong preference for protons for strong-interaction physics, predictions made by Drell suggested that enhanced secondary particle production would take place with electrons. This has now been confirmed and widens the scope of the SLAC accelerator.

Undoubtedly, one of the main reasons why this particular machine was built at Stanford stems from its predominance in this type of accelerator. The early chapters of the book deal with early history, the growth of the project, project administration, general descriptions of the accelerator and a simple but lucid account of the objectives of particle physics research. This part of the book—a mere 100 pages—is absorbing and should appeal to all those involved in project management.

Three important phases of linear accelerator development are in evidence. During the immediate post-war years, 1946–49, research at Stanford and elsewhere established the basic principles of particle acceleration using disk-loaded waveguides. Several small accelerators were built during this period, the largest of which reached an energy of 35 MeV. Of particular significance was the pioneer work by Hansen on the development of the high-power pulsed klystron. This was the key to future progress and soon replaced the magnetron favoured by other accelerator groups.

Success with low energies encouraged Stanford to set its sights on a one-gigavolt machine. So began the second phase of development in 1949. In stages—200 MeV by 1951, 600 MeV by 1955, 1 GeV by 1957—the energy was pushed up until it reached its present value of 1·2 GeV. During most of this time an active programme of particle physics research was pursued. Thus work on this machine became the test-bed of experience which laid the foundations for the multi-GeV machine. Although there was no change in basic principle, improved techniques for fabricating waveguides, increased reliability and continued development of the klystron were established.

Construction of the multi-GeV machine started in 1962. Electrons were accelerated along the entire length of the accelerator to the Phase I design energy of 20 GeV in 1966. It is proposed to extend this to 40 GeV at some future date by increasing the power. At peak, the total manpower on site during construction was 2,000. The cost of the project was 120 million dollars. The greater part of the book is concerned with technical details of the system. With the same remorseless thoroughness that attended the construction of the machine, each component part of the system is analysed, less promising solutions are discarded, and reasons for the final choice of parameters upheld. The only major surprise in operation was the occurrence of the phenomenon known as beam break-up. This phenomenon has been familiar to electron accelerator physicists since 1957 and occurs at relatively high currents on low energy machines. The reasons are properly understood and care was taken to avoid this trouble in the design of the SLAC machine. Much to their surprise, however, beam break-up occurred at the relatively low current of 10–20 mA. A very excellent account of theory, and observation, together with a discussion of possible remedies is given in the chapter on beam dynamics.

This book should be of interest to all accelerator builders and users. There is also a fund of technical material of interest to microwave engineers, including problems of fabrication, high-power pulse techniques with klystrons, multiple feeding, phasing and control of large systems. Beam control in this machine is a formidable problem. Ancillary equipment, such as large magnets and spectrometers, receive brief mention but are of general interest to accelerator users. W. WALKINSHAW

ORGANIC RADICALS

Organic Chemistry of Stable Free Radicals

By A. R. Forrester, J. M. Hay and R. H. Thomson. Pp. xi + 405. (Academic Press: London and New York, October 1968.) 120*s*; $18.

FOR the purpose of this book, "stable" free radicals are (sensibly) defined as those which can be prepared by conventional chemical methods and exist long enough for utilization in a subsequent chemical reaction or for examination by normal spectroscopic techniques. These days, this definition embraces a remarkably wide variety of species, all of which are dealt with in detail and with a literature coverage up to about the end of 1967: triarylmethyls and other carbon radicals such as aromatic hydrocarbon radical-anions, diarylamino radicals, hy-