A stringent goal on lead in urban air

Past experience wtih William D. Ruckelshaus, Environmental Protection Agency boss, reassures reporters that he knows what he is doing (although he doesn't always tell them what it is). Otherwise, events such as this week's press conference on EPA's plans for reducing lead in gasoline would leave the media men wondering.

What Ruckelshaus and his top staffers must surely be doing is laying the groundwork for a concerted attack on the automobile in urban areas. Their technique, possibly the only one open to them, is to go ahead with plans for emission controls as prescribed under the 1970 Clean Air Amendments. As these plans develop, the impossibility of realizing them will become so clear to everyone (the thinking may go) that the alternative of urban mass transit will be seen as the only possible option left open.

This week's proposal is for a maximum of two micrograms of lead per cubic meter in ambient air, averaged over three months, a level that is exceeded in cities from Fairbanks, Alaska, to Richmond, Va. (with rush-hour levels as high as 54 micrograms along the Los Angeles freeway). The means of reaching the goal is to have lead-free 91-octane gas available after July 1, 1974, and to step down the lead content of other gasolines (required for older cars with higher octane requirements) to a maximum of 1.25 grams per gallon after Jan. 1, 1977.

Two considerations are involved: 1) The need for lead-free gasoline to prevent ruining catalytic mufflers on cars meeting 1975 emission standards, and 2) public health. There is evidence that even a tankful of leaded gasoline would poison the catalysts in the mufflers. To prevent this, EPA is calling for automobile filler spouts and service station nozzles that fit together, or fail to fit together, in ways to prevent leaded gasoline from going into cars with catalytic mufflers. If this sounds Rube Goldbergish, a far greater problem comes in determining whether any given car has a poisoned catalytic muffler. (A gasoline delivery truck putting leaded gasoline in the wrong tank could possibly ruin a lot of them.) If the car had just been given an annual inspection, for instance, the failure of the muffler would not be detected for another year. But, as Eric Stork, EPA's vehicle air pollution chief, admitted, this doesn't matter much now anyway; presently there is no feasible testing device local or state testing agencies could use for the 1975 emission standards.

The lead-removal stakes are high as far as public health is concerned. Lead taken into the bodies of urban residents from food and air is already high, although not demonstrably toxic for a mythical average citizen. For an unmythical ghetto child, the scales can be tipped in favor of toxicity with painful ease. For instance, much of the lead from exhausts goes into roadside dust. "It has been calculated," says an EPA background paper, "that daily ingestion by a one-year-old child of as little as 1/24th of a teaspoon of dust from within 100 feet of a busy roadway would, within eight months, result in lead poisoning." Anemia is a prime toxic effect of lead. With many ghetto children already suffering from iron deficiencies and hemoglobin-inhibiting high carbon monoxide levels, it doesn't take much more to precipitate serious illness. □

Predicting when a metal becomes superconductive

Dietrick Thomsen

Mota: Extrapolating to pure metal.

Superconductivity presents theoretical difficulties for physicists. They can make theories that tell why it should exist, but the theories cannot predict the existence of superconductivity in particular metals nor at what temperature it will appear. Many attempts have been made to use the normal nonsuperconducting properties of a metal to predict the onset of superconductivity.

The basic belief persists that all metals become either superconducting or magnetic if they are cooled to low enough temperatures. But testing this prediction as well as other specific ones is often hampered because the temperature of transition may be below the lowest temperature obtainable in laboratory devices, two millidegrees K.

At the American Physical Society meeting in San Francisco two experimental methods of overcoming this difficulty were presented. One, by A. C. Mota of the University of California at San Diego uses alloys to extrapolate the properties of a pure metal. The other, by John Clarke, Stuart Freake and Michael L. Rappaport of UC Berkeley, uses sandwiches.

The Berkeley group placed the metal they wanted to study in a sandwich with lead. At two millidegrees the lead was superconducting, and some of its superconductivity overflowed into the test metal (iridium). The extent of the overflow allowed them to predict the lower temperature at which the iridium would be superconducting.

Mota's technique is to use an alloy of the test metal that is superconducting at attainable temperatures. Gradually she decreases the proportion of the alloying metal and makes a graph of the temperatures at which superconductivity sets in as the alloy becomes purer. She then extrapolates to find a transition temperature for the pure test metal.

Using a magnesium-cadmium alloy, Mota predicts a transition temperature of half a millidegree for pure magnesium. For rhodium she gets 0.2 millidegrees. The magnesium figure, she says, is in reasonable agreement with phenomenological predictions based on the nonsuperconducting properties of magnesium, the first time that such a prediction has been so closely supported by experiment. In the future she intends to study copper, silver and gold, "which is something nobody knows about." □

Recent discoveries at Lake Rudolf

For four years Richard E. Leakey has been excavating on the eastern shore of Lake Rudolf in Northern Kenya. His goal has been to establish, one way or the other, the relationship between the genus *Australopithecus* (discovered in 1924 in South Africa) and the genus *Homo*. It was first postulated that *Australopithecus africanus* was ancestral to *Homo*. *Homo* would have broken off from this line about one million years ago and developed into modern man. This interpretation, however, was based on sparse geological evidence and poor contextual data. Exact dating was impossible.

In East Africa the situation is different—especially around Lake Rudolf. Sedimentary levels, as deep as 2,000 feet, date back to at least 5 million years. Exposure of the various levels makes geological data and potassium-argon dating highly reliable. With such a favorable situation, Leakey went to Lake Rudolf hoping to prove that *A. africanus* was a contemporary, not an ancestor of *Homo*.

After his 1970 season, he had enough evidence to say *Homo* and *Australopithecus* are "quite separate and distinct early Pleistocene hominids" (SN: 6/12/71, p. 399). The theory, at the time, was not widely accepted.

Greater acceptance might soon be forthcoming. Preliminary evidence from the 1971 season was reported in November (SN: 11/27/71, p. 357). Last week at a talk in Washington, Leakey said he is now prepared to put his neck and his theory on the chopping block. His data (based on fossil skulls, jaws and post-cranial material) have been submitted to NATURE and will be published in March.

"One of the exciting results of these 3 jaws and the 14 other specimens attributable to the genus *Homo* is that we can now say absolutely, definitely, without any doubt at all that at East Rudolf the genus *Australopithecus* coexisted with the genus *Homo*," Leakey said.

The limb bones show that *Homo* was an upright walker. Site situations show that he was a hunter who brought his kill back to a fixed, firm base. And more than 400 manmade artifacts (chopper tools and a series of unexpected blade tools) show that *Homo* practiced hunting technology (the tools were found with broken animal bones). Meanwhile, *Australopithecus* ("we do not know anything about his locomotor behavior," said Leakey), probabaly without any technology, lived alongside *Homo*. All of this, Leakey stressed, took place 2.6 million years ago—1.6 million years before the previously accepted date.

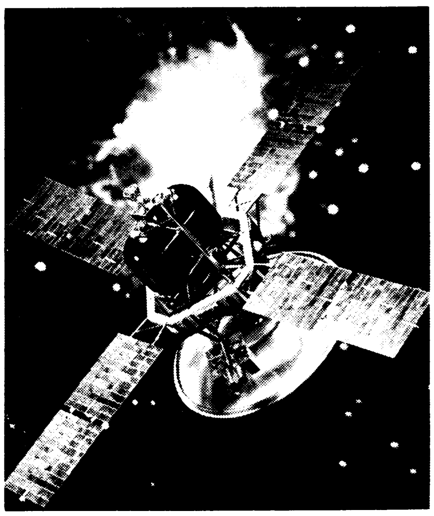
"This is the first time," he goes on, "that there has been sufficient evidence to really make this point stick. And it clearly has tremendous importance in the interpretation of the origin of ourselves. For me," he said, "I think we will take both lineages back well beyond two million, probaby as far back as four million years as quite distinct lines of hominid development with *Australopithecus* being a specialization (a herbiveral) that had nothing whatsoever to do with the development of the genus *Homo*. The genus *Homo* has its own ancestry going back equally far, both of them coming from the same common origin sometime in the Pliocene." □

Viking: Painful decisions on payload cutbacks

As Mariner 9 completed its third month in Martian orbit last week, scientists and program managers were meeting at the Jet Propulsion Laboratory to review the next probes to Mars—two Viking spacecraft that will place two craft in orbit and two landers on the surface in 1976 (SN: 7/24/71, p. 64). The meetings were billed as a major science review—the last chance to make major payload changes based on new information from Mariner 9. It may turn out, however, to be only the first of many such meetings between now and 1975 to find ways to keep Viking within the budget ceiling of $830 million that NASA has set for itself.

Now it appears that NASA headquarters will have to make some painful decisions within the next few weeks whether to cut out a few instruments or cut back by simplifying the ones that will fly.

The Viking spacecraft are the largest and most complex unmanned payloads (equal only to earth-orbiting geophysical observatories) NASA has ever tried to build. When NASA first studied landers, the cost of development was estimated at $300 million. But when industry looked at the proposals, it said the job couldn't be done for less than $600 million. Then in 1970 NASA postponed the launches from 1973 to 1975 (to save money in the 1971 budget), and the cost of delay was estimated to be from $100 million to $150 million. It was then that NASA placed the budgetary ceiling on Viking of from $750 million to $830 million. Since then, Viking costs have been kept within that limit.



NASA

Viking '76: Trimming the payload.

But recent trends—rising costs, problems with weight and volume, and difficulties with some of the instruments—began to alarm the project managers. In addition, scientists recently have been questioning the wisdom of not flying any instruments to analyze the soil—even though NASA's decision to fly primarily biology instruments was based on a National Academy of Sciences Space Science Board recommendation. What if there were no life on Mars? Shouldn't the landers tell us something about the soil? Two instruments were mentioned as possible candidates to fill this gap—one using alpha scattering and one using X-ray fluorescence. The X-ray instrument is believed to have a slight edge for getting on Viking because it weighs only two pounds (as opposed to 10 to 12 pounds for the alpha particle device), and it can distinguish between potassium and calcium concentrations in the soil—important ingredients in determining the amount of chemical differentiation a planet has undergone.

The recent cost-increase problems center on five complex experiments—a gas chromatograph/mass spectrometer that will measure the molecular weights of compounds retrieved by a soil sampler and the four biology or life detection experiments. Even in the beginning, these five experiments were assigned a "category 3" rating—too difficult to fly on a spacecraft without extensive further development. Although this has turned out to be the case, the instruments seem to be valued even more now that the Mariner 9 results have shown the possibilities of finding life to be apparently somewhat greater than had earlier been expected (SN: 2/12/71, p. 106).

In the judgment of most of the scientists participating in last week's meeting, the options now being considered by NASA headquarters will not compromise the over-all scientific aims of Viking. The options include: flying the Mariner 9 infrared radiometer instead of the more complex and expensive one proposed for Viking; using orbital cameras that provide 100-meter instead of 25-meter resolution; taking the gas chromatograph off, but leaving the mass spectrometer; and possibly taking off one of the biology experiments. (The space vacated by the biology experiment would leave room for the X-ray fluorescence instrument.) A few management changes could also be made to save money, and NASA is looking at these possibilities. The National Academy of Sciences is also looking at ways to cut back on spacecraft sterilization techniques (to save about $1 million) that would not compromise the biology experiment or contaminate Mars itself.

Even if all of these changes were made, Viking would still be a packed spacecraft. Three biology experiments would remain. There would be orbital cameras and two landing cameras (stereo and color); the mass spectrometer; sensors for measuring surface and atmospheric pressures, temperatures, wind and humidity; a seismometer; magnets to measure magnetic properties; a soil sampler; and radio and radar systems. There will also be water vapor and thermal mapping instruments.

It was the general consensus that NASA headquarters would make every effort for political if not scientific reasons not to take any experiment off and that most of the changes would be made by simplifying the hardware but preserving the gut of the experiments. □