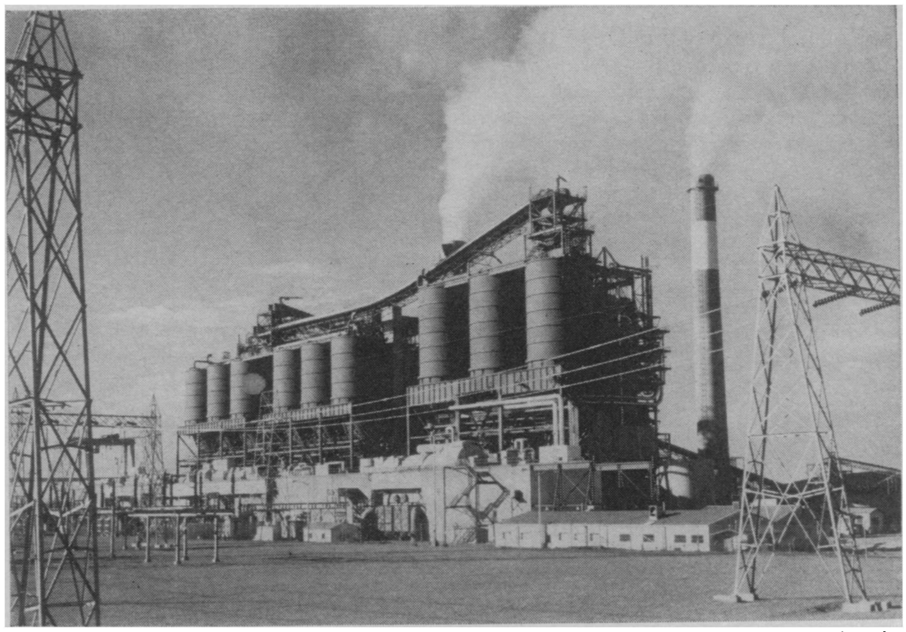
Power plants on the prairie

Emissions from new plants bring pollution controversy to the rural West



Interior

Four Corners plant: Environmentalists protest export of big-city problems.

Air pollution in cities was, until recently, an accepted fact of life. The Los Angeles haze that imparts a peculiar color to sunlight and blots out the nearby hills was something residents learned to live with over a period of many years. Urban air pollution, like inflation, sneaks up on people gradually.

But the experience in a pristine area suddenly exposed to pollution is different. Large portions of Nevada, Colorado, New Mexico, Arizona and Utah once were such places. It was possible in these parts of the West for an urban resident to step off an airplane and be dazzled by the clarity of the air. Sun-washed mountains and hills perhaps 20 miles away seemed almost within hand's reach. Stars at night were brighter than anyone reared in the city could imagine. Now, however, power companies are building coal-fired power plants on the deserts and prairies, and some residents are angry about the advent of air pollution in their areas. What is perhaps most vexing to them is that the power from the huge plants is going to feed the expanding energy needs of the big coastal cities. Now plumes of smoke and ash drift from the power plants across the once-virgin land.

But as with so many other environmental problems, the story is complex and many-sided; as usual, there are no villains. The movement to build power plants in the thinly populated Western areas got under way in the early 1960's and it seemed, all things considered, the best solution to the perplexing problem of expanding urban power needs. Coal for the plants was cheap and abundant. In many instances, there was a great potential—now partly realized in the Missouri River Basin—for a highly economical integration of the coal plants and hydroelectric plants. And everyone thought that pollution in the vast desert reaches would be far less of a problem than in the cities. Many power plants were built, or planned.

And now the Interior Department, which is involved in many ways (through power-trading agreements, as custodian of the Indian lands on which many of the coal mines are located, and as the agency responsible for the economic welfare of the Indians working in the plants), finds itself between a rock and a hard place.

Last week, after local environmentalists and state officials told regional hearings of the Senate Interior Committee that they opposed the plants unless environmental standards were upgraded, Interior Secretary Rogers C. B. Morton announced—somewhat vaguely—a moratorium on future construction. Involved in the total controversy are six plants in five Southwestern states. Two of them are in full or partial operation, three are under construction and one is in the planning stage. Environmentalists immediately attacked the moratorium—to apply during the usual study and only to the plant still in the planning stage—as no more than is already required under the Environmental Protection Act.

The problems involved for the power companies or consortiums that build the plants are complicated, and sometimes the technology simply does not yet exist for solving them. For instance, the usual way to remove fly ash from power plant stacks is with electrostatic precipitators, which work only if the fly ash can be ionized. The sub-bituminous Western coal has the virtue of low-sulfur content; but a high-sulfur content is sometimes necessary to make the fly ash ionizable. This appears to be the problem with the Four Corners power plant near Farmington, N.M. Plans now are to retrofit venturi wet scrubbers on Units 1, 2 and 3 of the plant (the units are owned by Arizona Public Service Co.). But wet scrubbers may pose large problems, too, particularly water pollution. Environmentalists point out that the units were originally built with only minimal air pollution abatement equipment and that electrostatic precipitators were well-known then. They contend that the companies should have learned about the problems long before they did and solved them.

There may be some justice in this contention. Basin Electric Power Cooperative of Bismarck, N.D., plans to go on the line in 1975 with Unit 2 of its plant on the North Dakota prairies; the unit will burn low-sulfur lignite. The power firm and an equipment manufacturer cooperated to build a pilot facility to learn if the electrostatic precipitator problems would occur with the lignite. Indications are they will not. The firm also insists its coal supplier restore strip-mined lands, which adds only about 2.5 percent to the cost of coal. Likewise, the Tennessee Valley Authority early on took an interest in the environment and began installing electrostatic precipitators.

The Interior Department's problems are obvious: On the one side the department is mandated to protect the environment; on the other, its agencies have a duty to taxpayers (or Indians) to maximize revenues for sale or lease of coal, water and power facilities. But, like the power companies, Interior in the past has been less than farsighted. Environmentalists point to the department's underfunded Office of Coal Research and the numerous undeveloped techniques either for using coal in nonpolluting ways for power production—the main one being magnetohydrodynamics—or for gasifying or liquefying coal to make nonpolluting fuels for conventional power plants (SN: 1/30/71, p. 84). MHD, for instance, promises to reduce not only air pollution but also the excessive use of cooling water. Environmentalists blame not only Interior, but private industry, as well, for not funding development.

At a press conference last week, Morton agreed with a reporter that the techniques will be highly significant in reducing pollution from coal-burning plants, not only in the Colorado Basin but throughout the country. But Morton was vague about whether he planned to make a commitment for their development. □

SELECTIVE PROCESSES

Chemistry between the stars

To keep track of new discoveries in molecular astronomy these days interested parties need the quick eyes and immunity to dizziness of a confirmed tennis fan. It took several years of radio observations of the interstellar clouds to record the existence of the first three or four molecular species. In the last three weeks at least six new molecules have been added.

For those who keep score, the new species are carbon monosulfide (CS), carbonyl sulfide (OCS) and methyl cyanide (CH_3CN), reported by Drs. Arno Penzias, Robert Wilson, Keith Jefferts and Phillip Solomon of Bell Telephone Laboratories; and methylacetylene (CH_3C_2H), isocyanic acid (HNCO) and hydrogen isocyanide (HNC), observed by Drs. Lewis E. Snyder of the University of Virginia and David Buhl of the National Radio Astronomy Observatory.

More important than simply scoring new molecules and elements (this is the first evidence for sulfur), is the growing body of knowledge that appears to indicate the existence of a new kind of chemistry. "Interstellar clouds have a chemistry all their own," says Dr. Snyder.

The abundances of molecules are all out of kilter. Initially people predicted the abundances of molecules from the cosmic abundances of their constituent atoms. But this was a rather naive way to begin, and, says Dr. Snyder, "we suspected that cosmic abundances didn't have relevance to molecular abundances." Observation has thoroughly confirmed that suspicion. For example, he says, the latest observation shows more abundance of sulfur in the clouds than in the cosmos generally.

The abundances, says Dr. Penzias, indicate that selective chemical processes are going on rather than random mixing of elements and the random production of compounds. One such selective process is the subject of a theory by Dr. William Klemperer, a Harvard chemist. The theory seeks to explain the existence of many of the diatomic molecules. Some of these show the most striking departures from cosmic abundances. An instance cited by Dr. Penzias is that observation shows less hydroxyl (OH) than carbon monoxide (CO), even though there is much more H than C.

Dr. Klemperer's theory depends on the widespread presence of ionized carbon in the clouds and its ability to form an ionized radical, CH^+. The carbon ion has a particular pair of energy states that differ slightly in energy. If the carbon ion suffers a collision with a hydrogen atom, some of the energy brought to the collision by the hydrogen will go to excite the carbon ion. If it is enough for the carbon to get to the higher energy state, the hydrogen will fly off and the carbon will radiate its excess energy. If the energy delivered is not enough to put the carbon into its higher state, there is a probability that the two atoms will stick together to form CH^+ and radiate the excess energy by a molecular rather than an atomic process.

Early calculations of the probabilities involved led to negative judgments on the possibility of doing much interstellar chemistry by this process, but Dr. Klemperer says his recalculation shows the process can be important.

Once the CH^+ exists, it forms the basis for formation of many other compounds since other atoms can strike the molecule, knock out the hydrogen and take its place. The hydrogen serves as an energy balance, and carries away enough energy to leave the remaining compound stable, a result that is difficult to achieve in a simple collision of two atoms.

"It explains why you see CH and CH^+ as common species and why not OH and NH," says Dr. Klemperer, "why CN and not NO. It will explain a lot of diatomic molecules." But he makes no claim that this is the only process. "There are lots more things of a different kind going on," he says, and this particular process might not be relevant to the formation of polyatomic molecules.

The polyatomic molecules appear particularly in the direction of the center of the galaxy, especially in the cloud called Sagittarius B. Chemically, says Dr. Penzias, there appears to be a radical difference between Sag B and other clouds.

To explain the polyatomics most theorists resort to interstellar dust grains. As these grains travel through space they accumulate large numbers of oxygen, carbon, hydrogen and nitrogen atoms, says Dr. J. Mayo Greenberg of the State University of New York at Albany. Influenced by ultraviolet light from stars these atoms form complicated compounds with each other. Eventually from 20 to 90 percent of the bulk of a grain could be made of such compounds, he says.

To check on the proposition, Dr. Greenberg set up laboratory experiments to mimic this possible process on a fast time scale. He and his co-workers have produced large molecules up to molecular weight 106. This leads Dr. Greenberg and his associates to believe that this process can produce large stable compounds like amino acids.

Eventually, says Dr. Greenberg, collisions between grains, sputtering, and the same ultraviolet that helped form the compounds will get them off the grains and into a gaseous state. Events of this kind can also break up the molecules, and Dr. Greenberg believes that the five- and six-atom molecules now being discovered are fragments of larger ones.

This idea can explain one of the oddities of the latest discoveries, hydrogen isocyanide (HNC). This compound is unstable. So far as Dr. Snyder knows it has never been seen in gaseous form on earth because under terrestrial densities it reacts with something else too quickly. The stable form is hydrogen cyanide (HCN).

A process of building from atoms would produce the stable rather than the unstable configuration, says Dr. Greenberg. But if the HNC had been part of some larger complex, it could have come off in the HNC form in the breaking down of the larger molecule.

Some of the grains, says Dr. Greenberg, attain the size of viruses. That does not imply they are viruses, but if they can be that big, then they can contain very large organic molecules. He suggests that here may be the origin of life.

If the planets were formed by cold accretion, such organic materials could have come to them in the process of formation and the compounds might have served as templates for the local production of organic material. (If the planets' origin was by a hot process, the complex compounds would initially be broken up by the heat, he says, but later when the planets had cooled, and before they had atmospheres, other grains might land.) This leads to what he calls an "interesting conjecture" of a common origin for life. "Wherever you get life," he suggests, "it has a chance to be the same" since its ultimate origin would be in the interstellar medium. □