

biological systems. However, a statement on page 21 needs amplification for the sake of clarity. It reads:

The simulations of contamination from the Chernobyl plant have concentrated on I^{131} and Cs^{137} because they pose considerable health concern and are released in appreciable quantities. Iodine-131 is a beta emitter and has a half-life of only eight days, but it is taken up quickly into the thyroid once it is inhaled or ingested. Cesium-137 is a gamma emitter with a half-life of 30 years, so it can contaminate the ground for long periods.

The above implies that I^{131} , being a beta emitter, presents only an internal hazard following inhalation or ingestion. In fact, the several betas emitted by I^{131} are followed in cascade by a number of potent gamma rays, as shown on the Seaborg Charts.

The average energy of these gammas is about 0.36 MeV, for which the half-value layer in lead would be approximately 0.22 cm. For comparison, the gamma (following the original beta) from Cs^{137} (actually from Ba^{137m}) has an energy of 0.66 MeV, with an HVL in lead of 0.65 cm. The number of roentgens per hour per curie at 1 meter for Cs^{137} is 0.30. The corresponding value for I^{131} is not much less at 0.21. Since the expected release of I^{131} is more than an order of magnitude greater than that of Cs^{137} , biological shielding needs in areas of heavy fallout concentration would be underestimated in the early weeks following the accident if the gammas associated with I^{131} were ignored.

Following the Windscale accident, large quantities of I^{131} were released. Cow milk selectively concentrates I^{131} , presenting a hazard to children's thyroids. Little else of concern would be in the milk. The response at the time was to dump millions of gallons of milk down the sewers. The milk could have been saved if it had been dried and stored for several years, until the radioiodine had decayed away. The response in Eastern Europe some 25 years later was no more sensible: Again, the milk was dumped.

Scientifically advanced countries use radiation monitoring badges for occupationally exposed personnel. In many or most cases, personnel badges assigned to a particular group are accompanied by a "control" badge. The control badge is kept away from radiation to evaluate local background radiation, which is then subtracted from the individual user's badge. Use of these badges goes back many years, and records are maintained of the readings. The control-badge readings for any particular time period (for

example, May) of past years could be compared with May 1986 control-badge readings. This would provide a valid and reasonable quantitative (but not qualitative) estimate of geographical dispersion of radiation from Chernobyl, as well as the corresponding dose or dose rate estimates.

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Restricting supercomputers

I would like to echo some of the concerns of Leo Kadanoff (July, page 7) regarding restricted supercomputing facilities at universities. Ultimately the restrictions must apply to US researchers who are judged to be security risks as well as to Soviet bloc researchers. The consequence will be that supercomputing results will be generated only by those with adequate security credentials, and that those results will be verifiable only by similar individuals. If a proposed facility requires any "political" clearance then its proper place is at a national laboratory, a DOD laboratory or a military contractor site.

The nice thing about physics is that undiscovered facts don't disappear. Facts not discovered today will be discovered tomorrow. I suggest that university researchers be patient and remain free; today's supercomputer will be tomorrow's PC.

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One could empathize with Leo Kadanoff's open-door concept if a "world scientific community" was a reality. Unfortunately, the reality is that technology is an important variable in the power balance equation and it is in supercomputers that the US has a ten-year edge. He asks what makes supercomputers different from ordinary instrumentation or lesser computers. The answer is threefold:

► The total supply of supercomputing power is small and concentrated in the US. The USSR has a large demand for this resource, mostly for military purposes, and work done here frees up computer resources in the USSR for "applied" work. We should not be too generous!

► Supercomputers are different, not merely evolutionary. They allow MFLOPS performance, parallel multi-program execution and vector string processing in a "single computer resource." This cannot be compared to kludged solutions of the past. An example is that for the first time an



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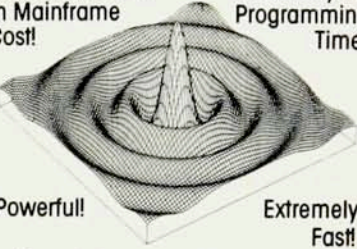
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entire airframe can be simulated on a computer system. That is new capability!

► History is replete with examples of scientific Trojan horses. Russia has been an expansionist nation for 200 years and continues to be one today. This is supported by all means, even science. The Politburo control over Eastern scientists mandates the current minimum security checks.

I too look forward to the day when engineers, mathematicians, scientists and computer experts can work together for the good of science and all mankind. Unfortunately, that is tomorrow.

DANIEL P. RÉMY
Tucson, Arizona

7/86

Physics and psychics

The article by Janet Oppenheim about physicists and psychical research in the last century (May 1986, page 62) omitted a number of details that I believe are interesting and important for a complete understanding.

It is important to try to imagine oneself in the time about which one is writing. In the middle of the 19th century, scientists were making so many technical and fundamental discoveries that to some there seemed no limit to the capability of scientific enquiry. There seemed no doubt then, and I think there is none now, that if it were possible to demonstrate unequivocally one-tenth of the claims of the spiritualists, study of these phenomena would be more important than most scientific inquiries. In 1871, a scientific study seemed possible; it seems less likely now.

There are probably many reasons that William Crookes gave up active study of mediums in 1875. One not mentioned by Oppenheim is the bitter feud between William B. Carpenter and Crookes. The vituperative letters published by Carpenter led some of Crookes's friends to advise him to lie low for the sake of his ordinary scientific career, which, after all, was his bread and butter. But it is not true that he said nothing. In 1897 Crookes was president of the Society for Psychical Research. In his presidential address he reaffirmed his belief in his earlier studies. He also speculated on the way in which the phenomena he had studied might fit into conventional scientific thought. Wilhelm Roentgen had just discovered x rays, and Crookes suggested that these, or rays of shorter wavelength, might be the carriers of telepathic thoughts. He also introduced

this idea at the British Association for the Advancement of Science the same year.

It is useful to distinguish two partially separable claims of the spiritualists: first, that various physical phenomena take place at séances—table turning, materializations of spirit forms and so on—and second, that mediums go into trances, display alternate personalities, supply information that may have been telepathically acquired, and claim to give messages from the dead. The two became strongly linked in the modern era by the knockings at the house of the Fox sisters in Rochester, New York, in 1847. However, there are many persons who believe in the second type of phenomena and not the first. Crookes was one of those who believed in both, at least in 1870, although his presidential address to the Society for Psychical Research is consistent with the idea that his belief in the physical phenomena was wavering. It is probable that Oliver Lodge did also, but Lord Rayleigh repeatedly expressed his skepticism about the physical phenomena.

Oppenheim's casual mention of Leonora Piper is incomplete without an understanding of her role in convincing many intellectuals of the 19th century of the reality of psychical phenomena. She was well known to the psychologist William James, and I have been told and believe, but have not independently verified, that she was his housekeeper in Cambridge, Massachusetts, and developed her mediumship in James's "home circle." She had three "spirit guides," who, according to James, produced "facts about the circumstances, and the living and dead relatives and acquaintances, of numberless sitters whom the medium had never met before, and of whom she has never heard the names."¹ There is no doubt that James, who repeated his wonder at Piper's mediumship in his presidential address to the Society for Psychical Research in 1896, the year before Crookes was president, strongly influenced the physicists.

There has been one major success of the Society for Psychical Research in its hundred years of existence. In 1882, hypnotism was as little understood, and as disreputable in scientific circles, as spiritualism. Now it, and its limitations, are part of our ordinary scientific understanding. The work of the society in its first 20 years, particularly the work of Edmund Gurney, who I believe was an engineer, played a considerable part in this. A casual reading of the *Proceedings of the Society for Psychical Research* for those early years leads me to the conclusion that Gurney was a better scientist than many of his more

famous colleagues.

Ninety years later not much has changed. I was brought up among spiritualists, and have personally known a hundred or so mediums. About several of them I can make the same comment that James made about Piper, and would add that I believe them to be as honest as any human being. That mediums go into trances is as fascinating to me as it was to James. But the study of such trances has not been brought into ordinary scientific thought. In these 90 years there have been some desultory efforts to "prove" telepathy by showing that mediums could not have made use of any sensory cues in their displays of knowledge. The lack of success at doing so in any reproducible manner leads scientists to despair. To most it suggests that the phenomena do not exist. But that, like most negatives, is unprovable.

Reference

1. W. James, *Principles of Psychology*, vol. 1, Macmillan, London (1890), p. 396.

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5/86

OPPENHEIM REPLIES: I am not quite sure that Richard Wilson read my article carefully. He refers to "the bitter feud between William B. Carpenter and Crookes" as "not mentioned by Oppenheim." Yet it is indeed mentioned on page 67, in the first and second columns.

I should merely like to add that many of the issues raised in Wilson's letter—including Crookes's interest in x rays, the significance of Piper's mediumship and the Society for Psychical Research's contribution to the scientific study of hypnotism—are discussed at great length in my book *The Other World: Spiritualism and Psychical Research in England, 1850-1914* (Cambridge U.P., New York, 1985).

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3/87

It is interesting to compare the conclusions of Janet Oppenheim's "Physics and psychic research in Victorian and Edwardian England" with those of David F. Marks in his "Investigating the paranormal" (*Nature* 320, 119, 1986).

Oppenheim concludes, "In the attempt to... find the hidden pattern, or unifying framework, of the universe, the physicists of the Society for Psychical Research shared with many of their critics a common goal." Marks concludes: "Parascience has all the qualities of a magical system while wearing