got an ill habit of sleeping and a distemper which this summer has . . . put me further out of order, so that when I wrote to you I had not slept an hour a night for a fortnight together and for 5 nights together not a wink."

For nearly a century after Newton's death, the curious episode was ignored or suppressed by his biographers, who evidently felt no need to portray Newton as anything other than the supremely rational being that most of his 17th century peers and a reverential public believed him to be. Suggestions of Newton's madness emerged during the 19th century, and in the 20th, with the publication by the Royal Society of Newton's *Correspondence*, the troublesome episode was placed before the public.

A common explanation is that the death of Newton's mother in 1689 ultimately led to his nervous collapse. At the time of her death she was perhaps the only person to whom he was genuinely close (*Science*, 30 January, p. 466).

Another is the loss of manuscripts in a fire. Like the story of the falling apple, this anecdote has become part of the Newton folklore, even though there are few facts to support it. If Newton did suffer the loss of certain papers in a fire, most historians now believe it probably occurred long before his illness.

Some biographers suggest that the failure of the young, reclusive Newton to get an administrative post on his first try may have touched off his depression. Another cause may have been simple exhaustion, as suggested in a just-published comprehensive biography of Newton (*2*). Five years before the bout with madness, after feverish work, Newton finished his *Principia*, which established the gravitational laws of the universe. What was left to be achieved after Newton had given birth to his system of the world? Perhaps he suffered from a post-*Principia* depression.

Of course, none of these explanations has ever seemed completely adequate. During the past decade historians have proposed an entirely different cause for Newton's mental disturbance—poisoning as a result of constant exposure to heavy metals (*3*). Considering the symptoms of chronic mercury poisoning—disturbance of the gastrointestinal tract, lack of appetite, foul breath, diarrhea, morbid irritability, insomnia, and mental hyperactivity—the suggestion seems to have merit. One manifestation of mercury poisoning is erethism, which a medical textbook (*4*) defines as follows: "Nervous irritability, tendency to blush easily, a history—often best obtained from friends or members of the family—of change of temperament, a tendency to avoid meeting friends, and unexplained outbursts of temper." Mercury was once used in the felt hat industry, and the resulting condition in workers was highlighted by Lewis Carroll with his characterization of the Mad Hatter.

That Newton was exposed to mercury and other heavy metals is clear from his laboratory notebooks and from the observations of his peers. Most of his alchemical experiments were carried out before the first signs of illness emerged in 1692, though some were performed during the illness. In many of the experiments metals were heated to convert them to volatile form. "After I had stirred the mercury and salt together," wrote Newton in one notebook, "I . . . put it in the fire to evaporate. The salt flew away quickly and left the mercury coagulated in a hard rugged lump." Pointed out by Spargo and Pounds in their paper is a fact that other scholars have overlooked: Newton had great enthusiasm for tasting the products of his chemical experiments, recording the results of such empirical nonchalance on 108 occasions. Typical comments by Newton were "tastless," "sweetish," "saltish," and the very powerful "strong stiptick vitriolique tast." At the end of one experiment with mercury, Newton notes that the product tasted "strong, sourish, ungrateful." A joke that Newton told in his later years was that his hair had turned gray at the age of 30 because of his experiments with quicksilver.

Having deduced from their reading that Newton was poisoned, authors Spargo and Pounds set out to prove their hypothesis. For this they obtained hairs from Newton's head, a feat that "proved rather easier than expected."

"Several locks were located, two in the possession of the Earl of Portsmouth and the others in the library of Trinity College, Cambridge," where Newton had spent his academic career. "In both cases the owners of these Newton relics responded warmly to our request."

In the lab, Spargo and Pounds subjected the relics to the rigors of neutron activation analysis and atomic absorption spectrophotometry, which revealed abnormally high concentrations of chlorine, gold, arsenic, antimony, lead, and mercury. One hair had 197 parts per million (ppm) of mercury. The normal mean is 5.1 ppm. By way of comparison, Spargo and Pounds present a contemporary case of mercury poisoning. A schoolboy took 200 grams of mercury home to play with. It was spilled and the

(Continued on page 1344)

Soviet Oil Projections Up for Grabs

The Central Intelligence Agency (CIA) and the Defense Intelligence Agency (DIA) have come up with wildy different projections of Soviet oil production. The estimates are so far apart that they lead to essentially opposite conclusions about the Soviet Union's export potential and, by extension, its economic relations with East and West Europe.

The CIA, which has been consistently conservative in estimating Soviet oil prospects, said in May that it expects production to level off in the next 3 years and decline thereafter. By 1985, the agency predicts, Soviet oil output will have dropped from its current level of about 12 million barrels per day to between 10 and 11 million barrels. This could turn the Soviet Union from an oil exporter into an importer, and in the process it would dry up the nation's most important source of foreign exchange (*Science*, 12 June, p. 1252).

Gloomy though it may be, this projection is a good deal more optimistic than an earlier CIA analysis. In 1977, the agency said that it expected Soviet oil production to peak in the late 1970's and drop to 8 to 10 million barrels per day by 1985. It was forced to change its projections in the light of record oil output in the past few years.

By contrast, the DIA, an intelligence unit attached to the Pentagon, is positively bullish about Soviet oil prospects. In a report presented to the Joint Economic Committee in July and released on 2 September, the DIA said that "the outlook for Soviet energy, from the perspective of the USSR's leadership, is highly favorable. Prospects for full satisfaction of domestic needs, planned exports to East European countries, and negotiated quantities for customers in Western Europe appear to meet Soviet expectations through the 1980s and beyond."

The DIA projects a slight rise in oil production to 1985, a leveling off in the late 1980's, and a further rise in the 1990's. Oil exports to Western Europe and Japan may bring in as much as $11.4 billion a year in hard currency in 1985, the study predicts, and natural gas sales—which will be

0036-8075/81/0918-1342$01.00/0

boosted by the construction of a giant pipeline between the Soviet Union and West Germany—will net a further $11.2 billion.

These export earnings will be essential to pay for grain, technology, and other goods from the West. (The bill for food imports alone is expected to reach about $12 billion this year, thanks to the third poor harvest in succession.) And an exportable surplus of oil is generally deemed to be a critical factor in the Soviet Union's economic relations with its satellites in Eastern Europe. The difference between the CIA's projection and that of the DIA is thus of more than passing interest.

In essence, the CIA argues that the Soviet Union is reaching the limits of its production technology, and output will drop as the drilling rigs move into more remote and more hostile areas. "Only the rapid discovery of very large amounts of oil can avert this outcome," the agency said last May. The DIA believes, however, that the Soviet Union already has the capacity to boost production above current levels at short notice. Moreover, while most analysts have pegged the U.S.S.R.'s proven reserves at between 60 and 70 billion barrels, the DIA says the figure is more like 80 to 85 billion barrels.

The DIA study says that other analysts have underestimated Soviet oil reserves because they have not taken into account the impact of recent increases in world oil prices. These have made it worthwhile to exploit oil fields that a few years ago were considered marginal and were thus not counted as reserves. In addition, DIA officials told the Joint Economic Committee that a major oil deposit discovered last year in western Siberia should be included. Known as the Salym field, it is expected to be in production in the late 1980's. As for evidence that the Soviets can step up current oil production, the DIA notes that last November they boosted output region by region in a test of production capacity. This indicated considerable flexibility. The study does not explain, however, why production levels have failed to meet targets in the past few years in spite of this reserve capacity.

The two projections have already sparked off a spirited debate among analysts of the Soviet oil industry. About the only conclusion that can be drawn at this point, however, is that neither should be relied on for strategic planning.—***Colin Norman***

House Bill Would Classify Much Computer Research

The Association of Computing Machinery (ACM) has passed a resolution objecting to H.R. 109—a bill that is an amendment to the Arms Export Control Act—and is encouraging other professional societies to join in its protests. According to the ACM's analysis, H.R. 109 would cause ideas relating to military hardware to be given a security classification until officially cleared by the government. These ideas would include research results on cryptography and very high-speed integrated circuits.

Peter Denning, president of the ACM, remarks that H.R. 109 has several unusual features. One of these is that "information . . . shall not be disclosed unless the Secretary of Defense, in consultation with the Secretary of State and Secretary of Energy, determines that withholding thereof is contrary to the national interest." This means, says Denning, that even harmless material would not be publishable unless publication could be shown to be beneficial to the nation. In contrast, other regulations controlling arms exports and the Invention Secrecy Act require that information be classified only if its publication would harm national security.

In addition, says Denning, the bill speaks of national interest rather than national security. Since the national interest includes foreign trade, the bill could allow the government to control publications on computer technology, for example, that might give an economic edge to competitors such as Japan.

In its resolution opposing H.R. 109, the ACM council says it "believes this bill threatens the free flow of ideas that has contributed to U.S. leadership in computing technology. It may encroach on First Amendment and other rights." The Computer Society of the Institute of Electrical and Electronics Engineers passed a resolution supporting the ACM, and the American Physical Society's president, Arthur Schawlow, sent a letter to the members of Association of American Universities informing them of the bill.

So far, H.R. 109, which Bennett introduced on 5 January 1981, has been sent to the House Foreign Affairs Subcommittee on International Security and Scientific Affairs, and the subcommittee has requested executive comment from the Departments of Defense, State, and Energy.

—***Gina Bari Kolata***

Mallinckrodt Money for Washington U

The chemical manufacturer, Mallinckrodt Inc., has awarded Washington University in St. Louis $3.88 million for hybridoma research. It joins the ranks of a host of other firms that are pouring research and development money into biotechnology research.

Under the terms of the agreement, the university scientists participating in the program will be free to publish their experimental findings and to exchange new cell lines and monoclonal antibodies with other researchers. A university spokesman said that manuscripts will probably be submitted to Mallinckrodt as a courtesy but emphasized that the company has no legal right to restrict publication.

Following the pattern of similar agreements between other schools and companies, Washington University will retain patent rights on any inventions and Mallinckrodt will have first option to license the patent exclusively. Royalties will be funneled back into education and research at the medical school.

The hybridoma research program will be headed by Joseph Davie, chairman of the department of microbiology and immunology. Studies will focus on areas including heart disease, cancer, blood clotting, and infectious diseases.

The spokesman said that the university is currently negotiating another biotechnology agreement with a second firm, but declined to reveal the company's name. He said that the Mallinckrodt agreement is the largest of its kind in hybridoma research.

—***Marjorie Sun***