immediate access to various technical services, such as libraries and glass-blowers' and toolmakers' workshops, and an administration whose purpose is the maintenance of conditions under which the search for knowledge functions most effectively.

The key scientists should possess minimum qualifications, such as extremely high intellectual capacity, proven talent, and first-rate training. They should each receive a salary of $40,000 a year or more, commensurate with the importance of their work to the nation, so that they could be drawn from any field of activity, including industry, and so that continuity of effort could be assured.

Such a development would be a tangible sign, for every gifted young man and woman in this country, that the development of new knowledge pays off. This would provide an incentive for our youth to undertake the study of science as a career. There would be an overflow of gifted, well-trained investigators, assuring qualified personnel for industry, the teaching profession, and project-solving teams (in such fields as missiles and cancer, for example).

I believe that such development in our scientific setup would have a snow-balling effect, resulting in reforms in our educational system, since, once it is realized that there are places to go to in science with self-respect and good pay, it will be seen that there is a good reason for undertaking such training and maintaining such activity.

The introduction of a program of professional scientists functioning in institutions whose primary objective is to develop new knowledge is suggested for three reasons: (i) to provide new knowledge at a faster rate; (ii) to reinforce our existing facilities for the development of knowledge, both in industry and at the universities; (iii) to inspire our youth to engage in science as a career. Our present universities and industrial development methods are essentially sound and should be kept intact, and, in fact, they will be reinforced by the stimulus of new knowledge from such professional scientists, just as they will, in turn, stimulate these scientists. The universities and industry have done a good job and will do an even better job, once we have proper scientific activities that feed new solutions into existing areas of research and create new projects.

The value of such a program of professional science for the United States would be that, when the Russians shoot up a sputnik, instead of merely imitating this accomplishment, we would be in a position to make their accomplishments obsolete. For example, a better understanding of gravity, or of social psychology, could render the threat of the sputniks obsolete. In peace, a foundation for better living and health would be created.

The introduction of such a program of professional science under the leadership of the gifted of the nation, under conditions that will promote more rapid exploration of new knowledge, would be a test of the flexibility of our system and is, in my opinion, essential for the protection and further evolution of the way of life we all hold so dear.

ALBERT E. SOBEL
Jewish Hospital of Brooklyn, Brooklyn, New York

The Maser

With reference to the statement in the article "The maser" by W. H. Culver [*Science* **126**, 810 (1957)] that apparently only in the microwave region of the spectrum can the necessary requirements for maser operation be met, it may be noted that a proposal for a solid-state radio-frequency maser was made by J. Itoh in the *Journal of the Physical Society of Japan* (September 1957).

NORMAN RABBINER
Belmar, New Jersey

Electronic Extension of Optical Observation Techniques

Two articles printed in the special Instrument Issue [*Science* **126** (25 Oct. 1957)] present interesting complementary approaches to the electronic extension of optical observation techniques. Quite interesting, also, is the apparent lack of communication between the adherents of the two methods. We refer to the articles "Ultraviolet television color-translating microscope," by V. K. Zworykin and F. L. Hatke, (p. 805) and "Automatic particle and bacterial colony counter," by H. P. Mansberg (p. 823).

In both techniques, the optical image is decomposed through scanning in order to provide a conventional electronic signal—a voltage which varies as a function of time. Two choices for accomplishing this are available. In system A the illumination on the subject is continuous and undirected during the scanning time. The signal is "read off" the photosensitive element in the camera's image plane as this is scanned by an electron beam. In system B the illuminating system and the photosensitive receptors are interchanged. The light comes from a "flying spot" which scans across the face of a cathode ray tube; this is imaged onto the object, and transmitted or reflected light is picked up by suitably placed photomultiplier tubes. The photomultipliers are continuously active during the scan time.

The interesting and disturbing situation to which we call attention is the following. Although method B can be used in microscopy and has indeed been so adapted by Montgomery, Roberts, and Bonner [*Nature* **177**, 1172 (1956)] in Great Britain and in this country, this fact is not alluded to by Zworykin and Hatke in their article. Similarly, method A could be used in particle counting and sizing—but the possibility is not referred to by Mansberg in his article. Both methods of image translation are used in commercial television—no doubt this complicates the issue through introduction of legal points and competitive business practices. But it seems safe to say that both systems A and B have merit and promise to be quite useful in wide areas of instrumentation and scientific research.

Is it possible that, in the situation cited, the groups involved were not aware of each other's work? Regardless of the answer, the general problem may not be dismissed. This is because it *is* a general problem. The fact that the practitioners of a method A avoid reference to the work of those who use a method B is but one example of a widespread tendency. Free scientific inquiry is being threatened with suffocation in other areas as well. No doubt other readers are familiar with current examples, even in areas which are vital to our national defense.

As users (for research purposes only) of one of the electronic-optical observation methods mentioned, may we reiterate the following: The erection of artificial barriers between research groups cannot but hinder the progress of all.

J. P. HELLER
L. S. GOURNAY
Magnolia Petroleum Company, Field Research Laboratory, Dallas, Texas

Heller and Gournay are entirely right in stating that the television-camera tube techniques utilized in the ultraviolet television color-translating microscope and the flying-spot tube techniques employed in the particle counter described by Mansberg are both applicable to television microscopy *and* particle counting. However, flying-spot techniques are not suitable for ultraviolet *color translation* microscopy, and reference to them in our article would have been a digression which did not seem justified. Mansberg had, without doubt, equally cogent reasons for omitting mention of articles dealing, for example, with the use of camera tube techniques for making blood counts.

In any case, the authors of the preceding letter are mistaken in attributing the omissions noted to a lack of communications or an effort to erect arti-

ficial barriers between research groups. On the contrary, we have been eager to present research workers in the field with opportunities to compare the several approaches, which would enable them to select more intelligently those best suited for their specific objectives. Thus, on 22 November 1957, the Professional Group on Medical Electronics of the Institute of Radio Engineers held a widely publicized symposium on ultraviolet scanning microscopy, in Philadelphia, at which Montgomery, Bonner, and Hatke gave papers and in which Mansberg participated, to mention only persons cited in the letter. A paper giving a comparison of flying-spot and pickup tube techniques applied to ultraviolet microscopy was included on the program. It is expected that these papers will be published shortly in the *Transactions on Medical Electronics of the Institute of Radio Engineers.*

In brief, we sympathize with Heller's and Gournay's concern that the channels of communication in scientific work remain unimpeded by commercial and other considerations. However, we do not believe that our articles can be cited as evidence of the existence of such impediments.

V. K. Zworykin
Radio Corporation of America Laboratories, Princeton, New Jersey

I agree with Heller and Gournay that the "erection of artificial barriers between research groups cannot but hinder the progress of all." Indeed, this fact is finally being realized even by many nonscientific individuals and is presently the subject of much discussion. However, Heller and Gournay could not have picked a more inappropriate example of the lack of communication between research workers. I have frequently met with all of the people mentioned in the letter and am quite well informed on the nature of their work and results, as they are with my efforts. Furthermore, the value and limitations of both methods of scanning (flying-spot and television-camera tube) are recognized by most of the research workers in this field. In fact, it was recently (22 November) the subject of an excellent symposium and panel discussion on ultraviolet scanning microscopy sponsored by the Philadelphia chapter of the Professional Group on Medical Electronics of the Institute of Radio Engineers.

Both articles published in the instrument issue of *Science* describe instruments designed for a specific purpose. Although the applications of the techniques described are broad in each case, it was not the intention to publish a general discussion of the field of scanning instrumentation.

Perhaps as further evidence that the respective workers are intimately aware of each others' efforts and contributions it should be mentioned that the automatic bacterial colony counter was developed by Carl Berkley, Y. Yamagami, and H. Mansberg. An article by these authors, describing in detail the circuit techniques, will be published soon (*Electronics,* in press). One of these authors, Carl Berkley, is now associated with Zworykin and Hatke and is participating in the color-translating microscope program.

Perhaps one reason that Heller and Gournay are not aware of the degree of interchange of ideas in this field is the fact that so many of the investigators are concerned with medical-electronic applications. I believe that these scanning techniques will find increasing use in industrial research applications, and I look forward to seeing more publication of such effort [see "Flying spot techniques and application," *Du Mont Instr. J.* (Nov. 1957)].

Finally, I would assure them that no "legal points or competitive business practices" were involved either in the design of these instruments or in the preparation of the articles.

H. P. Mansberg
Allen B. Du Mont Laboratories, Inc., Clifton, New Jersey