

Coal: Energy bridge to the 21st century

The world is returning to the coal age. It's inevitable. At least that's what the authors of the World Coal Study (wocoL), an international and ostensibly independent forecast of the mineral's prospects through the year 2000, say in a 247-page report released last week.

Coal already supplies more than a quarter of the world's energy, but the study says "coal will have to supply between one-half and two-thirds of the additional energy needed by the world during the next 20 years," even under moderate energy-growth assumptions. To achieve this, world coal production must increase 2.5 to 3 times and world trade in steam coal must grow 10 to 15 times above 1979 levels. The study's conclusion is simple: "Without such a coal expansion the [world economic] outlook is bleak."

Organized two years ago under the direction of Carroll L. Wilson, professor emeritus at the Massachusetts Institute of Technology, wocoL came to embody 35 key industrial, governmental and academic leaders representing 16 countries. But their participation, and the participation of associates they brought in to aid them, was to be voluntary, informal and independent of their employers.

To counter declining supplies of oil — the only fuel used more than coal — and to provide a transition until alternative fuels such as solar energy gain a larger share of

the energy market, coal production must climb five percent annually, wocoL says. This goal is achievable "without unacceptable increases in cost," its authors say, but they worry that "economic, institutional, and other considerations — not technological ones — are delaying a more rapid buildup in coal use." The National Coal Association agrees. In a recent report it sent to President Jimmy Carter, it said the United States alone can mine 100 million tons more coal a year than is being used. But identifying 44 separate problems, it said coal policies and regulations now constrain the mineral's development.

Because of its abundance and versatility (it can be converted to coke, synthetic gases, liquids and chemical feedstocks), coal is one of the only alternatives to oil, natural gas and nuclear power over the near term that can rapidly increase to meet demands. And with the exception of carbon dioxide (CO₂), technologies exist to control all environmental, health and safety problems associated with a scale-up in coal use, the study claims.

In fact, CO₂ buildup and associated global climatic changes (SN: 9/8/79, p. 173) is the one unsolved problem plaguing coal's prospects. Yet conceding that burning coal liberates 25 percent more CO₂ than oil, 75 percent more than natural gas, the study still concludes that CO₂ research findings do "not justify delaying the expansion of coal use." It adds that factoring in the energy conservation anticipated over the next two decades, there might even be up to a 50 percent drop in the growth of energy-related CO₂ emissions. □

Meeting of the moons

Although Jupiter's major moons, known for their discoverer as the Galilean satellites, were first observed centuries ago, it was not until last year that earthlings first got a good look at them, and the results were amazing. The exotic features and diversity of Io, Europa, Ganymede and Callisto abruptly placed them high on the list of the list of Most Intriguing Objects in the Solar System, and last week nearly 200 researchers met in Hawaii in an international colloquium called expressly to discuss and exchange information on the quixotic quartet.

Clearly monopolizing the gathering's attention was Io, which accounted for nearly half of the 133 formal presentations and probably a similar proportion of the conversations in hallways, restaurants and even on the lava-strewn beaches. Io's active vulcanism, sulfur-rich surface, ionized outpourings, brilliant coloration, strange electrical properties and other phenomena make it perhaps the most bizarre planetary body yet studied, and last week's meeting served to add yet another twist:

"Even when it's trying to look ordinary," said one participant, "Io just gets stranger." The latest analysis of the satellite's shape indicates that it may be, of all things, *too round* — with baffling consequences. Io, less than 30 percent of the diameter of the earth, is far more internally active (SN: 4/19/80, p. 251), sending some of its volcanic plumes hundreds of kilometers into space and (as three separate meeting reports seemed to agree) giving off about 30 times as much heat per unit area as the earth does. The favored explanation for Io's raging innards is that it is pulled out of shape by Jupiter's gravity, which creates a bulge that is cyclically wrenched in and out and back and forth as Io follows its elliptical orbit (a path kept out-of-round by the perturbing influence of Europa, the next satellite out from the planet). According to the theory's proponents, the tidal distortion causing the bulge should make Io's radius about 12 kilometers greater in the Jupiter-pointing direction than in the north-south direction. But according to Merton E. Davies of the Rand Corp., who has been calculating the satellite's shape using measurements from photos taken by the Voyager 1 and 2 spacecraft (which also revealed the vulcanism), the difference appears to be less than 4 km.

The seemingly small discrepancy threw the Io researchers into a tizzy. Either the bulge is unexpectedly small or the satellite is too fat in the polar direction. If the difference is the bulge's fault, scientists must consider the possibility that Io's outer layers are more rigid than the calculated amount of tidal heating ought to allow. If the polar radius is too great, it could mean

Chromosome changes in Love Canal victims

A pilot study looking at the blood of 36 residents in the Love Canal region of Niagara Falls, N.Y., last week identified 11 individuals exhibiting "significant" chromosome aberrations. Pending a review of the study by "recognized expert geneticists" this week, the Environmental Protection Agency will decide whether or not to recommend temporarily relocating 700 more Love Canal families or some other action.

EPA commissioned Biogenics Corp. in Houston to do the chromosome study as part of an evidence-gathering effort in connection with a lawsuit the agency is bringing against the Hooker Chemical Co. through the U.S. Justice Department. The \$124 million suit charges Hooker with the chemical contamination at Love Canal.

According to Biogenics's scientific director, Dante Picciano, a nationally recognized genetic toxicologist, eight of the 36 individuals studied showed chromosome breaks and four (including one with chromosome breaks) exhibited abnormal marker chromosomes, especially ring chromosomes. Normally one would expect to find only one person in 100 or 1,000 with chromosome breaks in the blood, Picciano says.

As a result of its findings, Biogenics concludes that "chemical exposures at Love Canal may be responsible for much of the apparent increase in the observed [chromosome abnormalities] and that the residents are at an increased risk of neoplastic disease [including cancer], of having spontaneous abortions and of having children with birth defects."

Due to the small sample size and lack of comparisons against blood from a control (unexposed) group of individuals, Picciano cautions for "prudence" in interpreting the Biogenics results. Similar blood changes can result from viral infections or exposure to radiation (SN: 3/3/79, p. 133) such as diagnostic X-rays.

In a letter to EPA's Frode Ulvedal, Picciano recommends a follow-up study including a minimum of 50 unexposed individuals together with like numbers of persons who have received low-level, intermediate and high-level exposures to chemicals seeping up through the ground and into the air around Love Canal. A chromosome study of such a group should detect chemically induced chromosome changes, he said, and might even generate a dose-response relationship. □