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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to ensure that the punitive government tax levied on foreign scientific grants (the current rate is about 50%) would be rescinded, that the national academy would be prevented from surrendering any more of its property to private interests, and that we government scientists would get our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 origi-

nally 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 Sakharov¹—and subsequently by Harold Puthoff and others²—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 vacuum³ 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

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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