jective measures of "life-style" they were able to make more sense out of events. Specifically, two measures of life-style were used—area of residence, and neatness of the respondent's house. Individual measures of socio-economic level (education, occupation, and so forth) showed little relationship with measures of discontent. However, "life-style showed more consistent trends. . . . in five out of six comparisons, the persons living in better residential areas and exhibiting a more 'middle-class' life-style indicated lower discontent [than those living in poorer neighborhoods or those whose homes were not as neatly kept]."

The UCLA study, and the few others in existence, raise more questions than they resolve. Its conclusions, if correct for Watts, may not apply to other cities. And even its findings about Watts 1965 may no longer be true of Watts 1967. This summer's violence has been too widespread and yet too random to suit simple explanation. Each new disturbance amplifies uncertainty and leaves room for almost as many theories as there are disorders.

—ROBERT J. SAMUELSON

British Fusion Research: Cuts May Reveal a Pattern

London. News of a cutback at the Culham Laboratory, the British center for plasma physics and fusion research, came as no great surprise, but still carried considerable shock effect here. It has been known for a year or more that Culham was under government scrutiny and that its future was in the balance. But because the laboratory was engaged in bringing the energy millennium through controlled fusion, and because it had rapidly achieved a high international standing, observers had thought it might escape harsh handling.

In the final days of the session of Parliament which ended in late July, however, Minister of Technology Anthony Wedgwood Benn announced that Culham's budget would be cut by 10 percent a year for the next 5 years. Thus the present $11.2 annual budget would be halved.

Culham, an Atomic Energy Authority (AEA) facility located on an old Navy airfield in Berkshire, was completed in 1964 at a cost of about $16.8 million. It is in a sense a "spin-off" lab, its staff having been formed mainly by bringing together teams working on plasma physics research at nearby Harwell and at the weapons research establishment at Aldermaston.

Culham rapidly came of age. The staff produced work of a quality which earned the lab a good international reputation, and able foreign scientists were attracted as visitors. Last year the lab added to its prestige when staff members stepped slightly out of their bailiwick to win a contract to build the scientific payload for the Large Astronomical Satellite for the European Space Research Organization (ESRO). This is the largest space experiment planned outside the American and Soviet programs.

The government decision on Culham seems based primarily on an assessment of the scientific prospects for generating power by nuclear fusion and an acknowledgment that the commercial payoff still lies in the indeterminate future.

When the idea of Culham as a special and separate effort was being developed a decade and more ago, British planners were dealing with several important unknowns. It was uncertain how work on fission reactors would go, and there was considerable worry in Britain about the adequacy of supplies of atomic fuel, particularly enriched uranium. Fusion research, therefore, looked attractive, although it was not possible to anticipate difficulties that were to arise.

In his statement on Culham in the House of Commons, Benn said, "Since the decision to start fusion research, rapid progress has been made towards economic nuclear fission power. In particular the fast breeder reactor program shows real promise. Consideration of this program in relation to the earliest period when fusion could conceivably contribute to the power program leads inevitably to the conclusion that plasma physics and fusion research should be substantially reduced."

The minister's statement was foreshadowed in March by remarks made to the Parliamentary select committee on science and technology by the retiring chairman of the AEA, Sir William Penney, who said, "The fast reactor now looks so attractive that there is enough power to be got from uranium for I don't know how many, possibly 100 years. So fusion if it is to be used even during the next century has to come in because it is *cheaper,* not because there is a shortage of fuel."

Asked about Culham, Penney put his reply in the form of a rhetorical question. "Should we take what is in fact a very fine engineering establishment and, because it is not going to produce a fusion device in our lifetime, should we say: 'We give this up'? Do we or don't we? I don't know."

The government hasn't given up on Culham. In his statement Benn noted that circumstances can alter fast in the realm of advanced technology, that the AEA would keep the matter under review, and that the decision would be reexamined in 5 years. Some suggest, however, that the same thing may happen at Culham, after a 50-percent cut, that would have happened had Solomon's verdict on cutting the baby in half been carried out. There are doubts that, with the staff of 800—about a quarter of them professionals—reduced by half, the laboratory can maintain its momentum. Culham has been notably free from brain-drain problems up to now. Other countries, including the United States, are expanding research on controlled fusion and it would not be surprising if some recruits were to be found at Culham.

Some observers think that the Culham action heralds a radical reshaping of government policy on R & D in Britain. A favorite theme of both Prime Minister Harold Wilson and Minister of Technology Wedgwood Benn has been the necessity of mobilizing British scientific and technological resources in support of the country's ailing economy.

Some things have been done in the way of diversifying research in the manpower-rich AEA and of encouraging industry-oriented research elsewhere in the government scientific establishment, but the measures up to now have been relatively gentle ones. Benn's warning that he does "not intend to authorize nonnuclear work for the Atomic Energy Authority solely in order to absorb surplus staff at Culham or elsewhere" strikes a tough new note and could signify a harder line in government use of its budget and program powers to effect a redeployment of scientists and engineers into applied research. Given the traditional attitudes of British scientists toward applied research, this may mean that storm signals are going up for British science policy.

—JOHN WALSH

Ionosphere after IQSY: London Meetings Review Findings

London. The F-region of the ionosphere is now becoming fairly well understood, and the outstanding problems are yielding to theoretical treatment. The new explanations often involve large-scale movements of charged particles in the upper atmosphere. Attention will now turn to lower layers (the D-region and below) where recent studies indicate unexpected interactions between the ionosphere and the stratosphere. These views were set forth by S. A. Bowhill of the University of Illinois, the last of a group of nine ionosphere physicists who summarized conclusions from measurements made during the International Years of the Quiet Sun (IQSY 1964–65). The occasion was the symposium on the results of the IQSY, held in London from July 17 to 21.

The Committee on Space Research (COSPAR) postponed its annual plenary meeting to run concurrently with the London IQSY assembly; evidence both of the contribution of rockets and satellites to the work of the IQSY and of the interest in solar-terrestrial physics that dominates current space science. Of the various research topics discussed at the combined meetings, the ionosphere accounted for the greatest number of papers. Sounding rockets, satellites (including topside sounders for studying the ionosphere from above the electron maximum), and, most recently, parachute-borne probes have provided new ways of looking at the ionosphere. Indeed, K. Rawer of the Ionosphere Institute, Breisach, West Germany, complained that the planetary network of ionosphere ground stations had not evolved to meet the many needs of the space era.

The ionosphere is a sensitive indicator of changes in solar-terrestrial relationships during the solar cycle: The amount of ionization, the variation with latitude, and the patterns of diurnal change in the ionosphere are all affected by events on the sun. The temperature of the F-region at middle latitudes has proved a reliable indicator of solar activity. Nevertheless, research during the recent period of solar quietude has been as much concerned with continued study of general features of the ionosphere as with solar-cycle investigation. The presentations at the IQSY symposium were not limited to the calendar years nominally under discussion.

Bowhill's provocative suggestion that the F-region phenomena were virtually explained followed brisk disputes between the participants about the relative importance of neutral winds, electric forces, and diffusion in moving the electrons about at different places and times. To have a choice of mechanism for vertical movements is certainly better than to have none, and makes several anomalies in the behavior of the F-region less perplexing. Moreover, as H. Kohl of the Max Planck Institute für Aeronomie emphasized in a theoretical paper, neutral winds and electromagnetically controlled drifts of ionization are intimately connected. For example, vertical drifts due to electric fields must be reduced by interaction with the neutral air. On the other hand, winds produced by pressure gradients in the atmosphere will drive the ionization along the local lines of force of the earth's magnetic field, which generally have a vertical component; as a result, the wind is subject to frictional drag.

For J. W. King, of the Radio and Space Research Station, Slough, England, the neutral winds provided sufficient explanation for some important vertical drifts. Winds of 150 meters per second give, for example, vertical drifts of about 75 meters per second at middle latitudes. In the F-region, the neutral winds blow constantly across the poles, from the late-afternoon meridians to the early-morning meridians, preserving that direction in space as the Earth rotates underneath. At night, therefore, the wind components parallel to the lines of force act toward the equator (from north and south) and upward, lifting the ionization to heights at which recombination is less likely. This mechanism helps to preserve the ionization at night. In the early afternoon, the wind components are reversed and sweep the ionization downward into regions where recombination is greater. This movement explains, according to King, the so-called "bite-out" of ionization, lost at a wide range of middle latitudes after midday. Calculations by Kohl and King of diurnal ionospheric changes at a given location (Port Lockroy), based on this theoretical interpretation, accord well with the observation. And in the ionosphere over Antarctica, the upward and downward motions are conspicuous, as the magnetic pole revolves around the geographic pole.

Other F-region vertical movements have been well explained by electromagnetic forces. In particular, workers in the United States and Britain arrived at an explanation of the rise of the "equatorial arch," discovered in the data from the topside sounding satellites. This arch is a large region of enhanced electron concentration following the lines of the geomagnetic field, and it rises through the F-region during the day. The phenomenon can be understood as a combined effect of the geomagnetic field and a horizontal electric field oriented east-west