

instituted in order to keep subjects perpetually at work and in poverty we may mention the pyramids of Egypt, the numerous offerings made by the Cypselids, the building of the temple of Zeus Olympius by the Peisistradae, and public works under Polycrates of Samos. Subjects are also kept poor by taxation, as at Syracuse under Dionysius, where in five years the value of the entire private property was paid in."

Three megascience programs for which the public is taxed at the multi-billion-dollar level today are space science, controlled thermonuclear fusion and high-energy particle physics. What benefit to they give to the public? Space science provides satellite television, weather surveillance, spectacular views of the outer planets and, of course, security from surprise attacks by enemy forces. Controlled thermonuclear fusion promises abundant safe nuclear power. Since it doesn't work, the promise of safety is fulfilled. Like Achilles racing with the tortoise, the program forever gets closer and closer to the tortoise without catching it. Some public utilities are having trouble running nuclear fission reactors, so how could they run the much more complicated controlled fusion reactors even if they worked? Still, if the project succeeded it would benefit the public that is taxed to support it.

Now to high-energy particle physics! Like the pyramids of Egypt, that program is of no earthly use to the taxpaying public or to any other branch of science. Its practitioners say that they must "probe deeply into the structure of matter." Isn't it hilarious that the structure of matter that makes the program technically possible is superconductors? That discovery was made by people working on small budgets in laboratory rooms where they could go in and shut the door on program managers.

Sometime we must stop building ever-larger pyramids for the high-energy particle physics community. Why not now? I suggest giving a medal, a prize and perhaps a splendid uniform to all top-level program managers in high-energy particle physics. That is really what they are working for anyway. The facilities should be put on a shutdown ramp over two fiscal years to complete all work now in progress. The funds and personnel would, over those two years, be divided among the first two megascience programs. The rest of the world would think we were on to something and would be totally confused! Actually, we would only be implementing the wisdom of Aristotle!

(P.S. I am working in molecular biology, a program that pays its piper.)

HUBERT P. YOCKEY

Bel Air, Maryland

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SDI: Some Darker Implications

Greg Blonder (January 1988, page 126) has pointed out, through a clever and simple analogy, the subtle mutability between defensive and offensive weapons. However, there is no need for analogizing, since copious examples can be found in the public domain of SDI's "darker side."

On 14 January 1986 the *Los Angeles Times* announced in an editorial that a local "think tank," RDA-Logicon Inc, had concluded from its own research that not only were the high-energy laser systems being planned for SDI extremely potent offensive weapons, they were also capable of rapidly igniting combustible urban materials in sufficient quantities that it appeared possible to catalyze a "laser winter" with the same catastrophic effects predicted to accompany a "nuclear winter."

At the time I was a staff member at the Jet Propulsion Laboratory in Pasadena, and I contacted RDA-Logicon to obtain a copy of the report. I was told that the report had been classified "proprietary" and was not available to the general public. Subsequently I contacted a physicist at Argonne National Labs who had published a paper shortly thereafter in the open literature predicting the laser winter effect. I suggested a collaboration to further refine the technical issues of laser physics, beam propagation and laser winter effects, but I was told in no uncertain terms that the Argonne management had communicated their displeasure upon learning that an employee was investigating such a politically volatile topic, and that further research was officially discouraged.

Apart from a single paper presented at an APS conference last year and personal communications with a private research organization in Los Angeles, I am unaware of any other ongoing investigations along these quite controversial lines, but I would greatly appreciate hearing from any readers who are.

Just prior to President Reagan's March 1983 "Star Wars" speech, the president's science adviser, George Keyworth, and the deputy national security adviser, Robert McFarlane, discussed the possibility of using high-

energy lasers to assassinate leaders like Muammar el-Qaddafi (*Bulletin of the Atomic Scientists*, October 1987, page 20). In light of the APS study of directed-energy weapons (see *PHYSICS TODAY*, May 1987, page 51), I think it's safe to assume that Qaddafi is not losing sleep over this prospect.

JIM BOGAN

Department of Physics

University of Oregon

Eugene OR 97403

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The Light Quantum, Viewed in Hindsight

Giorgio Margaritondo's article "100 Years of Photoemission" (April 1988, page 66) conveys the false picture that only Einstein's 1905 quantum theory explained the photoelectric effect and that the experiments of Robert Millikan and other physicists confirmed Einstein's theory of light quanta. Although this picture makes sense to a modern reader, it has no foundation in history. It is not true, for example, that Philipp Lenard's discovery of a maximum kinetic energy of photoelectrons (independent of the intensity of light) remained unexplained until Einstein solved the matter. Lenard explained the result by means of a "triggering hypothesis," which was developed by many other physicists and enjoyed general respect. Lenard's result was not considered to be particularly puzzling and certainly not in need of the sort of explanation Einstein could offer. The triggering hypothesis may not seem satisfactory to a modern physicist, but at the time it was regarded as a much better explanation than Einstein's strange alternative.

As to the experimental confirmation of the photoelectric law, one should distinguish sharply between Einstein's equation $E = h\nu - W$ and Einstein's theory. Margaritondo fails to make this distinction and thus claims that about 1916, experiments definitely established the idea of the light quantum. The facts are that Einstein's theory was almost unanimously rejected and that the experiments did not lead to acceptance of the theory. In his celebrated 1916 paper, Millikan argues that the Einstein equation was now verified but that the light quantum theory was "wholly untenable," a view he repeated the following year in his book *The Electron*. Millikan may not have understood Einstein's theory, which he saw as a modification of J.J. Thomson's ether-string theory, but he