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side are chosen by academy insiders to defend the academy's own interests and promote its members and protégés. In other words, top-down science funding is the rule in Ukraine—and it does not reach very far down from the top either.

There is no question that the science environment in Ukraine could—and should—be improved by setting up an effective bottom-up funding system. The kind of system that I and like-minded colleagues envision differs from the one Jacob describes in that both the peer review process and the distribution of grants and equipment would be kept free of links between the Western funders and the national government (including the national academy). Accordingly, the reviewers would be selected by the funders, and the national government reviewers would be excluded from the process. Furthermore, the funders would make distribution directly to the individual awardees, and care would be taken to ensure that the national government could not interfere. In addition, it would be left to the funded project leaders in Ukraine to determine what proportion of the grant money should go to their institutions to help cover administrative costs.

Furthermore, if such a system is to work, certain other and really quite modest obligations would have to be imposed on the national government. For example, arrangements would need to be made to ensure that the punitive government tax levied on foreign scientific grants (the current rate is about 50%) would be rescinded, that the national academy would be prevented from surrendering any more of its property to private interests, and that we government scientists would get our monthly salaries regularly and without delay.

Under this kind of bottom-up system, I suggest, the science base in Ukraine would be rebuilt, Ukrainian scientists would be better able to compete on an equal footing and the younger ones more likely to remain in science, there would be less corruption and misuse of funds, and our ties with Western scientists would be further developed and strengthened.

To make such a system a reality in Ukraine, what are now needed above all else are the active support and involvement of Western institutions.

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JACOB REPLIES: I am thankful to Kenell Touryan for presenting in detail the working operations and activities of the US-funded Initiative for Proliferation Prevention. It is indeed a very important and promising program that deserves to be more widely known in the physics community. I recognize that my article, whose aim was to promote the bottom-up approach, was biased in favor of physics research and also in favor of some European activities in which I have been personally involved. Therefore, I am pleased that Touryan has added this other important example of efficient collaboration to those discussed in the article.

I much appreciate the comments of Alexander Gabovich about the situation in Ukraine. He stresses certain difficulties that Western funding agencies need to be more fully aware of when they occur. With respect to INTAS, though, his remarks seem to apply more to the "joint calls" for proposals than to the "open calls," which operate directly at the research group level and account for a greater part of the funding granted by INTAS (see page 26 of my article).

One change has already taken place in the direction suggested by Gabovich and may lead to an improved situation in Ukraine. Some joint-call proposals that are rated as excellent by INTAS but not considered as deserving priority by the partner country or organization are being shifted to the open-call category so that they can qualify for a second chance to be funded.

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The Vacuum Field Is Real—and the Most Ethereal of Fields

It was good to see Frank Wilczek's essay (PHYSICS TODAY, January, page 11) in which he discusses the ether theory as a notion that just won't go away. Of course, as Wilczek so rightly points out, Albert Einstein wound up with a theory of spacetime that looked very much like an ether theory, but without actually calling it such. Einstein's web of spacetime was later joined by the web of quantum fields of quantum electrodynamics as developed by Paul Dirac and Richard Feynman, with virtual particles being created out of the vacuum—and so space did not seem so empty after all.

This vacuum field has had an interesting history, with Einstein originally invoking it as a source of opposition to gravity in his cosmological equation of the universe before Dirac and Feynman used it as a source of virtual particles, but its reality was never taken very seriously. More recently, we had the proposal made by Andrei Sakharov[1]—and subsequently by Harold Puthoff and others[2]—that the quantum fluctuations of the vacuum could be used as a source of such physical quantities as gravity, mass, and inertia.

Now we have experimental results that provide evidence that the vacuum field is real, or at least produces real effects—namely, the Casimir effect on plates in a vacuum[3] and the cosmological effect of the pressure of the vacuum on the expansion rate of the universe (an indication that the rate is speeding up with time, as discussed in the lead "Search and Discovery" story in your June 1998 issue, page 17). Therefore, Einstein's cosmological constant exists after all as a nonzero entity. Thus, this most ethereal of fields not only exists but seems to exist everywhere, with visible effects. It should be an interesting field of study in years to come, especially as it relates to quantum effects in the universe.

References

1. A. D. Sakharov, Sov. Phys. Dokl. **12**, 1040 (1968).
2. H. E. Puthoff, Phys. Rev. A **39**, 2333 (1989).
3. S. K. Lamoreaux, Phys. Rev. Lett. **78**, 5 (1997).

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Standard Model of Particle Physics Has Charge Quantization

In reporting on the important search for millicharged particles at the Stanford linear Accelerator Center (PHYSICS TODAY, September 1998, page 18), Bertram Schwarzschild states that the quantization of the electric charge is something of a mystery in the standard model of particle physics (SM) and that no established theory excludes millicharged particles. I would like to point out that these statements are not correct.

It is true that for a long time people thought that the SM could not explain charge quantization. One of the main motivations for invoking grand unification theories (GUTs) was precisely this fact. However, as was demonstrated in 1989–90, the complete structure of the SM is such that the

charge quantization is built into it and is as intrinsic to it as the existence of the neutral currents.[1,2] The proof is consistent and complete.

The SM is not without mystery. For instance, why are there three generations of quarks and leptons, and why do anomalies cancel generation by generation? Charge quantization, though, is now one of its certainties. In fact, the color dependence of the electric charge, as arising in the SM, has become a powerful tool to put constraints on the extensions beyond the SM. Also, a careful study of the same charge quantization shows that when the electroweak symmetry was restored in the early universe, there was no electric charge present.[3] So, in the absence of such a charge, who needs GUTs?

Furthermore, it is erroneous to think that the SM permits millicharged particles. It has been demonstrated that the same method that proves charge quantization in the SM also forbids the existence of millicharged particles.[2]

References

1. A. Abbas, Phys Lett B 238, 344 (1990).
2. A. Abbas, J Phys G 16, L163 (1990).
3. A. Abbas, preprint, hep-ph/9503496.

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Physics Students in 1950 Got PhDs Fast, Rarely Worked as TAs

As a graduate student who received his PhD in physics at Yale University in 1950 only three years after his BS, I'm reminded by your story on teaching assistants' union activities (May, page 57) about how well off I was then, and how poorly off grad students are today.

There were very few TAs in my time, and physics professors taught 9 to 12 hours per week. The GI Bill of Rights, preinflation, supplied my basic expenses for the first two years, although I did grade exam papers to supplement my income. Being a Navy contract assistant the third year just about covered my expenses, and my only duty was to do research for my dissertation.

It is now practically against the law to get a PhD in three years. I hear that four is possible, and five or more is the norm. The reason is that grad students are there to support government contracts or grants, and the university requires most faculty members to get outside support. In fact, they are paid in part or in full by this support. Profs don't teach now, at least not very much, and their job is often done by TAs.

Add to that the increase in the retirement age, and we have a very difficult situation for the grad student trying to get out and join a faculty. I was very fortunate, and present-day students are in deep yogurt.

Please spare me the comment that research is so much better today. It's just more expensive.

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In the 1950s, Some Physicists Suffered Inferred-Red Effects

While we are celebrating the centennial of the American Physical Society, we should not forget the less pleasant happenings of the century, especially those of the McCarthy era.

Unless one lived through the first half of the 1950s, it may be hard to understand its impact, which included the rise of a creeping sense of personal fear, even in an academic environment. One minor but telling effect that I experienced in New York City, where I was a Columbia University graduate student in physics, was that we students became wary of signing any petition. During the warmer months in those days, there was usually a group of tables and chairs set up near the corner of Broadway and 116th Street, with people trying to get signatures on petitions. Normally, we would have signed anything that sounded reasonable. But that changed when we began to realize that anything we signed might be used against us.

Even today, I recall three specific experiences that really jolted me. The first involved an individual, whom I'll call Dr. Bern, who was hired temporarily to help the students in the Columbia physics department. We found him to be very bright, patient, understanding, and helpful. So it was a shock to see a newspaper headline revealing that he had been indicted for perjury on the grounds that he had lied to one of the McCarthy committees about not knowing a person under investigation as a Communist spy. We were very upset, and some of us went to Bern's lawyer to volunteer to appear as character witnesses and to ask if a petition would help. The lawyer informed us that, out of fear, Bern had lied under oath about something that was easily disproved, so there was nothing we could do. I never did learn what then happened, but I do know that we were quite shaken up about having McCarthyism strike so close to home.

My second experience involved a very bright and creative physicist I'll call Dr. Robart. He had been fired from his job at a government laboratory because of suspicions that he was a Communist. He was given lab space at Columbia, and worked with me since he was interested in my thesis work. Of course, I spoke to him at great length about his difficulties. He never could understand why he had been fired; the best he could figure was that he had been punished for having received requests from Soviet scientists for reprints of his papers, even though he had never even sent the reprints out. I was alarmed. If that could happen to him, why not to me? I met Robart a few years later and learned that he had successfully sued the government and been awarded back pay. I said that it sounded like an excellent outcome, but he said sadly that he had never really recovered from the incident. Despite the favorable judgment, he had spent tens of thousands of dollars in legal fees, lost a few years of his life, and suffered unimaginable personal anguish.

My third experience pertained to J. Robert Oppenheimer. On Friday afternoons, the Columbia physics department held a seminar, for which outside speakers were invited at times. Typically, the audience would consist of perhaps 50 people from the department. At the height of the Atomic Energy Commission's actions against Oppenheimer, he was invited to give one of the seminars. The word rapidly spread throughout Columbia, and because of the large interest shown, his talk was moved from the usual lecture room to McMillan Hall, which could probably hold over 500 people. The hall was packed with people hoping that he would comment about his situation. As I recall, he started with the words, "Problems in this century have tumbled down like apples from a tree," and then he went to the blackboard, wrote an equation, and proceeded to deliver a highly technical talk. At the end, looking around the audience, I realized with grim amusement that most of the people there had not understand a word he had said, except for the opening sentence. When I chatted with some of them later, they agreed, but said that they had attended chiefly to show their support for a great man.

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