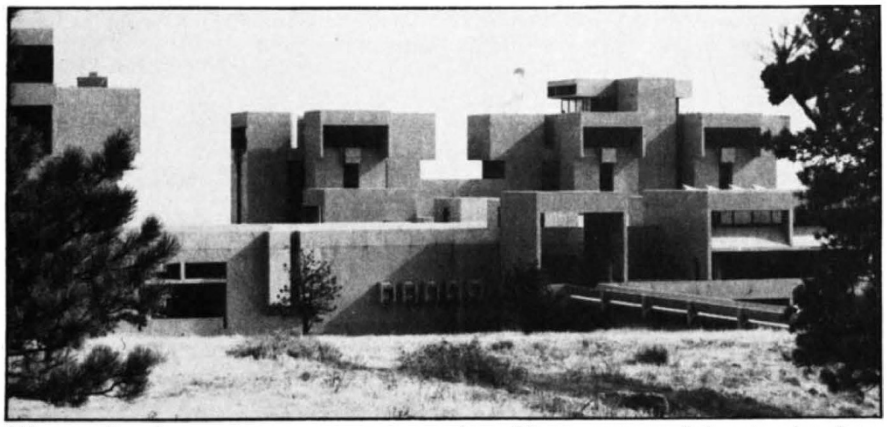

Trends in meteorology

by John Gribbin

THE National Center for Atmospheric Research (NCAR) in Boulder, Colorado, has just issued its annual report for 1974. The NCAR was set up in 1960, and is run by the University Corporation for Atmospheric Research (UCAR), a private, non profit corporation whose 44 members are universities and other institutions with doctoral programmes in the atmospheric sciences. The operation of the NCAR is supported by the United States National Science Foundation; in practice, this means that the NSF runs the NCAR for the UCAR on a contractual basis. The Center is unique—there are only four other national centres run by the NSF and all of those are centres of astronomy. Indeed the NCAR is itself responsible for the High Altitude Observatory (HAO) but this is not as odd as it might seem, since that observatory carries out research on the physics of the Sun and the solar terrestrial environment, areas of astronomy which seem to have great relevance to problems of the behaviour of the Earth's atmosphere.

Public, and indeed journalistic, attention has focussed on centres like the NCAR lately because of the increased awareness of the problems of climatic change. But as the new annual report shows, this kind of work has been somewhat out of the mainstream of research at the NCAR. That situation may now be changing but more traditional aspects of atmospheric research are clearly still at the forefront as yet.

Topics covered in the past year include research into storm forecasting, the investigation of the interaction of aerosol particles with liquid and ice constituents of clouds, and the airflow and moisture budget of a hailstorm. Some of the work on mechanisms of hail growth highlights just how great the problems of understanding all the workings of our atmosphere are—some theories of hail formation postulate that hail growth begins with the freezing of large supercooled water droplets; others argue that it begins with ice riming around individual ice cyrstals. Studies at the NCAR show that, for Colorado storms, growth from the ice phase is indeed dominant; but Soviet workers report great success with the alternative model. As the authors of the report put it "geographic and environmental differences may provide some explanation of the discrepancy", but if both theories can be correct, depending on circumstances, then a real understanding of hailstorms is far from being at hand.

If that is the case with something as seemingly simple as a hailstorm, the job of those working on climatic modelling might seem impossible. But progress is being made, at the NCAR and other centres. One study of the effect on surface temperatures which might result from changes in stratospheric aerosol or ozone concentrations brought about by operating a fleet of supersonic transport (SST) aircraft seems likely to fan the flames of the SST controversy once more. The effect of the increased stratospheric aerosols on the NCAR model is a reduction in surface temperature by 0.25 K, whereas the effect of the nitrogen oxides emitted by the hypothetical SST fleet is a rise in surface temperature by as much as 1 K. In the first case, increased reflection of solar heat dominates; in the second there is a net increase in absorption. These studies offer no easy solution to the question "is an SST fleet environmentally safe?" but since a change in surface temperature of 0.1 K is considered by the experts to promise significant climatic effects it does seem that the question should at least be asked once again before SST operations begin on a large scale.

Studies of the feedback between temperatures and cloud cover also show how climatologists must solve the chicken-and-egg problem. We hear a lot about how increased cloud cover can cause more reflection of solar heat and a fall in surface temperatures. On the other hand, preliminary results of studies now continuing at the NCAR indicate that there is a positive feedback between changes in surface temperature of the sea and the cloud cover.

The solar studies of the HAO also extend to include work on Skylab, through the Apollo Telescope Mount, and the Executive Director of the NCAR, John Firor, sees studies of the Sun as of increasing importance to problems of climate and atmospheric modelling. Such statistical correlations as there are between solar phenomena (notably the sunspot cycle) and terrestrial weather have not been explained by any satisfactory physical model, but they have encouraged a new look at the solar influence. Indeed, now that the astrophysicists have been forced, by the absence of detectable solar neutrinos, to accept that they do not know all about the workings of the Sun there is room for climatologists to question just how constant the 'solar constant' radiation reaching the Earth is. □

Cloud research

PROFESSOR Jim Megaw, of York University, Toronto, says that as far as man's influence on climate is concerned "the time for descriptive work is past". Like many other people he is greatly concerned about the effect of freon on the ozone layer and believes that its use as a propellant in spray cans should be stopped. Another problem which needs urgent attention is the growth of industrial clouds from the smoke and gas emitted by factories; here, Megaw is at least on the trail of a technique which would make possible the destruction of man's influence on the environment at source.

It seems that laboratory experiments on cloud formation have from time to time been hampered because the 'clouds' refused to form in the cloud chambers. The blame for this has now been laid at the door of the pure ion exchange water used by the experimenters. There is something in ion exchange water which can inhibit the formation of mist, clouds or fog, and it seems very likely that the elusive 'something' is an amine (one of the same family of compounds as those which give fish their characteristic odour). Megaw is now trying to identify the exact compound involved, which is effective in tiny quantities. If it can be pinned down, it could be added to industrial products to inhibit formation of industrial mist and fog. Although Megaw did not mention the possibility of use in aircraft, this would also seem an ideal way to reduce or remove the hazard of increased cloud cover produced by high flying jets.