with the view currently being expressed by the Overseas Development Council (*3*) that there has been a fundamental turn in the long-term food situation.

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**References**

1. *FAO Commodity Review and Outlook 1972–73* (Food and Agricultural Organization of the United Nations, Rome, 1973), p. 29, para. 89.
2. A. J. Mair, statement before the Committee on Foreign Affairs, subcommittees on Africa and on International Organizations and Movements, *World Food Security–A Global Priority* (93rd Congr., 1st sess., in press).
3. J. P. Grant, *ibid.*

## Advantages of Surface Mining

Having spent the last 23 years working in and around both surface and underground mines, I have a different view of strip mines than is expressed in the article by Robert Gillette (News and Comment, 2 Nov., p. 456). No mention is made of the effect on the miners of working underground as opposed to that of working on the surface.

Black lung and silicosis are rare diseases among strip miners. Very few men are injured by rockfalls in surface mines. In an underground mine, if something goes wrong, there is nowhere to go; the miner is surrounded by rock. Explosions of pockets of methane can kill or injure miners in an underground mine. In a surface mine the methane has a better chance to leak off or blow harmlessly into the air. Rock bursts, coal dust explosions, and fire are deadly hazards underground, and the bodies of miners are often never recovered when the ocean, a lake, or a river breaks into an underground mine.

Strip mines can and should be reclaimed. That is not to say that the terrain should be put back as it was. The character of the rock is changed by mining, and a different drainage pattern might be more desirable.

Coal seams sometimes serve as aquifers, but their permeability does not approach that of the spoil pile which is left by strip mining. The large rocks roll to the bottom of the pile, and the fine material stays at the top. Thus the spoil is segregated according to size and forms an excellent aquifer near the bottom.

Why not transport the coal by slurry pipeline rather than suffer the high electrical transmission losses of long-distance power lines? Slurry transport would require much less water than electric power generation at the mine site.

Underground mining can recover only 60 percent of the mineral that can be recovered by strip mining the same deposit. Which resources are we most concerned about conserving—human lives, the terrain, the vegetation, or the mineral?

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## Citation Analysis

The *Science Citation Index* is a valuable and powerful tool when used for the purpose for which it was intended, as an aid in literature search. It also invites a variety of statistical investigations, which must, however, be considered with prudence, since they may lead to misleading results. No matter how cautiously the authors express themselves, the casual readers, that is the majority, will treat the results as established facts and forget about the assumptions underlying them. This is also happening with the computer output for economic models, which is accepted as if it were experimental observation.

An example is the article by Jonathan R. Cole and Stephen Cole (27 Oct. 1972, p. 368) in which the authors conclude that only a few elite scientists contribute to scientific progress, contrary to the generally accepted "Ortega hypothesis" that the majority of active scientists contribute to the advance. Although the authors carefully consider possible weaknesses in their argument, their article proves merely that citation statistics give a distorted picture of the way in which physics advances. Every physicist knows that in his research he uses a multitude of contributions made by others, some important, many minor but nevertheless essential. Only a few of those are cited; others are taken for granted. A striking example is the article by Edwin D. Becker and T. C. Farrar (27 Oct. 1972, p. 361) just preceding the article by Cole and Cole. It describes the basic features of Fourier transform spectroscopy. One gathers that its authors consider "Fellgett's advantage" and the "Jacquinot advantage" to be significant factors in this research technique, but the article carries no footnotes referring to Fellgett and Jacquinot. In fact, all experimental papers mention techniques without a reference to their origin. Scintillation counters and photomultipliers are generally used in experiments in nuclear and particle physics, but their inventors and the dozens of researchers who have improved these essential tools to their present perfection are rarely cited. Many other examples of this kind can be found both in experimental and theoretical physics. The reason for citing a paper is primarily for possible support of the author's contentions and only secondarily in recognition of previous work. A closer study of the referencing habits of physicists is needed before one can draw reliable conclusions from counting footnotes. It is certainly unwarranted to accept Cole and Cole's recommendation for a reduction in the size of science on that basis.

Cole and Cole refer to one of the early citation studies of M. M. Kessler (*1*). However, they fail to cite an important warning in another report by Kessler and F. E. Heart (*2*). The warning reads: "CAUTION! Any attempt to equate high frequency of citation with worth or excellence will end in disaster; nor can we say that low frequency of citation indicates lack of worth." This conclusion was drawn from a citation analysis of 36 volumes of *Physical Review* covering 9 years, 1950 through 1958, containing 8,521 articles with 137,108 references.

There is a rumor afoot that the promotion of some faculty members is now based on the frequency with which their work appears in the *Science Citation Index*. I hope that this is just a rumor. One way to get cited more often than average is to publish an apparently important paper that is demonstrably wrong.

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**References**

1. M. M. Kessler, "Some statistical properties of citations in the literature of physics," Report (Massachusetts Institute of Technology, Cambridge, 1962).
2. ——— and F. E. Heart, "Concerning the probability that a given paper will be cited," Report (Massachusetts Institute of Technology, Cambridge, 1962).

Cole and Cole clearly show that the physics papers receiving the most citations are the ones that receive the most citations. Their other conclusions are less convincing and appear to be based on a mixture of questionable assumptions and non sequiturs. For example,