

tune ("Who owns what's in your head?") also discusses an aspect of these problems at some length (1). They appear to be important. It seems to me, however, that the core of the matter is being overlooked—that is, the question of the continuity of the supply of ideas. If the supply should cease, the problems would disappear.

Munster and Smith say, "The greater number of patented or protected items are the result of coordinated research in great laboratories." This is debatable. While Seymour Melman has written, "The [modern] conditions of interdependence in inquiry render the concept of the inventor obsolete to a considerable extent" (2), Admiral Rickover, on the other hand, says that "Nothing is created by a team or an organization. Every new idea comes out of a single human mind" (3), and Edwin Land that "There is no such thing as group originality or group creativity or group perspicacity" (4). In a report on "Group influence on creativity in mathematics," the authors conclude that "the contribution of the group has been overly emphasized. In none of the five research studies completed did the group factor make any contribution to problem solving. On the contrary, there seems to be a consistent, if slight, advantage to solving problems alone" (5).

Current U.S. production of significant scientific publications and patented inventions fails to support any optimism about the effectiveness of our massive group efforts. The total annual issue of patents now is no more than it was in 1930, or even in 1915. In terms of patents per unit population, it was less in 1960 than in 1870. The number of U.S. patents per unit of money spent on technological effort was about 90 times less in 1960 than in 1930. A sampling of data on large defense contracts has shown that roughly \$8 million was spent for each patent that arose from that employment. A sampling of papers listed in *Science Abstracts, Section A (Physics)* indicates that the number of papers of American origin has declined from about 9300 per billion dollars spent on R&D in 1920 to 213 per billion in 1960 (6).

It is popularly assumed that to get any given task performed it is only necessary to hire people to do it. But more sophisticated experience shows, I think, that rational individuals tend to balance the rewards of an

endeavor against the risks, and to act so as to maximize the benefit. Thus if an act of a rather special nature, such as producing an invention, gets no recognition, it is not likely to be performed again. And if such an act is believed to threaten awkward and unfamiliar problems and penalties for the individual, such as law suits, the individual may logically decide to avoid it.

We need more study of the relation between scientific creativity and the sociological and economic factors affecting it. We risk being naive when we assume that a given expenditure of money will produce a corresponding value in new ideas. It may well produce none.

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#### References

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2. S. Melman, "The impact of the patent system on research," *Subcommittee on Patents, Trademarks, and Copyrights, Senate Committee on the Judiciary, 85th Congress, 1958, Study No. 11* (1958), pp. 18, 24.
3. "National Patent Policy," *Hearing before Senate Subcommittee on Patents, Trademarks, and Copyrights, 87th Congress, 2 June 1961* (1961), p. 34.
4. E. H. Land, *J. Patent Office Soc.* 41, 502 (1959).
5. F. W. Banghart and H. S. Spranker, *J. Exptl. Educ.* 31, 257 (1963).
6. L. Fleming, *J. Patent Office Soc.* 46, 315 (1964).

#### Submarine Basalt: A Correction

Enrico Bonatti has pointed out to us that the two photographs of submarine basalt shown in our recent article [*Science* 146, 477 (1964)] have been erroneously located. The photograph shown in Fig. 3 (p. 481) actually was taken at latitude 18°30'S, longitude 126°30'W, the station designated D5 on our map (Fig. 2, p. 479). The depth of water in Fig. 3 is about 3200 meters. This corrected position is on the west flank of the East Pacific Rise.

The photograph of pillowed basalts shown on the cover of the issue containing our article was taken at ship's station 57, latitude 18°45'S, longitude 141°00'W. The depth of water is approximately 2100 meters. This locality is on the flank of a seamount on the south side of the Tuamotu Ridge, which projects northwest from the Rise, as shown in our Fig. 2. No volcanic rock was recovered from station 57, and Bonatti raises the question whether under these circumstances the pillowed

basalt should be described as oceanic tholeiite. The exact composition of this pillowed basalt cannot be told from the photograph.

The mismatch of photographs and dredge sites is in part due to the fact that separate numbers are given to designate ship's station, camera station, and dredge station, and these separate numbers are employed in the classification of rocks and photographs.

We wish to thank Bonatti, a member of the scientific staff involved in these operations, for his help in correcting this error.

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#### Undergraduate Training

While S. G. Bradley (Letters, 6 Nov., p. 718) complains that undergraduate majors in microbiology are not trained as technicians, I am surprised to learn that undergraduates can major in anything more specialized than biology. When he referred three times to undergraduate "training," he should have mentioned "education" at least once.

Two other sources in the same issue bear me out. One is A. J. Sharp's article (p. 745) on "The compleat botanist." The other is an advertisement (p. 844) in which the prerequisites for employment in a certain consulting firm are said to include "the ability to apply critical perception to unusual problems, as well as a strong interest in meanings and relationships and an eye for both the theoretical and the practical." These abilities are prerequisite to all significant work in science, and while they may depend on inborn traits, I think they are not themselves inborn, but are educed in college.

Traditionally in our culture the bachelor's degree marks both the end of supervised general education and an opportunity to change one's major field. After this comes professional training. The college curriculum is the student's last chance to be taught anything outside his professional field, and his last chance to learn how to choose his professional field. It is therefore a waste of time and a disservice to the student to teach in college the technical skills of any single profession.

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