systematizing the multiplicity of details which the "natural history" of organisms provides. Verne Grant is an evolutionist who has concentrated his attention for some 20 years on the angiosperm family Polemoniaceae. With regard to the fashions of biology, his search for data spans the equivalent of a time scale from present-day genetics to observations of floral ecology that were popular in the heyday of Darwinian naturalists.

The question that Verne and Karen Grant take as the theme of their book is, "Do the various flower forms within a diversified family represent floral mechanisms specialized for pollination by different kinds of agents?" This question seems innocuous, and its answer is easily anticipated by anyone convinced of the importance of natural selection in evolution; yet surprisingly, there are strong and conflicting opinions among students of pollination ecology. The Grants' position is safely in line with neo-Darwinian theory. The major portion of their text consists of a systematic presentation of data concerning floral mechanisms, breeding systems, and animal visitors for 18 genera and some 122 species (out of about 327 in the family). Such topics as flower form, color, odor, and periodicity comprise the sections on floral mechanisms; data on breeding systems come from experimental studies; the kinds of animal visitors and their relative effectiveness as pollinators are described principally from the authors' own field observations. Cross-pollination by animals falls into nine modes: bees (see cover on this issue of *Science*), long-tongued flies, scavenger flies, hummingbirds, butterflies, hawkmoths, noctuid moths, beetles, and bats. In genera of temperate zones, bee pollination is most common and is considered the original mode. Autogamy is frequent, but wind pollination is absent.

The many pages of descriptive material will be a most useful reference for future students, and will be of immediate interest to those familiar with the phlox family or with the numerous groups of insects mentioned. The book is profusely illustrated with life-sized drawings of the plants and their pollinators. A summary chapter presents an interpretation of evolution along orthodox lines that are a modern extension of classical floral biology. Differences in modes of pollination between races of a species are believed to arise gradually in allopatric populations, by adaptation to different spectra of flower-visiting animals. The authors hold the widely accepted view that speciation is an extension of race formation. An alternative idea, put forward by another student of the California flora, is that species barriers of a genetic sort may arise swiftly, in ecologically marginal populations subjected periodically to catastrophic decline in numbers. Many of the Grants' examples of racial and species diversity, as in *Gilia*, are in desert-border regions where "catastrophic selection" may be significant for rapid changes in flower form, and this should perhaps not be overlooked in the analysis of evolution in Polemoniaceae.

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History of Technology

A Theatre of Machines. A. G. Keller. Macmillan, New York, 1965. vi + 115 pp. Illus. $6.

Near the turn of the 16th Century there appeared three books of mechanical inventions that were intended to show the potentialities of machinery derived from the Middle Ages, in particular the waterwheel and windmill, and which also attempted to show the artisan how important it was to apply theoretical considerations to machines, instead of merely putting the machines together by rule of thumb. The books were Besson's *Livre des Instruments Mathematiques et Mechaniques* (1571–1572), Ramelli's *Diverse et Artificiose Machine* (1588), and Zonca's *Teatro Nuovo di Machine et Edificii* (1607). Although the mechanical inventions depicted in these books were not revolutionary, and it is doubtful whether some of them could ever have worked in practice, they provide historians with insight into the level of early modern technology as well as the imaginative quality of Renaissance technicians. Unfortunately, the fascinating illustrations that form the core of these books on machines are seldom reproduced and are known to only a handful of scholars who consult the original editions in collections of rare books.

Now Keller, who teaches the history of science at the University of Leicester (England), has compiled an anthology of 52 of the most interesting plates from the three major books of mechanical inventions, as well as from some minor sources. Choosing his plates on the basis of esthetic attraction, the boldness of their creator's mechanical imagination, or as early crude prototypes of what later became important inventions, Keller proceeds to indicate the particular machine's interest from the standpoint of the history of technology and to show how the machine worked—providing it could work at all.

Most of the plates depict hydraulic engineering machines; for the late Renaissance was fascinated with waterwheels and pumps, partly because of the needs for drainage and irrigation, but also because of the esthetic appreciation accorded fountains. But Keller does not neglect war engines, cranes and hoists, ingenious devices for the transmission of power, and other machines, including a homely "instrument for keeping the feet warm" and a pioneer parachute—an essential for an age whose technical imagination overflew its technological capabilities.

Keller has selected his illustrations well, and they are reproduced in good size with fidelity to the detail shown in the originals. Above all, he has written perceptively, and wittily, about the accomplishments and limitations of the Renaissance technologist. This book will fascinate, enlighten, and entertain all those who are interested in the development of mechanical inventions.

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Snow Line between Cultures

Wayward Servants: The Two Worlds of the African Pygmies. Colin M. Turnbull. Published for the American Museum of Natural History by Natural History Press, Garden City, N.Y., 1965. xiv + 390 pp. Illus. $7.95.

Colin Turnbull is one of those rare and hardy anthropologists who has studied a single band of forest nomads intensively throughout a calendar year. He was prompted to make this micro-sociological study of net-hunting Mbuti pygmies of the Ituri Forest in the northeast Congo (Leopoldville) in order to arrive at a valid picture of the

relationship between these hunters and gatherers and the Bantu- and Sudanic-speaking Negro village cultivators with whom they share the region.

In previous publications Turnbull has challenged the view long sustained by followers of the anthropological school of Wilhelm Schmidt in Vienna (Father Schebesta, Father Schumacher, and Father Gusinde are representative of Schmidt's followers) that the pygmies are now totally dependent on the villagers for food and metal, and even for their very culture. Spurred on by a desire to refute this standardized error, Turnbull decided that he would immerse himself in the daily life of a single band and attempt to acquire by empathy and experience what linguists call the "inside view" of its members. From this structural perspective a very different view of the Mbuti–villager relationship emerged.

Dyadic relationships, whether between individuals, roles, or groups, may have varied qualities—they may be symmetrical or asymmetrical, complementary or antithetical, and they may involve symbiosis or avoidance. What Turnbull found in the Ituri was a single ideological field whose polarities were the village and the forest. This field was a unity of tensed opposites. Against Negro political centralization, Mbuti society offered "complete decentralization and diffusion of authority." Against "a sedentary, patrilineal, patrilocal village," it opposed "the nomadic, nonlineal, territorial band." Moreover, "the vertical village kinship system" was confronted by "a horizontal age-level system." Detailed documentation, in the form of genealogies, plans showing changes of band composition over time, and sketches of the layout of camps in the opposed contexts of free forest and village environs, convincingly supports Turnbull's argument.

Most convincing of all is the way in which he shows how relative position in cultural space determines the values held by its occupants. "Village values are directly opposed by Forest values. And within itself Mbuti society uses these same principles, in a state of almost perpetual flux, to maintain a cohesion fully as powerful as that found among the villagers." When the Mbuti in their nomadic cycle choose to locate themselves within the village sector, they fall so strongly under its influence that the very spatial arrangements of their camps replicate those of the cultivators' villages. But they have for retreat their own autonomous focus, the forest, which they love and which the Negroes fear, and where no one calls them servant. In the village sector, forest values are transvalued; in the forest the opposite is true. Thus Schebesta and his congeners have grasped a mere half truth, because they have seen the village-forest continuum only from the angle of observation of what Kroeber would have called a "half culture," that of the cultivators. But the pygmies consider themselves independent raiders of the village economy, raiders who play off, to their own advantage, one group of cultivators against another in competition for the forest produce they offer. Both viewpoints are "true," but both are also "false." Objective truth embraces their opposition. To this analysis of dualism Turnbull has brought a twofold spirit—a blend of *l'esprit de finesse* and *l'esprit de géometrie* that befits a practitioner of the discipline of anthropology, which straddles, or ought to straddle, the "snowline" between the two cultures.

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On "Compleat" Archeology

An Introduction to Prehistoric Archeology. Frank Hole and Robert F. Heizer. Holt, Rinehart, and Winston, New York, 1965. x + 306 pp. Illus. $7.

This volume is an introduction to the variety of techniques and the many scientific fields that are now used in the interpretation of prehistoric archeology. It does not systematically describe the content of that endeavor and is, for that reason, mistitled.

The authors' definitions of their subject are seen in the following statements: "But no matter how it is defined, archeology deals with man in the past; its concern is with culture seen in the perspective of time. Prehistory, as a special example of archeology, deals with noncivilized peoples whose closest living counterparts are studied by ethnologists. A liaison with anthropology rather than history has thus been natural for prehistorians.

"However, prehistorians are concerned with more than culture. Their special needs require close cooperation among a wide range of scientists who study the past. Geologists, paleontologists, palynologists, chemists, physicists, botanists, linguists, and astronomers have all contributed toward understanding man's prehistory."

This volume, an admirable guide to the complexity of archeological work, is divided into four parts: Introducing the Study of Prehistory; Acquiring the Facts of Prehistory; Dating the Events of Prehistory; and Describing and Interpreting Prehistory. Three of these parts have four chapters, and the other has six. The 41-page bibliography has 900 titles and would have been longer by at least one title if "Davis (1959)," on page 137, had been listed.

Most of the world's prehistorians think of their subject matter as an extension of history. In the United States most of the archeologists specializing in prehistory were trained in American universities in departments of anthropology where the emphasis at the present time is on social anthropology and on nonmaterial culture. Students cannot now find in any American university adequate training that includes an understanding of the whole variety of disciplines available for interpreting the past, or a training in the tools of modern archeological research and in the knowledge of prehistoric research in the major areas of the world. Some institutions are moving slowly in this direction. Hole and Heizer's volume is a brief presentation of the ways in which the data about prehistoric culture can be gathered and interpreted. The volume can serve as a textbook and as a guide for anyone interested in a "scientific" approach to prehistory. "Prehistory can thus be contrasted with treasure hunting, art history, philology, history and even protohistory, in its inspiration and method" (p. 31).

In a number of places the authors refer to the excavation of sites during the early days as "looting," and in many cases that is what took place. The "looting" of prehistoric sites has not been stopped anywhere, even in countries where there are national laws intended to protect sites and prevent unqualified people from excavating. Our American museums, art and antique dealers, interior decorators, and private collectors constitute an unfortunately avid market for foreign artistic and exotic prehistoric specimens. These specimens are obtained by smuggling, bribing, and other forms of illegal and unethical operations, while the price escalates to an exorbitant