playing it unbelievably cool, are listening to the latest ball game scores relayed from the Houston space centre, and joking about watching the championships on television.

At about eleven o'clock on Tuesday morning Apollo 8 is due to enter lunar orbit and photograph the lunar surface from a height of only sixty-four miles. The worst hazards will still be ahead. On Christmas Day the spacecraft has to be boosted out of the pull of lunar gravity and on to an Earth bound trajectory, and on Friday afternoon there is the critical re-entry into the Earth's atmosphere. Apart from the inherent problems of hitting the Earth's atmosphere at the correct angle there is now the added problem of frosted windows, which has been the plague of most of the American astronauts. According to one of the flight directors, "The centre window is very opaque. The other four are somewhat hazy but they are usable for map sitings. The men can see through four of the windows adequately enough to identify the constellations". This reduced visibility should not affect re-entry so long as the two mechanical tube displays, which are to give the re-entry attitude, function properly on Friday morning. Like everyone else, we wish Apollo 8 the best of luck for the rest of the mission.

DRUG RESEARCH

Legality of Cannabis Experiments

A RECENT experiment on the effect of marihuana in man, conducted at Boston University School of Medicine, has drawn attention to the uncomfortable situation in which research of this sort would be placed in Britain. At a time when the widespread use of the drug, also known as pot, hashish or cannabis resin, makes knowledge of its effect in man all the more necessary, English research workers find themselves inhibited by the Dangerous Drugs Act of 1965.

Section five of the Act makes it an offence for the owner or occupiers of premises to allow them to be used for the smoking of cannabis. This restriction is absolute, and a scientist undertaking laboratory research on human volunteers would find himself liable to prosecution. The restriction was doubtless reasonable at the time the law was enacted, although had its legislators foreseen the rise of drug taking to its present prominence they would doubtless have worded the Act so as to allow approved research.

As it happens, the Act contains, by accident rather than design, a small loophole. Acts of this nature are held not to apply to the Crown unless specifically stated to do so. It is understood that the Dangerous Drugs Act in fact permits cannabis research on volunteers on government owned premises. Scientists working elsewhere cannot legally do this type of research as the law now stands, and unless government laboratories feel capable of handling all necessary research themselves, it may soon be desirable to effect a change in the law.

The Boston workers, A. T. Weil, N. E. Zinberg and J. M. Nelsen, concluded that it is "feasible and safe to study the effects of marihuana on human volunteers who smoke it in a laboratory" (*Science*, **162**, 1234; 1968). Theirs seems to have been the first study of the drug in man to be undertaken with appropriate control procedures. Protection from legal repercussions was obtained by specific "agreements" with the relevant legal authorities including the Federal Bureau of Narcotics, which was also persuaded to supply the raw material of the experiment. Nonetheless, the authors feel obliged to append to their paper the note that "we do not consider it appropriate to describe here the opposition we encountered from governmental agents and agencies and from university bureaucracies".

Legal impediments were not the only obstacles encountered. On a wry but not irrelevant note, Weil and colleagues mention that it took nearly two months of interviewing to find nine volunteers among the student population of Boston who had never smoked marihuana. The chief results of their study are, in brief, that smoked doses of marihuana have different effects on naive subjects and on habitual users of the drug. In a laboratory setting, at least, non-users did not get "high", even on strong doses, but their performance on simple psychological and psychomotor tests was impaired. Surprisingly the habitual smokers, who did become high, showed no impairment and even a slight improvement on the tests. Marihuana, which appears to be a "relatively mild intoxicant", does not alter the blood sugar levels, which means that the explanation for the well known effects on appetite must be sought elsewhere. There are grounds to suppose that the drug acts on the higher cortical functions without affecting the emotional balance maintained by the lower brain centres.

INFLUENZA

Unprotected against Epidemics

ALTHOUGH the British Government has had more than five months warning of the possibility of an epidemic of Hong Kong flu in Britain this winter, it now looks as though there will be insufficient vaccine to protect more than a small proportion of the population if and when an epidemic does break out. Vaccine production has been left completely in the hands of private firms—Beechams Research Laboratories, Crookes Laboratories and BDH Pharmaceuticals—and it is remarkable, to say the least, that the Microbiological Research Establishment at Porton, with its excellent facilities for growing viruses, has not been approached to ease the load.

The reason for this is not clear, but a good deal of passing the buck seems to be going on. A spokesman at the Department of Health and Social Security said this week that the production of vaccine at Porton is a matter for the Ministry of Defence. It seems, however, that the ministry has not asked for help. In any case, vaccine production is expected to fall 150,000 doses short of the target of 900,000 set for the end of the year, chiefly because of the difficulties in meeting the stringent testing requirements. This suggests that even some of the chronically ill and aged—the two groups entitled to protection—may have to go without vaccine. Admittedly there are reports of "substantial additional supplies" being imported, but these will have to be carefully tested before use.

Time is certainly not on the Government's side. Until recently it has been working on the optimistic and perhaps convenient assumption that an epidemic is unlikely to hit Britain before mid-February. But with 35 states in America affected, and in view of the present intensity of high-speed travel between America

and Britain, early January is a more realistic target. One suspected case of Hong Kong flu in Birmingham was confirmed before Christmas but, as there were reported cases earlier this year with no ensuing epidemic, that is not necessarily the start of a large outbreak.

Also questionable is the instruction to doctors to immunize—at least in the first instance—only those people who are at special risk. From the medical point of view, of course, healthy individuals should be able to survive an attack of flu without too much discomfort. But what of the economic aspect, which the spokesman at the Department of Social Security said was entirely a matter for the Department of Employment and Productivity to consider? British industry is hardly in a position to face a temporary shut-down. Although it would now be impossible to immunize the whole British population, there appears to be a strong case for providing industrial medical centres with enough vaccine to protect employees. In any case, it is naive to imagine that vaccine is going to be administered completely in accordance with instructions. Dr Sydney Greaves, secretary of the Medical Practitioners' Union, is reported to have said that at least one local authority has taken the bulk of its vaccine supplies for its own staff, and that some doctors are complaining that commercial firms are supplying individuals not in great need of vaccine, with the result that priority patients are having to do without.

POLLUTION

Controlling the Motor Car

from a Correspondent

A SYMPOSIUM was held at the London headquarters of the Institution of Mechanical Engineers on November 25 and 26 under the joint sponsorship of the British Technical Council of the Motor and Petroleum Industries (BTC), the Institute of Petroleum and the Automobile Division of the Institution of Mechanical Engineers.

The chairman of the organizing committee, Mr L. Martland from Ford Motor Co., started the proceedings by describing the Californian and American pollution regulations. The continued export of cars with engines of less than 140 cubic inches capacity, he said, was helped by the action of the BTC and others in securing higher permitted levels after demonstrating to the US Federal authorities the increased technical effort needed on the smaller car.

Mr W. T. Oliver (Ford Motor Co., Basildon) described how his company was meeting the American regulations by air injection into the exhaust ports; stainless steel tubes were used and positioned to deliver the air close to the exhaust valve heads. Back firing in the exhaust caused by pressure changes during deceleration was avoided by using a valve to divert the air supply. Mr D. L. Sutton (Rover Co.) showed the influence of air/fuel mixture, ignition timing, engine speed and load. He described work on a valve fitted to the carburettor throttle plate to secure improved combustion on overrun. Gas traces and results from tests on treated vehicles were produced showing compliance with the regulations.

Mr G. L. Lawrence (Zenith Carburettor Co.) outlined some of the advantages of the air valve type carburettor, and Mr E. W. Downing (Joseph Lucas Ltd) described the application of petrol injection to high performance cars. He pointed out the difficulties of securing low hydrocarbon and carbon monoxide levels on engines with large valve overlaps because the high exhaust gas content in the cylinders slows down combustion and limits the burnable range of mixtures.

Mr B. L. H. Bishop (Smiths Industries, Witney) reviewed the various crankcase emission regulations both in the United States and in Europe, and described various control systems to recirculate these gases into the induction system of the engine. It is well known, he said, that 85 per cent of the blow-by past the pistons into the crankcase of petrol engines is derived from the carburetted air/fuel mixture. The remainder—usually about 15 per cent—is exhaust gas. Hydrocarbon emission from the crankcase is therefore high and, ignoring evaporative losses from the fuel system, can account for some 25 per cent of the total discharge of hydrocarbons from an untreated engine.

Messrs B. V. Harris and H. I. Fuller (Esso Petroleum Co.) described the evaporative loss control device (ELCD) developed by Esso, which uses activated charcoal to trap hydrocarbon vapours from the fuel tank and carburettor, and then releases them to the engine at defined intervals of operation.

Mr B. W. Millington (Ricardo and Co., Engineers (1927), Ltd) reviewed recent work on the study of soot formation in the exhaust, and explained that X-ray spectroscopy showed it to have a graphite structure with hexagonal basic carbon units linked into platelets giving a crystallite about 21×13 Å in size. Mr A. E. Dodd (MIRA) and Mr J. Spiers (Perkins Engine Co.) reviewed various smoke meters for assessing diesel exhaust and pointed out their various shortcomings. The relationship between density measurements and subjective appearance to non-technical observers of vehicle emissions from the exhaust pipe confirmed that, for steady speed full load conditions, the subjective reaction was related to carbon concentration and rate of discharge by the formula $C\sqrt{G}=K$, where C is solids concentration (g/m^3); G is the rate of discharge (litre/s) simply calculated for 100 per cent volumetric efficiency; and K is a constant representing a particular degree of acceptability.

Details of experiments with a barium compound diesel fuel additive for suppressing smoke were given by Mr B. E. Knight and Mr C. H. T. Wang (CAV, Ltd). Films of combustion with and without the additive were shown by the authors and illustrated the earlier disappearance of the luminous flame when the smoke suppressant was used. Results from engine tests showed that 0·5 per cent of additive in the diesel fuel reduced the weight of carbon by some 50 per cent; carbon monoxide and carbon dioxide were slightly increased and hydrocarbon content in the soot was reduced. Aspiration of the additive in petrol with the intake air has a smaller effect on smoke.

AMERICAN RESEARCH

Gloomy Forecast

IT will come as no surprise that for the second year in succession a marked drop is forecast in the growth of expenditure on research and development in the United States. The prediction, prepared by Dr W. Halder Fisher and Mr L. Lederman, economists at the