# letters

## Making research more efficient

Research in universities and industry, both basic and applied, must rely increasingly on government funding. To protect the taxpayer, it is essential that the granting of these funds be subjected to thorough and rigorous scrutiny. However, this scrutiny may have reached such proportions that it becomes self-defeating.

A government contract usually involves three aspects: writing of a proposal work statement (including goals and "milestones"), and progress reports. Here are some comments on these three aspects.

**Proposal.** A good proposal requires a good idea, competent scientists, and adequate equipment. At present it takes six months, or more, to get a positive response to a proposal. During this period a better idea may have turned up that can no longer be incorporated without renewed negotiation; also, the scientist and the equipment earmarked for the project may be unproductive during the waiting period or transferred to another project. In other words, if and when the contract is finally awarded, the recipient may find himself obliged to work on a project that is partially obsolete and/or with scientists who are not the best qualified for the job.

It is, of course, difficult and time consuming for the contractor to pick the best of several competing projects, but the long delay is, typically, not caused by lengthy scientific deliberations as much as by the bureaucratic, especially financial, complexes. The time may have come where a faster decision, even at the risk of an occasional error, is less wasteful than the long delay with the resulting disadvantages.

The proposal stage involves another potential waste. In awarding a contract the reputation of the professor or industrial researcher is, justifiably, a major criterion. Since only a small fraction of submitted proposals leads to a contract, top scientists spend a great deal of their time, often more than 50%, meeting with government representatives in Washington and elsewhere. Most of this time would be spent more productively at the desk or in the laboratory! Again, speedier decisions could reduce this waste of valuable brain power.

**Progress reports.** The writing of progress reports is obviously essential. It may be a chore for the writer, but the obligation to account for his effort in written form is often beneficial for the researcher. However, report writing could be improved in two respects.

First, the interval between reports should be related to the effort. Monthly reports on a project handled by two or three scientists are unreasonable. Even in major projects, the intervals could well be longer in the early stages where the work involves building of equipment rather than obtaining results. Second, reports often hold back the work in hand, not because of the time spent on writing, but because the project manager feels under an obligation to demonstrate progress during each research period. Many a useful new approach has been abandoned because "we must have something to report by the 15th." The solution to this problem is not necessarily longer report periods but willingness on the part of the contractor to accept, occasionally, a report saying "no progress during the last period" without detriment to the scientist who is honest enough to say so.

**Work statement.** Whereas the setting of goals is necessary and justified in a development contract, a goal in a true research project can and should be defined only in the vaguest terms. Yet many research contracts specify not only the goal but also "milestones" to be reached by certain dates. Goals and milestones tend to have two detrimental effects on a research program.

First, in the course of the program an unexpected result may appear that is not useful for achieving the contract goal although valuable in other contexts. Under the contract the scientist is frequently not at liberty to pursue the new discovery. (The industrial scientist is better off in such an event because his company may be willing to explore the novelty with their own funds.) Second, the "milestones" may put the same pressure on the researcher as the progress reports: to avoid getting "bad marks" he abandons a more promising approach to meet the date for his milestone.

The foregoing discussion suggests three ways in which the efficiency of government-sponsored research could be im-

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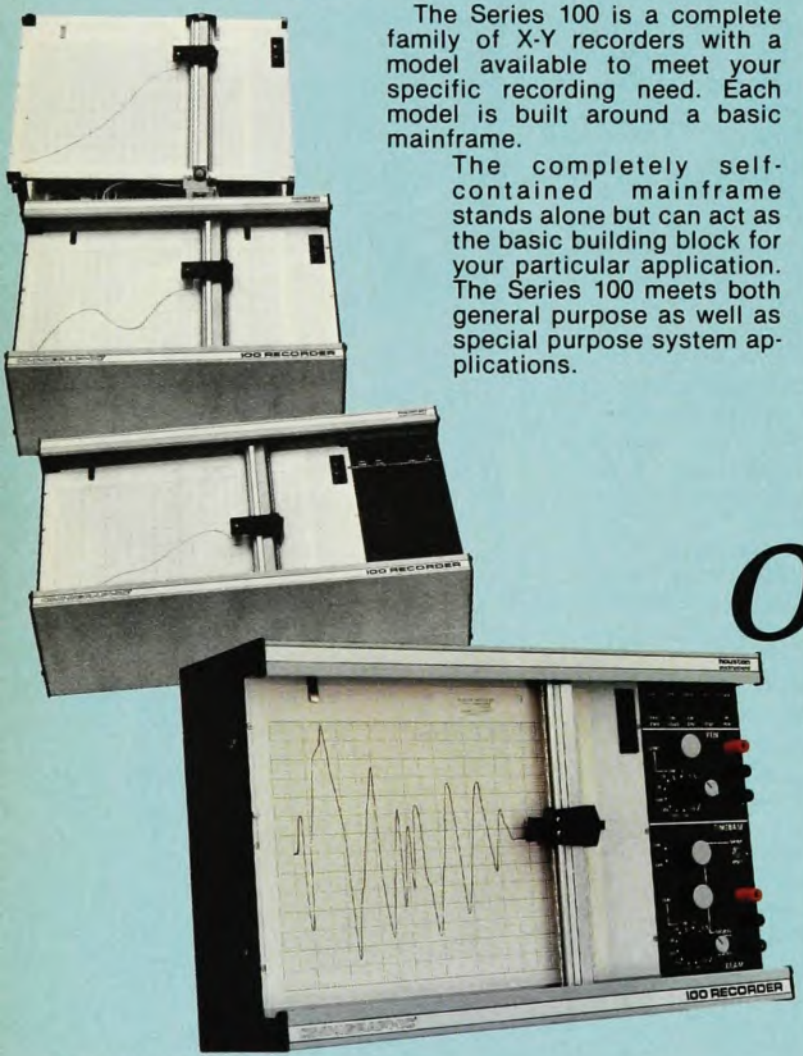


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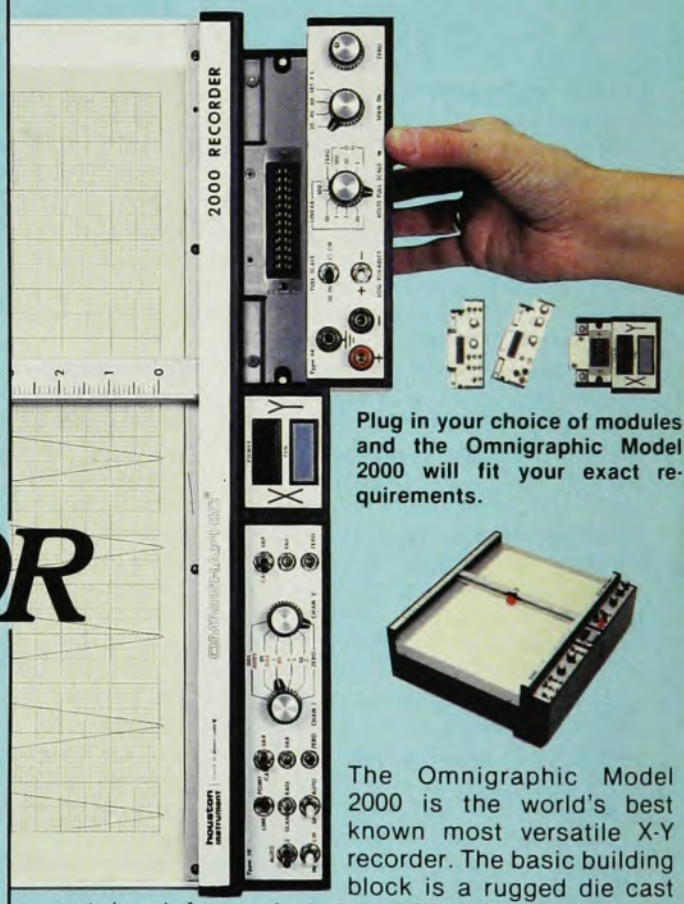


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proved. First, reduce the time between proposal and contract award, even at the risk that a "second best" contract slips through occasionally. Second, adapt the frequency of progress reports to the type and size of the project and do not insist on significant progress in each period. Third, make research goals as flexible as possible and eliminate milestones altogether.

ALFRED SOMMER
*Wellesley, Massachusetts*

## Sex-linked ability

In my physical science classes one of the major objectives is to help nonscience majors understand the nature of science and how the laws of science are induced. In working toward this objective I stress that there are very few "facts" in science, but rather, that scientists base their inferences on the statistical evidence available at the time.

While agreeing heartily with virtually all of Jewel Plummer Cobb's recommendations for ways to encourage young women to consider careers in science, I was surprised by her statement in August (page 72) which said, "—women scientists and mothers should stress the fact that proficiency in mathematics is not a sex-linked characteristic." Was the word "fact" one of Cobb's own choosing or was PHYSICS TODAY paraphrasing her message at the January APS–AAPT meeting in New York?

If Cobb has sufficient statistical evidence to claim that proficiency in mathematics is not sex-linked as a fact, I would very much appreciate learning about that evidence. Although I don't believe the research I'm familiar with is conclusive, the preponderance of it suggests that mathematics ability may be sex-linked when considered statistically.

Just because our sense of fair play urges us to want to believe that proficiency in mathematics is not sex-linked, we should not claim this ideal as a "fact" or assumption which is never to be questioned. If an evaluative instrument of aptitude for mathematics having generally accepted validity were administered to a large randomly selected sample of young men and women, I have no doubt that certain females would score higher than 95% of the males. Certainly these, and many other mathematically gifted young women, should be encouraged to consider careers in the physical sciences. It would also be useful to carefully scrutinize the mean and deviation scores of the male and female students on an accepted valid instrument administered under tightly controlled experimental conditions. After applying appropriate statistical treatment to the data we may be able to tentatively infer the existence of a relation with sex in the sample or the lack of such a relationship. Drawing such an inference is different from claiming an idea to be a scientific "fact," however.

HAROLD L. CRATER
*The University of Mississippi*
*University, Mississippi*

Dean Cobb replies: My statement is made following a study of the literature citing various scientific studies that confirm the absence of clear differences in ability between boys and girls in elementary school. There are national studies to confirm that, up to nine years of age, boys and girls score equally in mathematics tests. If the ability to do math is sex-linked, it would show itself in this age group. There is a paper by Richard Stafford which is most controversial. It has received little acceptance. Most studies indicate that cultural and environmental influences are responsible for any differences noted in older males and females, rather than biological differences that are "intrinsic." As a biologist I am very uncomfortable with the fuzzy data that attributes human intelligence performance in adolescent and post adolescent subjects to genetic causes. The level of clear and sophisticated research is not yet available. If you will read my recent paper "Filters for Women in Science" in the *Annals of the New York Academy of Sciences,* you would be enlightened.

JEWEL PLUMMER COBB
*Rutgers, The State University of New Jersey*
*New Brunswick, New Jersey*

## More on free-electron lasers

In July your news story entitled "Update on free-electron lasers and applications" gives credit to "Henry" Motz for building the "undulator" with reference to my *Journal of Applied Physics* paper of 1951. I was very pleased to see this, but it is unfortunate that my name is not Henry but Hans. At the same time I would like to comment on the explanations given of the device. It is, of course, not wrong to use atomic physics concepts, because quantum phenomena are underlying the purely classical laws of physics—which are sufficient for the theoretical description, except perhaps in the x-ray region. My idea of the amplification process was inspired by R. Kompfner's traveling-wave tube, where the helix slows down the wave so that it can be in near synchronism with the electron beam. It occurred to me that near synchronism could also be achieved[1] by making the electrons undergo a periodically deflected path. A recent analysis by Norman Kroll[2] elaborates my theory in an admirable way. In a recent paper[3] I pointed out that there are essential differences between the operation of a laser

*continued on page 78*