

Sakharov's scientific legacy

SIR—Erast B. Gliner is right to say that Sakharov's contribution to science¹ should be emphasized in the campaign to end his exile and to save his life. However, Gliner's statement that Sakharov "is not considered as a head of some scientific school inside of the Soviet Union or abroad" is not entirely correct. Sakharov's pioneering work on the problem of a controlled thermonuclear reaction, which began the well known tokamak project, was the main reason for his election as a full member of the Academy of Sciences of the USSR in 1953, together with his co-author Igor Tamm. More than 20 years later, Sakharov was elected as a member of the US National Academy of Sciences for similar reasons. In a brief autobiography² published in 1974, Sakharov made a special point about two projects that he considered the most important of his contributions to nuclear physics:

In the summer of 1950, almost simultaneously with the beginning of work on the thermonuclear weapon, I. E. Tamm and I began work on the problem of a controlled thermonuclear reaction; i.e., on the utilization of the nuclear energy of light elements for purposes of industrial power. In 1950 we formulated the idea of the magnetic thermo-isolation of high-temperature plasma, and completed estimates on the parameters for thermonuclear synthesis installations. This research, which became known abroad through a paper read by I. V. Kurchatov at Harwell in 1956 and through the materials of the First Geneva Conference on the Peaceful Use of Atomic Energy, was recognized as pioneering. In 1961 I proposed, for the same purposes, the heating of deuterium with a beam from a pulse laser. I mention these things here by way of explaining that my contributions were not limited to military problems.

In the Soviet Union, acknowledgment of Sakharov's work has been made only in publications from before 1968. Even though the tokamak project for which I. Tamm and A. Sakharov laid the foundations is continuing in the Soviet Union (the tenth, eleventh and twelfth tokamaks are now operating for research purposes), Sakharov's name has been omitted from the history of this field. Sakharov's role was last acknowledged in two official biographies of Igor Kurchatov published in 1967^{3,4}. I. Golovin, a close colleague of Kurchatov (the head of the Soviet atomic project), recorded Kurchatov's reaction to Sakharov's theory in a very clear way: "Kurchatov was sitting in his study on New Year's Eve 1950 when he turned [to Golovin] and said: 'Sakharov has boosted us to tackle the second atomic problem of the twentieth century which is no less magnificent [than fission] — obtaining boundless energy by burning the waters of the ocean'"⁵. In some Western histories of Soviet science, the role of Sakharov in the tokamak project is fully acknowledged⁶.

When asked about Sakharov's fate, some Soviet officials (including Anatoly Alexandrov, president of the Academy of Sciences of the USSR) normally answer that Sakharov is restricted to Gorky because he is in the possession of important military secrets and that this exile is made in strict observance of Soviet laws. Neither reason is correct. Sakharov was exiled to Gorky on the basis of an "individual" decree signed by the late President Leonid Brezhnev in 1980 as a reprisal for Sakharov's protest over the Soviet invasion of Afghanistan. There are no provisions in Soviet law for such a form of punishment, and the exile was imposed without any trial or decision of the court. Sakharov had had no access to classified information since 1968.

Now, when the new leadership clearly considers many aspects of Brezhnev's internal policy in a very unfavourable light, his legal actions may also be re-examined more carefully and critically. Gorbachev's intention to accelerate scientific and technological cooperation between East and West could not be served better than by restoration of full freedom to Sakharov.

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1. Gliner, E.B. *Nature* **318**, 513 (1985).
2. Sakharov, A.D. *Sakharov Speaks*, 30-31 (Knopf, New York, 1974).
3. Astashenkov, P. *Kurchatov*, 173 (Moldaya Gvardija, Moscow, 1967).
4. Golovin I.N. *Kurchatov* (Atomizdat, Moscow, 1967).
5. Parry, A. *The Russian Scientist*, 172-173 (Collier Macmillan, London, 1973).

Velikovsky

SIR—In his letter (*Nature* 10 October, p.470) criticizing the discussion of the Babylonian Venus observations in my review of Bauer's *Beyond Velikovsky*, Lynn E. Rose claims that he and Vaughan have worked to vindicate these data whereas Huber has rejected two-thirds of them.

The Babylonian texts in question were copied a millennium after the observations; there are so many variants between the copies as well as self-contradictions within individual tablets that at least 20 per cent of the data is suspect from the outset. As one of the most enthusiastic Velikovskians, Rose wishes to use these questionable data to prove that the Earth's orbit has changed dramatically in the past three millennia. Huber, as a scientist inclined to believe in the stability of the Earth's orbit, wishes instead to show that this corpus of material is statistically consistent with modern parameters, and even after throwing out the demonstrably bad sections of the text, over half of the 49 observations agree with modern values

within the accuracy of the Babylonian observations.

C. Leroy Ellenberger, no longer a convinced Velikovskian, has pointed out to me that I might nevertheless have even better cited the uniformity of Greenland ice core Dye 3 as a way in which science could actually demonstrate that Velikovsky's scenario did not happen. This 2,000-metre sample is continuous and datable for the past 10,000 years and shows no dust or acid layers that would signal the sort of universal catastrophe predicted by Velikovsky.

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Metric system

SIR—While endorsing all the comments made by your correspondent Alex Berezin (*Nature* **317**, 762; 1985), I hope that a mixture of different systems of units, including some nonmetric ones, will be retained, at least in the field of aviation. It is a major contribution to safety for a pilot to know that data quoted by radio in feet refer to altitude, while data quoted in metres refer to visibility, and that nautical miles are used to refer to distance along a route, from a radio beacon or airport, etc.

This system is standard throughout the world, the only exception being, characteristically, the United States, where statute miles are thrown in for measuring both visibility and distances, runways are measured in feet instead of metres and air pressure is quoted in inches (of mercury) instead of hectopascals.

If one overlooks this idiosyncrasy, the system works most satisfactorily and is very well suited to be used throughout international airspace, a space which is non-Euclidean, anisotropic and subject to changes of scaling factors (wind, air-pressure and so on) at any time.

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Nuclear weapons

SIR—Edward Teller's letter (*Nature* **318**, 99; 1985) is accompanied by two graphs, one of relative numbers and the other of relative yields of US nuclear weapons. In both cases, the data presented end in 1980, before President Reagan's accelerated weapons programme, with which Dr Teller was closely associated and of which he should be in a position to present the consequences, both for numbers and yield. What are the figures for the past two years?

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