

*taria* (Estudios Geológicos, Madrid, 1968). The measurements of the enamel thickness are taken either at a regular distance from base to top in a vertically cut ridge-plate, or on each figure of abrasion in the grinding surface, since here each plate appears worn out at a different height; the value of the mean for each species is a constant independent of the collection, preservation technique, measuring instrument, and the different single values obtained with either method or in either molar of the same individual.

11. The need to isolate evolutionary trends in the study of elephants was emphasized by J. B. S. Haldane, in L. Trevisan, *Ric. Sci.* **19**, 10 (1949).
12. F. M. Bergounioux and F. Crouzel, *Estud. Geol.* **14**, 260 (1958).
13. C. Petrocchi, *Rend. Accad. Naz.* **IX** 76-77, 1 (1953-1954).
14. It is primitive, since the presence of lower tusks is a regressive tendency; the elephantlike morphology of its molar ridges is advanced [C. Petrocchi, in (13), Figs. 3, 4, and 5].
15. C. Fuentes, *Bol. Roy. Soc. Españ. Hist. Nat. Biol.* **64**, 277 (1966).
16. C. Arambourg, personal communication.
17. R. Singer and D. A. Hooijer, *Nature* **182**, 101 (1958).
18. "Elephas proplanifrons," "E. andrewsi."
19. H. F. Osborn, in (2), p. 1354, Figs. 1211, 1212, and 1213.

20. L. Ginsburg, personal communication; V. I. Garutt, *Tr. Comm. Izuch. Chetvertichnogo Perioda* **10** (2), 8 (1954).
21. J. F. Evernden and G. H. Curtis, *Curr. Anthropol.* **6**, 343 (1965).
22. The former types must be retained; neither the neotype of *Elephas imperator* [H. F. Osborn, in (2), p. 1000], which is *E. columbi* from Guadalajara, Mexico, nor the neotype of *E. columbi* [H. F. Osborn, in (2), p. 1075], which seems to be a transient form with most primitive traits except hypsodonty, must be admitted. F. C. Whitmore, Jr., has supplied me with one specimen of elephant tooth from the Atlantic continental shelf [F. C. Whitmore, Jr., K. O. Emery, H. B. S. Cooke, D. J. P. Swift, *Science* **156**, 1477 (1967)]. I do not consider it a new species, since, in different scatter diagrams for diverse ratios, when the size of the sample is sufficient, this species lies within the range of variability of *E. columbi* and *E. columbi jeffersoni* Osborn; in the thickness of the enamel and some other traits, these forms overlap with *E. primigenius*; the morphology of the specimen known to me is that of *E. columbi* and *E. columbi jeffersoni*; a mixed assemblage in the continental shelf is possible.
23. "Elephas sheppardi" Dart, "E. hanekomi" Dart, "E. willmani" Dart [see H. B. S. Cooke, in *African Ecology and Human Evolution*,

F. C. Howell and F. Bourlière, Eds. (Methuen, London, and Wenner-Gren Foundation for Anthropological Research, Ltd., New York, 1963), p. 105].

24. B. Accordi, B. Campisi, R. Colacicchi, *Atti Accad. Gioenia Sci. Nat. Catania* **12**, 168 (1959).
25. C. Arambourg, in preparation.
26. ———, *Mission Scientifique de L'Omo* (Editions du Muséum, Paris, 1949), vol. 3, p. 254 (Fig. 7), p. 267 (Fig. 13), plate II (Fig. 2).
27. *Mammuthus hungaricus* from M. Kretzoi, *Foldt. Kozl.* **71**, 7-12 (1941); the rest from H. F. Osborn (2).
28. I thank A. C. Blanc and M. Crustafont for the initial ideas for this study and the directors and paleomammalogists of museums in London, Vienna, Basil, Darmstadt, Mainz, Heidelberg, Stuttgart, Ferrara, Padua, Bologna, Florence, Pisa, Rome, Naples, Leningrad, Budapest, Rabat, Paris, Washington, New York, Yale University, Harvard University, University of Michigan, University of Nebraska, University of Chicago, University of Colorado, Idaho State University, University of California, Oviedo, Barcelona, La Coruña, Santander, Seville, Toledo, Soria, Madrid, Capetown, and Nairobi. Supported by the Spanish Council of Research, the NSF, the Wenner-Gren Foundation, and the State Museum, University of Nebraska, Lincoln.

## NEWS AND COMMENT

# CBW: Pressures for Control Build in Congress, International Groups

The highly classified issue of chemical and biological warfare (CBW) is under intense public scrutiny this year as pressures build up to bring germ and gas weapons under stricter control. Several Congressional subcommittees have recently held hearings on aspects of the U.S. Army's CBW program and have subjected the Army's gas warfare experts to the most hostile questioning from Capitol Hill in a decade or more. A spate of books, television shows, and "educational" meetings held by scientific groups have tried to enlighten the public on the dangers of CBW. And at least three major international organizations, including the United Nations, are preparing detailed reports on the nature and effects of germ and gas weapons. These reports are expected to be the most comprehensive and authoritative analyses of CBW ever made public.

The net result of all this activity is that the public and its political leaders will be better informed about this secrecy-ridden subject than ever before, and the groundwork will have been laid for a serious drive to bring

CBW under a strict arms-control agreement.

The recent inquiries on Capitol Hill are notable for their reflection of deep-seated hostility and skepticism among congressmen toward the military CBW program. The hearings have not yet produced a full-scale review of the entire CBW program. Indeed, they seem to have been launched almost by accident and have focused on convenient targets of opportunity, such as the safety of outdoor CBW testing and of dumping surplus gas weapons into the ocean. Nevertheless, persistent prodding by hostile congressmen has forced the Army to release new information about the American CBW effort.

Congressional concern this year has largely been sparked by Representative Richard D. McCarthy, a Democrat from Buffalo, N.Y., who happened to be sitting at home watching television with his wife in early February when he saw an NBC-TV documentary on CBW. McCarthy found the program "rather gripping and shocking" and, at the urging of his wife, set out to inform himself about the weapons. He

first arranged a Pentagon briefing for 19 congressmen and senators. Then, finding that unsatisfactory, he fired off letters asking further questions of the Defense Department and other agencies.

In response to McCarthy's queries, the Pentagon, for the first time in several years, publicly revealed the dollar magnitude of the American CBW program. Expenditures for fiscal year 1969, according to John S. Foster, Jr., director of defense research and engineering, will total \$350 million. The bulk of this—\$240 million—is for procurement of smoke, flame, and incendiary weapons; tear gas; herbicides; and defensive equipment—all used primarily in the Vietnam War. Some \$20 million has been spent for operation and maintenance of CBW facilities, and about \$90 million has financed research, development, and testing activities, including work on the lethal agents that arouse the most fear and controversy. Foster stated categorically that the Pentagon is no longer procuring lethal chemical or biological agents for the weapons stockpile.

The Pentagon's figures have been disputed by some CBW critics. Congressman McCarthy finds it "difficult to accept" the \$350 million estimate. And journalist Seymour M. Hersh, author of a book on CBW, has asserted that "CBW spending exceeds \$650 million a year."

McCarthy has raised a number of broad policy issues during his crusade. He has questioned the tight secrecy

surrounding the CBW program, has urged the Administration and the Congress to conduct a close review of CBW activities, and has charged that the United States, by using chemicals to kill food crops and tear gas to drive enemy soldiers out into the open where they can be killed by conventional weapons, has imperceptibly drifted into a policy of "limited chemical warfare" in Vietnam. McCarthy has also urged that the United States ratify or support various existing and proposed arms control measures. But his campaign has been hampered by lack of a convenient forum. He attracted relatively little support until he hit upon tangential safety and pollution issues that excited the interest of some of his colleagues. Then the rush to hold hearings on an issue that touched deep public antagonism toward both the military and pollution turned into a small stampede.

The incident that provoked Congressional interest was McCarthy's revelation, in early May, that the Army planned to transport 27,000 tons of surplus chemical weapons across country by train and then dump them into the Atlantic Ocean. The weapons were to be moved in 809 railroad cars from as far away as Denver, Colorado, to the Naval Ammunition Depot at Earle, N.J., where they were to be loaded on four old Liberty ships, towed at least 145 miles out to sea, and then sunk with the ships in at least 7200 feet of water. McCarthy expressed concern that a railroad accident might spray the lethal chemicals over the countryside and cause a massive disaster, particularly since the proposed train routes passed through such cities as Indianapolis, Dayton, Philadelphia, and Elizabeth, N.J. He also questioned the ecological consequences should any of the gas leak out of its containers under the ocean. The material to be dumped included about 2152 tons of GB, a nonpersistent nerve agent, which was contained in rockets and bombs; 4786 tons of mustard agent, which was held in steel containers; and 3.4 tons of CS, a military tear gas.

After McCarthy revealed the Army's plans, congressmen from the states to be traversed raised shouts of alarm, and at least three Congressional subcommittees—representing the Senate Commerce Committee, the House Foreign Affairs Committee, and the House Merchant Marine Committee—held hearings on the plans. Under the barrage of criticism, the Army quickly

## McElroy Discussed as NSF Director

The word on Capitol Hill is that the successor to Leland J. Haworth as director of the National Science Foundation is likely to be William D. McElroy, chairman of the biology department at Johns Hopkins. There have been no hints from the White House about the appointment, but as *Science* went to press McElroy's name was going through the customary clearing process with key congressional Republicans. It would not be surprising if the appointment were getting special handling because of the uproar that ensued when the Administration backed away from naming Franklin A. Long to the NSF directorship after congressional pressure was exerted (*Science*, 18 and 25 April and 2 May 1969). McElroy, 52, did his undergraduate work at Stanford and earned his Ph.D. at Princeton. A member of the National Academy of Sciences (biochemistry section) and a trustee of Brookhaven National Laboratory, he served on the President's Science Advisory Committee from 1962 to 1967 and was president of the American Institute of Biological Sciences in 1968.—J.W.

announced that it would hold up its shipments until the National Academy of Sciences and other federal agencies had a chance to review the plans. An Academy panel, headed by George B. Kistiakowsky, Harvard chemist and former Presidential science adviser, is expected to report its findings shortly.

### Haphazard Planning

Though the experts have not yet rendered their verdict, the various hearings produced some interesting insights into the hit-or-miss planning that governs some CBW activities. The Army said one reason for dumping the weapons in the ocean is that it would be too dangerous to take the weapons apart and neutralize the chemicals—a dilemma which suggests that whoever designed the weapons in the first place didn't give much thought to the disposal problem. The Army also said that, on three previous occasions, it had dumped chemical weapons into the ocean but had made no effort to determine whether there was any effect on marine life. Several Congressmen also complained that there were few safety requirements imposed on CBW shipments. They said other federal agencies gave the matter only perfunctory attention, and thus much of the responsibility for safe transport was left to the carrier.

Under the original plans, the weapons-carrying trains were not required to follow a prescribed route to avoid cities, they were not limited as to speed, and they did not have to be paced by a pilot train to lessen the chance of collision or accident. The

plans did call for buffer cars to separate the lethal cargo from the rest of the train, for specially trained Army guards to accompany the shipment, and for civilian authorities along the route to be alerted—but McCarthy questioned whether even some of these safeguards were being carried out.

After hearing the Army's presentation, Senator Vance Hartke (D-Indiana), chairman of the Senate subcommittee on surface transportation, called the Army's attitude "cavalier." Senator Harrison A. Williams, Jr. (D-N.J.), said that the Army's plan for a "poisonous parade across America" was a "bizarre scheme" that represented "the ultimate in railroading risk."

Late in May, just as the hubbub over the dumping plan was temporarily quieting down, the Army was again called on the carpet. A House subcommittee on conservation, chaired by Representative Henry S. Reuss (D-Wis.), held hearings on environmental dangers of open-air testing of CBW agents. According to a key staff assistant, Reuss became interested in the matter partly because of McCarthy's vigorous campaign, and partly because of a recent issue of *Environment* magazine that was devoted to the nerve gas accident that killed some 6000 sheep outside the Dugway Proving Ground in Utah last year.

The Reuss hearings were remarkable for their skeptical and hostile tone. Reuss took the unusual step of actually swearing in the Army witnesses and he repeatedly reminded them that they were under oath. "Do you swear to tell the truth, the whole truth and

nothing but the truth?", he asked, emphasizing the word "nothing."

Much of the hearing was devoted to giving the Army a tongue-lashing for the misleading statements and outright lies it put out at the time of the Dugway accident. Some of the testimony was contradictory, and it was not clear that the Army actually committed all the sins attributed to it; but Representative Guy Vander Jagt (R-Michigan) detected "a pattern of deception" under all the verbal hemming and hawing. Reuss himself got impatient at the failure of Army witnesses to provide certain information and ordered them to "Call the man at the Pentagon who has it and get him up here as fast as he can come." On another occasion Reuss looked at Mortimer Rothenberg, chief scientist for Dugway, as if he were Doctor Strangelove and asserted, "Doctor, you frighten me. You really do. Who gave you your authority to spew these poisons all over the environment? Who told you to do that?"

#### Safety Program Challenged

On more substantive matters, Reuss produced several scientific witnesses who challenged the adequacy of new safety procedures that have been established for open-air CB testing at Dugway. Gustave L. Davis, of the St. Louis-based Committee for Environmental Information, and Victor W. Sidel, of Harvard Medical School, suggested that people in Salt Lake City, some 80 miles from Dugway, might be endangered if there are further tests. "If an accident could happen such that sheep are killed 35 miles away there is very little confidence an accident can't happen to kill people 80 miles away," Sidel commented. Reuss also brought out the fact that a nominally "independent" chemical safety committee, set up to monitor Dugway operations, is headed by an employee of the DuPont Company, which makes the red marker dye used as a tracer in CBW tests at Dugway. The Army said DuPont had supplied less than 100 pounds of the dye over the years, but Reuss questioned how "independent" the committee was likely to be.

Whether the Reuss probe will result in further restrictions on Dugway's testing remains to be seen. Reuss obviously faces an uphill battle—for Dugway's new safety procedures were recommended by a blue-ribbon panel of experts, headed by Surgeon General William H. Stewart.

The hearings on open-air testing and on the plan to dump chemical weapons into the ocean have given a handful of Congressmen an opportunity to vent their fears about CBW. But Congress is not apt to make a broad review of CBW issues until congressional leaders get interested in the problem and an appropriate forum is found. Last year Senator Edward M. Kennedy (D-Mass.), in his role as chairman of a subcommittee of the Senate Committee on Labor and Public Welfare, asked the Library of Congress to prepare a background report on CBW. The report\*, which was printed last month, discussed alternative approaches to reducing the danger of CBW, but aides to Kennedy say he has made no decision on whether to pursue the issue further. The most likely forum for a broad review might be the disarmament subcommittee of the Senate Foreign Relations Committee. Subcommittee chairman Albert Gore (D-Tenn.) has hinted he might hold hearings, and the full committee, on 30 April, held an executive session on CBW. But the committee, which is heavily involved in the ABM fight and other issues, has not yet indicated that it will turn its attention to CBW.

The most powerful thrust toward CBW arms control this year may come from several international studies now under way, of which the most important is being conducted by the United Nations at the request of the Eighteen Nation Disarmament Committee at Geneva. The UN study, which is scheduled for completion on 1 July and is supposed to be given wide public distribution, will analyze the nature and effects of CB weapons. Participants in the study say it will indicate, either explicitly or implicitly, that CB weapons are unpredictable and could cause mass destruction unless they are brought under stricter control. The World Health Organization and the International Institute for Peace and Conflict Research (SIPRI) are also preparing studies, which are expected to be more technical than the UN's and are expected, at least implicitly, to point to the need for arms control.

These three studies, according to some participants, will be at least "an order of magnitude better than anything existing on the same subject." The studies will thus significantly ad-

vance the public discussion of CBW which has slowly been building up for the past year or so. Since the beginning of 1968 there have been at least four books on CBW published for the general public; both CBS and NBC have produced major documentaries on gas and germ warfare; and several scientific groups have focused attention on CBW. The New York Scientists Committee for Public Information, for example, held a breakfast symposium on CBW this week for all interested members of Congress. And last month, a group of perhaps 100 microbiologists announced the formation of a committee to work for the elimination of CB weapons from the world's arsenals.

#### Weaknesses in Protocol

The United States is not currently a party to any treaty prohibiting germ or gas warfare, but it has pledged to observe the principles of the 1925 Geneva Protocol banning the use in war of "asphyxiating, poisonous or other gases" and of "bacteriological methods of warfare." The Protocol is essentially a "no first use" agreement—that is, the parties agree not to use CB weapons except in retaliation against a CB attack. The Protocol does not ban research, production, or possession of CB weapons, and there is disagreement as to whether it covers use of "nonlethal" chemical weapons, such as tear gas and herbicides, or use of the full range of biological weapons.

To repair some of the deficiencies, the British have proposed a ban on research, production, possession, and use, even in retaliation, of microbiological agents causing death or disease by infection in man, other animals, or crops. The British believe it might be easier, for a variety of reasons, to control the essentially untested biological weapons than to control the well-established chemical warfare arsenals.

Great difficulties lie in the way of an arms control agreement on CBW, most notably the problem of verifying compliance with such an agreement. But the combined impact of the international studies now under way, the British initiative, and the growing domestic concern over the perils of germ and gas weapons has persuaded such CBW experts as Matthew S. Meselson, professor of biology at Harvard University, that this may be a "now-or-never" year for making substantive progress on CBW arms control.—PHILIP M. BOFFEY

\* *Chemical and Biological Weapons*; prepared for the Senate Committee on Labor and Public Welfare, May 1969; for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402; 30 cents.