related forms are in boreal and temperate marine waters, they should be excellent subjects for studies by the neuroscientists located in the northern hemispheres who are concerned with variations in the efficacy of marine neurotoxins.

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Roddier Wavefront Sensor

M. Mitchell Waldrop's article "Astronomers try to put Mauna Kea 'into space' " (Research News, 31 Aug., p. 987) provides an account of some of the gains that astronomers are now seeking by application of adaptive optical systems to telescopes. As has been described many times, such systems compensate for the wavefront distortion that results from atmospheric turbulence (imperfect "seeing"), thereby producing diffraction-limited images at the focus of a telescope; for a brief survey of the field see (*1*).

The two essential components of any adaptive telescope are (i) a deformable mirror upon which a starlit image of the primary mirror is formed, and (ii) a two-dimensional sensor that measures the changing pattern of wavefront distortion across the image of the primary mirror and continually feeds back this information to the deformable mirror to compensate for the atmospheric turbulence. Various types of deformable mirrors and wavefront sensors are in stages of research, development, and testing by different research groups. The best known type of wavefront sensor today is probably the Hartmann-Shack; it measures the *tilt* of elements of the wavefront as imaged on the primary.

Waldrop reports on an innovative wavefront sensor proposed by F. Roddier and C. Roddier (*2*). It responds to the *curvature* of wavefront elements. Unfortunately, Waldrop's account leaves the strong but incorrect impression that F. Roddier's instrument does not rely on reference stars. In fact, any adaptive telescopic system requires a reference star, whether it is the object of investigation, or a nearby star, or perhaps one or more artificial sodium stars generated by a focused laser beam high in the earth's atmosphere. The use of such sodium stars in the mesosphere, at an altitude of about 92 kilometers was proposed by Foy and Labeyrie (*3*) and by Gardner, Thompson, and Welsh (*4*).

The Roddier wavefront analyzer, when further developed, may indeed turn out to be simpler than the Hartmann-Shack. It may also be well suited for driving a membrane-type deformable mirror. No quantitative estimate of the anticipated gain in sensitivity seems to be available, but I know of no reason why a very large gain should be expected. In any event, it is to be hoped that development work on the Roddier wavefront sensor will be speeded so that it can be tested soon.

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Science Curriculum Reform

Marcia Barinaga's article "Bottom-up revolution in science teaching" (News & Comment, 31 Aug., p. 978) distorts the nature of the Scope, Sequence and Coordination (SC&C) project. This project is not simply copying what is done in the Soviet Union. The statement in the title that the program "relies on Soviet principles," referring to my supposed "Soviet epiphany," and equating our project with "Mao's Little Red Book" trivialize what has become the most important reform in science education since Sputnik. And why the excessive references to Communist countries? We discussed France, England, and Japan just as much. Such references convey a certain negative image to some in our society. Thirty-five years ago this was called "red-baiting."

The portrayal of Tom Sachse's California project as somehow being in conflict with the national effort has done all of us a disservice. At no time did I suggest that we needed "control from the top." All of our project centers have teachers central to the development and trial process. My concern was that resources in California might not

provide the kinds of assistance that a more concentrated effort in Houston, Texas has permitted.

Although California plays a pivotal role, SS&C is not juct a "California program." With five project centers, including those in North Carolina, Puerto Rico, Iowa, Texas, and California, and total funding at $10.6 million ($8.6 million from the National Science Foundation and $2 million from the Department of Education), this is a serious national effort.

The SS&C project has at its basis three fundamental features. Only *one* can be found in Soviet education. That same feature—"spaced learning" (studying a science subject area every year for several hours a week, rather that every day of the week for just 1 year)—can be found in virtually every industrialized nation except the United States. Two other features are far more important: (i) sequencing content from experience with phenomena to build concepts, and revisiting science topics at successively high levels of abstraction through 5 or 6 years of study; and (ii) greatly reducing coverage to increase depth of understanding in terms of How do you know? Why do you believe? and What is the evidence? These latter two features are missing from most European and Eastern block national educational programs, including the Soviet Union's.

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"High Risk" Anthropology

Ann Gibbons (Research News, 22 June, p. 1488) describes recent findings on indigenous development of complex culture in Amazonia, highlighting the research of Anna Roosevelt. Roosevelt's research has been funded twice by the Anthropology Program of the National Science Foundation. We frequently fund research such as Roosevelt's that is contrary to the consensus in the field. The NSF Anthropology Program now has a specific initiative, "Grants for Exploratory Anthropological Research," that is designed to encourage exploratory "high-risk," innovative study in archeology, cultural anthropology, and physical anthropology. We applaud *Science* for choosing to highlight such iconoclastic scientific inquiry.

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