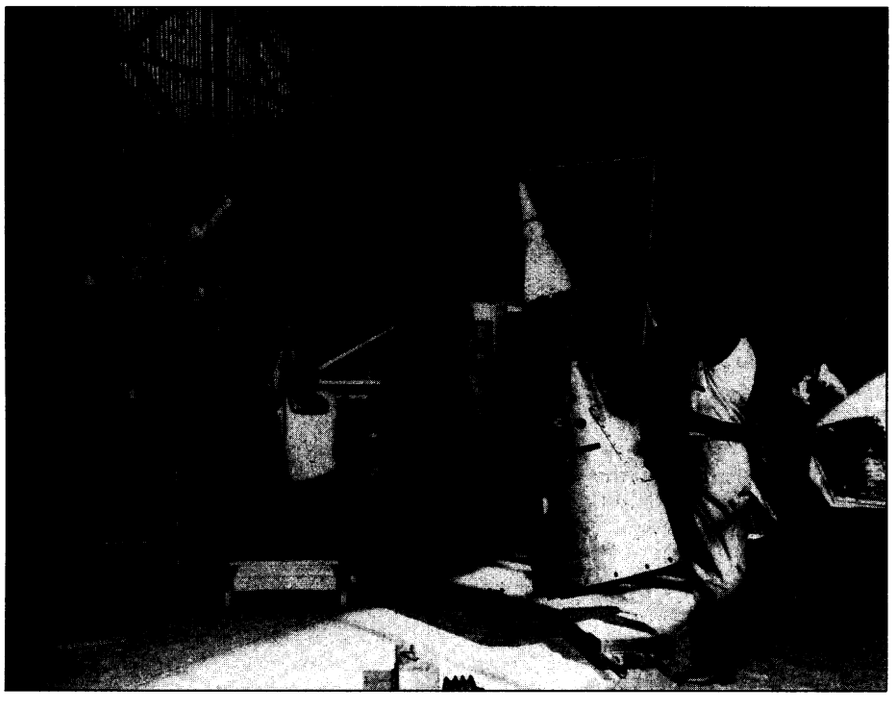

American rocketeers at work, 1946. James Van Allen's "stated 'strong back, weak mind' syndrome pervaded all areas of scientific rocketry in the first five years of effort." This syndrome "is well-illustrated in this scene of Naval Research Laboratory personnel improvising to find the center of gravity of a warhead suspended in the White Sands assembly building. . . . After the warhead was weighed on the scale beneath it, it was hoisted and tilted by Ralph Havens, kneeling on another scale. Thor Bergstralh (obscured by the scale, left center background) is preparing to read the scale to determine the tension that Havens is exerting on the rope. Serge Golian (at the left on the stand) is keeping tension on the rope to keep the pulley directly above Havens. F. S. Johnson is holding a ruler to let Krause (at the right, background) read the tilt of the nosecone from the vertical, defined by the cables holding the warhead." [From *Science with a Vengeance*; U.S. Navy photograph, Ernst Krause collection, National Air and Space Museum]

has researched the story thoroughly in primary documents and oral histories.

The main themes, however, often get lost in the detail. It is not clear, for example, that the fortuitous and fleeting availability of the captured V-2s meant that these scientists "had to develop instruments and logistical systems with a vengeance reminiscent of the wartime effort" (p. 341). Surely other scientists felt a similar pinch as wartime resources dried up or were diverted in the late 1940s. Nor is it clear that these researchers exemplified "a new definition of the scientist" (p. 2), though this proposition bears comparison with experience in other fields of "big science" and team research emerging after World War II. The military is not nearly as visible or as influential in DeVorkin's account as his subtitle suggests; it is rather an arm of government that brings to mind the warning of Lionel Tiger and Robin Fox: If you have a Pentagon, you will use it and it will use you.

Still, this is an important book. It reveals how thoroughly the military has been involved in scientific and technical development since World War II. It presents a richly detailed case study of the role of technology in modern scientific research. And it demonstrates, as DeVorkin claims, the way in which external forces—social, political, economic, and technological—can shape scientific research.

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Routes to Agriculture

The Origins of Agriculture and Settled Life. RICHARD S. MACNEISH. University of Oklahoma Press, Norman, 1992. xx, 433 pp., illus. $75.

In this volume one of the best-known of contemporary American field archeologists discusses an issue of great concern to many scholars. MacNeish himself has pursued primary archeological evidence about agricultural origins in both North and South America at various periods during the past 40 years. Here he presents his conclusions about how and why village agricultural economies developed not just in the regions he knows at first hand (Mexico, Peru, and New Mexico) but in all other portions of the globe.

MacNeish begins with a brief history of theories about agricultural origins, then outlines his own formulation, which he calls the trilinear theory because it specifies three main routes (each with several variations) from hunting-collecting bands to agricultural villagers. Most of the rest of the book consists of overviews and syntheses of relevant archeological data from all the world areas for which such information has been published. These overviews are ordered according to MacNeish's categorizations of regions into domestication centers and non-centers (the latter subdivided into temperate and tropical). The evidence from each area is described with reference to the appropriate parts of the trilinear theory in order to check or test the theory. Results are often unsatisfactory because of sparsity of data, but in several areas MacNeish finds support for the essential portions of his theory and concludes that "we have moved from speculation and hypothesis toward the ideal state of scientific generalization or laws of cultural change" (p. 363).

The trilinear theory itself (best summarized in figure 10, p. 362) is a paleoecological, materialistic, subsistence-settlement system model elaborated and somewhat updated from MacNeish's writings of the 1960s and '70s about his important research in Tehuacan, Mexico. MacNeish's account of this model and the processes or conditions he envisions as fundamentally crucial (necessary) and specifically explanatory (sufficient) are likely to stimulate considerable discussion. He has been thinking about the general issue for a long time and has some interesting insights to convey.

There are major problems with the rest of the book, however. One has to do with the definition of centers and non-centers. MacNeish follows Vavilov's original description of centers as "those culture areas where a large number of plants were initially domesticated." MacNeish opposes centers to non-centers, the latter being "those areas where this did not occur" (p. 20). Thus he departs significantly from the usual definition of non-centers as provided by Jack Harlan in 1971 (*Science* **174**, 468). MacNeish's set of definitions is not only rather vague (how many domestications constitute a large number?) but is ultimately dependent upon archeobotanical information to demonstrate the occurrence and extent of domestication. That means that the classifier of regions as centers and non-centers must be thoroughly conversant with the latest results in all the world areas where paleoethnobotanical research

is taking place. This global level of information flow and comprehension is simply not possible for a single scholar to command, and herein lies the second major problem with MacNeish's book. He has tried to incorporate recent data from all world regions but inevitably falls far short of being able to do so. My own expertise is restricted to parts of eastern North America and of the Near East, so I cannot assess MacNeish's accounts for other world areas in any detail. But I can see that he has not been able to integrate the fast-breaking information for the two regions I do know something about, with consequent serious implications for his presentation. As regards the Near East, for example, he makes no reference to Don Henry's recent volume (*From Foraging to Agriculture: The Levant at the End of the Ice Age*, University of Pennsylvania Press, 1989). In fact, he makes no overt reference at all to the Levantine primacy syndrome ably advocated by Ofer Bar-Yosef, Henry, Gordon Hillman, Andrew Moore, and others in a series of publications in the 1980s. That is, MacNeish seems unaware of the current focus on the Levant as the region where legumes and grains were first domesticated but instead discusses the Zagros and Taurus highlands as a primary developmental region, with initial plant domestication taking place there, and the Levant as secondary, receiving domesticated plants from the highlands.

For eastern North America, MacNeish has not integrated such crucial developments as Bruce Smith's demonstration—in a series of papers published during the 1980s—of morphological characteristics that define an early, indigenous domesticated *Chenopodium*, dated by accelerator mass spectrometry to the second millennium B.C. Nor does he refer to recent and continuing discussions about wild north-of-the-Mexican-border ancestors for the earliest (accelerator mass spectrometry dates indicate, at the latest, 4000 to 5000 years ago) domestic cucurbits in eastern North America. If cucurbits and *Chenopodium* were both taken into cultivation north of (and independently of) Mexico, then the center/non-center status of eastern North America vis-à-vis Mexico obviously needs reassessment. Another relevant issue missing from MacNeish's discussion is the increasing evidence for significant dependence on pre-maize, indigenous agricultural systems during the Early and Middle Woodland periods in some portions of eastern North America.

MacNeish's book is noteworthy because of his standing in the field, but archeologists venturing into its 300-plus closely written pages should be prepared to read with reservation the data summaries for areas they do not know at first hand and be prepared to reevaluate the summaries for areas they do know well.

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Plasma Astrophysics

Extragalactic Radio Sources. From Beams to Jets. J. ROLAND, H. SOL, and G. PELLETIER, Eds. Cambridge University Press, New York, 1992. xvi, 372 pp., illus. $69.96. From a meeting, Paris, July 1991.

It is well accepted among astrophysicists that the nuclei of some galaxies eject highly collimated jets of plasma, often with speeds very close to that of light. The traces of these jets on the sky are readily visible to observers with radio telescopes, and their signatures are also read in the intense, flickering gamma-rays that have recently been discovered to come from some quasars and radio galaxies. But the mechanisms responsible for powering, accelerating, and collimating cosmic jets remain the subject of intense speculation among theorists. Although it has its share of observational papers, this proceedings volume has a decidedly theoretical bent. The focus of the theoretical contributions is somewhat unorthodox, with an unusual emphasis on plasma physical processes. This is not too surprising, since the conference organizers (and editors of the volume) are among the few to have approached the study of jets from a plasma physicist's viewpoint.

Over the years it has proven notoriously difficult to make progress in the subdiscipline that has become known as "plasma astrophysics." The physical effects that one needs to study are quite subtle and complex, even in the most idealized of models, and sound observational diagnostics are often elusive. All of these difficulties are evident in the theory papers in this book, which treat such topics as beam instabilities of electron-positron plasmas, relativistic magnetohydrodynamics, and mechanisms for accelerating particles to relativistic energies. The speculative and exploratory tone of the theory papers contrasts with some solid observational contributions. Perhaps the most interesting new result is the discovery of "intraday radio variability," which is summarized crisply by Wagner and Witzel. The rapid flickering of radio flux, if interpreted naively, indicates enormous intensities at the source, posing a serious problem for existing theories of radio emission. A radical solution is suggested in the theory papers by Benford and Lesch, who suggest that the radio waves arise from coherent plasma processes rather than the incoherent synchrotron emission that is usually invoked.

By virtue of its timing, the book misses out on reporting other, equally exciting observational developments of the past two years. There is some discussion of early results from the French-Soviet SIGMA/GRANAT gamma-ray experiment, but the conference was held shortly before the announcement of dramatic observations of jet emission by Gamma Ray Observatory. Likewise, Brinkmann's report on results from the ROSAT x-ray satellite is very preliminary and has been superseded by more recent reports at conferences.

Some conference proceedings serve as useful references for students or other novices who wish to get up to speed in a field, because of the careful balance or breadth of topics covered. Some are distinguished by the high pedagogical quality of their review papers. This volume has none of those distinctions. Most of the contributions are terse summaries of work in progress or recent publications. It is just another conference proceedings and should mainly be of interest to specialists who want to know what was discussed at the Institut d'Astrophysique in July 1991.

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Adaptive Abilities

Insect Learning. Ecological and Evolutionary Perspectives. DANIEL R. PAPAJ and ALCINDA C. LEWIS, Eds. Chapman and Hall, New York, 1993. xiv, 398 pp., illus. $54.95.

From the data we have on major animal phyla, it seems that learning in the form of habituation appeared almost as soon as nerve nets arose. Associative learning is probably almost as ancient, and we can be reasonably sure that learning evolved almost as soon as did nervous tissue. In this volume issues of learning are addressed with respect to what is arguably one of the most highly evolved life forms on Earth. Learning is a requisite to the existence of many species, but at the same time there is much to be said for the adaptiveness of consistent behavior. Indeed, learning is often designed to *achieve* fixed behavior