Fastest shot in the West: A railgun

Clark Kent may have to go back into training. *Ten times* as fast as a speeding bullet? Can Superman manage? Railguns apparently do. In a recent announcement Los Alamos National Laboratory reports that during a series of railgun tests in Ancho Canyon there, one shot apparently reached a speed of 30,000 feet per second, ten times that of a bullet and almost escape velocity from the earth.

Railguns are not guns that ride rails. They are guns made of rails. The ones under test at Los Alamos are a joint research effort of Los Alamos and the Lawrence Livermore National Laboratory, which is part of a national and international push toward developing electromagnetic methods of accelerating and launching projectiles that may replace the conventional chemical (and sometimes mechanical) methods in many applications and also open up new ones by reason of higher muzzle speeds (SN: 4/4/81, p. 218).

A basic railgun consists of two parallel electrically conducting rails. The electrical circuit is completed by an armature that crosses between the rails and is free to slide down the space between them. If a current is run through the circuit, it generates a magnetic field in the space around the conductors. The interaction of this field with the current that generated it creates a force, called the Lorentz force, that accelerates the armature down the bore and out the muzzle. In some railgun experiments the armature is itself the projectile, but the Livermore-Los Alamos group, which is led by Max Fowler and Dennis Peterson of Los Alamos and Ron Hawke and Al Brooks of Livermore, prefers nonconducting projectiles. In the Los Alamos-Livermore experiments the armature is an arc of ionized gas made by the vaporization of a fuse at the base of the projectile. The projectiles are Lexan plastic, some with metal cores. The one that reached 30,000 feet per second had a tantalum core.

Electric current is supplied by a large bank of capacitors located in a gallery at the Ancho Canyon site. Current is amplified by a device called a magnetic flux compressor. This is essentially a metal box connected to the capacitors in such a way that their discharge establishes a magnetic field inside the box. A series of chemical explosive charges is attached to the outsides of the box. Firing these charges implodes the box in a sequential way, compressing the magnetic field trapped inside it. Compression of the field generates current, transforming the chemical energy of the explosive into electrical energy that greatly amplifies the jolt first given by the capacitors.

Because of these explosions, as well as the high muzzle velocities, the tests must be held in an isolated and shielded area like Ancho Canyon. Approaches to the canyon are closed off and researchers retire to sandbagged bunkers when a shot is fired. X-ray flash cameras are used to record flight data. The projectiles are stopped by metal or styrofoam buffers.

Railguns of this design have tended not to be reusable. The swift acceleration of the projectile does severe damage to the rails so that even the part that does not explode could not usually be salvaged. This is a serious hindrance to practical application. Now, however, a round-bore design is beginning to be used instead of the earlier square bore. The round-bore guns are built in sections, and the experimenters find that damaged sections are easily replaceable. The round bore also makes possible the eventual preacceleration by compressed air, which should lessen the strain and damage on the main bore. —*D. E. Thomsen*

Railgun shot in Ancho Canyon: Another magnetic flux compressor raises the dust.

Los Alamos/Fred Rick

Gene rule violation causes funding loss

The National Institutes of Health has cut almost $200,000 of funding for research by Martin J. Cline. Cline, a professor at the University of California at Los Angeles, was reprimanded last spring for experiments in which he violated regulations regarding protection of human subjects and guidelines for research involving recombinant DNA (SN: 6/6/81, p. 357). He injected recombinant DNA molecules into two patients, one in Israel and the other in Italy, having an incurable blood disease. The work did not have the approval of the UCLA Human Subject Protection Committee.

A decision by NIH last May requires Cline to go through extra steps to receive permission to do further experiments either involving human subjects or recombinant DNA. The three institutes funding Cline's research have now reached quite disparate decisions regarding his current grants, and the NIH has accepted those recommendations.

The National Heart, Lung and Blood Institute recommended that Cline's three-year grant be discontinued March 31, 1982, at the end of its first year. The institute had previously authorized $162,000 (plus overhead to UCLA) for the remaining two years. The institute's advisory council informed NIH that it considered Cline's actions "reprehensible." Cline may appeal the NHLBI decision.

On the other hand, the National Institute of Arthritis, Diabetes and Digestive and Kidney Diseases recommended that funding be continued for the last three years (about $118,000) of its 10-year grant to Cline. An NIADDKD spokesman reports the advisory council felt implementation of NIH's May recommendations should serve as sufficient chastisement.

The National Cancer Institute, which had administered two grants to Cline, took the middle road. It recommended continued funding, $49,000 in direct costs, for an 8-year research project scheduled to finish next May. However, Cline also had received NCI funding through a grant awarded to a collection of projects by several researchers. Cline has been replaced as principal administrator of that grant, but NCI requests he also lose his $30,000 through that program, scheduled to reapply for funding in January.

William F. Raub, NIH associate director of extramural research and training, says that the different decisions can be explained by the distance between the research areas of each institute and the subject matter of Cline's transgressions. In a recent letter to NIH, Cline said, "I intend to make every effort to adhere to my responsibilities in meticulously following local and federal guidelines in the conduct of my research." —*J. A. Miller*

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