

gineering last month, but none of them included a full-scale projection of the effects of the jetport on surrounding lands.

"To date," the group reports, "no known study of this nature has been conducted by any agency." In addition communication was poor at best between the various Federal agencies involved and between Federal and state authorities.

As a result, objections to the training strip did not emerge until more than a year after the site was selected, the group reports, and the partially constructed facility finds itself suspended in limbo while new attacks are mounted against it.

The Environmental Study Group, for example, which was studying the development of south Florida only as a case history with which to develop methods of handling environmental problems across the country, declares that a special water conservation district in surrounding Monroe, Collier and Hendry Counties is a prerequisite to any airport in the region. Pollution from the airport and aircraft, as well as from the people and facilities that would accompany such a development, could pose a serious threat to the ecology of the area.

The 26-man group, assisted by an additional 35 observer-participants, also recommends a comprehensive local-state-Federal management plan to avoid the pitfalls of past experience, as well as "the avoidance of all measures that would encourage commercial or residential development in the vicinity of the jetport." Furthermore, says the group's report, the area is a veritable "tropical reservoir of insect vectors," necessitating more study of diseases that could develop in any nearby population center.

An even more strongly worded document is that prepared by a team headed by Dr. Luna B. Leopold, chief hydrologist of the U.S. Geological Survey. The best solution, his report suggests, is to abandon the present site completely and go elsewhere.

Expanding the airstrip to a cargo facility and ultimately to a full commercial airport would be catastrophic, the Interior report says. "Regardless of efforts for land-use regulation," it declares, "the result will be the destruction of the south Florida ecosystem. Estimates of lesser damage are not believed to be realistic."

Sewage and industrial wastes from the jetport would total about 5.5 million gallons a day, with more from the inevitable surrounding urban areas. The resident Miccosukee Indians would be virtually destroyed as a tribal entity. Finally, despite existing adequate technology, says the report, there is no precedent to indicate that legal, administra-

tive or social practice would in fact result in keeping water quantity and quality adequate to continue the natural ecology as it is.

Some promise is voiced by Transportation Secretary John Volpe, whose department will be studying both reports in a joint task force with the Department of the Interior. "From what we have now," he says, "it looks quite doubtful that a major international airport could be developed here and conserve . . . the Everglades National Park. . . . This area in here would be rocking from the construction of this jetport, unless something by way of technology that we don't have today could be developed. None of us see it today." ◇

METRICS

A preliminary report

In 1866 Congress made the metric system of measurements legal in the United States, but not compulsory. "So no one used it," says Dr. Alvin G. McNish, technical director for the metric study at the National Bureau of Standards.

In the century since, all the world but the United States and Canada has adopted the metric system or declared its intention to do so soon. Last year Congress authorized NBS to make a study of the activities and costs that would be involved if the United States were to replace its traditional measures more and more by the metric ones (SN: 1/25, p. 91).

Congress has always been shy of compelling a change in measurements as the British Government is doing. Congressional committee spokesmen say that one reason for authorizing the study is to see whether there are ways short of compulsion to promote a changeover.

The study is still in its early stages, but already its leader, Dr. McNish, concludes that going metric would not cost nearly as much as some people have feared. On the other hand, he says, it would not benefit U.S. foreign trade as much as some of its proponents have hoped.

Changing to the metric system has conjured up images of vast expenditures to switch the entire economy all at once. Estimates of \$26 billion, \$100 billion, a tenth of the gross national product, have been bruited about.

But "you don't do that," says Dr. McNish. "You're crazy if you do." Instead, a gradual changeover could be carried out at much lower cost.

Some areas, like retail trades, would have to change all at once. A mixed or dual system in markets would engender too much confusion. But many industries, such as machine tool manufacturers, could change gradually as dies

and patterns were replaced. And things like land measurement would change slowly if at all. Dr. McNish and his co-workers have taken a preliminary look at examples of each of these cases, laying scare estimates to rest wherever possible.

Of the estimated \$3 billion to change over all the parcels of taxable land in the United States, Dr. McNish says the best thing to do is to let sleeping deeds lie.

In New Orleans, he says, are two adjacent lots, one measured in English feet, one in French feet. The records have been so for hundreds of years and nobody has been inconvenienced. "You don't buy the feet, you buy the land," he says.

On the other hand there are, especially in the retail trades, many items that are manufactured and packaged in sizes that are round numbers of some basic unit. For a true conversion to the metric system these sizes would have to be converted to metric units: quart packages to liter packages, pounds to half-kilos and so forth, and it will all have to be done at once.

Such a sudden switch calls for a high capital investment. Nevertheless an NBS pilot study of milk packaging gives grounds for optimism.

A machine that packages milk has six measuring reservoirs. Changing these from half-gallon to two-liter size would cost \$1,000 per reservoir or \$6,000 per machine. Since all the machines in the country would have to be changed at once, the capital investment would be large. Yet each machine, if it works a 16-hour day six days a week, will fill 45 million cartons a year. If the capital cost of the change is amortized over a year, it comes to 0.0133 cents per carton.

In further studies of the retail trade, says Dr. McNish, his group will try to determine the cost per item. Even if the initial capital investment is large, the cost per item may be reasonable.

A more gradual changeover, at very little capital cost, could be made in industries like screw manufacturing. The dies on a machine that makes screws have to be replaced after every 200,000 screws. As dies made to inch standards wear out, they can be replaced with dies made to metric standards at the same cost as would have been incurred with new inch-standard dies.

Under this scheme industries would have the expense of keeping dual inventories for a time, but many already have to.

The automobile industry is a large user of machine parts. A study shows that gradual replacement and redesign have generally resulted in complete replacement of parts in about 12 years. That is, a 1970 model is unlikely to

contain any part used in cars of 1958.

As such replacement was going on, the industry could change to metric standards. As standard parts, nuts, bolts, washers, etc., became available in metric standards, says Ford's William K. Burton, engines, for example, could be designed around these parts to metric modules. "If we had something designed to even inches, we could redesign it to even millimeters and not change the actual size by more than 20-thousandths of an inch." Systems analysis would be needed to find out which components would have to be converted together to minimize problems in making interconnections, and which could be separate steps.

The change to metric units, says Burton, would involve the entire mechanical products industry. Standards for parts like nuts and bolts are made by professional associations, and these must approve standards for metric module parts and decide whether existing European standards are to be adopted or a new international system of metric sizes sought.

Burton estimates the time for a changeover by the automobile industry at "not less than 15 years and not more than 20."

Dr. McNish's study is charged also with finding out what the benefits would be if a conversion to the metric system is made. There would be some educational benefit, he says, but he finds little evidence of a 10 percent time saving. The schools don't spend 10 percent of their time on all of arithmetic, he says.

There would be a bigger educational benefit in engineering. The confusion of English units in engineering is so bad that it is even reputed to drive students away.

In foreign trade the benefit does not seem likely to be as great as some commentators have speculated. But in exports of machinery and transportation equipment, there could be some benefit. In this category U.S. trade with metric countries declined about 25 percent between 1960 and 1966. If one could assume that this decline was all due to the lack of metric standards, then the lack would have cost the U.S. \$1.6 billion over those years in this category of export.

But the assumption is not a safe one, because a large part of that category is aircraft and related machinery, and this, all over the world, is standardized on English units. Many other factors also influence foreign trade, and it is therefore hard to predict the specific effect that metrization will have.

Dr. McNish expects his full study to be complete by the end of 1970. By then he should have a good idea of what things would be practical to change and at about what cost.

WEATHER PREDICTION

The past tells the future

There are two basic ways to go about forecasting the weather, just as there are about predicting the future behavior of any continuing process. One, the physical approach, is to attempt to understand the physical laws that govern complex atmospheric processes, then plug readings of current weather conditions into dynamic equations. With the help of computers, the process produces forecasts of weather conditions a day or two in the future. Such hydrodynamic numerical modeling is the technique commonly used by the Weather Bureau in its daily forecasts, and there are many efforts in progress to extend the capabilities (SN: 9/6, p. 185).

The other method is a statistical approach and ignores physical processes. It relies only on past weather records and the search for patterns that may repeat themselves predictably.

The statistical approach has long had a stepchild status. It has never completely died, though it has seemed unable to produce a clear pattern to relate past weather to future weather.

Now two scientists, after seven years of work at the Massachusetts Institute of Technology, say they have found one. The research findings by Dr. Donald B. DeVorkin and John T. Prohaska are a breath of fresh air for the statistical approach and for forecasting of long-range weather trends.

As a result the two claim it is now possible to forecast general monthly and seasonal trends in the weather, six months or longer in advance. In fact, Dr. DeVorkin, Prohaska and Dr. Hurd C. Willett of MIT have now formed a commercial service, Statistical Weather Information Inc., to do just that.

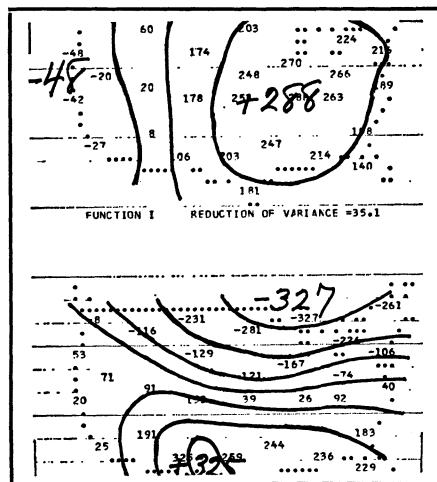
Their meteorological colleagues are expressing cautious interest.

Using computers to analyze monthly weather records since 1899, what the trio basically has found is that atmospheric pressures at some geographical locations tend to show relationships to temperatures at other locations, one to 12 months later. The odds that the relationships are due to chance are calculated to be as low as one in 10 million.

The computers also detected nonrandom relationships between monthly average temperatures in certain parts of the United States and precipitation in other parts during the same month.

They make no effort to explain their findings; they simply use them.

Thus to find out what the monthly average temperature will be in Washington six months from now, the computer compares atmospheric pressure readings for the three previous decades at 132 locations in the Northern Hemisphere.



MIT

Computer sifts past weather records.

This indicates which locations have in the past served as the best predictors of Washington's monthly temperatures. The analysis can then tell how many degrees warmer or cooler than normal the average temperature is likely to be for April 1970.

Once the temperature is known, a similar sifting of the data produces a prediction of the precipitation for April.

While their work is arousing interest, it is regarded as far from conclusive.

"They certainly have demonstrated that there are some nonrandom relationships," says Jerome Namias, chief of the Extended Forecast Division for the Environmental Science Services Administration. "But a scientific evaluation will have to await a little more evidence."

"Their work is further evidence of some statistical pattern to the weather," says Glenn Brier of ESSA. "It is not the key or the solution—we realize there is quite a long way to go—but I am encouraged by the results." As chief of meteorological statistics at ESSA's Air Resources Laboratory, Brier has been doing research on the statistical technique for some time.

"I don't think the results of their system will be spectacular," says Dr. Frederick Sanders of MIT, "but if they can lessen the degree of error in seasonal forecasts at all, it will be significant." He too feels that it will be several years before the method's performance can be judged.

Although simple in concept, a demonstration of nonrandom relationships between average pressure and temperature and average temperature and precipitation had to await the closing of many gaps in weather records of the past half-century. Records for many stations in the Northern Hemisphere were not made available during World