weight equaled the strength of the rock. Their collapse would squeeze hot plastic rock into the rifts and crush cold brittle rocks into fragments. The failure of these rocks would cause large chunks of the surface rocks to break off and fall into the widening rifts. The original size of the fragments of the crust would be measured in hundreds of kilometers, but their thickness, limited by the weakness of the hotter interior rocks, would be perhaps 25 km. The changing direction of the tidal forces would eventually break these large crustal fragments into sizes of the order of 50 km. When the weight of the materials at right angles to the tidal forces is considered, as well as the reduction in their tensile strength because of internal heat, the size of the fragments would vary from Jeffreys' (*2*) 200 to 400 km to fragments perhaps the size of sand or dust (*3*).

The materials in the fragments would be identical in composition and structure with the materials of the disrupted body, just as the fragments of crushed rock are identical chemically and physically with the rock from which they are broken.

*Quasi vulcanism.* If the planet is assumed to have been similar to the earth, its subsurface rocks would have contained gases, principally steam, dissolved under pressures that exceed 10,000 atm in terrestrial subsurface rocks. On the earth, when tension rifts through the crust penetrate deep enough, molten magmas well to the surface, often escaping with explosive violence. If the interior rocks of the disrupted planet were not hot enough to flow into the rifts, but were too weak to retain the rapidly expanding gases, the dissolved gases would expand with such terrific violence that they would hurl the fragmented rocks into the widening rifts and at the same time fill the rifts with gases under considerable pressure.

When tidal forces were great enough, the metal core itself would be violently torn apart. At the temperatures and pressures existing within the planet at this stage, the metals would be fluid. Sulfides, halides, other volatile salts, volatile metals, and possibly dissolved water and occluded gases would all expand with terrific violence, tearing apart the tidal fragments of the core. The expanding gases would hurl molten metal toward the surface of the planet, but the molten metal would be expected to collide with and adhere to or interpenetrate the fragmented rocks in their paths, for unlike gases, their paths could deviate only slightly from a straight line. In general, the metal fragments would be larger than the stones, since tidal tension would be less effective in the fragmentation of the denser metals, the back pressure of the expanding gases above would partially replace gravitational force, and the time interval of tidal disruption of the core would be shorter.

*Conclusion.* If the tidal disruption and fragmentation of a planet would cause it to explode, it would seem that the whole interior of the planet would become an enormous volcano, belching forth its substance through every tidal crack and at the same time tearing to pieces and nearly pulverizing all rocks hot enough to permit the escape of their dissolved gases. Such an explosion, detonated almost simultaneously throughout the entire planet, would be so much more disorderly than an ordinary explosion that any attempt to describe the results in detail is necessarily speculative.

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### References

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2. H. Jeffreys, *Monthly Notices Roy. Astron. Soc.* **107**, 260 (1947).
3. P. S. Palmer, *Nature* **173**, 499 (1954).

28 June 1954.

*This communication, which is based on a portion of Mr. Palmer's unpublished paper, "The origin of meteorites," was prepared by Katharine B. Palmer after the death of her husband in September 1953. Mr. Palmer's paper and the present communication have been the subject of some criticism, privately transmitted to the authors. But our advisors, who saw these critical comments, have pointed out that none is very specific, probably because of the difficulty or impossibility of giving a merit rating to a hypothesis that involves essentially qualitative reasoning—however, this can hardly be held as an argument against publication.*

## Some Comments on a New University

It was certainly a pleasure to read William Seifriz' thoughtful article [*Science* **120**, 87 (1954)]. Surely he will not lack applicants for positions in the new university. I doubt, however, whether under present conditions his goal can be realized.

Seifriz complains that science has become tough. But is not everything tough today? Why should science be exempted from the general trend of events? Young men who wish to make science their career are not taught the value of contemplative attitudes, of a fuller view of life, but instead are trained in graduate "trade" schools where their advancement must depend on their ability to get results, that is, answers to problems posed by their teachers or initiated by themselves. If such results lack significance in a deeper sense, it is hardly fair to blame the students or their preceptors. In investigative work it is just impossible to foresee where an idea will lead. Some ideas that appear brilliant at their conception unfortunately turn out to be dreams without any basis in fact and, therefore, have to be discarded; others that seemed of little value at first yield results significant beyond expectation because they happen to be in accord with the course of natural processes. Failures will outnumber successes; but, regardless of what he himself may think of the results he has obtained, the scientific worker feels he has to present them in order not to lose in competition with others. No doubt, this makes many scientific congresses a hodgepodge of trivia, as Seifriz describes them. But should one blame the scientists, who believe they have to keep up with the times for the sake of prestige and financial rewards that go with it? Obviously, they are on the defensive and may be most unhappy about it. But what are they to do? How can they change matters?

Seifriz recognizes the root of our present difficulties in the completely erroneous, yet commonly accepted, notion that science is power. Power to do what? How can a knowledge of natural laws give man power, that is, some kind of arbitrary decision over the workings of nature? Has our understanding and subsequent application of thermonuclear reactions had the slightest *effects on the laws governing them?* The only such power that can be gained from science is, in fact, power over other men, and that is the evil the world is facing today. It forms the major obstacle, not only to the new university, but to all pursuits and aspirations of civilized people.

What can scientists do about it? Kirtley Mather says they have an obligation to interpret science to the layman [*Science* **119**, 299 (1954)]. Of course, they have, and that is exactly what they have always done. There have always been scientists because men had to relate themselves to the world around them in order to survive. Even in prehistoric communities there must have been those who observed nature, learned something about her order and regularity, which certainly was of considerable help to their fellow tribesmen. Their interpretation of natural events was, of course, based on the very limited knowledge they had gained. It, therefore, should not surprise us that they attributed to good spirits whatever in nature appeared favorable to their well-being, and to evil spirits what they considered harmful. Later world religions were also attempts at an interpretation of the cosmos and man's place in it. Today these religions have lost much of their effectiveness, because, as Seifriz states, "the appeal is purely emotional, the reasoning often biologically unsound, and the approach too sentimental." In short, in the way that they are stated, they cannot claim objective validity. That is why men's actions only too often belie their protestations of belief in a formal religion.

To my mind, the fundamental problem before us today can be stated briefly as follows: Do we have to accept as true a materialistic interpretation of the universe and of man? Or can we recognize in the workings of nature a basic rationality that is akin to our own reasoning power? If in all sincerity we must reach the conclusion that the facts of nature all favor the materialistic theory, then we should be candid enough to admit it. It would mean, of course, that reason is only man's special tool in the struggle for existence, making this struggle between men and groups of men ever fiercer as our globe becomes more and more crowded. This in turn would lead inevitably to increasing regimentation, whether on the Soviet or any other model, and it seems quite possible that eventually a full-fledged dictatorship would be set up by the will of the majority. However, if there is reason behind the multitude of natural phenomena that we have been studying—and I personally believe that the evidence in support of this assumption, which cannot be given here, is overwhelming—then there is no cause for gloom, for then we shall be able to use the laws of nature to create health and order in men's minds, and not just in their bodies as we have done in the past. From such disciplined minds, I have no doubt, there will emerge all the things that Seifriz and so many of us want: a culture that man will respect, an intelligent biological system of ethics, a new university, a civilized society.

May I then humbly suggest that men like Seifriz, Mather, Loewi, and many others get together in a truly scientific congress, not to exchange information about trivia, but to consider this one vital problem only. The conclusions reached by them will be of immeasurable value to their fellow men.

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I agree with Dr. Kopper on all points except one. I feel that science is not only guilty but doubly so. I have used the word science to mean all academic learning, for we now have the social sciences and the philosophy of science. In my article I state that the layman has come to expect goodness from the church, justice from the state, and knowledge from the university, knowledge mellowed by understanding. In this, science and all academic learning have failed. A Polish gentleman at the Sorbonne said to me recently: "In my youth I worshipped science; in my old age I have come to detest it." What a pity to fail to see the beauty in something so magnificent because of the weakness of men.

Why do so many of us recommend Claude Bernard's *Leçons* for supplementary reading? It is because he gives us not only experiments and data, but also hypotheses, then more experiments and data, always ending in a thought, a speculation, in anticipation of the next experiment. War, the business world, and society may become tough, but this does not relieve science of its obligation any more than it relieves the church of its obligation.

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16 August 1954.

*Raphael paints wisdom; Handel sings it, Phidias carves it, Shakespeare writes it, Wren builds it, Columbus sails it, Luther preaches it, Washington arms it, Watt mechanizes it.*
—R. W. EMERSON.