Sodium found in Mercury's atmosphere

Astronomers used to believe that the planet Mercury had no atmosphere. Earth-based observations could find no trace of one. About a decade ago, however, the space probe Mariner 10 sent back news that Mercury had a trace atmosphere that seemed to be mainly hydrogen and helium. So tenuous is this atmosphere that its pressure at the surface of the planet is estimated in ten-trillionths of the surface pressure on earth. Now, ground-based observations report that sodium is also present in Mercury's atmosphere.

Andrew Potter of NASA's Johnson Space Center in Houston and Thomas Morgan of Southwestern University in Georgetown, Tex., report in the Aug. 16 SCIENCE that sodium is by far the most abundant component now known to exist in Mercury's atmosphere, being about 33 times as abundant as helium, the next most abundant. Potter and Morgan estimate the density of sodium at Mercury's surface to be 150,000 atoms per cubic centimeter, compared with 4,500 atoms per cubic centimeter for helium and 8 atoms per cubic centimeter for hydrogen. The sodium exerts a pressure of about 1.2×10^{-11} millibars. (The surface pressure of earth's atmosphere is 1 bar.)

The relative abundance of sodium in Mercury's atmosphere invites comparison with Jupiter's satellite Io, which also has a lot of sodium. In Io's case sodium appears to be sputtered off the satellite's surface by energetic particles in Jupiter's magnetosphere. In Mercury's case the solar wind probably does the sputtering. (The hydrogen and helium seem to come directly from the solar wind.) The solar wind can also take sodium from the atmosphere of Mercury, but bombardment of the planet by meteors could provide a replacement supply to maintain a steady amount. All in all, Potter and Morgan say, the atmosphere of Mercury resembles the coma of a comet more than it does the atmosphere of a planet like earth.

The figures for Mercury's helium and hydrogen come from work done with Mariner 10, which found no definite evidence for any other constituents except possibly atomic oxygen, for which the spacecraft got a signal at the extreme low limit of detection. Those observations also set upper limits for neon, argon and carbon, which would have been detected had they been present in amounts greater than those limits. The Mariner 10 work used an ultraviolet spectroscope to identify elements in Mercury's atmosphere.

Sodium does not have a prominent signature in the ultraviolet. However, it identifies itself in visible light by a pair of yellow lines, the Fraunhofer D lines. Potter and Morgan found these lines in light resonantly reflected off the atmosphere of Mercury.

"It was daylight work," Morgan says. Mercury is so close to the sun that it is rarely seen at night, and then only immediately after sunset or immediately before sunrise. Morgan points out that the managers of telescopes do not like to have their instruments pointed closer to the sun than 10° away — direct sunlight can damage equipment engineered for much fainter starlight. So Potter and Morgan worked mostly when Mercury was at greatest elongation, that is, its farthest distance from the sun, which is 28° away. They used the 2.7-meter telescope, the largest belonging to the McDonald Observatory at Ft. Davis, Tex.

The density of sodium present can be determined from the ratio of the widths of the two Fraunhofer D lines, provided the temperature is known. The two lines are not single, precise wavelengths. Each has a certain small spread of wavelengths. The amount of spread depends on the density of sodium and its temperature. The figures quoted are calculated for the point on Mercury where the sun is at the zenith, assuming a temperature there of about 500 kelvins. (Earth's surface temperature on a warm spring day might be 300 K, which is about 75°F.)

If sodium is present in the Mercurian atmosphere, potassium might not be far behind. Potter and Morgan plan to look for potassium next. *—D.E. Thomsen*

Short-stature treatment reevaluated

Since 1963, about 10,000 short-statured children in the United States have received extracts of human cadaver pituitaries, rich in growth hormone, to boost their growth. But within the last year three of them have died of Creutzfeldt-Jakob disease (CJD), a rare, infectious neurological condition; and the federal government in April stopped distribution of the hormone product, which over the years has been prepared by a variety of different techniques.

According to a report in the Aug. 3 LANCET, the type of purification in use since 1977 — which purifies the growth hormone on the basis of its size and electrical charge — is capable of eliminating the infectious agent. Prior to 1977, the hormone was purified by solvent extraction and salt and alcohol fractionation, which resulted in a relatively impure product. In all three deaths, the victims had for years received the hormone prepared by the older method.

The epidemiological connection between the receipt of human growth hormone and CJD was first made last November, following the death of a 20-year-old man who had received growth hormone for 14 years. Since the average age of death from CJD is 57, the report from Stanford University researchers was met with some concern. When two more hormone recipients died of CJD, the National Institutes of Health (NIH) stopped its growth hormone distribution through the National Hormone and Pituitary Program (NHPP), and the Food and Drug Administration (FDA) pressured the two commercial distributors into halting sales.

The growth hormone-CJD relationship is a thorny one, complicated by the enigmatic nature of CJD. Scientists have been unable to isolate the CJD causative agent — the only way to determine whether it is present is to inject a questioned tissue into monkeys and watch them for a couple of years to see if they develop the disease.

The new LANCET report, from the laboratory of A.G. Dickinson of the Medical Research Council's Neuropathogenesis Unit in Edinburgh, evaluates one of the current extraction methods by proxy. Because CJD-infected tissue presents a potential hazard to laboratory workers, the researchers used scrapie, which causes a similar disease in animals and is believed to share properties with the CJD agent. They added scrapie to human pituitary tissue, ran the result through the purification process, and injected it into mice. They found that, provided the material is handled with extreme care, the infectious agent can be eliminated.

"We feel it's very hopeful and encouraging, but not definitive," says Judith Fradkin of NIH, whose office oversees the NHPP. But more research is needed before it can be assumed that a procedure that eliminates scrapie also eliminates the CJD agent, she says.

NIH has begun injecting monkeys with samples of all the pituitary extracts that have been used in U.S. children since its program was begun in 1963, and will try to locate all 10,000 people who have received the extracts to see whether any have died of CJD.

In the meantime, NIH is still providing the hormone to children who have medical problems related to growth hormone deficiency. And a handful of children are receiving genetically engineered hormone manufactured by Genentech in South San Francisco, which is awaiting FDA approval to market the product (SN: 2/11/84, p. 92).

Some scientists worry the moratorium will harm research. In the August ANNALS OF INTERNAL MEDICINE, Salvatore Raiti, head of the NHPP, comments, "The future of human pituitary research is at great risk at this time." Albert Parlow of Harbor-UCLA Medical Center in Torrance, Calif., who purifies pituitary hormones for NIH using a size-and-charge-type extraction process he developed, says he fears the stoppage will cause a loss of momentum, and that NIH will decrease funds for pituitary research. But Fradkin says the NIH will continue its support. *— J. Silberner*

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