have not found the astronomical thinking convincing.

Now, however, Dr. Fred Hoyle, director of England's new Institute for Theoretical Astronomy at the University of Cambridge, has built a bridge between the two sciences. He presented arguments that eliminated many of the archaeologists' reasons for disagreement at the Autumn Meeting of the National Academy of Sciences in Ann Arbor, Mich., last week.

Archaeologists have generally attacked the astronomical theories on the grounds that Stone Age man lacked the sophistication to figure out the theoretical basis of such a complex observatory. Dr. Hoyle suggests that they didn't start with a theory, but with a pragmatic wooden model that they could change as its defects became obvious. Only when the observatory evolved and actually worked did they make it permanent.

Dr. Hoyle believes that the outer part of Stonehenge—the 56 circular markers—was built a little after 3000 B.C., and that the center structure for predicting solar and lunar eclipses was built several hundred years later.

The great stone monoliths at the center of Stonehenge were put in place after a long, painstaking test by trial and error using wooden posts.

The first wooden model tested could have resulted from the insight of a Stone Age genius equivalent to this century's Albert Einstein, Dr. Hoyle believes.

One of the most recent and ardent exponents of Stonehenge as an astronomical observatory is Dr. Gerald Hawkins of the Smithsonian Astrophysical Observatory in Cambridge, Mass. He also suggests that the large stone markers were placed in a pattern for predicting solar and lunar eclipses but thinks the ancient men had worked out the proper positions theoretically. Rather, suggests Dr. Hoyle, the pattern of Stonehenge was worked out as a field experiment by very observant men who noted that every year the sun's position in the sky was the same at the same time, such as mid-summer or mid-winter.

To measure such positions accurately, they would have had to use relatively long distances for sighting, such as a circle about 100 yards in diameter, which is the size of Stonehenge. Many of the stones, however, seem to be slightly out of place for accurate measurements of solar and lunar positions.

Dr. Hoyle has found that 19 of the 23 positions that seem to be out of line would be correct if they were lined up for observing not the actual date of mid-summer, but for two other observations: one during the week it approached its solstice and one as it moved back again. The average of these two observations would give a more accurate astronomical position than a single sighting at the time of solstice.

After several years of such observations, Dr. Hoyle speculates, the Einstein-of-his-time would have noticed that solar eclipses occurred only when the sun, earth and moon were lined up. The group then added the markers necessary to predict solar eclipses, first using wooden posts and then replacing them with the immovable stones so that later generations could not move them out of line. ◈

AUTO POLLUTION

Pursuing the possible

Henry Ford made the internal combustion engine America's means of private transportation—and brought with it economic blessings and social woes. The blessings have been here for decades; the woes—traffic jams and air pollution—are rapidly catching up.

"We're on our way to a public catastrophe; people are going to get killed," said Dean Myron Tribus of Dartmouth's School of Engineering last week. "Carbon monoxide levels in New York City are approaching the lethal level."

Dr. Tribus is a member of the private Panel on Electrically Powered Vehicles which is delivering its report on autos and air pollution to the Department of Commerce. Part I, the general report, is in hand; Part II, report of the technical panels, is on the way.

In effect, the panel's recommendations play down the possibilities of other modes of moving automobiles and concentrate on cleaning up the trail of the internal combustion engine.

The report as could be expected, immediately stirred up controversy. It's bound to stir up more.

The measures recommended to cut auto pollution are tough and expensive. Total emissions should be cut to a seventh of the 1968 national standards by 1980; antiknock lead should be limited; standards should be based on the amount emitted, rather than a percentage of the total exhaust, a procedure which favors big cars.

The panel's approach is based on practical economics. The internal combustion engine is here and the pollution problem demands action. Pollution controls, although expensive, are economically feasible with known devices and those in sight. Any alternate, low pollution propulsion, such as electric cars, steam engines, and turbines, are too far down the road to get in production fast enough to help.

In its enthusiasm to focus immediate attention on cleaning up the internal combustion engine, however, the panel

raised the hackles of enthusiasts for other types of motors, who claimed the report doesn't give their favorites a fair shake.

One part of the report, for example, shows that cars powered by lead-acid batteries, the type used in ordinary autos for starting and lights, could maintain a steady 20 miles per hour for something like 50 to 75 miles before recharging. But lead-acid cars have apparently already done better than that. According to Robert Aronson of the Electric Fuel Propulsion Co., an electric car he designed recently traveled 2,000 miles on Interstate highways, keeping a minimum of 45 miles per hour up to 65, and traveling 60 to 100 miles between charges.

Steam cars are another maligned possibility, according to Robert Ayers of Resources for the Future. Although the panel did say that steam engines "potentially offer a satisfactory alternative to the present automobile," the panel's report rates them lower than internal combustion engines in power per unit of weight.

"I don't know where they got their statistics," said Ayers. "Out of old textbooks, maybe." He said that considering horsepower at the wheels, the steam engine is directly competitive with the internal combustion engine.

Where the panel's analysts goes wrong, says economics Prof. Lloyd Orr of Indiana University, an electric car enthusiast, is in deriving their figures from off-the-shelf items. For instance, one assumption is that the power plant should make up only one-quarter of the total vehicle weight; much higher proportions than that could be used, he said. In Aronson's car, the ratio is more like 50-50, according to the inventor.

Another big item is the estimate of how much power is needed to push a car. By streamlining, reducing rolling resistance and properly designing the car to handle batteries instead of an engine, electric cars could be a lot more efficient than the panel's charts show.

If the panel's views on unconventional systems are unduly pessimistic, its hopes for cleaning up the internal combustion engine are optimistic.

Present standards are being met by methods that won't be capable of being carried much farther, says the report. These include fine adjustments and injecting air into the exhaust gas to complete combustion. But more advanced methods, including large air injectors, afterburners and chemical cleaners, are being developed.

"Further substantial reductions in tailpipe emissions can be achieved with known control devices with adequate development work," said the report.

But the critics say pollution controls such as afterburners and catalytic cleaners will be too expensive and won't work after a short time. Further reduction of emissions will require fuel injection systems in the engine, complicating its operation and making it much more expensive and difficult to maintain, they say. ◈

HOSPITAL COSTS

Down the up escalator

If costs and inefficiencies continue to rise, a hospital room within a few years will cost $100 a day. To ease the fiscal crunch, a Princeton University team suggests cost control by the states.

Prof. Herman M. Somers and his wife, Anne, authors of "Medicare and the Hospitals: Issues and Prospects," a Brookings Institute study in social economics published last week, say the need for planning hospitals as community service organizations has become more urgent than ever before. Medicare can serve as fulcrum and lever for financing medical care in a way that represents a better future.

"Our hospitals represent a random growth of uncoordinated institutions," the Somers' book says. "Agreement on the need for health planning is becoming almost universal. There is, however, no such agreement as to either means or ends." Brookings, though it creates the atmosphere in which such studies can be made and published, (SN: 9/2) never endorses the final product.

Due to the hospital's historic beginning as a community charity for the poor and hopelessly ill, the authors explain, the majority of the 5,700 non-Federal institutions with their 741,000 beds still operate on a "tripartite arrangement of trustees, administration and medical staff, with the formal lines of authority often in conflict with the realities."

This structure, they suggest, is an anachronism. Health insurance, public medical programs and new patterns of hospital use have made the large majority of admissions into paying patients.

"The dwindling proportion of indigent cases is now generally paid for, in part at least, by public funds," the authors point out, saying that when Title XIX of the Social Security Act (covering the indigent) becomes fully operational, possibly by 1975, free care will virtually disappear, and every patient will be able to have his own doctor. It is time the hospitals themselves caught up.

The authors cite instances of the cumbersome method of payment for Part A (the hospital portion of Medicare) and Part B (for the doctor's direct services) when a hospital pathologist is concerned. In that case the hospital will make two separate collections from Part A and Part B intermediaries.

"If the two Medicare programs are ever combined into a single plan," they say, "this might help to bring about an amalgamation of Blue Cross and Blue Shield (private hospital and medical plans). Both seem highly desirable."

Here are some of the changes the Princeton couple foresees:

- Quality controls of hospitals will be strengthened. Full-time heads of departments will become the rule rather than the exception. More hospitals will be staffed by full-time physicians, salaried, or organized in groups contracting with the hospital.
- All medical staffs will be required to assume closer identity with, and accountability to, the hospital. Hospital standards will be raised and the competence of physicians, nurses and technicians will improve.
- The internship may be abolished, as has already been recommended by an American Medical Association commission. Greater use of electronic equipment for repetitive functions will reduce human error and allow more personal attention to patients.
- With the growing influence of Medicare, Medicaid and other public and private health insurance programs, traditional ward service and free clinic services will virtually disappear.
- Some hospitals have too many beds and too much equipment for the use that is made of them. There are too many quality gaps. Careful review of bed use, made by a medical staff committee, will save dollars as well as days. ◈

FAVORITE SPANKED

Hill scores NIH

The National Institutes of Health supports between 40 and 60 percent of the biomedical research in the United States. The most pampered child on Capitol Hill, it annually receives from Congress more money than it asks for. And in some views it's been getting more than it can intelligently spend.

Last week the child was publicly spanked. A scathing report by the House Intergovernmental Relations Subcommittee, headed by Representative L. H. Fountain (D-N.C.), paddled NIH for, among other things, failing to stimulate new centers of research excellence, subsidizing research of low quality, overpaying for indirect costs, and relying on the same senior scientists year after year for decisions on who gets the money.

All this tends to widen the gap between the rich and poor schools, said the subcommittee, accusing NIH of being lax, inefficient and unscientific in building a structure of biomedical knowledge. ◈