George Ellery Hale brough about creation of the National Research Council in 1916. The Research Council is the chief operating arm of the Academy; it conducts most of its studies and writes its substantive reports. The parent Academy provides guidance and prestige.

The NAS, uniquely a private but official adviser to the Government, has always jealously guarded its scientific reputation. This has produced tendencies toward caution, passivity and resistance to precipitous change. Critics both within and without have called this a fault; supporters, a virtue.

In any case, when Dr. Philip Handler came on as NAS president last year (SN: 6/14/69, p. 579), he made no secret of his interest in examining the need for restructuring the organization's advisory apparatus. In the fall he appointed Dr. Franklin A. Long of Cornell University to head a committee to study the matter.

It was the Long committee's report, proposing a specific new structure, that last week stimulated the liveliest NAS business session in years. Many members took part in the discussion; most were critical. When it was all over, the report had been accepted in spirit if not in detail, the committee had been thanked for its effort and dismissed and Dr. Handler had been asked to appoint a new group to continue the examination until the next meeting.

Members in favor of reorganization in principle were not satisfied the Long proposal was the best way. They wanted more alternatives, more time to consider ramifications, and more evidence of thought and care on the part of the proposal's authors. Although the specific proposal was, in effect, rejected, the basic idea that some changes are called for to enable the Academy to better meet its obligations to society was not. There seems a good possibility a significant modification of the Academy structure will eventually come about.

"I think this shows there is a healthy yeast in the Academy," says NAS Home Secretary Merle Tuve of the Carnegie Institution of Washington. "The members are interested in changing with the times."

A number of problems have prompted the reorganization stirrings, but perhaps two are most important. One is the difficulty of applying the traditional disciplinary structure of the eight divisions of the NRC, such as physical sciences, biology and agriculture and engineering, to social problems—urban decay, over-population, environmental deterioration—that respect none of the neat, tidy boundaries of scientific fields.

Another was the need to re-examine the NAS' relationship with the semi-independent offspring, the National Academy of Engineering (SN: 6/8/68, p. 548), plus the need to respond to recent proposals for new and separate Academies. The NAS Board on Medicine, for instance, has recommended creation of a National Academy of Medicine. Dr. Handler is particularly concerned about the threat of a proliferation of Academies. "I think it would be a very serious disservice to science to have this fragmentation," he says.

The Long committee's suggested answer to the first of these two problems was to restructure the NRC, in part, along problem-oriented lines. Replacing the present disciplinary divisions, it suggested some 10 new units: health, environment, transportation, defense, scientific personnel, agriculture, urban, communications, space and materials standards, as examples.

The most controversial part of the proposal was addressed to the second problem. The group proposed creating four new sub-academies, each under the parent NAS: Physical sciences and mathematics, engineering, health sciences and life and social sciences. In due course, the social and behavioral sciences would be split off from the life sciences to form a fifth such body.

Each of these sub-academies would be headed by a chairman who would also be a vice president of the over-all NAS. The purpose of this part of the plan, says Dr. Handler, was to obviate the need for separate independent academies.

It was all rather mind-boggling to members of the 107-year-old NAS, not accustomed to rapid institutional change. Many questions and problems made the plan unacceptable in that form. But important groundwork was laid.

"It was too difficult to tell all the ramifications of such a fundamental restructuring," says NAS member Dr. Ernst Cloos of Johns Hopkins University. "But the Academy can't go forever without change." □

CHEMICAL ENGINEERING

Mining the Great Salt Lake

Hal Rumel

Great Salt Lake: Mineral harvest.

Utah's Great Salt Lake is a remnant of what was once a vast, inland sea that covered 19,000 square miles. After thousands of years, geological changes and a withering sun have left a 2,150-square-mile lake in the northwestern part of the state. Also left were tremendous mineral resources at so high a concentration in the water that relatively little energy is needed to precipitate them out.

Mining companies so far have concentrated on the common sodium chloride in the lake, leaving largely untouched the lake's vast reserve of sodium and potassium sulfate, magnesium chloride and lithium chloride. This will have changed by year's end, when the first full-scale effort to extract these other minerals begins.

A sprawling complex of evaporation ponds, processing plants, pumping stations and canals already in place will begin then to process 10 million tons of slurry a year to extract 150,000 tons of sodium sulfate, 240,000 tons of potassium sulfate and 600,000 tons of magnesium chloride a year.

These will constitute sizeable chunks of United States production of these minerals. For example, the sodium sulfate will equal about 10 percent of present United States production while the potassium sulfate will exceed the present annual production of that mineral by 1,000 tons.

But for chemical and business reasons, the mineral responsible for the whole operation—lithium chloride—will not be produced until the mid-1970's. Lithium Corp. of America got into the project because of the lithium in the lake. But before they can get to it, the other minerals, which crystallize ahead of it, must be taken out first. Studies in 1963, showed that this was economically feasible. By 1967, a pilot plant had tested the idea, and Lithium Corp. and Salzdetfurth, A. G. of Hannover, West Germany, a major salt and potash producer, formed the jointly owned Great Salt Lake Minerals & Chemicals Corp. Now seven years and almost $30 million later, the facility is ready to go on stream with sodium and potassium sulfate in October and magnesium chloride in late 1971.

Potassium sulfate, of which there is an estimated 170 million tons, is used in medicine, making potash fertilizer, glass manufacture and artificial mineral waters. Sodium sulfate (380 million tons) more commonly called Glauber's salt, is used as filler in detergents, a laxative, a diuretic and in dyeing and printing textiles. Magnesium chloride (210 million tons) is used in making magnesium metal, sugar refining, disinfectants, construction and fireproofing wood.

Key to the operation is the fact that different minerals precipitate or crystallize at different concentrations. Sodium chloride comes out first, the lithium chloride is last.

Taking advantage of the desert climate, chemical engineers use solar energy to supply the precipitation energy. Without the sun the operation would not be practicable, since gas or coal would cost too much.

In the process, the minerals are extracted in sequence by two main routes: concentration via evaporation, and precipitation. Ordinary salt, of which 6 million tons are produced annually, is the first to be precipitated in salt ponds. The remaining brine moves by pumping and gravity to the harvest ponds, where the crude salts of sodium sulfate precipitate and are harvested and trucked to a processing plant for recovery. The remaining brine flows on to other harvest ponds, where the crude potassium sulfate salts precipitate. They are also harvested, trucked and then recovered at a plant. The bittern or brine left over after the salts have precipitated out, are pumped to a plant where a high-purity magnesium chloride is recovered.

The final stage will be the construction of a plant to remove the lithium chloride.

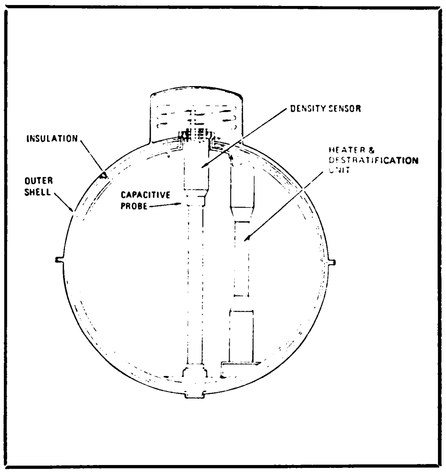
"We can't start up a (lithium) plant until GSL has supplied us with sufficient bitterns feedstock," says E. E. Smith, president of Lithium Corp. "The earliest would be 1973." There will be further delays to mesh the Salt Lake operation with other Lithium Corp. operations.

Although the system may sound simple enough, its construction was an engineering feat. The pond system, with its 130 miles of dikes and 14,000 acres of pond area, required the handling of 6 million cubic yards of material—all of which was done in six months in 1967.

In addition, to get the potassium sulfate, conventional processing proved inadequate and chemical engineers were forced to develop a new method. "We developed a process by ourselves," says Dr. Gerhard Flint, vice president of corporate development for GSL. He describes it as a unique two-stage leach-crystallization process with an intermediate material, shoenite, which was converted to potassium sulfate, the desired end product. □

APOLLO REVIEW BOARD

Shorts in the system



NAR

Oxygen tank: Internal items must go.

In the weeks since the Apollo 13 mission was aborted because of a major power breakdown, space officials have been fairly confident that they could locate the malfunctioning subsystem and change the design to eliminate the probability of a repeat.

That feeling continued last week, when the appointed Apollo 13 Review Board verified earlier suspicions that the instigator of the eruption in the oxygen tank had been a short circuit (SN: 5/2, p. 431).

A single component failure should be easy to fix. But that failure caused the shutdown of a major system, an event that Apollo planners had not predicted. They are thus having to review the whole system, not just the oxygen tank, to see if any other such conditions exist.

Dr. George Low, Deputy Administrator of the National Aeronautics and Space Administration, described the most probable sequence of events. A short could cause a type of combustion that would raise temperature and pressure beyond the valve capability and rupture the tank. The tank would then blow off one of the side panels of the service module.

Dr. Low further narrowed the short circuit to the wires leading to the tank's fans or fan motors. These are encased within the tank itself, along with temperature gauges, quantity sensors and heaters. The heater wires themselves are eliminated as possible culprits since the heaters were not on at the time. The current leading to the gauges and sensors has been written off as well; it is so low that these wires are unlikely candidates.

If the wires leading to the fan components are the culprits, this will necessitate investigating other spacecraft areas where similar situations may exist. The prime targets will be sections of the crafts where wires could make contact with combustible materials. One probable point of investigation is the tanks containing nitrogen tetroxide, the oxidizer used for the service and command module fuel systems, although the components inside these tanks, such as gauges, require very little current compared to the fan motors.

Since the fans and motors in the oxygen tank are of the same design that flew successfully on other Apollo flights, the design itself is not the prime suspect. The board (in scrutinizing the complete history of the oxygen tanks from their birth at Beech Aircraft in Boulder, Colo., to their death in deep space) has come up with some events that may have affected the performance of the components where the breakdown occurred.

One notable event was the need to replace the motors and fans at Beech Aircraft because the initial ones did not meet specifications. Another occurred at North American Rockwell at Downey, Calif., where the service module is built, when the tank slipped in a hoist, jarring it. And at Cape Kennedy, prior to launch, there was an anomaly that made it difficult to empty the tank of its oxygen, and an untried method was used. These events, while not particularly significant in themselves, are being examined, says Dr. Low.

"We had some anomalies in every Apollo flight. But none of them was as critical, none of them was potentially as catastrophic as these might have been on Apollo 13," he says.

After the cause has been identified, tests must be devised to reconstruct the entire sequence of events. Changes to the tanks themselves are inevitable: the fans, fan motors, wiring, all nonmetallic and aluminum parts that could react with oxygen will be removed from within the tank.

The fans, which are used to stir the liquid oxygen to keep it from forming layers of different temperatures, might be eliminated entirely, according to some space engineers. It has been necessary to use the fans only infrequently on previous Apollo flights.

What the board's ultimate findings will mean in terms of the launch date for Apollo 14, no one at NASA is predicting. However, Dr. Low remains confident. "There was a time when we launched Apollo flights on two month (intervals) and made some very major dramatic changes in those fairly short periods of time," he says. □