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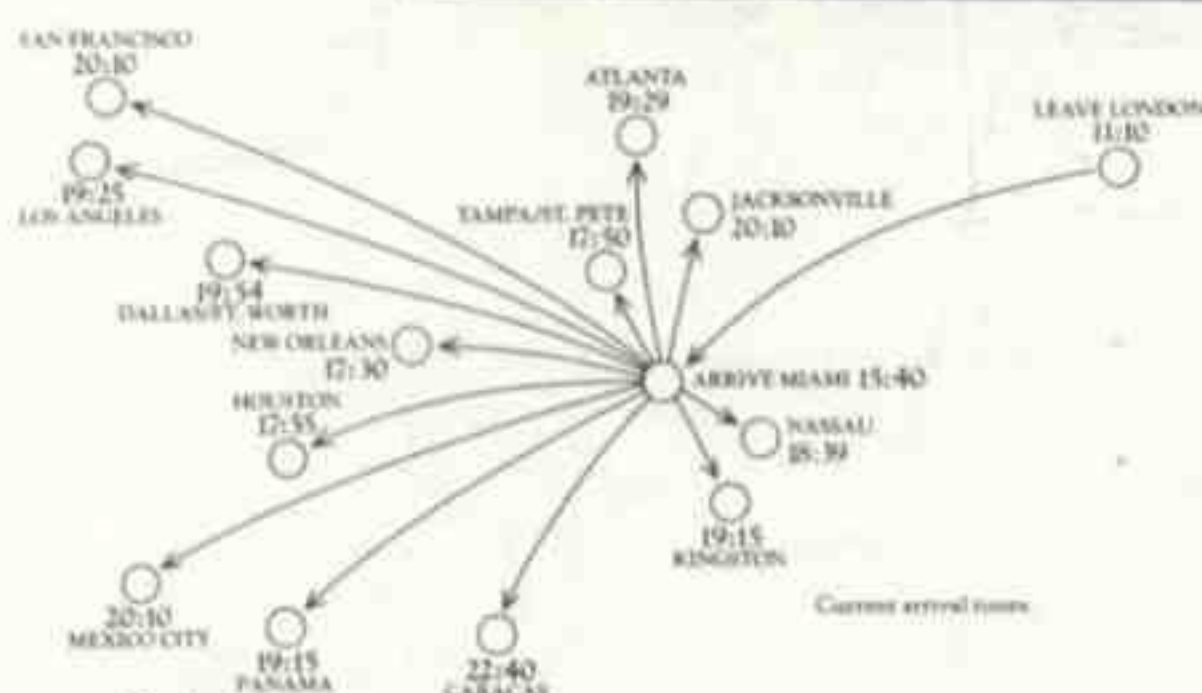
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This One



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What's cold and wet and keeps you warm when it's cold and wet?

The answer to this apparent paradox is liquefied natural gas.

A good way of storing natural gas is to freeze it to -160°C , at which point it becomes a liquid and much easier and more economical to store.

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It will store up to 20,000 tons of liquid gas while the weather's reasonably warm and people are not using so much gas. Then this will be available to boost supplies when the temperature drops.

This plant at Glenmavis, in Lanarkshire, is one of the first in Europe.

The British gas industry were also pioneers in the shipment of natural gas.

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feasibility of shipping natural gas. It proved a success and the Methane Princess and Methane Progress have been bringing supplies from Algeria to Britain for several years now.

It's all part of the progress story of gas. But progress is only part of the story of gas.

Gas promises a brighter, warmer future and more and more heat for everyone.

GAS-THE NATURAL FUEL

Comment

Incendiary weapons: legality and prohibition

The quantity of napalm (jellied petroleum) used in the current war in Indo-China during the past 10 years now well exceeds 338 000 tons—more than 10 times the amount used in the Korean War, and almost 25 times as much as was used during the Second World War—according to a report just published by the Stockholm International Peace Research Institute (SIPRI). Prepared by Dr Malvern Lumsden, research fellow of SIPRI, the report examines the legal, political and humanitarian issues raised by the use of incendiary weapons, and is intended to serve as a background document for the forthcoming discussions on these problems in the Conference of the Committee on Disarmament (CCD), the UN General Assembly, and elsewhere. It concludes that the use of napalm, and indeed of other incendiary weapons, is a direct contravention of the fundamental principles of the international laws of war—for two reasons. First, napalm causes unnecessary suffering, considerably in excess of the requirements for preventing a soldier from carrying out his mission. From the data available, it appears that, apart from those incinerated in the immediate fireball resulting from a napalm attack, 35 per cent of those hit by burning drops of napalm die within 30 minutes. Depending on the hospital facilities available, perhaps as many as 50 per cent more will die a slow and painful death within the following six weeks. Even under ideal treatment conditions, only some 10 to 15 per cent of burn casualties will recover, of which many will be permanently deformed or disfigured. This characteristic of napalm therefore makes its use directly contrary to the customary principle that weapons should not be calculated to cause unnecessary suffering.

The second characteristic of napalm which makes its use legally questionable is that it is an indiscriminate weapon. Because it is often difficult to locate and hit a particular military target directly, there is a strong military demand for weapons intended to cover and affect everything within a large area, including, but not restricted to, the target. Fire is particularly applicable as an area weapon because no other weapon, with the exception of biological weapons, has the capacity for self-propagation. Thus incendiary weapons are particularly liable to affect indiscriminately both combatants and civilians, in contravention of the principles of international law.

Although, under the terms of existing conventional international laws of war, the use of incendiary weapons is not unequivocally prohibited, conventional law does contain a number of important precedents with relation to such weapons.

The humanitarian considerations which inspired these and other past legal formulations retain their force today. But international law has not developed at the same rate as military demands or practice. Prohibition of all in-

cendiary weapons may be an appropriate first step in a general move towards re-establishing the primacy of humanitarian constraints over the demands of military convenience.

The SIPRI report outlines three possible approaches to a prohibition of incendiary weapons. First, the International Committee of the Red Cross in Geneva is at present updating the 1949 Geneva Conventions, which, although attempting to codify the field of humanitarian law of armed conflict, stopped short of covering all aspects of human rights in armed conflict. (The Draft Rules of 1955 were one of the steps which have been taken to extend the provisions of the conventions, but their effect was minimal). A diplomatic conference to agree on an additional protocol will be held in 1974, and government experts have made a number of proposals to expand the paragraphs relating to weapon use. These paragraphs could be further strengthened by specifying prohibited means and methods of warfare. As an additional step, it is suggested that a review body be established to monitor developments in weapons technology, so that potentially inhumane and indiscriminate weapons be prohibited before they enter into active service.

While agreeing that the ICRC is competent to deal with humanitarian issues raised by the use of incendiary weapons, another school of thought believes that the appropriate forum for discussing disarmament (including prohibition of production and stockpiling) in this context is the CCD, also in Geneva. The forerunner of the present conference drew up a draft convention which included the prohibition of "chemical, incendiary and bacteriological weapons" in 1933, a prohibition which should be re-examined, either together with chemical weapons, or separately. The first priority seems to be for a prohibition on the use of incendiary weapons to be written into the Geneva Conventions. Simultaneously or subsequently, a specific disarmament treaty, aimed at prohibiting the production, stockpiling, trade and so on of such weapons might be negotiated.

Third, although the Hague Conferences of 1899 and 1907 drew up laws of land warfare and of sea warfare, the draft rules of air warfare (1923) were never ratified. Indeed, there is at present no law of air warfare. Yet the most indiscriminate uses of most incendiary weapons are those where civilian populations are bombarded by air, so the need for international rules of air warfare are more pressing today than ever before. Without them, individual nations are unlikely to draw up legal manuals constraining the conduct of air war by their own forces. There is every reason for some government to take the initiative by summoning an international diplomatic conference to draw up laws of air warfare.

John Stares

Victims of poor planning

The British government has finally agreed to partially compensate the victims of noise and disruption caused by motorways and airports, but has declined to force its planners to minimise these environmental disturbances in the first place. Thus the White Paper issued last week, *Development and Compensation—Putting People First* (Cmnd 5124), is both significant and disappointing. It

admits for the first time that motorways and other public works have an impact on people other than those actually displaced; the government will require compensation for some of the nuisance suffered and permit land not actually needed for the road to be taken on environmental grounds. It will increase the cost of urban motorways by 15 to 20 per cent and cost £35 million/year.

But even this price is the cheap way out. The White Paper declares: "Heretofore, some of the wider results of development, such as severance of community and loss of amenity, have been paid for by the people whose properties have been adversely affected. In future, *more* of these costs must fall on the community at large." Not most or all, just more.

Issued with the White Paper and approved as "the right general policy" is the report of the Urban Motorways Committee, *New Roads in Towns*. The report stresses planning and warns that "it is doubtful whether a compensatory approach alone would be acceptable." The White Paper emphasises compensation; planning is talked about only in generalities.

Noise is the environmental aspect of motorways best understood, and it is the one where money will be offered based on specific levels. It also provides a good example of the values and limitations of the government approach. Last year, the government accepted the recommendation of its Noise Advisory Council (NAC) that the loudest desirable noise level outside a house was 70 dB(A) on the L_{10} scale (the level exceeded 10 per cent of the time between 6 am and midnight). Ordinary windows cut sound about 15 dB(A), so this leads to an inside L_{10} level of 55 dB(A). The White Paper requires grants for sound insulation—generally double glazing—if this level is exceeded, despite motorway committee protests that it was too high. The Wilson Report of 1963 recommended 50 dB(A) inside during the day and 35 dB(A) in bedrooms at night.

The 70 dB(A) level was selected because it is the one at which only half of the people are dissatisfied. Inside the house it means that a person speaking in a normal voice can be heard at 3 m, while outside he can only be heard

at $\frac{1}{2}$ m. Inside, the television must be turned up slightly louder than normal to be heard comfortably and sleep is slightly disturbed.

The choice of levels is critical. The Road Research Laboratory predicts that by 1980, 30 per cent of the urban population will be subjected to L_{10} traffic noise of over 70 dB(A) and twice that number over 65 dB(A).

The danger with the government's stress on compensation over planning is that the compensation level becomes the design standard. For example, the Road Research Laboratory cited the NAC L_{10} level of 70 dB(A) as the measure of success of an experimental noise barrier on the M4 at Heston which reduced the noise outside nearby houses from an L_{10} of 76 dB(A) to 69 dB(A).

The Urban Motorways Committee called for a complete reversal of the fact that "little if any account is generally taken of indirect costs in working up road plans." Instead, planners should clearly specify the indirect effects and numbers of people involved, and that more advanced cost/benefit and cost effectiveness techniques be used to calculate social and environmental costs. These are not mentioned in the White Paper.

Although groundbreaking in theory, the White Paper in practice is just the minimum that is politically acceptable in an environmentally conscious time. The Urban Motorways Committee warned that "the addition of the environmental costs in the appraisal of new road proposals may remove the justification from some of them." So the government has chosen to ignore some of those costs. When the pretty words are removed, the White Paper says that people living near motorways must be pacified so we can get on with the building of new ones. And the noise won't be too bad if they don't use the garden or open a window.

Joseph Hanlon

Perils of secrecy

Members of the UK Select Committee on Science and Technology now have copies of the Docksey report on the future of the National Research Development Corporation (NRDC). While this may be seen as a minor triumph for the doctrine of open government, the act itself has little to commend it. Docksey is one of three reports concerned with high-technology industry which the government has repeatedly refused to make public on the ground that such departmentally commissioned documents are its business alone, and are not related to anything Mr Heath may have been talking about when he promised more open government. Airey Neave, chairman of the Select Committee, has shown considerable determination in trying to get at such material when it falls within the field of interest of his committee. It appears that he has succeeded in the case of Docksey; unfortunately, this success may be no more than a Pyrrhic victory.

Last Thursday, during the traditional weekly session in the House of Commons on business of the House, Tam Dalyell raised the question of limited release of the Docksey Report with Robert Carr, who is, *inter alia*, Leader of the House. "It seems", said Dalyell, "that there is, perhaps, an issue here as to whether some Members ought to get a report which is denied to others, and an issue whether there are perhaps first-class and second-class Members of the House." Carr asserted that "These matters are difficult", and then slid round the issue by suggesting that it was existing practice to let Members of Select Committees obtain information in advance of the whole House. This reply was not good enough for Michael Foot. "Some of us", he said, "feel a new principle may be involved in regard to the circulation of documents to a Select Committee. We appreciate that confidential documents are in a different category, but this matter relates

to a government report, the circulation of which is another matter."

At this point, Sir Harry Legge-Bourke, a member of the Select Committee, intervened with the information that what the committee had obtained was "not a totally unexpurgated edition of the report concerned". He went on to point to the "backlog of Select Committee reports and the government White Papers on them, which are overdue. This is beginning to put in jeopardy the whole system of Select Committees."

Select Committees on specialist subjects are still tender plants, and can be damaged easily. Sir Harry was right to point to the possibility that they may die from governmental neglect. However, the Docksey case raises another danger. If the Honourable Members get it into their heads that there are first- and second-class MPs, it may not be beyond them to destroy the Select Committee in a fit of egalitarian pique. Unless the government itself wishes to destroy the Select Committees in an underhand manner, it has behaved very badly in handing out lollipops (and, apparently, partly sucked ones) to the Select Committee. This is not to suggest that it would have been better to keep the report secret. However, the government should have made a clear public statement about the course of action it was taking and why. In the interests of the Select Committee on Science and Technology, it would seem right that Airey Neave should make good the lack of thought from those members of his own party who form the government by issuing a statement on the committee's behalf about when it received the report, whether it is satisfied with the mutilated condition in which it received it, and what the committee's attitude is towards receiving such documents—in particular if it will permit itself to be gagged by them.

Martin Sherwood

What new initiatives can local authorities take to resettle Ugandan Asians?

How can the CBI persuade the TUC that voluntary price restraint can be effective?

How will the current wage demands from the Public Sector affect wage claims from other groups?

Etcetera.



**The more you think about October,
the more you need The Times.**

Monitor

Diet halves heart-disease deaths

The results of a massive study—"based on a total of 29 217 person-years of experience"—into the effect of a cholesterol-lowering diet on deaths from coronary heart disease have just been published in *Lancet* (vol II, p 7782). The Helsinki group responsible for the survey, conducted in two mental hospitals over a 12-year period, is regarded as among the best of the several teams involved in long-term investigations of the effect of diet on heart disease. The new results from Helsinki go a long way toward finally clinching the argument that the risk of death from coronary heart disease in men can be significantly lowered—in fact in the present study, just about halved—by the adoption of simple dietary precautions. Moreover, the study lays the unpleasant ghost conjured up last year that a diet aimed at preventing heart disease simply increases the risk of death from cancer.

Matti Miettinen, Osmo Turpeinen and their colleagues argue that previous studies on dietary manipulation and heart-disease have contained few data on mortality—the "hardest" end-on point upon which the interest of coronary heart-disease can be assessed. Their present paper looks at deaths from all causes that occurred in the two mental hospitals that contain their sample population. Over the 12 years of the survey, each hospital has had six years of a normal diet and six years of a cholesterol-lowering diet: from 1959 to 1965, hospital A received the control and hospital B the experimental diet, while from 1965 to 1971 the diets were reversed. The cholesterol-lowering diet was straightforward: ordinary milk was replaced with an emulsion of soybean oil in skim milk, and butter and ordinary margarine were replaced by a "soft" margarine with a high content of polyunsaturated fats.

For the men in the total population, the results were clear-cut. The switch from normal to experimental diet in hospital A halved the number of deaths from coronary heart disease, while the change back to a normal diet in hospital B doubled the mortality from heart disease. For women inmates the data were less consistent, the death rate increasing upon the switch from experimental to normal diets but the expected reverse change failing to materialise (possibly because of a change in the admissions policy of one of the hospitals).

A further important result of the Helsinki study was the slight but not statistically significant decrease in deaths from any cause in the patients receiving the experimental diet. In particular, there was no increase in deaths from cancer in the experimental population; this is in contrast to a Los Angeles survey published last year which suggested that a diet rich in polyunsaturated fats, while cutting mortality due to coronary heart disease, increased the risk of dying from cancer.

First results from new Cambridge radio telescope

Within a few days of the official opening ceremony, the first trickle of new radio maps from the Cambridge Five-Kilometre telescope has appeared in this week's *Nature*. When the trickle turns into a flood, sometime in the next year or so, the high resolution pictures will be important for distinguishing between various models of radio galaxy evolution, and perhaps give insight on the formation of new stars inside huge gas clouds.

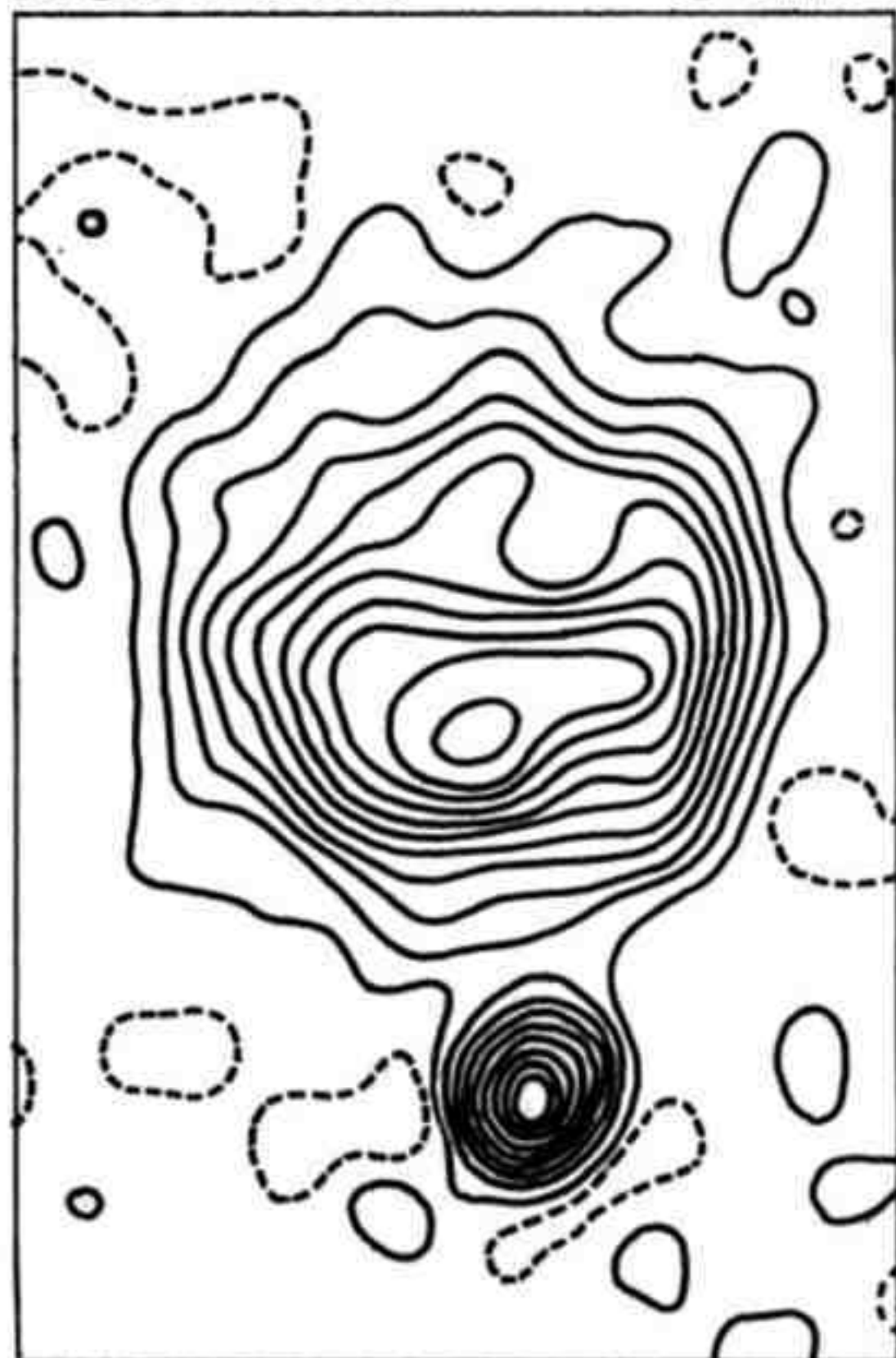
Included in the sample batch are two extragalactic radio objects, 3C 86A and 3C 295, neither of which

could be resolved properly with previous instruments. It is not known whether 3C 86A is associated with a quasar or radio galaxy, but the more detailed diagrams will enable astronomers to search for a suitable candidate. 3C 295 is of interest because it has a larger redshift than any other galaxy (although quasar redshifts are larger still of course), and the Cambridge maps show it consists of two compact components separated by 4.5 seconds of arc.

Since the discovery of molecular-line and infrared emission from gas and dust clouds in the Galaxy, radio astronomers in general have shown an increased interest in galactic sources. One of the maps illustrates the radio contours of NGC 7538, a galactic hydrogen cloud. Besides extended emission from the main cloud, there is an intense compact source at the bottom of the map. This could well be a region where newly-formed stars exist, and are exciting the gas cloud into intense radio emission.

During the construction of the telescope, American observers announced the discovery of radio waves from the bright star Algol (see "Eavesdropping on the stars", by Dr Simon Mitton, *New Scientist*, vol 53, p 638). This development has allowed the Cambridge researchers to calibrate their radio coordinate system to better than 0.1 seconds of arc, relative to Algol; the results are in excellent agreement with the exacting measurements made by the Ordnance Survey. Already the position of Cygnus X-3 has been measured to within 0.15 seconds, and this will assist the bid to identify the X-ray star with an optical object.

NGC7538 5GHz



A mythical rabbit hops on the skin

The impression of a tiny rabbit hopping up one's arm from wrist to elbow—and even up one arm, around the back of the neck and down the other—is the baffling perceptual illusion described in the latest *Science* (vol 178, p 178). Frank Geldard and Carl Sherrick of the Cutaneous Communication Laboratory at Princeton University discovered this strange phenomenon in the course of designing some experiments in cutaneous perception. They found that, under some conditions, the taps given to the skin on the back of the forearm by small mechanical contactors appeared to "escape" from the actual point at which the contacts were made. For instance, if five brief pulses are given to the back of the wrist, five more to the middle of the forearm and five more at the elbow, the result is a smooth progression of taps up the arm, "as if a tiny rabbit were hopping from wrist to elbow."

Further study of the phenomenon showed that the rabbit could hop down the arm as well as up; that two rabbits could hop both away from and toward each other (the latter resulting in a "rabbit collision"); and that two contactors on each arm and one at the nape of the neck could result in the rabbit hopping the complete course from wrist to wrist. The best interval between taps, for which the hopping "is optimal in regularity and vividness", is between 40 and 60 milliseconds. Moreover, the phenomenon persists even if small electric shocks are substituted for the mechanical taps: as Geldard and Sherrick put it, "The rabbit could not be electrocuted". The Princeton workers confess themselves mystified by the rabbit: *Monitor* will gladly pass along any readers' explanations.

Gravity appears in a repulsive light

Gravitation, the oldest-established of the fundamental physical interactions, remains full of surprises: following a recent speculation upon the existence of the graviton—the hypothetical quantum of the gravitational interaction—and Joseph Webers' exciting experimental work on gravitational waves (see *New Scientist*, vol 48, p 122), a recent report from the University of Texas examines the possibility that the force may exhibit repulsive features. Such a suggestion is a direct break with previously held views on gravitation, which maintain that the interaction can only manifest itself as an attractive force between massive bodies.

A paper published earlier this year by C. Chiang and A. E. Hwang (University of Texas report, CPT-146) indicated that a new solution of Einstein's gravitational field equations provided for a short-range repulsive component in gravity. Now Chiang, Hwang and J. Dykla, have examined more fully the consequences of such an effort on macroscopic, presumably gravitationally bound, systems such as globular clusters and pulsars. They find that the new solution is consistent with existing observational data on these bodies. In addition, their results show agreement with the more conventional Schwarzschild solution as far as the two

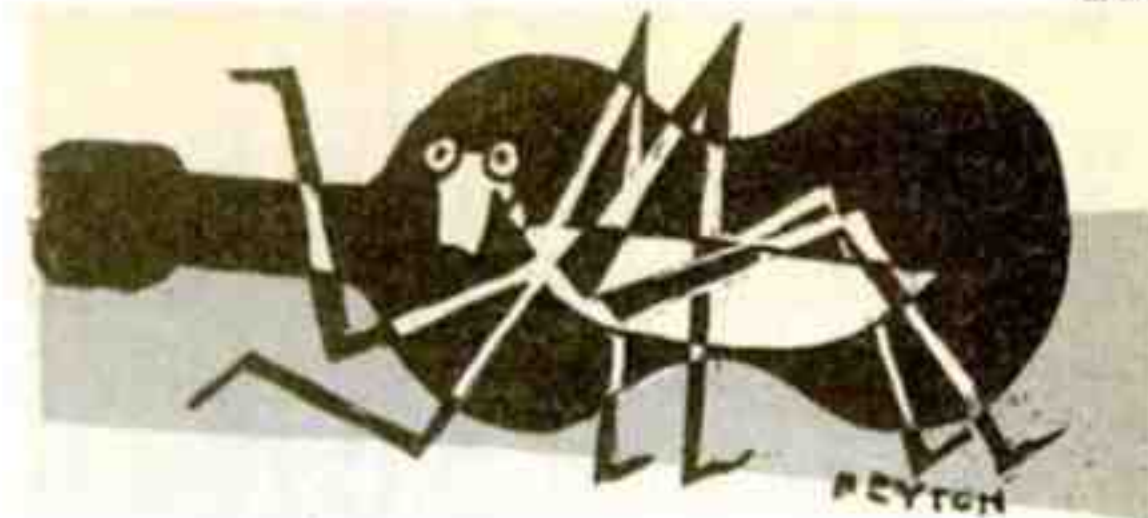
major tests of general relativity theory are concerned—the bending of light by massive bodies, and the perihelion-advance phenomenon.

The paper is unfortunately lacking in possible experimental tests of its basic hypothesis: nevertheless, the possibility of a repulsive gravitational component is such a radical suggestion that, no doubt, further work of this nature will be forthcoming.

The Menuhin of the insect world

Crickets and other stridulating insects are better known for the sheer volume of their songs than their virtuosity. By stroking a scraper on one forewing against a file on the other, the great majority of such insects produce a single, rasping, monotonous song. But a katydid described in *Science* (vol 178, p 174) by Thomas Walker and Donald Dew of the University of Florida possesses an imaginative repertoire of four distinct movements, or "phonatomes".

Each phonatome is produced by a single cycle of wing action. The song begins with a 70 millisecond burst of 50-80 repeats of phonatome I, each produced by a rapid opening of the forewings and a slower closing, with a brief hesitation toward the end of the "down-bow". Next come 7 to 12 type II phonatomes—the most ambitious of the song's



components. Each type II phonatome starts with a rapid opening, followed by a silent close-open movement which spreads the wings even wider. There follows a fast closing movement, with a longer pause in the middle than the hesitation in the type I phonatome. The third movement consists of a repeated series of type III phonatomes, each a relatively straightforward open and close. The song ends with a burst of sharp double clicks, produced in a manner which Walker and Dew's high-speed camera cannot capture.

From the tone of their paper, the Florida workers are obviously quite pleased with their analysis. "Those working with simple movements in one-or-two phonatome species", they remark wittingly, "should note the challenge that remains". And in reference to the fact that the insect in question—Uhler's katydid—produces its complex song from a quite straightforward instrument, they are also scornful of "those taxonomists who have assumed that the distinctive features of the song can be deduced from the stridulatory apparatus".

Anaesthetics hamper a walking model of a nerve cell

It is not entirely by accident that one developmental biologist is often heard to refer to the cellular slime moulds absently as slime models. Many embryologists have believed for years that if they could discover how slime mould amoebae manage to migrate into a heap, organise themselves into a microscopic slug, and finally differentiate into vegetative stalk cells and polysaccharide-coated spores, they might gain some insight into how a fertilised egg organises itself into a sea urchin—or even a man. But now it seems that it is not only embryologists who regard slime moulds as a promising model organism. R. A. Wiklund and A. C. Allison, at the MRC Clinical Research Centre in Harrow, see them as walking models for nerve cells; and they have used *Dictyostelium discoideum*, which for some reason is a particularly popular variety to test a theory about how anaesthetics might work (*Nature New Biology*, vol 239, p 221, 1972).

What slime mould amoebae and nerve cells have in common (for the purposes of Wiklund's and Allison's experiment) is that they both use microfilaments. The slime mould amoeba uses them to put out pseudopods, which is how it gets around, and the nerve cell is believed to use them to release neurotransmitter, which is how it communicates. Wiklund and Allison reasoned that if, as they suspect, anaesthetics silence nerve cells by interfering with neuronal microfilaments, then they should also immobilise slime mould amoebae.

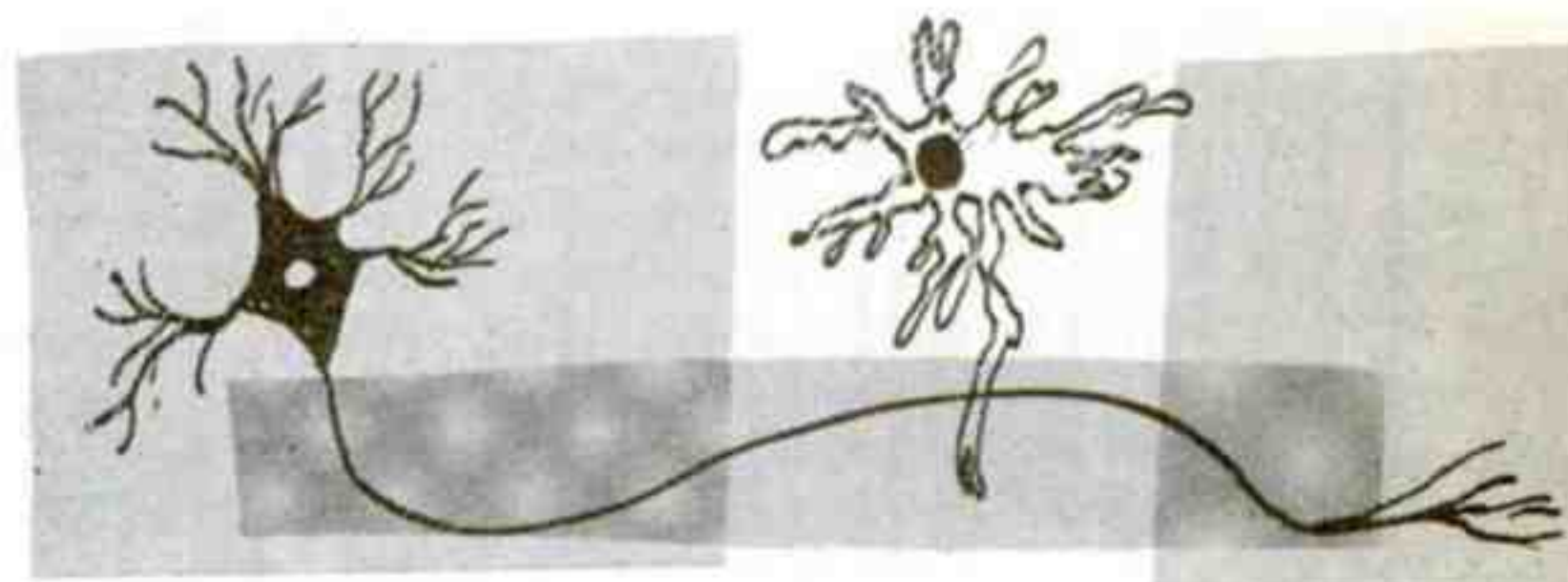
Wiklund and Allison accordingly took time-lapse movies of *D. discoideum* amoebae while bubbling various anaesthetic gases—halothane, methoxyfluorane, cyclopropane, chloroform and ether—through their watery environment. Under the influence of these agents, the sprawling, crawling amoebae lost their pseudopods and settled down in globular fashion. On withdrawal of the gas, they started off again.

The success of *D. discoideum* as a model nerve cell comes hard on the heels of its success earlier this year as a developmental paradigm. Anthony Robertson and his colleagues at Chicago finally managed to demonstrate that the amoebae form into a slug under the control of waves of a pulsatile

signal propagated from one amoeba to another in a way which fits in nicely with one of the two main theories about how embryonic development is controlled. And in a recent talk for the Institute of Biology, Robertson (who is actually a neurophysiologist turned developmental biologist) managed to link the two roles of this versatile model organism.

His synthesis is based on a number of parallels between the nervous system and the amoebae when they are aggregating into a slug. Both use diffusible transmitters which are released in packets of constant size and which are fairly promptly destroyed by an enzyme. (This last refinement prevents them from signalling backwards and forwards simultaneously.) Moreover, both aggregation in slime moulds and development in the nervous system involve the migration of cells; and, as Wiklund and Allison point out in their paper, microfilaments play a part in the outgrowth of developing nerve fibres as well as in the production of amoebal pseudopods. Robertson argues from considerations of this sort that the highly specialised mechanism for transmitting signals in the nervous system could actually have evolved from developmental control systems.

It seems that all the slime mould needs to make it the ideal all-purpose, grant-getting, Nobel prize-winning research organism is a role as model tumour in cancer research. And last year at the Lepetit Symposium, Professor Morrel Cohen, who works with Anthony Robertson in Chicago, suggested that, too.



A Soviet search for harbingers of earthquakes

There is still no known fore-runner of an earthquake which occurs at a sufficiently definite interval before the tremor to allow accurate prediction. That was the negative conclusion of a recent discussion among seismologists, mainly from America, Japan and the Soviet Union, recorded in a special issue of *Tectonophysics* (vol 14, nos 3/4). But they are still trying.

Mankind has long had some notion of the pattern of world-wide seismicity on a basis of historical destructive earthquakes. Much of the detail in our current image of the distribution of tremors has, however, been built up only in the last decade or so. Such a time is too short to allow the picture to be complete, since unreleased strains may continue to build up over a much longer period. The concepts of plate tectonics are certainly tied up with the global pattern of seismicity and are of some help in the problem, but often the stresses involved may be related to much more localised movements.

Workers from the Schmidt Institute of Physics of the Earth in the Soviet Academy of Sciences, are making a continuous study of the Garm region, about 150 miles south of Tashkent (M. A. Sadovsky and others, *ibid*, p 295). They see the problem as breaking down into three stages: long-range forecasting; short-range forecasting; and operational forecasting. The first stage consists of predicting the most probable locations of strong shocks likely to occur within the next few years. This is of importance so that those geophysical instruments which can help predict with greater precision the time and magnitude of the coming event may be deployed most effectively. The three criteria they reckon to be of most use in long-range forecasting are: the increase of weak seismic activity, as measured by a permanent seismometer station; any change in the relative movement rates of bench marks, as monitored by repeated surveying, and—perhaps the most reliable—the aligning of the directions of slip movement of weak tremors, as deduced from seismogram records made at several observatories.

In attempts at short-range forecasting, earthquake researchers still use seismograms in attempts to recognise even subtler changes in the pattern of small events. They are, however, turning to other methods—investigating small changes in the magnetic field, in the electrical conductivity of rocks and in earth temperature gradients. Even variations in the radon content in thermomineral wells appear to be of some significance, possibly due to the release of that gas in larger quantities by minor fracturing in the rocks (Figure 1).

While the Soviet scientists claim to be able to predict the timing of earth-

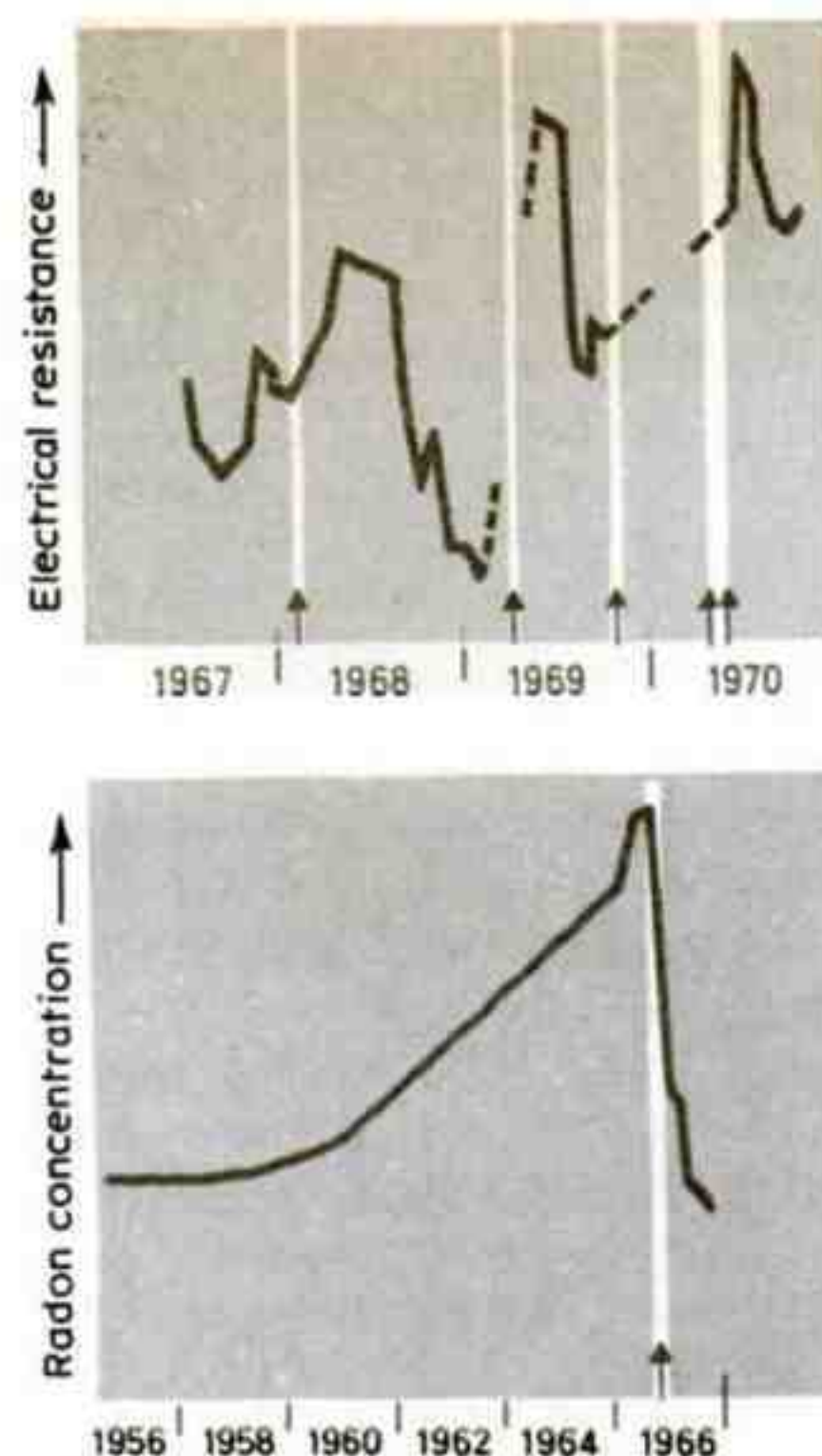


Figure 1 Soviet results show (left) a drop in crustal electrical resistance preceding each of several strong earthquakes (arrows); and (right) a rise in the radon content of a well prior to a shock

quakes in the Garm region to within a month, they admit that accuracy of this order is quite inadequate as far as the human situation is concerned. They hope that their future efforts may allow true "operational forecasting" on a time scale shorter than 24 hours.

From a more publicised part of the world with a rather different seismic pattern, workers at the National Center for Earthquake Research, California, report progress on the experiment under way at Rangely, Colorado. Here J. H. Healy and his co-workers have deployed a dense array of seismograph stations in the vicinity of an oil field while pumping in four injection wells alters the fluid pressure in rocks at depth. When the fluid pressure is higher, so is the number of small earthquakes, particularly near the bottom of the experimental wells (Figure 2). Their observations raise hopes that strain building up along the San Andreas fault may

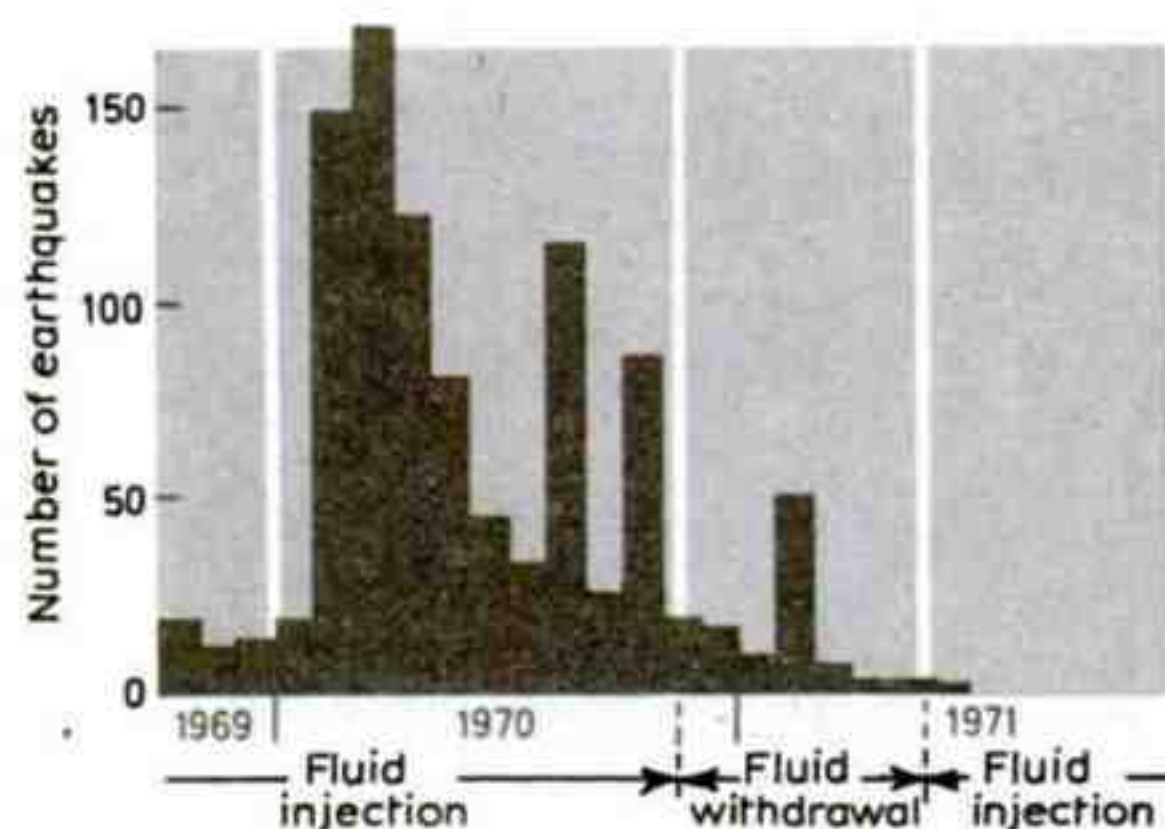


Figure 2 Injecting water into the strata at Rangely, USA, decreases the seismicity

be released gradually in a like manner by the drilling of holes and the injection of water along small sections of the fault in turn.

If this method were to work, the Californians might well lose interest in earthquake prediction. In a way, that would be sad, because such methods of "controlled lubrication" could only ever be feasible in regions where the destructive earthquakes occur at shallow depth (around 10 km). In many other parts of the world, such as the west coast of S. America, the earthquakes are largely deep-seated (up to 500 km) and quite beyond the reach of any artificial lubrication. In such areas, the only hope of mediating disasters like that of the Peruvian earthquake of 31 May 1970—which killed around 50 000 people and did damage comparable in value to the yearly national product of that country—lies in the development of accurate prediction.

Where the groaning Earth quietens down

Seismologists are so busy attending to specific events such as earthquakes or nuclear explosions, that they have not had a lot of time just to "listen in" to the background creakings of our planet which go on the whole time. But five geophysicists from the Lamont-Doherty Geological Observatory at Columbia University, New York, have been doing so on a world-wide basis with equipment designed to look at the long period "noise" which the Earth generates (*Journal of Geophysical Research*, vol 77, p 5042). They find that the spectrum of this noise is remarkably constant in both space and time and that, at the six stations they set up, it displays an apparently ubiquitous minimum—a spectral "window"—for seismic waves with periods between 30 seconds and 40 seconds.

Andrew Murphy and his colleagues devised a special detection system to overcome problems of instrumental and local environmental noise which, in the past, have bedevilled observations of these slow waves. Their prototype instrument, at Ogdensburg, New Jersey, produced a satisfactory performance limited only by Earth noise and they went on to set up stations in Alaska, Australia, Israel, Thailand and Spain. They selected records free from earthquakes and showed that the power spectra for both horizontal and vertical Earth noise were strikingly alike from all stations. Moreover the absolute noise levels agreed to within 10 decibels for vertical, and 18 db for horizontal, noise. The 30- to 40-second minimum, they say, appears "to be nearly worldwide in occurrence". It could prove invaluable to seismologists keeping a watch on underground nuclear tests and anxious to distinguish them from natural Earth tremors.

Pigeons fly home with frosted specs

The way pigeons find their way home is perhaps the hardest problem in animal navigation, and the emphasis of its human investigators has latterly swung away from the idea that the birds simply look where they are going and toward their use of more subtle navigational cues such as the position of the Sun and the Earth's magnetic field. K. Schmidt-Koenig of Duke University and H. J. Schlichte of Göttingen University, West Germany, have recently obtained dramatic evidence that pigeons can find their home lofts without being able to see by fitting the birds with frosted contact lenses (Proceedings of the National Academy of Sciences, vol 69, p 2446). The initial orientation of the experimental birds upon release was as good as that of controls. And while, perhaps not surprisingly, their homeward flight was often bizarre, a number of the birds actually made it right into the loft—a performance the authors rightly call "astonishing."

Experimenters stride ahead in positronium measurements

Experimental physicists are continuing to give their theoretical colleagues a hard time in the bid to measure very precisely the energy levels in simple particle systems, such as hydrogen, and muonium (see Monitor, vol 55, p 423, and vol 56, p 72). Four physicists from the Gibbs Laboratory, Yale University, have determined the fine-structure splitting of positronium with substantially smaller error than previous experimenters achieved. They conclude that the theorists must now undertake further difficult computations to explain the results. (Physical Review Letters, vol 29, p 1059).

The interest in finding the energy splitting of positronium to within a few parts per million centres on the fact that such measurements afford a sensitive test of "applied" quantum electrodynamics. At Yale the purpose of the positronium experiments is to check the equation devised by Hans Bethe and Edwin Salpeter to describe a bound electron-positron pair. Correction terms that involve high powers of the fine-structure constant and the Rydberg constant are uncertain, a feature shared by the experiments already described in Monitor.

A large electromagnet producing a highly homogeneous field of nearly eight kilogauss forms the centre-piece of the Yale apparatus. When positronium is in the magnetic field, a variable microwave source induces Zeeman transitions at the magnetic resonance frequency of positronium. The magnetic resonance curves yield a value for the fine-structure splitting that is 2.5 times more precise than previous determinations.

At this level of precision the empirical results compete fiercely with the current theoretical value. Taking due account of all the errors, it turns out that four standard deviations separate theory and fact. This gulf is too large for comfort,

and it demands a more accurate calculation of the effect of high-order QED corrections. Another puzzle to emerge is that the measured energy interval changes in proportion to the ambient gas pressure, so that the results have to be extrapolated back to zero pressure. No-one has advanced a quantitative explanation of this pressure shifting in positronium, although a group at Heidelberg recently argued that three-atom interactions could explain similar effects in muonium. It will be interesting to see if this also applies to positronium. Meanwhile the Yale group are pushing for a further factor of 2.5 improvement in their apparatus to keep ahead in the great fine-structure race.

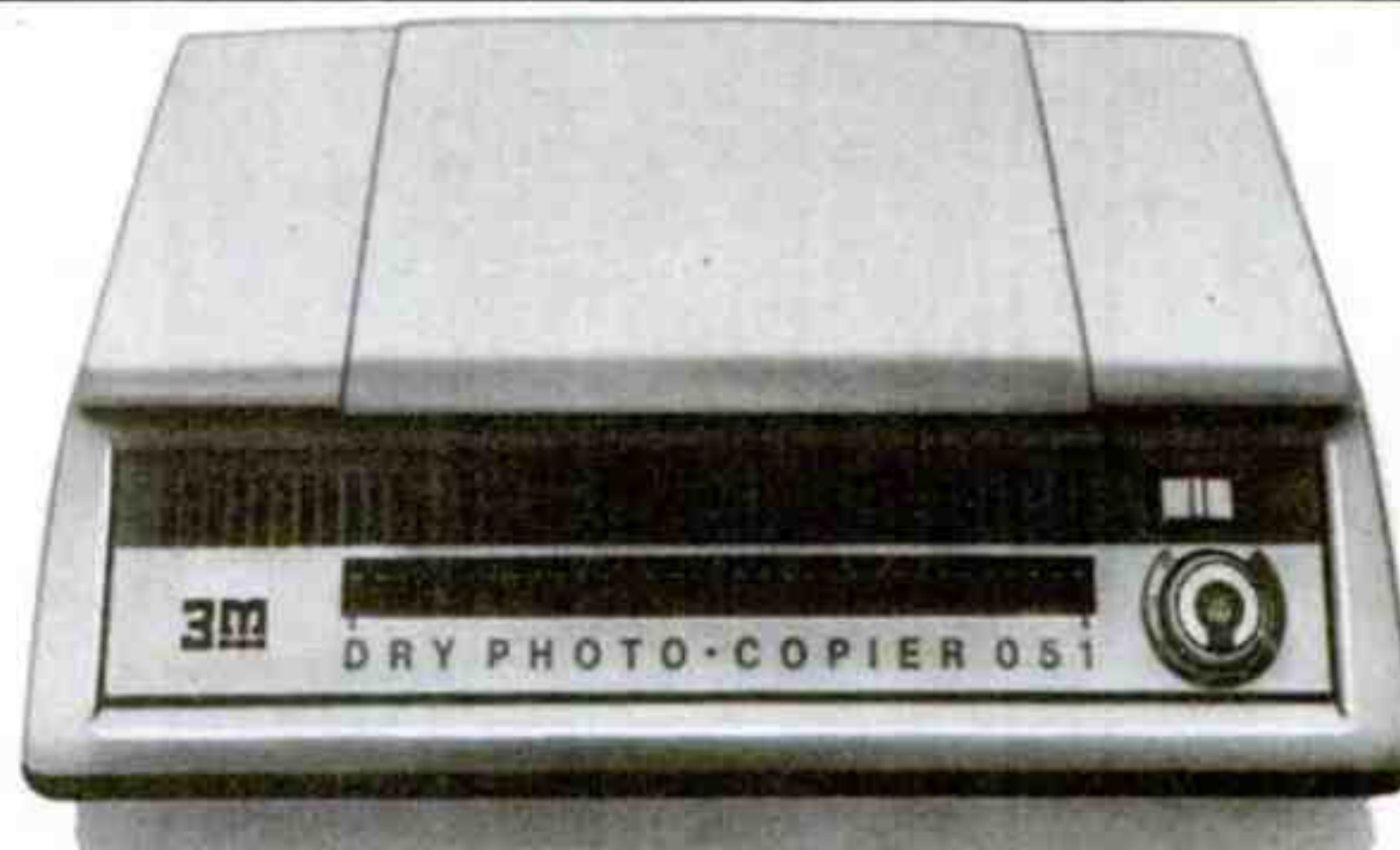
Naked microbes get around with sex

There can be found, living in the genital tracts of both men and women, representatives of a group of small "naked" bacteria known as mycoplasmas. At least one member of this rather bizarre life form has been positively implicated in a human disease (a form of pneumonia), while genital mycoplasmas have been associated with infertility, habitual abortion and premature birth in women, and non-gonococcal urethritis in men. Several studies of the incidence of the mycoplasmas in both men and women have suggested a relationship with sexual activity: for instance, nuns and teenage girls "presumed to be virgins" have a low incidence of mycoplasma colonisation,

while the converse is true of women attending VD clinics and for residents of institutions for promiscuous girls. A team of Boston medics, headed by William McCormack of Boston City Hospital, have now published a survey of nurses which confirms this correlation of genital mycoplasma colonisation with sexual activity. And so widespread is such colonisation of "sexually active young women" that the survey casts doubts on the bad reputation the mycoplasmas have acquired.

The 183 students and graduate nurses who took part in the Boston survey did so anonymously; they completed their own forms recording sexual activity and took their own vaginal swabs. Of the girls who recorded no genital contact with a male, 5.6 per cent were bearing mycoplasmas. In those recording sexual intercourse with one partner the figure was 37.5 per cent, and rose further to 54.5 and 75.0 per cent respectively when two and three partners were involved.

The correlation of mycoplasma colonisation with sexual activity is clear; and such is its incidence that the Boston group believe that mycoplasmas are part of the vaginal microflora of many sexually active young women. The simple isolation of mycoplasmas in pregnancy complications such as abortion cannot therefore be taken as proof of their involvement. And since young women are so frequently colonised, so must be their male partners, throwing doubt on the role which has been claimed for genital mycoplasmas in non-gonococcal urethritis in men (Journal of the American Medical Association, vol 221, p 1375).



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In the hope of alerting public opinion, the International Rhine Pollution Commission recently organised a 500-mile study-cruise from Switzerland to the sea. Jon Tinker was the only journalist present from a non-Rhine country, and he pinpoints French opposition as most likely to prevent agreement at next week's commission meeting in The Hague

Jon Tinker

The United Nations conference in Stockholm was concerned with politics and the environment. Its inspiration was the possibility that mankind might forget national differences in the face of the threats to his common habitat. If the state of the Rhine is anything to go by, Stockholm was a pipedream. For on the Rhine, politics and the environment come face to face. To the environmentalist, the Rhine is a single river which ties together one European valley, the home of 26 million people who must drink, wash in and defaecate in its waters. To the politician, the Rhine is a dividing line, the frontier between Austria and Switzerland, between Germany and France, between socialist Hesse and christian-democrat Rhineland-Palatinate.

It is over 1200 kilometres from the snow-fields and glaciers of the Swiss alps down to the polders and dykes of the Netherlands. The Rhine is heavily polluted for most of the way. This is, of course, nothing very new. The burghers of Rhenish towns have for centuries regarded their river as a convenient place to empty the slops. But today, the Rhine has reached crisis point. There are more people,

so there is more sewage; industry pours out more and new toxic effluents; pesticides and fertilisers drain off the vineyards and fields; oil spills from the thousands of barges which ply from Switzerland to the sea.

Finally, at a time when Germany and the Netherlands must increasingly draw their water supplies from the river itself, the hot water from scores of new power stations threatens the coup de grace to a river already hovering on the edge of biological disaster. For hundreds of years the Rhine has been a commercial waterway, a source of power, a frontier, a water supply and a sewer. Today it can no longer fulfil all these purposes. The peoples of the Rhine valley must choose: either they stop treating their river as an international drain, or they run out of drinking water.

Unlike most other polluted rivers, the Rhine is no longer holding its own. As Figure 1 makes clear, the Rhine is becoming worse every year. In spite of extensive expenditure on treatment plant, the oxygen content of both upper and lower Rhine is declining steadily, and the BOD (biochemical oxygen demand: a measure of sewage and other organic pollution) is climbing. Figure 2 shows pollution data over the last decade at the German-Dutch frontier: in almost every respect, the Rhine has become markedly filthier during this period.

Beyond a certain point, rising pollution in a river sets off a vicious circle: more contamination means less self-purification, which in turn means higher pollution. The Rhine, for example, contains less than a quarter as much phytoplankton as the Danube. While the Danube's planktonic plants can produce 32 grammes of oxygen per day per square metre of surface, the Rhine's polluted waters can only manage 7 grammes. The Rhine has now reached the state where a multiplicity of pollutants are acting synergistically with one another, and where even a moderate further increase in contamination may deoxygenate great stretches of the river, eventually forming a vast, septic sewer from the Alps to the North Sea. In the words of Dr Werner Best, Environment Minister for the German state of Hesse, "the question is whether or not the Rhine is to stay a living river".

Incredibly, faced with a challenge of this magnitude, the countries of the Rhine have so far been unable to agree on what should be done. As long ago as 1885, Switzerland, Germany and the Netherlands signed a convention establishing the Rhine Salmon Fishery Commission, a body which has long since disappeared with the salmon it failed to protect. Today, only eels and whitefish can be caught in the Rhine, and they are often so tainted with oil as to be uneatable. Later,

Figure 1 The minimum oxygen content (white) and the maximum sewage burden (black lines) recorded each year in the upper Rhine (near Kembs) and the Lower Rhine (near the Dutch border)

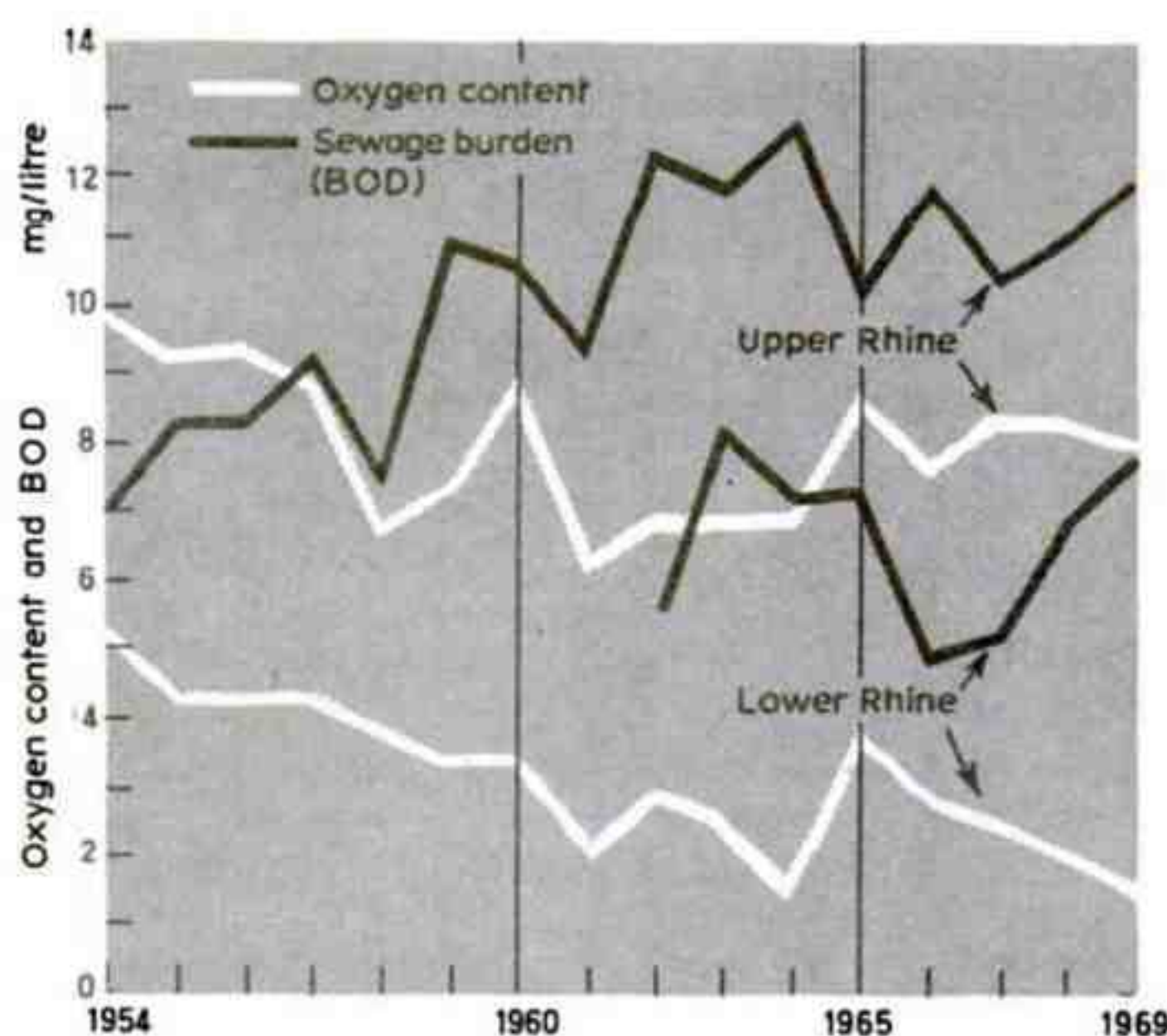


Figure 2 Annual average pollution levels in the Rhine at the Dutch border

		1959	1964	1971
River flow	m ³ /s	1584	1421	1451
Oxygen	mg/l	5.9	5.4	4.5
Oxygen saturation	%	57	50	41
Electrical conductivity	µs/cm at 20°C	—	920	1055
Chloride	mg/l	180	187	232
Sulphate	mg/l	—	102	107
Nitrate	mg/l	8.4	10.7	12.0
Ammonium	mg/l	2.3	3.2	3.6
Orthophosphate	mg/l	0.26	0.57	0.67
Total hardness	D°	15.1	14.9	15.9
Phenol	µg/l	27	38	52
Permanganate demand (filtered)	mg/l	—	—	35
Permanganate demand (unfiltered)	mg/l	42	62	—
BOD ₅	mg/l	7.8	8.7	9

the Central Commission for Rhine Navigation was established, and in 1946, faced with the widespread destruction of sewage treatment plant during the war, the Dutch demanded that this commission take up the question of pollution. In 1950, the International Commission for the Protection of the Rhine Against Pollution was set up by Germany, Switzerland, the Netherlands, France and Luxembourg (Austria being a notable absentee), although its establishment was not finally ratified until 1963.

The International Rhine Pollution Commission, though, has no powers whatever. It can only recommend action on its member governments, and even its recommendations are

often hamstrung by the need for international unanimity. According to its president, Dutchman M. F. Vigeveno: "Our experts from five countries do excellent work. We know what must be done to improve the situation. But I cannot point to any actual measures we have taken." A German official put it to me rather more bluntly: "The commission has a pretty, red roof, but nothing underneath it."

It would be unfair to imply that Vigeveno and his Rhine Pollution Commission are satisfied with their present impotence. They have despaired of persuading their governments to agree any increase in powers, and have decided to appeal direct to public opinion. With this in mind, Dr Best (who besides being Hesse's Environment Minister is also chairman of the German section of the Rhine Pollution Commission) suggested an International Rhine Protection Week. This took place last month, and its key event was a five-day voyage, largely by boat, from Basel down to Rotterdam. I joined some 150 politicians, engineers, officials and journalists from the five Rhine states.

We listened to a series of lectures and discussions whose official purpose was to inform participants and the general public about the river's pollution problems. Unofficially, the Germans and the Dutch used the voyage to bring pressure on France to reduce her salt discharges from the Alsace potash mines, to fit cooling towers to the nuclear power station she is building at Fessenheim, and to agree to a modest increase in the powers of the International Commission.

During its long journey from Basel to the sea, the Rhine is throughout a navigable river. Rotterdam, which only three years ago came after New York and Yokohama as the third largest port in the world, today carries more traffic than its two main competitors put together: 230 million tons a year. From Rotterdam over a quarter of a million smaller craft carry goods upstream to the Rhine and the canal systems connected with it. Even Basel, itself merely a transit port for the upper Rhine which is navigable as far as the Bodenees (Lake Constance), receives over 8 million tons.

The volume of traffic is enormous: at the Dutch-German frontier 600 cargo barges pass every day; at Koblenz there are 300 a day and even as high as Karlsruhe there are still 200. Many of the Rhine's tributaries are themselves major commercial waterways, the Moselle carrying 50 barges a day, the Main 110 and the Neckar 90. Via canals, the Rhine links up with the Rhone and the Seine, and will soon be joined to the Danube.

What were the main pollution problems outlined during the Rhine Protection Week cruise? In Switzerland, the Rhine is very much a secondary problem so far as water pollution is concerned: a river can be relied upon to cleanse itself eventually, while a lake, once contaminated, may remain in a eutrophic state for decades. In cantons whose effluents drain into lakes, many sewage works are now using tertiary (chemical) treatment, to remove the phosphates which are the main cause of



eutrophication. Following a special convention signed in 1950 between Switzerland, Austria, Bavaria and Baden-Württemberg, for example, much of the sewage has now been diverted entirely around the Bodensee, being discharged directly into the Rhine below the lake. As a result, the oxygen levels in the Bodensee have more than doubled in recent years; the Zurichsee has been similarly improved.

On the rivers of Switzerland, pollution is still widespread. The first federal water pollution law did not appear until 1955, while a second law passed this year foresees the treatment of all waste waters no earlier than 1982. Today, Switzerland is far from that target. In the Swiss basin of the Rhine, only half the municipal sewage and one-third of the industrial waste waters receive any treatment at all.

The conurbation of Basel, which sprawls over two Swiss cantons and parts of Germany and France as well, so far has no sewage works. Two are currently being planned, one in France and one in Germany. River purification is especially important in these lowland parts of Switzerland, for underground water supplies are virtually exhausted, and future increase in demand must come from the Rhine and other rivers.

Switzerland has been closely involved, with the German *länder* (states), in discussions on thermal pollution. The Swiss are already building an 850 MWe nuclear power plant at Kaiseraugst, which will pour heated effluent into the main river, and another four atomic plants are planned on the Aar. But this is nothing to what is in preparation downstream.

In 1970, between the Aar-Rhine confluence and the German-Dutch frontier, there were already some 19 major nuclear and conventional power stations, generating between them 6100 megawatts of electricity. By 1975 the figure will have nearly tripled to 17 100 MWe from 29 stations, and by 1985 it will have virtually tripled *again*, to 43 100 MWe from 39 stations. A joint working group of the German states calculated recently that, if all these plants were cooled direct from the river, the peak temperature of the Rhine would rise in summer to 28°C in 1975 and to 35°C in 1985 (see Figure 3).

A river 12°C hotter than normal could have disastrous effects, since the dissolved oxygen content of fully-aerated Rhine water drops by about 16 per cent for each extra centigrade degree. When the river is at its lowest, which

for the Rhine is in winter, anything remotely approaching a 12°C warm-up would (even on current pollution loads) cause total deoxygenation over long stretches, making the river foul and lifeless. The German wine-growers in particular fear the effects of a warmer Rhine on the vineyard microclimate, since the choice *auslese* wines depend on frosts in early autumn to sweeten the grapes. Would the steep vineyards in the Rhine gorge be defrosted at night by a heated Rhine? And would fogs from the river cut out the vital sunlight by day?

The German *länder* have agreed on three provisional measures to counteract thermal pollution. First, all nuclear power stations must have cooling towers. Second, no conventional station may heat up the river by more than 3°C. Third, the water temperature below a power plant, after mixing, must never exceed 28°C. At considerable expense, Baden-Württemberg is fitting cooling towers to its 2610 MWe plant under construction at Phillipsburg. Hesse has done the same to its 3600 MWe station at Biblis, and the Swiss federation has adopted the three German guidelines. But there are two major snags. First, environmental issues are reserved by the West German constitution to the *länder*, and it will take a constitutional amendment for Bonn to impose the three rules. Meantime, Bavaria shows every sign of ignoring the proposals and heating up the Main before it joins the Rhine. Second, France refuses to join the agreement.

France has two reactors totalling 2100 MWe under construction at Fessenheim in southern Alsace. They have no cooling towers, and according to official figures, they will together increase the river temperature on average by less than 1°C, and even during the low winter flows by no more than 2°C. But it is an open secret that the French plan four more reactors at Fessenheim, and some believe the eventual total may be as many as nine. This might raise river temperatures in winter by 15-18°C, allowing France an inequitably high proportion of the Rhine's cooling capacity.

For France, Fessenheim represents the future industrialisation of Alsace, the only gateway to the Rhine and the commercial heartland of Europe. German attempts to persuade the French to install cooling towers at Fessenheim, substantially increasing the price of her nuclear electricity, are suspected of being deliberate sabotage from the rich

Figure 3 The projected summer temperature of the Rhine in 1985, if all the planned power stations were built without cooling towers

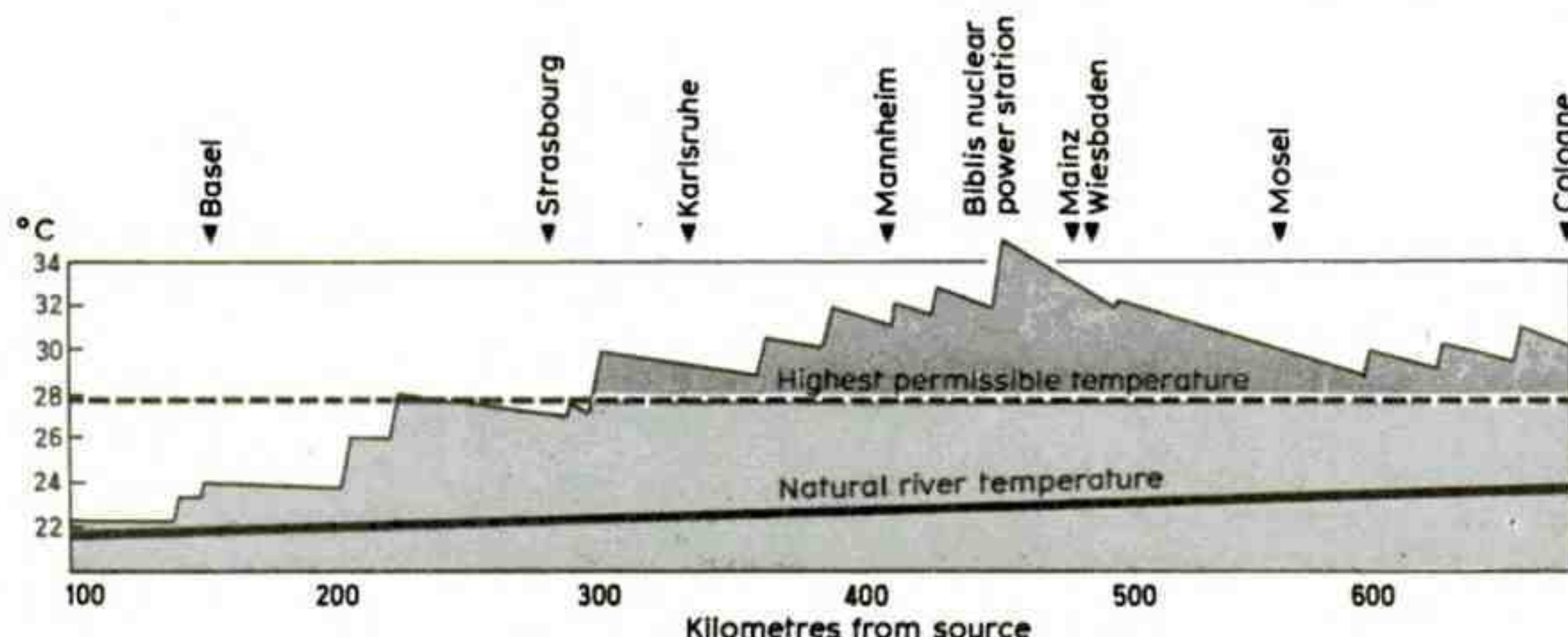


Figure 4 Water treatment standards in those parts of the German *länder* which drain into the Rhine

Land	Volume of wastes, expressed as the sewage equivalent, in millions of inhabitants	Percentage of waste waters receiving:		
		a) biological treatment	b) only mechanical treatment	c) no treatment or only crude mechanical treatment
Baden- Württemberg	7.8	44	31	25
Bavaria	3.7	32	34	34
Rhineland-Palatinate	3.7	23	26	51
Hesse	4.0	45	31	24
Saarland	1.1	29	29	42
North Rhine-Westphalia	12.0	42	33	25
Total	32.3	39	32	29

men of the Ruhr. This is probably why the International Rhine Pollution Commission has been deadlocked on the cooling water question.

The French feeling of being got at by everyone else is accentuated by the salt problem. One of the biggest potash mines in Europe is that owned by the nationalised company MDPA in Alsace. The raw potash consists of only 26 per cent of potassium chloride, combined with 61 per cent sodium chloride and 13 per cent of insolubles. As a result, MDPA has some 7 megatons (million tons) of cooking salt to dispose of each year. Little of this can be sold (France's total needs are only 5½ megatons) and for technical reasons it is apparently not possible to put it back into the underground mines. So it is simply dumped into the Rhine.

Today MDPA pours into the river brine containing 6 megatons of salt per year. Another 3½ megatons from western Alsace flows into the Rhine via the Moselle, so that of the 18 megatons of salt which enter Holland down from the Rhine every year, over half comes from France. The chlorine content of the Rhine at the Dutch frontier has grown from 150 mg/l in 1940 to over 350 mg/l today. No one seems to know what effects this has on river biochemistry, but in view of the bactericidal properties of chlorine, it seems likely that MDPA's salt seriously reduces the capacity of the Rhine to break down sewage and other organic residues.

Since 1955 the French have operated an agreement with the Dutch whereby salt discharges from MDPA are limited to 250 kg per second, with a pro rata reduction when the Rhine is at a low level. Even so, the Dutch and the Germans feel more action is needed. In principle, MDPA has agreed to store the salt, but the problems of finding a site which will not risk contaminating underground aquifers have (according to France) so far proved insuperable. Even if only half the salt were stored, in 20 years there would be a mound 40 metres high covering 100 hectares to be safeguarded.

The groundwater, on which Alsace relies for 80 per cent of its drinking water and 75 per cent of its industrial supplies, is already so badly contaminated in the Strasbourg region that no new boreholes can be sunk—and the subterranean pollution has spread under the river into Baden-Württem-

burg. Some of the engineers feel the only long-term solution is to take the salt by river barge or pipeline and dump it in the sea—a scheme which is unlikely to be cheap. In spite of offers from the Netherlands and the German *länder* to share the cost, France has so far not reduced her discharges of brine. The MDPA's 40 000 jobs weigh more heavily in Paris than contamination of the Rhine.

There are, of course, other forms of pollution besides heat and salt on the French section of the Rhine. At present, those areas of France which drain into the Rhine (the Saar and Moselle river basins as well as the Rhineland proper) discharge totally untreated wastes equivalent to the sewage from 7.6 million people, 5.4 million of which is industrial, and 2.2 million domestic.

Some of these discharges are extremely large. The firm Cellulose de Strasbourg, for example, releases the sewage equivalent of 1 million people. A scheme to reduce this by 80 per cent is merely under discussion, and if the expenditure is approved will in any case not be operative until 1975.

In Germany, the Rhine's problems are essentially the same as in Alsace: inadequate treatment of both municipal and industrial wastes combined with an increasing need to use the Rhine's waters for drinking and industrial purposes. Six of the German *länder* drain into the Rhine, and Figure 4 shows the standard of sewage purification they achieved. Overall, little more than a third of the domestic sewage receives the biological treatment without which gross pollution is bound to occur, and nearly a third gets nothing more than the most crude settlement before being discharged into a watercourse.

Between 1966 and 1971 the six Rhine *länder* spent 6300 million DM on sewers and treatment plant: about £160 million a year. But there is such a large backlog of neglect that water quality in the Rhine has not improved, and it is clear that industry in particular has not been exactly enthusiastic about reducing river pollution.

In Baden-Württemberg, for example, the BASF complex at Ludwigshafen produces half a million cubic metres of waste waters a day, with a BOD equivalent to the sewage of 6.5 million people. Treatment is so minimal that the BOD equivalent of 4.7 million people goes straight into the Rhine. Together with the Ludwigshafen municipal authorities, a joint treatment plant is being planned, but construction will not start until the end of 1973. In the same province, Dynamit-Nobel, Ciba-Geigy and Hoffman-La Roche all have plants which discharge into the Rhine without any treatment facilities at all.

Another concentration of municipal and industrial pollution lies around Frankfurt, Darmstadt and Wiesbaden at the junction of the Rhine and Main rivers in Hesse. The Main is heavily contaminated. Its annual average oxygen saturation has varied from 54 down to 27 per cent since 1966, and in spite of new treatment plants it gets worse each year. Farbwerke Hoechst AG, the largest polluters on the Main, are releasing wastes with a daily BOD equivalent to over 2 million people.

Most of this receives only the most primitive treatment, and adequate plant is not expected to be ready until 1979.

In the downstream land of North Rhine-Westphalia, which includes the Ruhr conurbation, the pollution problem is even more critical. North Rhine-Westphalia contains 49 per cent of the industrial discharges and 43 per cent of the municipal discharges in the whole of Federal Germany. Out of 23 sewage outfalls into the Rhine itself, 18 (from 7.9 million people) receive only crude mechanical treatment, compared with only 5 (from 3.3 million people) which receive some further purification. Among the cities whose sewage goes into the Rhine virtually raw are Cologne, Duisberg, and the federal capital Bonn, plus nearly the whole of Essen and half Dusseldorf.

It is generally agreed among the *länder* governments that water pollution can no longer be controlled on a provincial basis. One problem, for example, is that when a large chemical corporation is contemplating establishing a new works, it will tout around among the *länder* to find one which will promise immunity from pollution regulations in return for the local taxes the factory would bring. The appalling discharges from BASF at Ludwigshafen, for instance, are widely believed to reflect the close ties between the company and the Christian-Democrat administration in the Rhineland-Palatinate. Another worry is that present regulations give polluters no financial incentive to improve their effluent standards. The solution proposed by the federal government is a national levy on all wastes, with charges inversely proportional to the degree of treatment.

The Rhine delta complex, showing some of the main barrages



Across the border in the Netherlands, both municipal and industrial wastes are in general better treated than in Germany: the Dutch have learned to respect water. Nevertheless, the Netherlands have a highly complex series of problems arising from pollution in the Rhine.

As soon as the Rhine enters Holland, it splits into two arms, known as the Lek and the Waal. The Maas (Meuse) also comes into the Netherlands from the south-east, and the Lek, Waal and Maas flow westwards parallel to one another, connecting up by side-streams and splitting into further arms and branches in the complex delta to the south of Rotterdam. The Lek also spawns the IJssel, a river which flows away northwards into what used

to be the Zuyderzee. This great inland sea has now been dammed off, partly reclaimed and turned into a freshwater lake (the IJsselmeer) which serves as a drinking water reservoir. Via the IJssel, shipping from the lower Rhine can travel to Amsterdam and north Germany. Via the Maas barges can reach the industrial centres of Belgium and northern France, so the canalisation of the IJssel and the various branches of the lower Rhine has long been an objective of Dutch policy.

Water management in the Rhine delta is essential for another reason. The Dutch live in the most densely populated country in the world. There are 350 of them in each square kilometre, and half the population sleeps below sea level. In February 1953 freak tides breached many of the dykes and drowned over 1800 people. The Delta Commission, appointed to see that this never happened again, decided that to strengthen the hundreds of miles of dykes along the many arms of the delta would probably prove technologically and financially prohibitive. Instead, the Dutch determined to exclude the sea from the delta entirely.

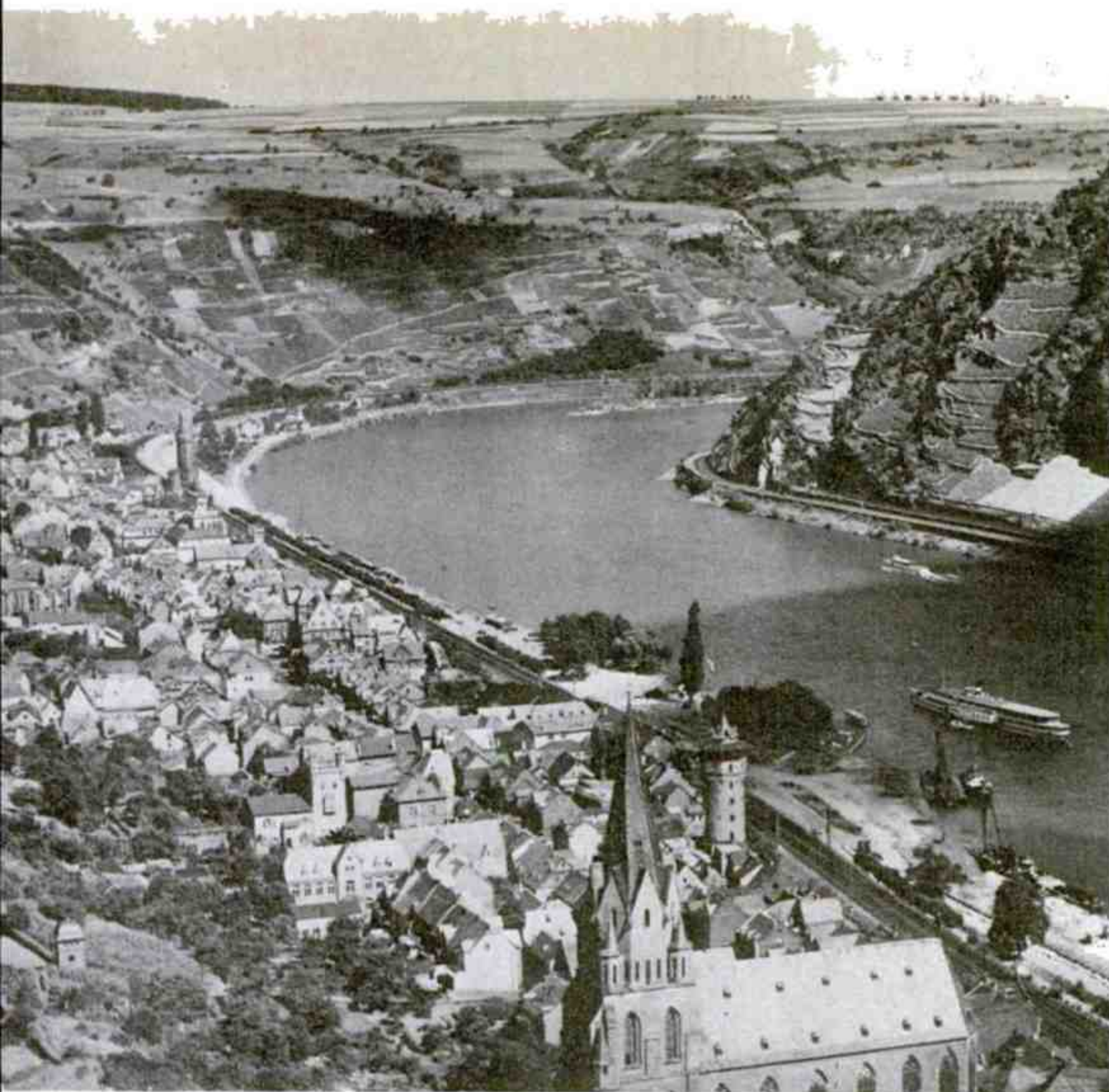
Each arm of the sea is now being dammed off, and the outflow of the Rhine and Maas concentrated down the New Waterway, the main shipping channel from Rotterdam to the North Sea. The current of freshwater down the New Waterway will be sufficient to keep seawater from backing up into the many navigation channels and river arms even during the very low flows of winter.

The need to prevent salt water flowing back up the delta is the more acute since the topmost dam on the Lek, at Driel immediately below the branching off of the IJssel, can now be completely closed. This is done to divert about 20 per cent of the Rhine's annual flow northwards into the IJsselmeer, where it can be stored and used eventually for drinking and industry. It is during the 120 days a year when the Driel wier is shut that the danger of salt flowing back up the Waal and Old Maas mouths is greatest and their seaward entrances are kept closed. The partial diversion of the Rhine into the IJssel started in 1970, and the whole Delta Plan should be completed by 1978.

The improvement of navigation on the lower Rhine complex and the exclusion of the sea from the delta are two of the three main planks of the Dutch Rhine policy. The third aspect is the growing need for freshwater. By the end of the century, the Dutch will have more than quadrupled their need for clean surface water: from 700 to 3000 million cubic metres per year. Treatment of this much of the Rhine's present filthy flow would be inordinately expensive, so a purer Rhine is essential.

The Netherlands' biggest headache is salt. Salt creeps up the river mouths when their flow is low; it percolates beneath the dykes into groundwater; and it flows down the Rhine from Alsace and elsewhere. "A fall in the salt level of the Rhine," says Dr B. J. Udink, Dutch minister for transport and water, "is for us urgent and vital."

By the end of the century, the Dutch will



View of the Rhine from the Steilhänge, looking down on the Oberwesel

be drinking water which overwhelmingly comes out of the Rhine. Salt and sewage can be removed—at a price—but there are other pollutants, such as phosphates and nitrates; lindane, DDT and other biocides; heavy metals, and the carcinogenic hydrocarbons. These are all present in the Rhine at significant levels—there are at least six substances in the river water which depress cholinesterase, for example—yet they are too dilute to be removed at the waterworks. “We have no idea what the effect of these non-biodegradable substances in our drinking water will be over several decades,” warns J. van de Kerk, director-general of the Dutch national water authority.

Sewage, salt, hot water, biocides, heavy metals: the pollution picture on the Rhine is not very encouraging. But there is one success story: bilge oil. Eight thousand Rhine barges normally release around 10 million tons of oily water from their bilges each year, and although discharge into the river is forbidden by law in Germany at least, skippers can safely discharge it at night, when it is churned up by the screws and the culprit is 100 km away by dawn. To overcome this problem, the Germans now operate six boats, which collect bilge waters free. The bilge oil collected has grown from 530 tons in 1962 to 5300 tons in 1971, and is expected to be nearly 7000 tons this year. The service is financed partly by the sale of the oil removed, and partly by contributions from the länder governments and—of key political importance—from the Dutch. While only about half of the bilge oil is yet being collected, the scheme is an encouraging

example of practical cooperation.

What is the future for pollution control on the Rhine? There are two main stumbling blocks, one scientific and one political. On the scientific level, there is appallingly little data on either the actual state of the river or on the likely effects of abatement measures. Regular monitoring of water quality is only just starting, and still lacks international coordination. The German länder, for instance, are planning a network of 25 stations to take daily readings of a dozen or more parameters, but only two are yet operating.

Inadequate data is not the only scientific problem. Just what is the contribution of heat for example? The all-heat-is-bad school are not supported by the experimental facts, which suggest that plankton and other aquatic life are not affected either in numbers or species composition by moderate warming. Nor is it certain that added heat means deoxygenation: in the UK, CEEB data shows clearly that passage through a power station's turbines can increase dissolved oxygen levels, for the added temperature is counteracted by mechanical aeration. More heat can speed up the bacterial degradation of sewage and other organic wastes, and in the presence of adequate oxygen can assist self-purification. So while it is obvious that raising the Rhine's summer temperature to 35°C would be biologically intolerable, it might well be that careful siting of some direct-cooled power stations, perhaps combined with artificial aeration over weirs, could improve water quality. The Dutch electricity authorities, for example, fear that they will be prevented from exploiting the natural cooling capacity of the lower Rhine, because of political pressures to conform with an all-Rhine cooling tower policy. Without a stronger scientific base, equitable supranational control of national policies will be impossible.

In the end, though, the problem is political. In spring 1972, the EEC Commission in Brussels published a study of Rhine pollution, which proposed a long-term plan for purifying the waters of the whole river basin. To complement this, it urged that a special executive Rhine authority should be established under the Treaty of Rome, with Swiss participation as a non-member of the EEC. Because of French opposition this scheme apparently never even came up before the Council of Ministers. Multilateral negotiation can never solve the Rhine's complex pollution problems: a supranational authority will one day have to be established. Until France is prepared to accept this, action can be no better than palliative.

On 30 October, the International Rhine Pollution Commission will meet in The Hague for its first-ever meeting at ministerial level, and there are likely to be tough negotiations on the salt and cooling tower questions. But whether the commission can ever be changed, as Hesse environment minister Werner Best demands, from “an organisation that merely spends money into an organisation that acts” is, in the present state of European politics, doubtful in the extreme.

Cygnus X-3: dying swan or vigorous phoenix?

On the evening of 2 September a new star burst in the radio sky to become the most spectacular outburst ever observed by radio astronomers. A massive programme of international collaboration has documented this unique event in great detail. The radio flare probably originated in a rapidly expanding cloud of high-energy electrons

Dr Simon Mitton

One of astronomy's occupational hazards is a telephone call in the middle of the night reporting some strange flashing star. Usually it transpires that the excited caller is seeing a normal bright star close to the horizon. In the early hours of 2 September Dr Robin Conway of Jodrell Bank received such a call, but this time in deadly earnest: news direct from the USA of a unique event in the cosmos. Within the previous three days the X-ray star had flared dramatically to become the third brightest object in the radio sky at short wavelengths. The rude awakening was partly a mistake, for the discovery had so bemused the Americans that they calculated the British local time incorrectly! Nonetheless the Manchester researchers duly rose from their beds to participate in the most successful programme of international cooperation yet witnessed in astronomy. Telex and telephone messages flashed round the world, so that the powerful radio surges of Cyg X-3 were being monitored at all major observatories within a few hours. One outcome is an entire issue of *Nature Physical Science* (vol 239, p 114-136) devoted to the greatest outburst ever recorded by radio telescopes. In only six weeks the observers have published over 20 papers, so the Cyg X-3 bandwagon is bowling along swiftly, and making the classic pulsar saga of 1968 look rather pedestrian.

A rocket scan in 1966 first revealed the Cyg X-3 source of X-rays, and its emission has since received intense scrutiny from the Uhuru satellite telescope. The X-ray spectrum shows strong and variable absorption effects that can be attributed to a thick hydrogen fog close to the source. In May of this year the Uhuru team found that the X-ray intensity is modulated with a period of 4.8 hours, which may indicate that a spinning star with some hotspot produces the X-radiation. At the end of June, L. Braes and George Miley of the Leiden radio observatory reported weak, highly variable, emission from a radio source in the vicinity of Cyg X-3. The close positional agreement of unusual objects is still the only justification for associating the radio emission directly with Cyg X-3. The Leiden observers struck a prophetic tone in their paper "... (the radio emission) suggests that we are dealing with a completely different type of object (to other X-ray sources)."

Just how different came home forcefully on 2 September. At Canada's Algonquin Park Observatory, Dr P. C. Gregory and his co-workers (University of Toronto) were measuring the signal strengths at 3 cm of radio stars—part of a project to see how these objects may vary in timescales of a few months. When the telescope turned to Cyg X-3, it detected a signal almost 1000 times stronger than on 31 August. The Toronto

workers rapidly checked their system. Everything seemed in order, so they called up colleagues in West Virginia, and within the hour the US National Radio Astronomy Observatory confirmed a giant outburst in Cygnus. An intense source had suddenly appeared in the radio sky, generating all the excitement that a spectacular comet or nova explosion would give an optical astronomer. To their lasting credit, the Canadians spread the news as fast as possible, so that the phenomenon has been followed at many different frequencies from 408 MHz, to 90 GHz, as well as at infrared and X-ray wavelengths. Already theorists are spawning the first tentative models.

The alert by the Canadians came when Cyg X-3 was already over the top at 3-cm wavelength. At longer wavelengths however the observers managed to capture the rising trend. For example, the 73-cm observations made at Jodrell Bank peaked on 7 September, which gives a time lag of five days between the maximum intensities at 3 cm and 73 cm. All observatories managed to get good data on the decay side of the outburst, which showed a beautiful exponential fall-off. Hugh Aller (University of Michigan) and William Dent (University of Massachusetts) followed the decline at 8 GHz by making signal strength measurements at 40-minute intervals. The most outstanding feature of the variation is a precise exponential law (analogous to radioactive decay) for the demise of the outburst, with a time constant of 27.5 hours; this agrees exactly with 15.5-GHz results from the Haystack observatory. The two important characteristics of the decay curve are that it is exponential over several half-lives, and the spectrum of the radiation remains constant. This type of behaviour parallels the giant bursts from the Sun, although the scale of operations is much larger for Cyg X-3. Throughout the burst no significant circular or linear polarisation appeared in the radio signals, a point of interest for the interpretation.

The unprecedented activity at radio observatories soon spilled over to other groups. In Boston, American Science and Engineering Inc. looked over scans of the Cygnus area made by the Uhuru X-ray detectors; no unusual activity showed up, so whatever precipitated the radio event cannot have had a significant impact on the X-ray emission over times of a few days. The Vela 5B satellite has turned in a similar null result.

In Britain the Mullard Space Science Laboratory have contributed to the X-ray observations with a telescope aboard the Copernicus satellite. This can be pointed directly at interesting objects, whereas Uhuru makes wide sweeps. In *Nature Physical*

Science, P. W. Sanford and F. H. Hawkins report absence of any massive X-ray flare, although they can confirm the 4.8 hour period for regular variations.

How far away is Cyg X-3? It is certainly inside our Galaxy, but there are very few distance estimates for galactic X-ray sources. The giant radio outbursts provide a special opportunity for distance measurement by seeing if there is any evidence for absorption of the radiation in galactic gas clouds. Robert Lauqué, James Lequeux, and Nguyen-Quang-Rieu (Observatoire de Meudon) tried this technique on 4-6 September, when they obtained the 21-cm hydrogen absorption spectrum of Cygnus X-3 with the Nançay radio telescope (Figure 1). Their spectrum (see Figure) shows features attributable to local hydrogen and a spiral arm 28 000 light years (ly) from the solar system. However, there is no effect from the arm at 40 000 ly that is also along the line of sight. These data therefore locate Cyg X-3 at 28-40 thousand light years, a conclusion reached also at the Mullard Radio Astronomy Observatory. Barry Turner (US NRAO) has carried out a similar experiment in the lines of hydroxyl and formaldehyde, and this suggests a smaller distance of 10 000 ly or less. A point at issue in the distance estimates is that the gas and dust distributions in Cygnus are very complex, making interpretation fraught with difficulties. At present most astronomers are adopting the French figures.

By 12 September the signal strength had dropped below the level of detectability as far as most observatories were concerned. Slowly they picked up the threads of disrupted research programmes, trying to get the telescopes back on schedule. A research colleague remarked to me: "thank goodness it's shut up at last—now we can get back to some real astronomy!" That was not to be, for on 18 September, Cyg X-3 started festering once more. The Mullard Radio Astronomy Observatory, with five telescopes on the alert, appear to have been the first group to detect a sharp increase in the flux in only a few hours. Within a day the signals at all frequencies were on the way up. Here was a new outburst, caught on the rise side this time.

For this second outburst, the data at three frequencies obtained at Cambridge reveal a complex pattern of variation (Figure 2). Up to 27 September two principal maxima and

several minima had appeared in the light curve (see Figure 2). Note that the variations at each frequency are closely correlated, although the time lags preceding the appearance of peaks at longer wavelengths are not constant, spanning a range 0.1 day. At its peak this second flare exceeded the intensity of the first.

The Five-Kilometre telescope has fixed the celestial coordinates of Cyg X-3 to within 0.15 arc seconds, which may assist the bid to match the radio—X-ray source with an optical counterpart. So far British and US observatories have failed to do this. Four researchers at the Hale Observatories have found an infrared star coincident with Cyg X-3, but they state that the optical obscuration due to dust is extremely large towards Cyg X-3.

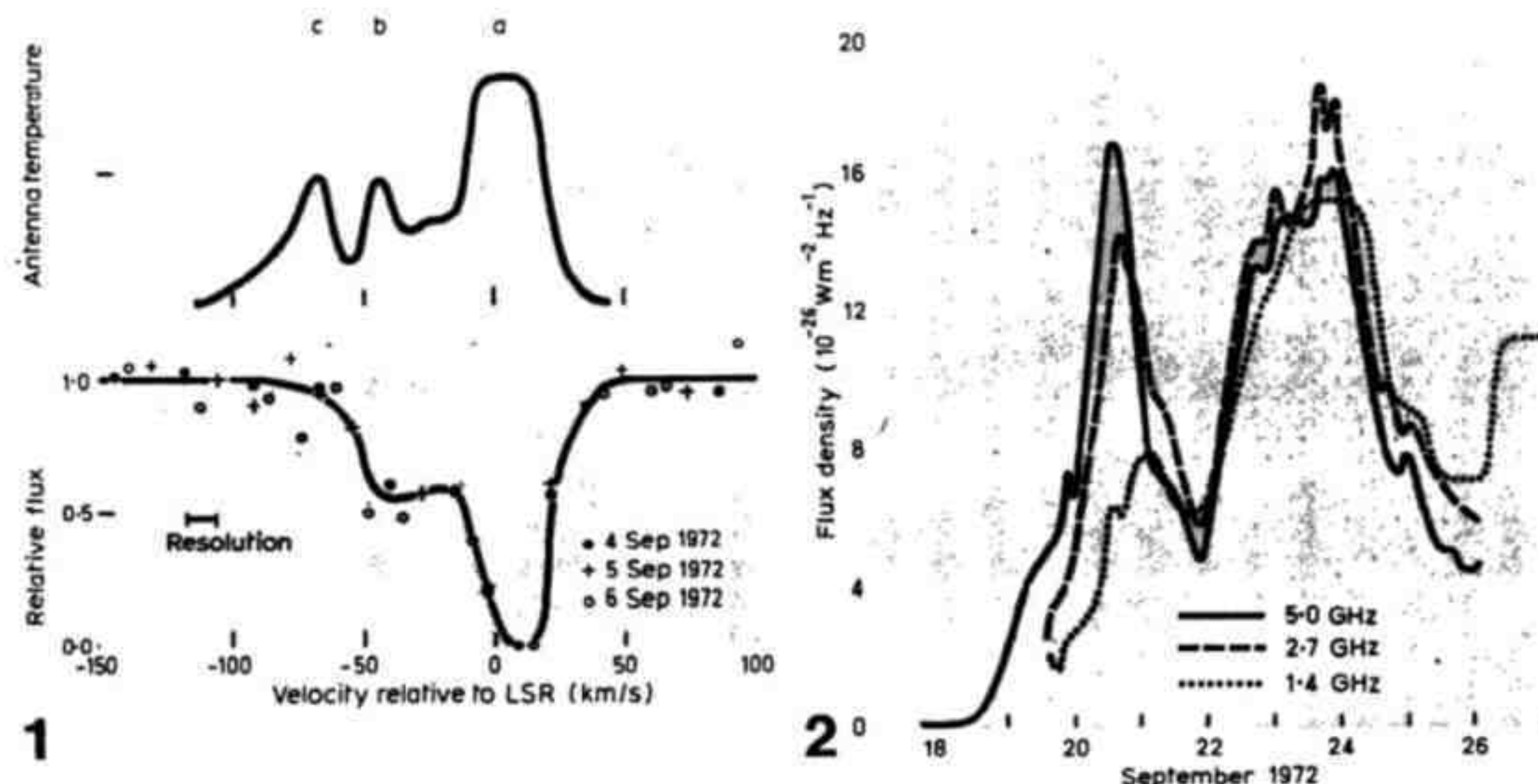
An impression of the size comes from the rapid rise-time of the second cataclysm, which indicates a source diameter of about 1 light day (3×10^{10} km). A larger emission region could not contrive to light up simultaneously, as seen from Earth, unless an unusual source geometry is involved. The size inferred from the variations is smaller than the apparent diameters published by radio observers because of marked random scattering of the radio waves by hydrogen clouds in the Milky Way. The same clouds could also smear out intrinsic polarisation in the signals, and thus account for its unpolarised character by the time it reaches Earth.

In two major papers in *Nature Physical Science*, 15 astronomers set down their thoughts on the nature of Cyg X-3. The overall behaviour at radio frequencies mimics the variable quasars, which suggests that some similar mechanism is at work. The consensus view is that an unknown *deus ex sidera* has created an enormous cloud of high-energy electrons and tangled magnetic field around Cyg X-3. The cloud contains an enormous amount of energy— 10^{46} erg—which causes it to expand rapidly, perhaps at half the speed of light, into the near vacuum of interstellar space. As the bubble of energy expands the electrons dance a mad whirligig around the magnetic spaghetti, emitting electromagnetic radiation by the well-known synchrotron process. On account of the great density of electrons, the cloud is not transparent to all frequencies; at first only the high frequency radiation can penetrate the cloud, so the burst is first detectable at, let us say, 5 GHz and above. Within a day or so the cloud was worked out some six years ago by the energy and electron densities. This has two effects: lower frequency radiation starts to penetrate the cloud, so the burst can be picked up at 1.4 GHz and eventually at 408 MHz; also the expansion diminishes the net intensity of electromagnetic radiation, so that the burst will start to decline.

The basic physics of such an expanding cloud was worked out some six years ago by Harry van der Laan (now at Leiden), and the features of the model seem to fit the radio bursts of Cyg X-3 tolerably well. There is a suggestion that once the Cyg X-3 cloud starts expanding, further supplies of high-energy

Figure 1 Emission from hydrogen towards Cyg X-3 shows local gas (a), and spiral arms at 28 000 ly (b) and 40 000 ly (c). Absorption spectrum shows Cyg X-3 is located between (b) and (c)

Figure 2 Second outburst recorded at three frequencies.



electrons are being injected to keep the event going. A similar situation occurs in the Crab Nebula, where NP 0532 is continuously dumping relativistic particles into the expanding nebulosity.

No one has yet speculated on where Cyg X-3 might fit into the chain of stellar evolution. Could it be a massive, unstable, new star crying in agony as it tries to reach a normal configuration? Or is it a weird endpoint in the

evolutionary track—a neutron star or black hole perhaps? At first the possibility of a supernova explosion was bandied about, but the energy involved in the burst is some 10 orders of magnitude lower than for a supernova. So for the present it's a case of a wait-and-see attitude. Meanwhile there is plenty of work to do: looking for new outbursts, interpreting the first two, and improving the expanding cloud model.

Preventing pulmonary embolism

About one in every 200 persons undergoing major surgery dies as a result of a blood clot lodging in the lungs. Recent improvements in understanding and diagnosing pulmonary embolism have now been followed by a development which could help to prevent many of the resulting fatalities

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Weddel
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London

Blood clotting in a wound is a vital protective mechanism of the body. Under certain conditions, however, blood forms clots inside the veins, usually the leg veins, giving rise to venous thrombosis. Occasionally, the clot breaks away from the walls of the vein to circulate in the bloodstream. It is then known as an embolus. When the clot lodges in the lungs, the resulting condition is called pulmonary embolism. It is a widely feared cause of sudden death following a major operation.

As long ago as 1856, the brilliant Prussian pathologist Rudolph Virchow described the basic causes of venous thrombosis. They are: stagnation of the blood, an increase in the coagulability of the blood, and damage to the inside of the walls of the vein affected. One current and controversial hypothesis, however, relegates these to aggravating factors and considers the primary cause to be our refined western diet. Because it is low in fibre content, such a diet causes a mild degree of constipation (compared, for example, with the frequently passed, unformed stools of the tribal African), and it has been suggested that a full bowel presses on the external iliac veins (Figure 1), so predisposing to leg-vein thrombosis by slowing blood-flow in the legs. Also, constipation causes "straining at stool" and the considerable increase in abdominal pressure associated with this is relayed to the leg-veins and their valves—perhaps gradually weakening them. Eventually, this may cause the veins to become dilated and inelastic, thus encouraging pooling of the blood and therefore thrombosis.

Epidemiological data reinforces this fascinating hypothesis: venous thrombosis is common in economically developed countries, rare but increasing in developing countries such as urban Africa, and virtually unknown in tribal communities. Other factors appear to favour the theory, such as the marked increase in the incidence of pulmonary embolism in Britain which has accompanied the tendency of hospitals to abandon their routine practice of giving purgatives before an operation. But definite proof of the theory is conspicuously lacking.

Modern-day physiologists view with a good deal of scepticism the statement that "the

heart pumps blood round the body". In all probability the heart itself has very little to do with the return of blood to the heart. This is accomplished by other mechanisms, one of the most important being the so-called "calf-muscle pump". Soleal veins, embedded in the calf-muscles, are large arcades arising from the tibial veins. When we walk, our calf-muscles alternately contract and relax, emptying and filling the soleal veins with each step. Standing still or sitting, and to a lesser extent lying, encourages stagnation of the blood in the soleal vessels. This helps to explain why a guardsman may faint while standing on parade for protracted periods—insufficient blood is being pumped to his brain.

A major operation involves a period of profound immobility, during both the operation (when it is worsened by the use of anaesthetics and muscle relaxants), and convalescence. This causes a marked degree of stagnation in the blood of the soleal veins but by itself this is insufficient to cause thrombosis. In addition, however, surgery induces several changes in the blood which tend to increase its coagulability. In a proportion of patients the net result is venous thrombosis. The thrombus usually starts in the soleal veins and then spreads to the tibial veins. In about half of these patients the thrombus begins to form during surgery, and in the remainder, any time up to about 10 days after the operation. In a few patients, the thrombus spreads into the knee-vein and sometimes into the thigh-vein or even iliac veins. It is in these patients that there is a danger of embolisation. When this occurs, the embolus is almost certain to lodge in a pulmonary artery and the outcome will often be fatal. (In China, where acupuncture is widely practised, post-operative thrombosis is rare and this is no doubt at least partly explained by the avoidance of conventional anaesthesia and post-operative immobility—many patients climb off the operating table and walk back to the ward.)

Different types of operations carry different degrees of risk, and the condition of the patient is also important in determining whether venous thrombosis may occur. Obesity, for example, decidedly increases the

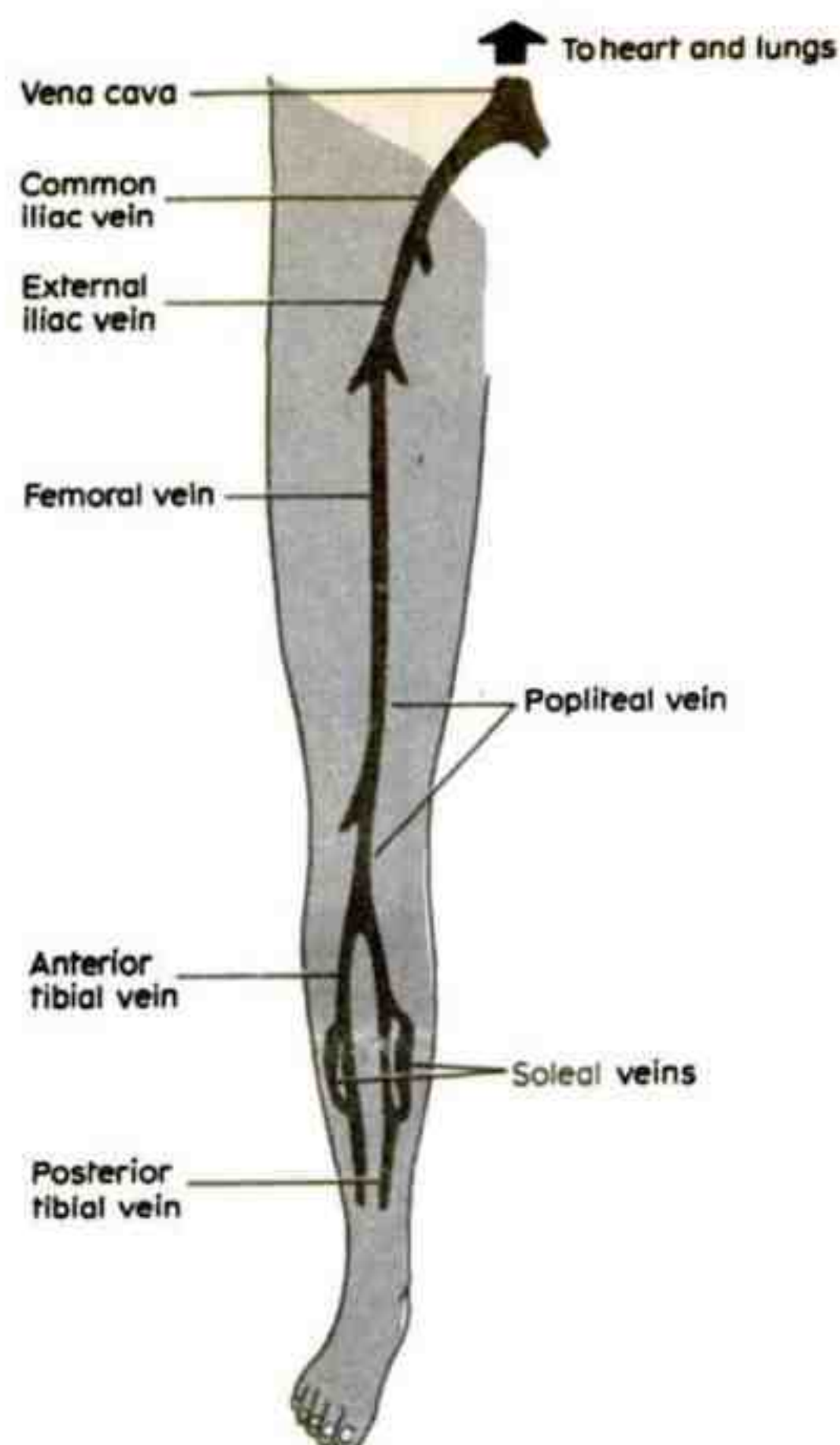


Figure 1 The deep veins of the leg

risk. Patients of blood group "O" are less likely to develop venous thrombosis than those of other groups.

Venous thrombosis is not limited to surgical patients. It may follow any severe prostrating illness, especially in a patient with heart disease. It may also occur in pregnancy. This is probably because the blood tends to increase in coagulability in readiness to prevent excessive blood loss during childbirth and because the enlarging womb tends to press on the iliac veins, causing a progressive decrease in the velocity of blood-flow in the leg-veins. However, venous thrombosis associated with pregnancy occurs mainly after birth, and as it is more common in women who bottle-feed than in those who breast-feed, it may be that the precipitating factor in such cases is the oestrogen given to suppress lactation. If so, this practice should be abandoned and an alternative method such as binding the breasts should be adopted. It is also the oestrogen component of oral contraceptives that has been blamed for the thromboembolism which these products occasionally cause, and now that the oestrogen content has been reduced, the "pill" seems to be appreciably safer.

In some apparently normal (although often elderly) people, protracted periods of chair sitting—caused, for example, by a fond attachment to the television set or a prolonged aeroplane flight—may result in a mild form of leg thrombosis. The temporary damage to the knee-vein that occasionally occurs in long-distance racing cyclists may also lead to leg thrombosis. "Car drivers' leg", sometimes encountered on the Continent after the insane non-stop marathon drives of holidaymakers making for Mediterranean holiday resorts, is often no less than thrombosis. Its cause is complex but factors such as exhaustion, stress, heat and vibration are probably involved.

In about half of the patients suffering from postoperative venous thrombosis, the condi-

tion gives rise to physical signs such as swelling and tenderness of the lower leg, but is clinically "silent" in the remainder, even when thigh-vein thrombi are present. (This explains the often unexpected and unheralded nature of pulmonary embolism.) Diagnosis presents a special problem in these patients. The definitive technique is a "venographic" procedure in which a radio-opaque substance is injected into the leg-veins and an X-ray is taken. The thrombi then show up as translucent segments in the veins. More recently, a simpler, very sensitive method has been developed which can reveal a thrombus while it is actually forming. Fibrinogen, the substance which is the precursor of the fibrin in a blood clot, is tagged with a radio-active isotope and injected intravenously. If a thrombus is developing, the labelled fibrinogen is incorporated into its structure, and the radiation which builds up can then be detected from outside the body by using a scintillation counter.

The diagnosis of pulmonary embolism presents little problem if the patient shows the classical signs and symptoms, but when the signs are not so obvious, diagnostic procedures must be employed. A chest X-ray is often unhelpful and an electrocardiogram may be normal. A "lung scan" involves the intravenous injection of aggregates of radio-active albumin which are sufficiently large to lodge in the capillaries of the lungs. The distribution of the albumin can then be determined using electronic scanning apparatus, when one can easily discern defects in the perfusion of blood through the lungs. As other illnesses may give rise to an abnormal lung scan, the diagnosis must be confirmed by pulmonary angiography, a technique similar to that of venography.

Immediate treatment needed

When venous thrombosis is confined to the calf, no treatment is necessary and the thrombus dissolves spontaneously. When the thrombus extends above the knee, however, immediate treatment with anti-coagulant drugs is essential to stop further propagation and pulmonary embolism. Occasionally, the surgeon may have to remove the thrombus or tie off the vein above the thrombus, so locking it in the leg. Pulmonary embolism is also treated with anticoagulant drugs, but when the embolus is large and threatens life, it must be removed by emergency surgery. Certain new drugs can dissolve a thrombus or embolus and are showing considerable promise, but unfortunately they may have severe side-effects or are difficult to produce and are therefore very expensive. One of these, urokinase, is extracted from human urine (obtained from the Danish army). For many years, French farmers have been treating horses with thrombosed limbs by feeding them onions, so it may be that a cheap clot-dissolving extract could be produced from this common vegetable.

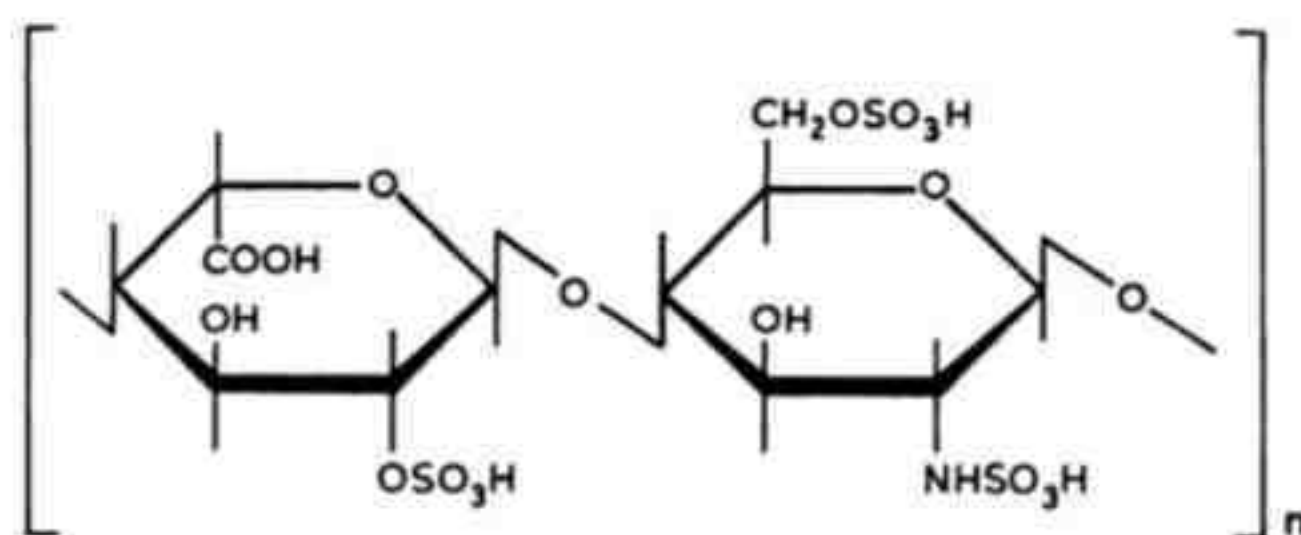
The most spectacular advances, however, have rightly been made in preventing venous thrombosis (and hence pulmonary embolism), although so far, prophylaxis has been limited mainly to surgical patients. The radioactive

fibrinogen test has commonly been employed to detect thrombosis and because this test is unreliable in the region of the extreme upper thigh and above, and because thrombi very occasionally start in this area without lower-leg thrombosis developing, some critics have argued that pulmonary embolism may still occur even though this test is negative. In practice, such an event is extremely rare so this criticism can almost certainly be discounted.

Many of the methods tried have centred around discouraging blood stagnation in the veins, both during and after an operation. Such methods are more likely to be successful when they are applied during surgery, because this is when the most profound slowing of blood-flow occurs. But postoperative measures such as early mobilisation and intensive physiotherapy which includes leg exercises, are undoubtedly helpful. One very effective method involves intermittently stimulating the calf-muscles with an electric current during the operation. This forces them to contract and relax rhythmically, thus simulating the natural calf-muscle pump. The optimum rate of stimulation has been determined and found to be once every four seconds. In a recent trial in which the stimulus was applied at this rate, postoperative venous thrombosis was virtually abolished. Unfortunately, this technique cannot be employed in many types of operation and its routine adoption would present considerable difficulties.

Other methods have concentrated on reducing the excessive coagulability of the blood. So far, the only consistently useful agent is heparin. Heparin is a naturally occurring substance of complicated chemistry (Figure 2) obtained commercially from the intestines

Figure 2 Probable structure of the repeating disaccharide of heparin



of slaughtered cattle. Doctors have exploited its powerful anticoagulant properties therapeutically for many years, but its use in surgery has never been considered possible because of the substantial risk of haemorrhage. In 1962, however, an American surgeon, Mr J. G. Sharnoff, reported that provided heparin is injected subcutaneously (just beneath the skin, rather than intravenously—it is not absorbed when given by mouth) some 9 to 10 hours before the operation and again in much smaller doses for a few days afterwards, bleeding does not occur. To date, using this method Sharnoff has treated over 1300 severe-risk patients and has succeeded in reducing dramatically the frequency of pulmonary embolism. Despite the encouraging nature of this work, surprisingly only a handful of surgeons have adopted Sharnoff's methods. One such surgeon, Mr J. Lannon in Johannesburg, who had previously experienced a frequency of fatal embolism of

4 per cent, reduced the frequency to nil in a group of 750 high-risk patients.

The first British trial of "perioperative" heparin was conducted by a group of surgeons led by Mr V. V. Kakkar at King's College Hospital Medical School, London. Although Kakkar and his colleagues used a different dose schedule from Sharnoff and assessed the incidence of venous thrombosis, not fatal pulmonary embolism, they succeeded in achieving a similar improvement. Their latest trial was a "double-blind" study (in which, to reduce bias, neither the patients nor the investigators know who is receiving the drug or who is receiving the placebo until after the trial is completed). The frequency of venous thrombosis in the untreated group was 42 per cent, compared with 8 per cent in the heparin-treated group.

Thrombosis massively reduced

Even better results seem to have been attained by a group headed by Mr A. N. Nicolaides at St Mary's Hospital Medical School, London. Using the same dose schedule as Kakkar, they have reduced the incidence of venous thrombosis from 22 per cent to less than 1 per cent. The apparently increased success of this trial, which is the largest controlled trial of prophylactic heparin published, may be partly due to the additional preventive measures routinely taken by the St Mary's group. These include ensuring that the patients wear elastic stockings from the time of admission to discharge (compressing the superficial veins increases the velocity of the blood in the deep veins, so discouraging stasis), elevating the patients' legs during surgery, and encouraging frequent active leg exercises during the postoperative period to promote the return of blood through the veins. If these simple precautions really do account for the relatively low incidence of venous thrombosis in the untreated group and the greater response seen in the heparin-treated group, then they should universally be regarded as mandatory.

Finally, Mr H. T. Williams of St George's Hospital, London, has conducted a small trial in which he used the dose schedule of Sharnoff and assessed the incidence of venous thrombosis. Even though some types of high-risk patients were excluded from this trial, the frequency of thrombosis was reduced only from 41 per cent to 15 per cent. Although other factors could be involved, this suggests that the dose schedule employed by Kakkar and Nicolaides is superior to that developed by Sharnoff.

Several other investigators have demonstrated the prophylactic value and safety of small doses of heparin, so it really does seem that a turning point has been reached in the prevention of postoperative thromboembolism. In England and Wales alone, over 20 000 deaths associated with pulmonary embolism occur annually, so clearly the prevention of even a small proportion of these is worthwhile. The next few years should see the spectre of pulmonary embolism and its harbinger, venous thrombosis, receding steadily from the scene of the operating theatre.

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Technology review

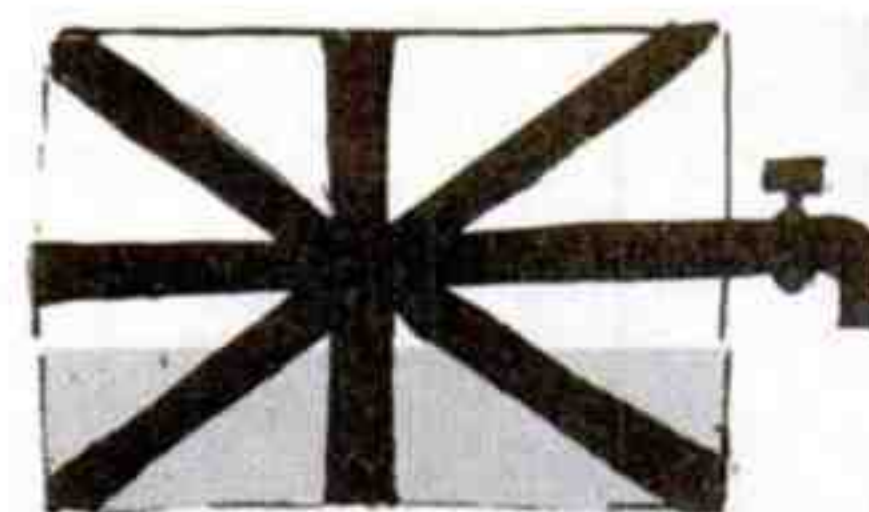
National plan should keep Britain wet

A very dry summer during the next two years would mean water rationing in London and several other large cities, says Ken Clarke of the Water Resources Board. Even with rationing, over extraction would cause the depth of water in the Thames at Teddington Weir to fall well below the statutory minimum of 170 million gallons/day which the Metropolitan Water Board is normally bound to leave in the river. Below 170 mgd the water velocity is so low that the river approaches stagnation—a highly undesirable situation from the point of view of public health. "In theory London is already in a deficiency situation now" Clarke explains; a dry spell could take

it into the red by some 50 million gallons/day, (normal average daily extraction is between 300 and 400 million gallons/day).

With luck London may find itself out of difficulties after 1974. A public enquiry was held earlier this year into stage one of a large underground storage scheme in the chalk of the Thames Valley. This £15 million scheme should, in five stages, increase the average amount of water in the aquifer to 100 mgd in times of drought by 1982—enough to last until 1984.

Thereafter water supplies for the whole country will depend on the national water plan, which has been the main



task of the Water Resources Board, Reading, since its establishment in 1963. After eight years of computer based work, the WRB's national plan is now almost complete, and should be published early next year. The study has looked at the water needs of only $\frac{2}{3}$ of the country, but includes 35 centres which account for 85 per cent of the national water demand. Projections of water needs till the year 2001 have been matched against available resources at different rates of development. Two forms of water supply have been left out: desalination (which WRB believes will never become cheap enough for wide use in the UK) and weather control. "While it has useful applications in the US," said deputy director Barry Rydz, "cloud seeding over the UK would probably have no effect until the clouds were over Denmark or Sweden."

A solution using only reservoirs, would be cheapest at £1300 million, but would have the most impact on the inland environment. Nevertheless, claims Rydz, the amount of land needed would be only 0.01 per cent of the predicted total land appropriation for building each year. If all the possible reservoir sites were accepted by parliament they would cover the UK's needs four times over at the end of this century and be adequate until at least the middle of the next century. At the other extreme an estuary based solution, storing water in three of the five estuaries considered in the study—most likely the Dee, the Wash and Morecambe bay—would cost £1600 million. Because the first stages of the estuary barrages could not be in operation before 1980, three inland reservoirs would also be needed as an interim measure.

In the event, the WRB will recommend a compromise solution, costing around £1450 million. Estuaries, underground storage in chalk aquifers, reservoirs, river regulation and large scale water transfer via canals and aqueducts to the Thames from Welsh rivers such as the Wye and the Severn are all likely to be included.

Barry Rydz also insists that increased industrial recycling will be essential—eventually "80 to 90 per cent of industrial needs will be met by recycled effluent," he predicted, although "if anything we have been overoptimistic regarding the amount of industrial reuse during the next 30 years." New factories will have to be designed in complexes to take best advantage of the water resources they themselves generate.

Is Access a poor credit risk?

Unsolicited credit cards may be new to Britain, but they are notorious—and illegal—in the US. The chaos that followed the launches of the US versions of Access several years ago brought such a public outcry that two years ago today a law took effect banning unsolicited cards. Even the negative option or inertia selling technique used by Lloyds Bank, where the consumer has 10 days to refuse the card, is banned in the US. The American cards were dogged by a long history of computer problems, erroneous bills, fraud, lawsuits, and damaged credit ratings.

To consumers and politicians, the most upsetting aspect was the inability to stop what they saw as computers run wild. Demands and threatening letters spewed out while frustrated consumers tried for months to reach a human, who in the end blamed it all on the computer and often said he could do nothing.

A Pennsylvania student, for example, received demands for a year even though he had never owned a credit card. Letters, damaged punched cards, and telephone calls to top executives all proved surprisingly unsuccessful. In the end, it turned out that after the petrol company involved had done a massive unsolicited mailing, its computer centre inadvertently separated card numbers from names and address. Matching was attempted after purchases were made, and the student was billed for someone else's purchases.

But errors were not the only problem. Fraud reached £80 million per year—1 per cent of turnover—and has forced the introduction of complex computerised checking systems. Thousands of cards were stolen from bulk mailings at post offices. Some were sold, at £4 each, to people who would make several purchases under the £20

limit for which checking was required. Another ring kept the cards and used them to emboss credit sales slips which were sold at a discount to dishonest merchants.

The frauds, errors and bad feeling led to extremely strict laws. Credit card issuers must now be able to prove that the card was specifically requested, and further that the consumer is aware of his full liability in case of loss or theft. The law is so strict that some card issuers lost large amounts of money in losses they could not recover because their cards had been illegally issued. Whether Access will have the same problems only time will tell, but with 3.5 million cards in the post and stories of unopened card mailings stacked on hallway tables, it seems inevitable.

Women and bank managers are being discriminated against by Access. Women are much less likely to get cards than men. In joint accounts, Access cards are almost invariably sent to the husband, who must give his permission if his wife is to have a card on the same account. Even women with their own accounts are less likely to get cards—National Westminster Bank admits that its target group is young male householders and that only one-quarter of the cards went to women.

Another intriguing aspect of Access is that NatWest is using it to take power away from branch managers. For the initial mailing, branch managers made the choice, but future cards will go only to people who get a high enough score on a credit rating. If the scoring is successful, the other banks will adopt it, too, and probably computerise it. In future, the computer may decide who gets credit cards. The scoring incidentally, gives extra points for being a man.

Splintered IBM may benefit Europe

If IBM is dismembered, its international operations will definitely be affected. Last week, the US Justice Department expanded its anti-trust suit against the computer giant to include operations outside the US. If successful, the suit could free a large pool of European R & D talent to work on European problems for the first time.

However, the Justice Department also made it clear that after four years it still does not know how to break up IBM. Despite a demand by Judge David Edelstein that the Justice Department spell out the exact relief and penalties demanded, the government could only respond with a request that IBM be broken into several unspecified "discrete, separate, independent" components that would, after a transition period, be able to compete against each other. This is the first time the US government has suggested that IBM be broken up rather than that the firm divest itself of some pieces.

By avoiding the issue, the Justice Department leaves Edelstein with three choices: throwing the case out of court, demanding that the department try again, or specifying a remedy (if IBM is found guilty).

The case has been a political football since it began. It was filed in the last days of the previous, Democratic administration, and remained untouched by the Nixonites until newspaper pressure and the smell of the ITT case became too great. The IBM case has since progressed at a crawl, with the Justice Department clearly

hoping it will go away until after the election, when it can quietly be dropped.

Political pressure may also explain the inclusion of international operations in the case. The EEC's anti-monopoly man, Altiero Spinelli, has made noises about IBM and the US State Department apparently does not want to be seen as unconcerned.

Breaking up IBM (see New Scientist, vol 54, p 8) is like smashing a diamond—the sum of the pieces could be worth much more than the original whole, but should the hidden lines of



cleavage be missed, the result could be dust. IBM is obviously not going to volunteer suggestions on the subject and the tons of documents the company has submitted will not help. The only answer is to trace product development and assessment, which means looking at IBM's R & D effort.

Although IBM dominates 60 per cent of the world's computer market, some experts suggest that it does 90 per cent of the world's computer R & D. But the wasted money of thousands of world computer users bears vivid testimony to the sheer cost ineffective-

ness of IBM's £200 million a year R & D effort. It has resulted in nothing better for the average data processing user than the mundane and limited improvements included in current IBM product lines.

IBM's research policy takes a particularly high toll in Europe. The firm's policy is to run multiple research programmes in centres across the world to arrive at several solutions from which the "best" can be selected. But "best" is assessed in terms of IBM's profit potential and not users' interests, and US needs override Europe's.

For example, IBM developed at least two third-generation computers. It chose the US developed 360 series which was not compatible with previous machines instead of a European one that was. It made less difference in the US where computer budgets were rising anyway, but worked a real hardship in low budget Europe. The trust busters would clearly rather have seen both machines produced and the decision made in the market place.

Perhaps worst of all, IBM has locked up Europe's best talent doing unused research in European research establishments. In the past year, the UK, France and West Germany have found that local manpower is not available to exploit the new money the governments have given to their domestic computer companies. Industry sources estimate that three quarters of the top ranking product development engineers in Europe work for IBM. If Judge Edelstein looks closely at IBM's R & D, some of the engineers may find themselves working on European products again.

Technology books go to school

Technology teaching in secondary schools is just now receiving a long awaited boost with the publication of the first batch of course material from Project Technology. Project Technology was set up by the Schools Council in 1967 to "help children get to grips with technology as a major influence in our society" and had spent some £300 000 preparing course literature and helping establish local technology centres in various parts of the country before it closed down at the end of August this year. Rather than just provide cannon fodder for the engineering industry, Project Technology was intended to give pupils in all kinds of secondary schools an understanding of some of the technology they will have to cope with as adults.

A much more limited operation, the National Centre for School Technology, aimed mainly at improving the supply of qualified technology teachers has since started up at Trent Polytechnic. Trent is paying most of the costs. Several staff members, including the director, Geoffrey Harrison, have transferred from the old project to the new, and the new centre still publishes the two regular maga-

zines started by Project Technology to inform technology teachers of projects and techniques in other schools.

The course material now being published has been field tested in several hundred schools. Feedback from these guinea pig schools has been gathered by a separate group at Keele University and used to bring the final versions of the course material as near as possible to teachers' and pupils' needs. The first six titles, released last week, include "Simple Bridge Structures", "Engine Test Beds" and "Introducing Fluidics". The rest of the course material—including handbooks, films, review material and packs of large cards "which outline many different open-ended project ideas"—will appear over the next two years. The range of material is intended to be of value both to pupils who need well-defined guidelines to follow and to those who simply need to be pointed in the right direction. In all cases Project Technology aims to familiarise the pupil with technology by encouraging him to make things (from simple electromagnets to hovercraft and aids for the blind).

Inevitably, there are gaps—large ones—in the courses. Time and money meant that few courses could be designed to suit female pupils, for example. Some of these gaps should be plugged eventually

by local technology centres, however. Moreover, the National Centre for School Technology will be available to advise on course content and equipment. The accumulation of expertise at the centre should be highly valuable in directing the shape of technology teaching to come.

After fingerprints and footprints come handprints. The ideal way to identify a credit card holder is by the shape of his hand, claim both the US Stanford Research Institute and an American company, the Identification Corporation.

Fingerprint and signature identification systems are of little practical use as a simple method of ensuring that a credit card holder is who he claims to be, because they require either a skilled human or a considerable amount of both electronic logic and processing time. Fortunately, the geometry of an individual hand is virtually as unique as a fingerprint and can be measured using far fewer parameters. Identification is now marketing an electromechanical device which measures hand shapes in less than a second and compares them with data on a special credit card. The company has also designed a handprint operated clocking in device.

Watchdog to sniff out novel proteins

With new forms of protein much in the news at present, it is heartening to hear that a watchdog unit has been set up by the Ministry of Agriculture, Fisheries and Food to channel information about future products for human consumption and animal feedstuffs. The Novel Protein Intelligence Unit established in the ministry's Food Science Division will collect, review and publish information on all aspects of novel (not to be called "synthetic") proteins. The Unit hopes to develop a network of contacts and would be keen to hear from scientists working in the field (contact the Unit's director, Dr G. Elton, at Gt Westminster House, Horseferry Road, London SW1).

It is only in the past decade that work has been intensified into the agronomy, preparation, quality and use of such foods as leaf protein (one of the major themes of the International Biological Programme) and on new ways of producing protein from such seemingly unlikely sources as petroleum, methanol and certain industrial residues. The Unit's remit includes assessing all the routes for producing single-cell and fungal proteins but does not include consumer protection or legislation. The Ministry already has a Food Standards Committee whose current review of unconventional proteins should be finished by the end of this year. There is also a Food Additives and Contaminants Committee, at present reviewing regulations governing the use of mineral hydrocarbons in food. The Novel Protein Intelligence Unit will liaise with these and other divisions, coordinating their efforts and producing regular reports on different aspects of this important new field.

Synthetic diamonds try for hardest cut of all

Synthetic diamonds are raising their heads in yet another bastion of the natural diamond market—cutting tools for superalloys and other extremely hard metals. Although artificial diamonds have been commercially available for grinding purposes since 1957, they are normally supplied as very small grains. The user mixes a paste of synthetic diamonds and a binder, then forms the paste into, say, gear teeth, which are stuck on to the edge of a grinding wheel.

Now the US giant, General Electric, has developed a method of doing away with the paste. Synthetic diamonds are made by applying high temperature and pressure (some 1204°C and 7 kilobars) to carbon materials. GE's Research and Development Center at Schenectady, New York, has discovered that a second heating at high pressure can force the tiny diamond crystals into larger, compact, polycrystalline shapes suitable for use as cutting edges in a much wider range of tools than the individual grains.

Although GE does not explain exactly how it forms the larger synthetic units, it admits to having produced composites from between 6.5 and 15.5 mm square, both synthetic diamonds and Borazon

CBN (cubic boron nitride), another extremely hard material. The shaped heads are joined to shafts of other metal working materials such as carbide alloys.

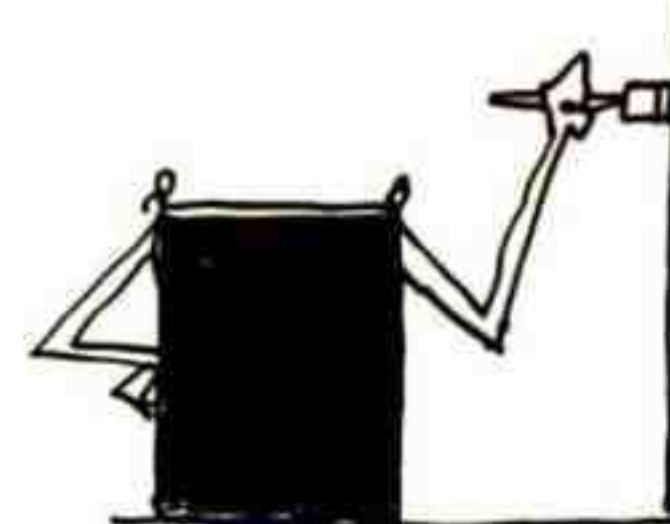
GE claims that the new tools cut superalloys up to eight times faster than conventional metal working heads of tungsten carbide or silicon carbide, and that the hardness of the cutting head also gives a smoother finish to the worked surface.

However, like their natural diamond counterparts, the new cutting heads are expensive (natural diamond heads usually use large diamonds of poor colour but of high purity and few flaws). The major area of application is likely to be aerospace and perhaps the nuclear industry. Various companies in the US and Europe are already testing the new tools.

Brush off for paint workers

Although officially opened only last Friday, ICI's new integrated paintmaking plant at Stowmarket is already well on the way to full production. By the end of the year, the £2 million investment in new plant (said to be unique in Europe, if not the world) should be complete and capable of churning out 14 million litres of decorative paint annually—with a staff of only 38 people.

In a conventional paintmaking plant, materials often have to be transported up and down between floors for a succession of batch processes. The new "big batch" process building at Stowmarket is 90 ft high, has three floors, and is fed with



raw material from the top. Gravity, with pumps to help speed the process where necessary, carries the materials down the building through batch processes which are chosen and controlled by one operator, who masterminds the proceedings from a control room on the second floor. His fingertip selections decide which varnishes, solvents or pigments are pumped from neighbouring storage tanks and silos to the top of the process building.

High speed rotary dispersers perform the first operation on the raw materials on the top storey. Then, if the resulting paste needs it, there is another stage of dispersing, this time by a glass-bead mill on the second storey. The white paint that reaches the first storey has tint added to it, if required, and receives its final stirring. At this stage batches are quality tested in the laboratory. The last descent, through strainers, is to the conveyor lines on the ground floor, where pre-labelled cans are automatically filled with the paint and cartoned up.

Full integration and automatic handling have brought economies amounting to unspecified thousands of pounds a year. Conventional paintmaking plants receive pigment in hand-loaded paper bags, which always retain some powder after being emptied. This kind of loss is now avoided, because specially adapted road tankers deliver pigment to Stowmarket's new

Soviet power runs on hot air

The Nevinnomyssk power station in the North Caucasus is at present testing the USSR's first purpose-built steam and gas turbine (stag) unit—the first operating unit of its kind outside the United States. Hot exhaust gases from the gas turbine are used to turn water into steam, which operates another turbine within the same unit.

Until now, high capacity steam turbine units have been the mainstay of the Soviet power industry. Gas turbines have only been used in a small way. A 4MW gas unit was installed in 1964 in a Leningrad heat and power station for topping up the existing 30MW steam turbine. Experience from that and from gas turbines developed for pumping, in aviation and other fields means that the Soviets are now in a position to introduce gas turbines into the electric power industry.

The engineers see two main jobs for the gas turbines. They can cope with peak demands in areas where demand is uneven; and the exhaust gases can heat water for district heating units, which are very much part of Soviet philosophy and winter comfort. The current development aim is to in-

crease the overall operating efficiency of the present steam turbine units.

The 200MW Stag unit being tested at Nevinnomyssk was built at the Kharkov turbine plant. It has the highest thermal efficiency of all turbine plants being developed in the USSR at the moment—5 per cent more efficient than a comparable steam turbine plant. The initial costs are 7.8 roubles/kW lower. Successful operation of the Nevinnomyssk plant should pave the way for the widespread introduction of higher capacity Stag plants and for uprating old thermal power stations. However, all this also depends on a reliable year round supply of natural gas—a factor which has so far hindered more widespread use of gas turbines in the power industry.



silos in bulk. There are eight of these silos (and space for another four) and each can store 100 tons of powder. Fluidised by aeration, the pigment is pumped from the silos up to and over a bridge to the top of the process building. The bulk handling equipment deals with the equivalent of 10 000 hundredweight bags per week.

Fast change-over between product types is facilitated by mechanised cleaning of vessels and pipework. The ease with which the plant can produce 20 000 litre batches of the various paints in the range helps to solve ICI's stock-holding problems—unpredictable shifts in demand can suddenly run down supplies of a paint in some of the company's network of depots. Now Stowmarket can replenish unexpectedly depleted stocks quickly.

Make hay while the sun peeps through

More than almost any other crop, hay is plagued by the weather. Each year losses varying from 25-40 per cent occur when over three million acres of grass are made into hay in the UK. The National Institute of Agricultural Engineering at Silsoe, Bedfordshire, argues that speeding up the haymaking process would allow the farmer to take better advantage of fine spells of weather. An increased choice of mowing times would also allow the farmer to cut his grass at a more suitable stage of growth, thus improving the nutritive value of the hay.

Frank Brown, head of the NIAE's machinery department has been trying to develop a simple machine which will mechanically bruise the crop without using too much tractor horse power or leading to high field losses. The prototype design, which has been patented by NRDC and licensed to two manufacturers, operates with a conventional reciprocating mower with a cutter bar, and a flail rotor. The teeth on the rotor, which rotates at 70 rev/min, comb the crop against the machine casing, bruising and crimping the stalks. The rotor throws the crop into a loosely formed, low density swath to ease air penetration during the wilting stage of haymaking.

A more radical approach using superheated steam has been adopted by Dr Philipsen at the Dutch Research Institute in Wageningen. The equipment, which has recently been under test in Britain, sprays superheated steam at 200°C over a standing crop of grass, before mowing. The high temperature breaks down the waxy layer covering the cells of the plant. Once broken, moisture is lost more rapidly to atmosphere, the cell structure collapses and the plant wilts, being unable to maintain an adequate supply of water from the roots. Within six hours, the crop moisture may fall from 80 per cent to 65 per cent. The crop is then mown and dried artificially or by the Sun. No ill effects have been observed on the health of the plant. Work is now in progress to see whether the same effect can be achieved more economically using dessicant chemicals sprayed on to the surface of the standing crop.

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Computer takes over dyed in wool operations

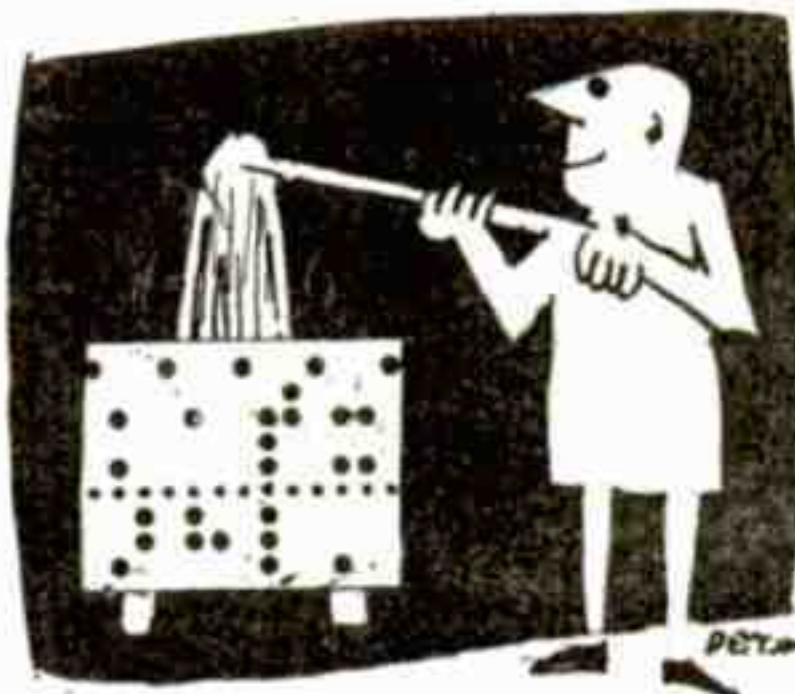
Computer based dye matching has now got to work in the wool industry and is already solving some of the problems encountered in recent years from greatly changed dye specifications. New wool processes—the latest are designed to give knitted woollen garments that will withstand shrinking for at least three hours continuous machine washing—are too demanding for traditional dye recipes, which are simply not stable enough to cope with these conditions.

The normal method of matching colours with dyestuffs is expensive and time consuming. The dye technician has to experiment with baths of various dyes until he obtains a close match. Each test takes about three hours and an exact match often proves elusive.

With the £17 000 computer matching system, developed jointly by the International Wool Secretariat and International Colour Systems Ltd, Newbury, (see New Scientist, vol 52, p 218) the average matching time is cut to five seconds and the cost per match is cut to 5p, compared with about £3.50 by conventional methods. The system consists of a spectrophotometer and a Digico minicomputer, which between them can recognise some 2 million shades—far more than any manufacturer would normally have access to. An operator shows the spectrophotometer a piece of fabric of the required colour and the computer searches its memory for the right recipe. The computer printout may also include

details of how the colour will appear under different lighting conditions.

The computer is held at the IWS's technical centre at Ilkley and can be linked via Post Office lines to a spectrophotometer on a manufacturer's premises. Alternatively, the manufacturer can send samples of fabric through the post.



IWS claims that any manufacturing firm which bought a system would cover its costs within two years. IWS's own dye matching service is free to member companies, but should nevertheless pay for itself within roughly the same period. Some of the staff at Ilkley, previously employed on dye matching, are now dealing with other more important projects, such as effluent treatment and developing new dyeing processes.

Chemical processors look to the East

European process industries may move many of their major plants to the Middle East and other oil-producing areas over

the next seven years, according to business consultancy Arthur D Little International. The main reasons for this shift, the company concludes in a report prepared for the Dutch Metal and Electrical Industries Federation, are the high cost of complying with anti-pollution legislation and pressure from the developing oil producing countries for a larger slice of the profits from oil based industries.

Anti-pollution measures will add 10 to 12 per cent to the bill for new investment in the Benelux countries, the report concludes, but Belgian process industries will not be forced to take too much notice of pollution measures until the end of the decade. Dutch process industries, on the other hand, will be made to face up to their pollution problems throughout the seventies.

Both Belgian and Dutch growth rates in new investment in process plant will be higher than the average for Western Europe, where investment has been growing at 6 per cent annually from 1969 and should reach a total annual investment of £5800 million by 1974 and £7400 million by 1979. Twelve of the dominant 15 process industries in the Benelux countries over this period will be based on naphtha.

The report has hard tidings for industries dependent on chemical processing companies. In particular, process engineering contractors are "in for a severe bout of rationalisation: independent contractors with genuinely international operations are expected to fall in number from approximately 80 in 1971 to 20 to 30 by 1980."

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Patents review

Adrian Hope

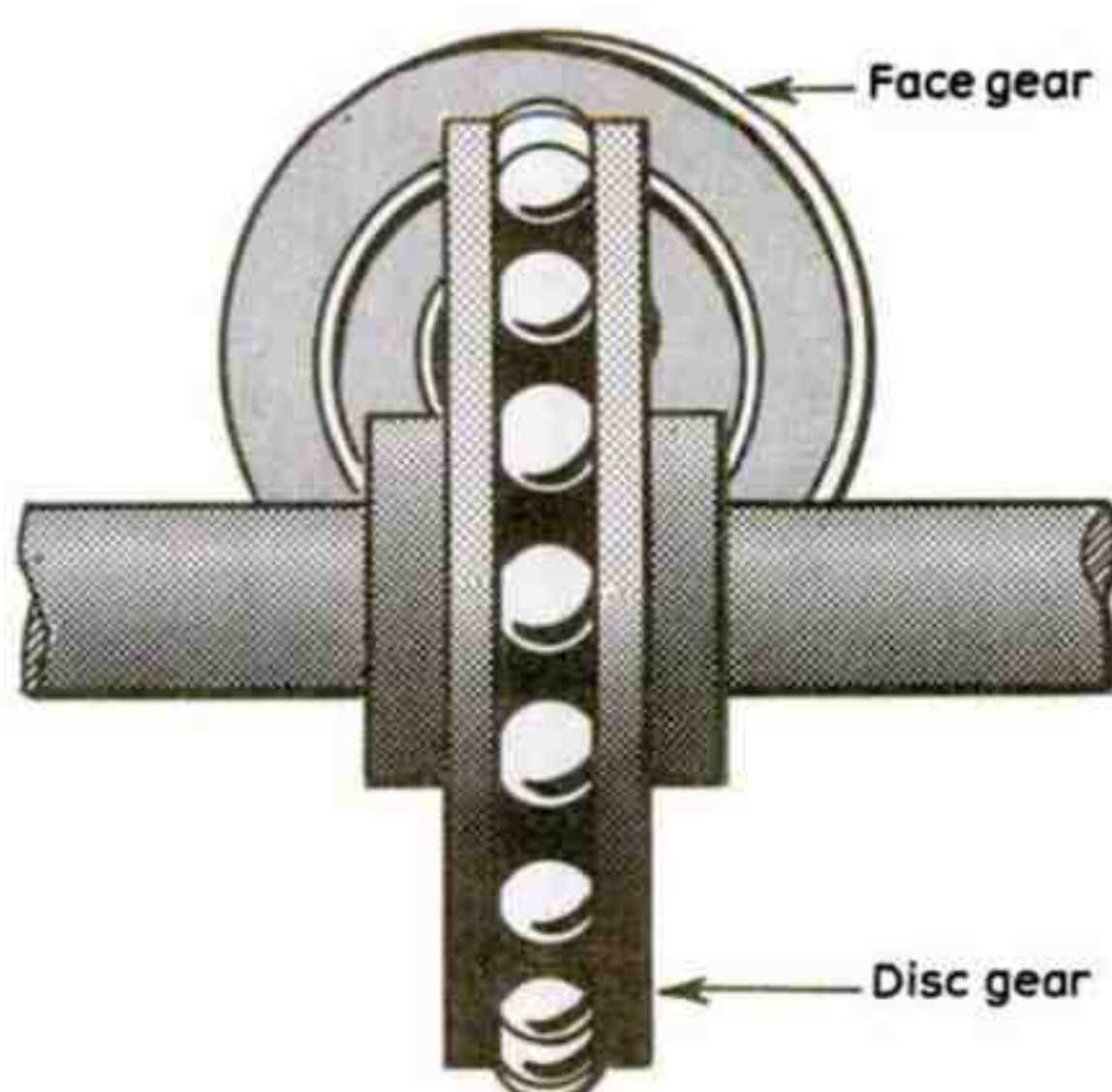
Know your patents library

Since the library of the British Patent Office went under the wing of the British Museum as the National Reference Library of Science and Invention (NRLSI), the aids it offers to readers have multiplied. For instance, how many people realise that they can have *free* linguistic help in the libraries at Holborn and Bayswater for prearranged periods of up to 30 minutes? The linguists work orally in just about every European language and the sessions are intended to give the reader a fair understanding of whether or not a book, patent or article is of real interest and relevance to his research. He can then go to a translation bureau and pay for a full written translation, safe in the knowledge that he will not be wasting money on a translation of something totally irrelevant.

Almost all foreign documents can be copied for readers on a while-you-wait basis. But, because home-grown Patent Office publications are supposed to be bought direct from the Patent Office Sales Branch, the NRLSI Library will copy patents only in cases of dire necessity. Many readers would doubtless welcome a more flexible approach here especially as there are still some documents, such as the weekly Patents Journal, which the copy service flatly refuses to touch. However, to the library's credit it provides, free, a whole series of "Aids to Readers" booklets explaining how the complicated system works. During the past five years, the free bonanza has also included one-day introductory courses on the use of technological literature. The number of places is limited to 16—although the keeper promises to try to meet whatever demand exists.

Groovy twist to right angled drives

Right angled gear drives are notoriously inefficient but Spyro Dynamics Corporation of New Jersey claims efficiencies of 99 per cent or more with a new system



patented in BP 1 283 731. In this drive a ball-toothed gear is driven by a face gear with a spiral groove into which the ball teeth fit (see diagram).

A disc or wheel is mounted on a shaft. Around the disc periphery is a race of hardened steel ball bearings, free to rotate in all directions about their geometric centres. Thus each ball sits in a socket at the disc periphery and serves as a gear tooth. This disc is driven by a face gear at right angles to it. The face gear is also mounted on a shaft but has a spiral channel or groove in its working face—rather like a grossly exaggerated gramophone groove. As the face gear is rotated, each ball enters the groove and turns according to the pitch of the spiral. Each movement of the balls causes the disc carrying them to move by a small amount, too. For each revolution of the face gear, the ball gear disc rotates by an amount equal to the distance between the centres of adjacent balls.

The company acknowledges that hard materials and adequate lubrication will be necessary. But the inventors claim long life, no back drive and high horsepower rating.

Sends lasers round the bend

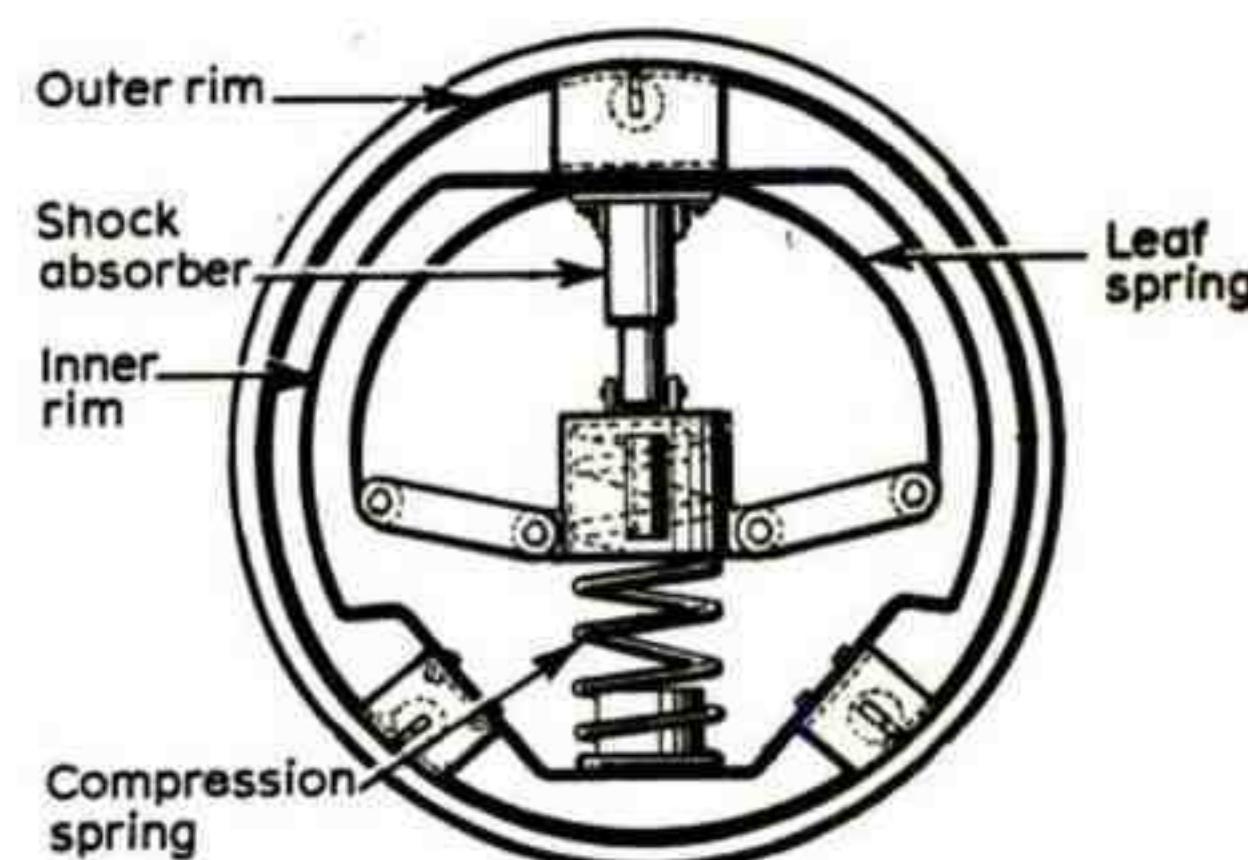
Persuading tools such as lasers to follow a line automatically is difficult when the line includes tight bends, cross overs or sharp angles. At a sharp intersection, for instance, the tool may be confused about which line to follow.

In BP 1 285 704, British Oxygen Company suggests an interesting new approach to the problem. As an example it cites an operation to produce the steel rule cutters used in scoring blanks for cardboard boxes. The steel rules are set into grooves in a backing sheet of plywood—cutting the grooves is a difficult operation, even with a laser, because the guidance systems cannot always cope with sudden changes of direction. The basic principle of the BOC invention also applies to most other cutting tools.

A photoelectric sensor controls the movement of a tool or work table by reading a control pattern as usual. But instead of using a single pattern, replete with awkward bends and crossovers, BOC employs a series of complementary patterns, none of which has intersecting lines or sharp corners. The photoelectric head follows the first of these patterns and guides the tool accordingly, stopping at the end of the trace. The next pattern is designed to start where the first finished. For those parts of the path where the laser is not meant to cut, an additional parallel line is drawn on the pattern. When a second photoelectric cell detects this line it temporarily switches off the cutting mechanism. At any intersection where one of the lines is not to be cut, the auxiliary line is deleted for a short distance on either side.

Now for the really low sprung car

Vehicle springing is usually open to the elements and suffers from corrosion. A sensible answer—reminiscent of the sprung hub arrangement used formerly on motor bikes—is to enclose the springing inside the wheel itself, says William Woolley of Mississippi. In BP 1 282 700, Woolley mounts the vehicle tyre on a rim which is rotated around an inner rim by roller bearings. This inner rim is supported by a spring system joined to a central block, which is a rigid part of the vehicle chassis.



The spring mounting consists of a heavy, coiled compression spring between the centre block and the inner rim. Diametrically opposite the spring is a shock absorber, also extending between the centre block and the inner rim. A semicircular leaf spring is arranged to act in the opposite direction to the compression spring. The strength of each spring is adjusted to ensure that the rigid block stays at the centre under normal load.

In use, the outer rim rolls freely round the inner rim and both are sprung with respect to the centre block. In theory at least, no shocks should ever reach the vehicle frame.

Flapping lorries all sealed up

Airflex Containers Limited suggests in BP 1 284 732 a simple, sensible answer to the problem of flapping tarpaulins on the backs of loaded lorries. However carefully a tarpaulin is tied down over the lorry load, wind and weather can usually conspire to loosen at least one edge or corner. The tarpaulin then flaps in the wind and becomes a danger to pedestrians and other vehicles.

Airflex's suggestion involves a conventional lorry with a solid rim around the rear and a tailboard. A plastics sheet is sealed to the top of the rim—looking like a giant plastics bag. The driver first stows his load under the sheet, then evacuates the air with a vacuum pump. Atmospheric pressure moulds the sheet to the shape of the load and keeps it moulded for as long as the low pressure is maintained.

For explaining away resistance

The Nobel prize for physics this year is shared by three American physicists for their highly successful theory of superconductivity advanced 15 years ago

Dr Peter Stubbs



John Bardeen

For half a century after its discovery in 1911 by the Dutchman Kamerlingh Onnes, the phenomenon of superconductivity confounded the theorists. The problems began to yield in the 1950s, and, in 1957 three American workers—John Bardeen, Leon Cooper and John Schrieffer—came up with a remarkably successful theory which has become a cornerstone in this branch of low-temperature physics. This week the authors of the BCS theory, as it is commonly called, see their efforts crowned by the award of the Nobel prize for physics. The occasion naturally echoes that of their celebrated forerunner, for Onnes received the Nobel prize in 1913 for his researches in low-temperature physics. Professor Bardeen is at the University of Illinois, Professor Cooper at Brown University, Rhode Island, and Professor Schrieffer at the University of Pennsylvania.

Kamerlingh Onnes was the first man to liquefy helium gas and thus to inaugurate the science of cryogenics. In 1911 he discovered that, at a temperature just below 4.2°K , mercury passed into a new state in which its electrical resistance became vanishingly small. Although it is only in the past decade that technology has begun to look intensively into the applications of this astonishing effect, Onnes himself must have seen the promise which superconductivity held out. Large currents could be established with low voltages, implying a revolution in the design and operation of big electromagnets; low-loss DC transmission lines became feasible in principle. Modern applications include the possibility of better particle accelerators employing superconducting cavities, and exploitation of the effect for electric motors and generators of the coming decades.

Today about 30 metals are known to be superconducting each at a specific critical temperature. In the superconducting state, these metals, placed in a magnetic field, completely exclude lines of magnetic flux; in a magnetic field of critical strength they lose their superconductivity, setting a major technological problem to the designers of practical materials for superconducting devices.

The BCS theory which accounts for all these aspects of superconductivity dates from 1957. Physicists had realised for some while that they were dealing with an effect that depended on the very-low-temperature ordering of electrons in the metallic crystal lattice. At liquid-helium temperatures, the influence of thermal agitation on particles making up a substance is minimal, permitting new types of ordering in which macroscopic quantum effects become apparent. Like the superfluidity of helium itself, superconductivity is

one of these.

In 1950 H. Fröhlich and John Bardeen, independently, put forward the idea that superconductivity was related to some kind of interaction between electrons and phonons, the quantised "packets" of vibrational energy in the crystal lattice. Fröhlich envisaged the process as one in which electrons travelled through the crystal by emitting and absorbing virtual phonons.

Then in 1956, Leon Cooper took the next step. He showed that, in such an electron-phonon-electron exchange the normal electrostatic, or Coulomb, force tending to hold two electrons apart could become very small or even vanish within a superconducting lattice. Under certain conditions it appeared that an attractive force could occur between a pair of electrons interacting via a phonon. These would then form a bound pair, since termed a "Cooper pair", in which the spins and momenta were opposite to one another. The energy considerations were satisfied for the crystal taken as a whole, although the energies of the first and second interacting electrons did not need to be conserved between them.

A comprehensive theory by Bardeen, Cooper and Schrieffer developed 15 years ago, taking these ideas into account. An absolute zero, they proposed, a superconductor would have the maximum number of electron pairs, giving rise to a high degree of "coherence"; put simply, if the electrons are considered in terms of "matter waves" these would all be "in step" with one another in much the same fashion as the electromagnetic waves in a laser. Under these circumstances an electric current—that is, the flow of electrons—will not be scattered by the vibrations of the lattice or by defects within it, the obstacles which give a material its electrical resistance.

Since then the BCS theory has gone from strength to strength. It satisfactorily explained the so-called "isotope effect", discovered in 1950, which is that the critical temperature of a superconductor is inversely proportional to the square root of its mass number. It has been refined and extended by a number of theoretical workers. But it has not been displaced. From it have stemmed several important new effects.

For John Bardeen, at 64, the occasion is especially gratifying—he has become the first scientist ever to share a Nobel prize twice for the same subject. In 1956 he received a third share in the physics prize which went also to William Shockley and Walter Brattain for the development of the transistor. His co-winners this time are much younger than him; Cooper is 42, Schrieffer 41.



John Schrieffer



Leon Cooper

Biochemists beat the enzymes

Enzymes hold a key position in the chemistry of cellular activities. Using chemical probes it is now possible to discover how enzymes work

Dr Roger Lewin



Christian Anfinsen

This year's Nobel Prize for chemistry goes to three biochemists: Christian Anfinsen, Stanford Moore and William Stein. The announcement may give traditional chemists reason for some quiet reflection, but the enzymologists I spoke to were delighted with the news. By their independent two-pronged attack Moore and Stein—who had a long and fruitful partnership at the Rockefeller University, New York—and Anfinsen—at the National Institutes of Health, Bethesda—opened up a new era in the understanding of the structure and function of enzymes.

More than half of the solid material in animal tissues is made of proteins which perform essential mechanical, protective and catalytic functions. Of all their jobs catalysis is probably the most intriguing, and it certainly places proteins at the centre of life itself because they are the vital key in driving all the chemical reactions—from replicating DNA to metabolising glucose for energy—in the cell. Clearly, without a detailed understanding of how these protein enzymes work much that is fundamental to biology must remain obscure. The work of the three new Nobel laureates has gone a long way to giving us this understanding.

It was Claude Bernard—the 19th century French physiologist—who commented so acutely that real progress in science frequently depends on the development of new methods, an observation that history has proved right so many times. At least part of Moore and Stein's great contribution to enzymology is their development of the automatic amino acid analyser, an instrument without which the study of large complex protein molecules would be indescribably laborious, if not impossible. Using their analyser the Rockefeller bio-chemists were able in 1960 to determine the amino acid sequence of ribonuclease, an enzyme that splits ribonucleic acid (RNA) into its subunits. Although ribonuclease was the second protein to be sequenced—the first was insulin by Fred Sanger in Cambridge in 1955—it was the first enzyme whose primary structure (amino acid sequence) was known.

Insulin is a relatively small protein—it has 51 amino acids joined together in two separate chains—compared with bovine ribonuclease—124 amino acids. The techniques behind Sanger's Nobel Prize winning efforts with insulin were therefore inadequate in the Americans' assault on the bigger enzyme.

With the exception of a few years' break as a result of the war, Moore and Stein have been working together at the Rockefeller University (known as the Rockefeller Institute until 1965) since the early 1940s. Unlike Sanger, who separated amino acids by paper chromatography, Moore and Stein set about developing separation methods that involved columns. By 1948 they had produced a column

packed with starch granules that could separate the amino acids in a milligramme sample of hydrolysed protein. A vital step was the ability to measure the quantity of the individual amino acids as they come off the column; Moore and Stein achieved this by a simple modification of the reagent ninhydrin which produces a purple colour with amino acids. A single analysis involved something like 900 individual ninhydrin tests and took about 12 days to complete. Later improvements involved replacing the starch by ion exchange resins, and automation of amino acid detection. By 1958 the fully automated amino acid analyser was born.

The determination of the primary structure of bovine ribonuclease—a feat achieved with the help of C. H. W. Hirs and D. H. Spackman—was of course only the first step in unravelling the mode of action of the enzyme. Although enzymes are undoubtedly long chains of amino acids joined together, they are inactive until they assume their specially folded shape. The extreme sensitivity that proteins display to even slight modifications in shape implies a very tight specificity as far as the overall conformation is concerned. The problem is: what rules govern the folding of the protein chain in to the correct shape? The answer to this problem—which has profound implications for the mechanism of biochemical evolution—was provided by Anfinsen in the early 1960s.

Anfinsen also chose to work with bovine ribonuclease—the high purity with which it was available and the corpus of data already collected about it made the enzyme a favourite research tool in many laboratories. Ribonuclease has four disulphide cross links—like the rungs of a ladder. If, after the links have been split, the chain is allowed to fold up once again, there are 105 possible ways it could do it. But Anfinsen discovered that the correct conformation is, almost exclusively, the one formed. He concluded that the active form of the enzyme is the thermodynamically most favoured conformation. It became evident therefore that the only information necessary for the assembly of the complicated three dimensional structure of the active protein is that in the primary sequence of amino acids, and the information for this is laid down in the genetic code.

The three dimensional structure of enzymes is crucial to their catalytic activity, a feature about which the enzyme's primary structure gives no clues at all. Separately the Rockefeller and Bethesda researchers continued their efforts to pin down the mechanism of action. Anfinsen switched his attention to another nuclease (from *Staphylococcus aureus*) and carried out some beautiful work showing that previously inactive enzyme fragments can recognise each other, combine and become active, thus emphasising the



Stanford Moore



William Stein

structural information that is built into the primary sequence. He went on to experiment with artificial fragments—as a substitute for the real ones—to try to pinpoint the functionally important sections of the molecule.

Meanwhile Moore and Stein were searching out the active centre of the bovine ribonuclease by reacting it with specific inhibitors. Their classic experiment was with the inhibitor iodoacetate which inactivates the enzyme by attaching itself to the amino acid histidine in position 119, confirming that this

acid is an important element in the catalytic event. Perhaps more important, it became clear that other elements in the active site were provided by amino acids which, though distant from residue 119 on the chain, were brought close to histidine-119 by the folding of the three dimensional structure.

These approaches make possible the intimate probing of an enzyme's catalytic centre, an achievement whose impact on enzymology will be apparent long after the initial excitement of revolution has subsided.

Laboratories move towards flexibility

The Laboratories Investigation Unit of Britain's DES has applied scientific methods to laboratories, rather than to the work done in them. The traditional laboratory may hinder research, and the LIU has produced a new and flexible approach

**Dr Martin
Sherwood**

Look at an illustration of an early laboratory, Lavoisier's or Faraday's for example. There is not much in common with a modern lab—in fact, most of the fittings look as if they might be discarded kitchen furniture, and provide a stark contrast to the uniform rows of benches that characterise many of today's labs (Figure 1). Yet these early labs had one advantage that is often missed nowadays—flexibility. Because they were makeshift, they could easily be remade. Once laboratories became organised, utilising piped services to supply gas, electricity and water, they fell into a conformity that is only just beginning to be shaken off.

Currently, the laboratory is one of the most expensive types of building and, as many laboratories in Britain are built out of government budgets, the Department of Education and Science set up, a few years ago, a Laboratories Investigations Unit to provide authoritative advice on laboratory design and to find ways of keeping costs down. In the last five years, the LIU has undertaken a number of research projects on laboratory usage and scientists' needs and has emerged with its own

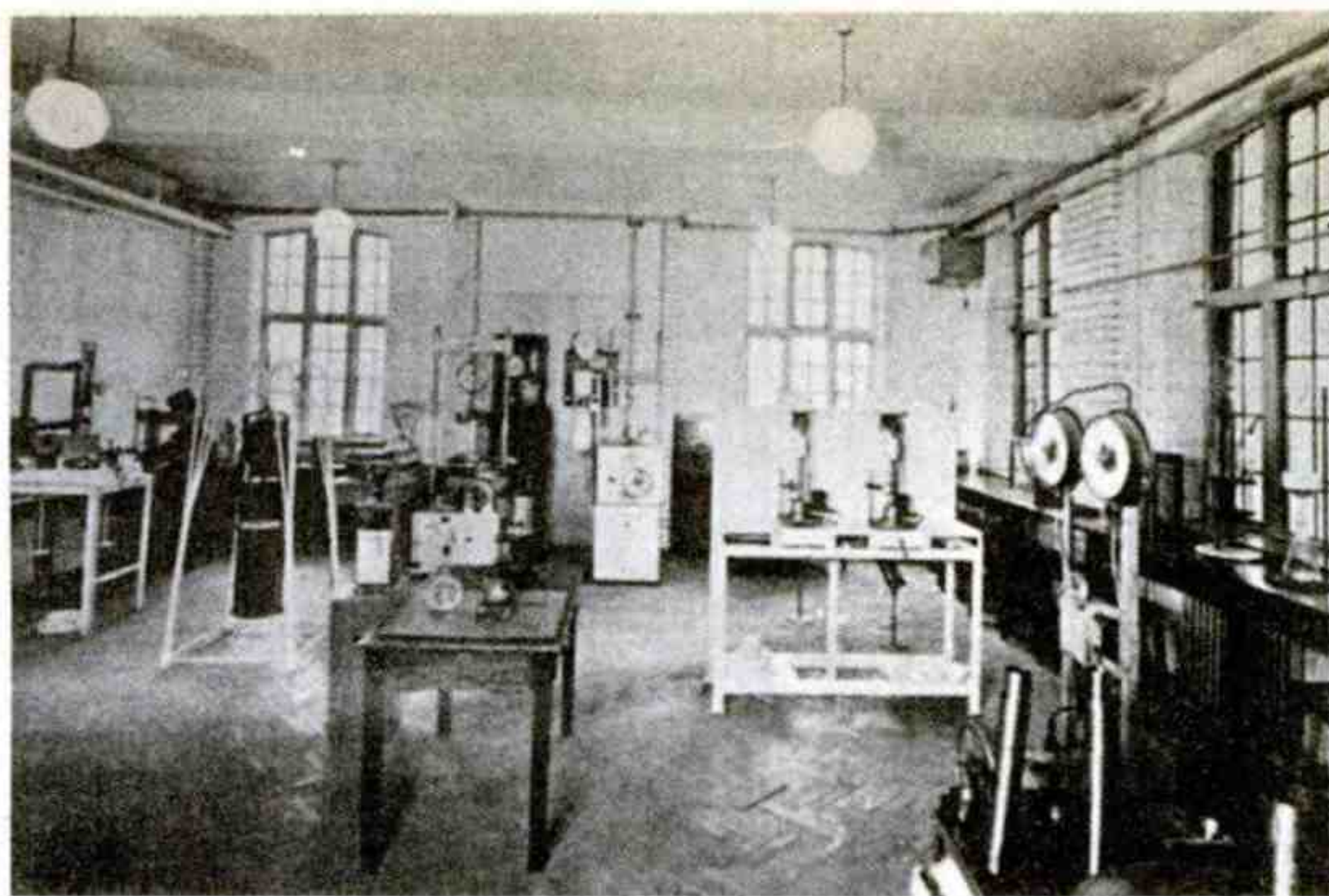
system of laboratory fittings, and a firm commitment to a new style of laboratory, in which flexibility is the main feature.

The idea of making laboratories more adaptable is not new. In a *Laboratories Supplement* to *New Scientist* published three and a half years ago, Dr Vivian Wyatt argued for greater flexibility in design, and made a number of specific suggestions, most of which appear in the LIU's recently-developed system. What is different about the LIU's approach is the amount of basic research which the unit has undertaken about laboratories and the people that use them.

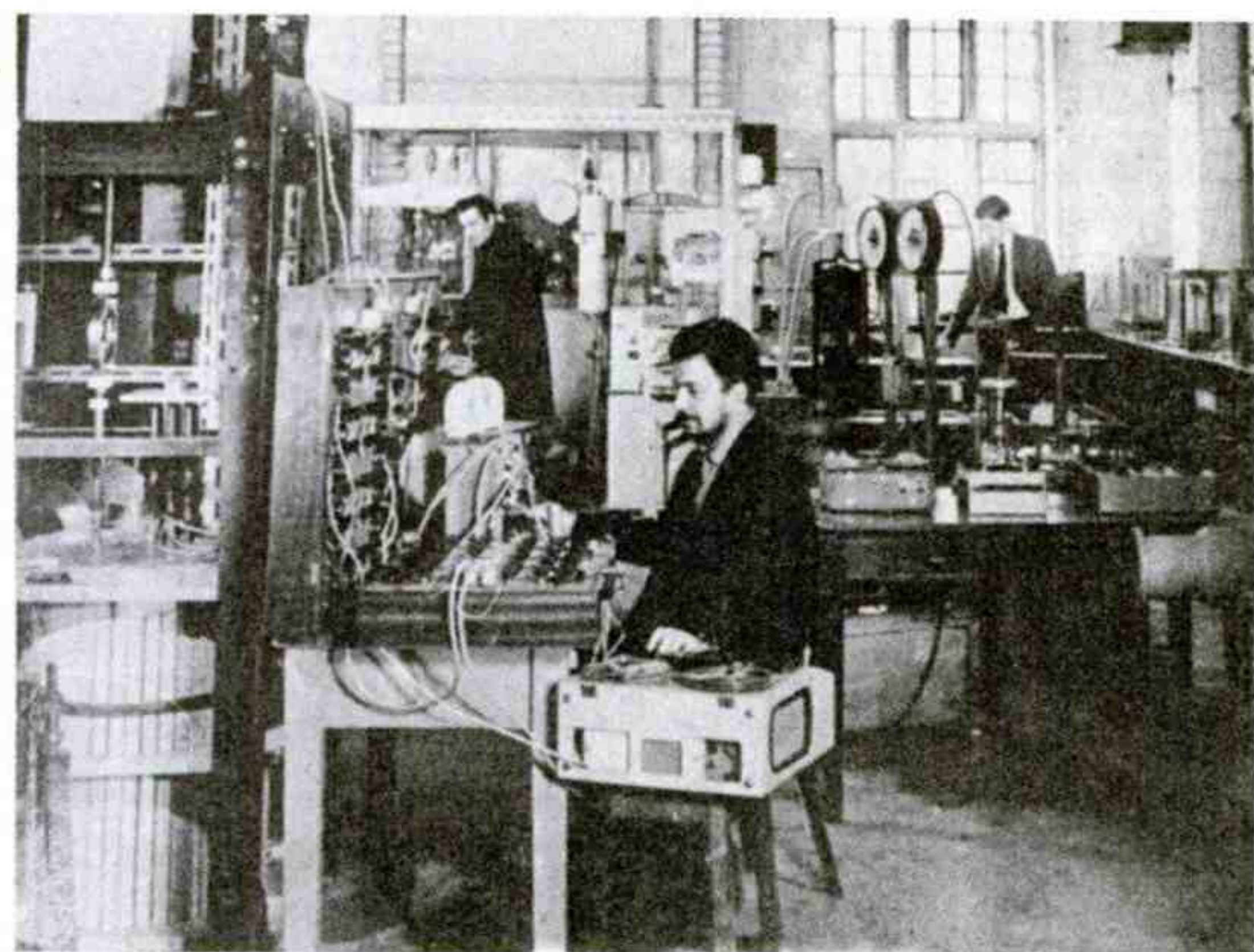
One of the fundamental problems in designing any building is that it usually outlasts the people for whom it was designed. While one might expect scientists—familiar with the unexpected twists and turns of research—to appreciate that not only their successors but also they themselves, a few years hence, may have changed requirements, the LIU, in talking to them, found that the stress in laboratory design was nearly always on a personal solution. Given that the design for a building may be complete in all but minor



Figure 1 Research laboratory at Ardeer in 1890. Piped cold water and town gas had just been introduced but were not integrated with the furniture (from *A History of Research in the Nobel Division of ICI*)



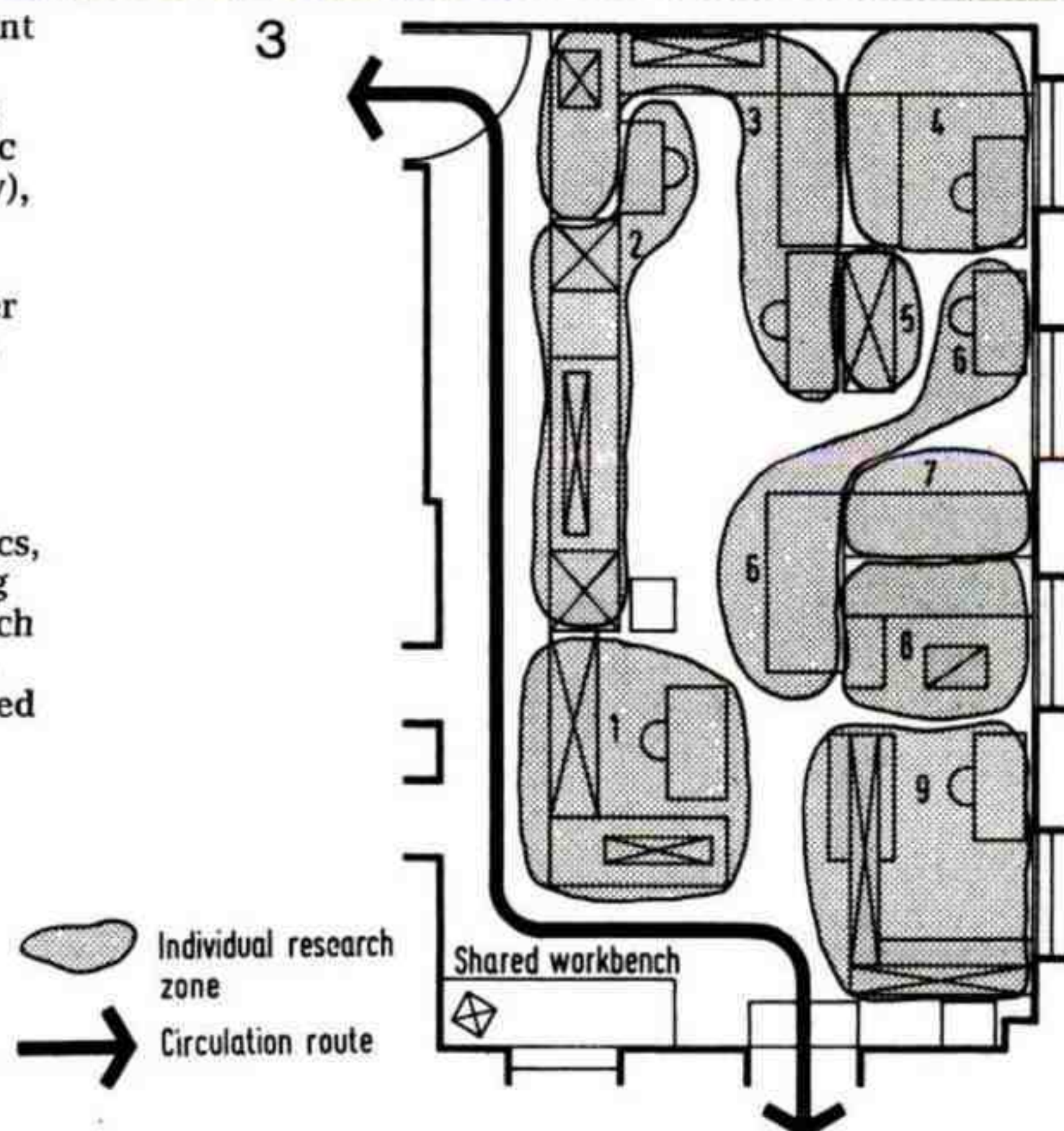
2a



2b

Figure 2 a Department of Civil Engineering soil mechanics lab at Battersea Polytechnic (University of Surrey), in use as a teaching lab in 1962; b the same lab in 1963 after introducing research work into the area

Figure 3 A research laboratory in the Department of Physics, at Battersea, showing the individual research zones of nine people. Area per person varied between 1.40 and 7.62 sq. m.



detail three or four years before it comes into use, there must always be some predictive effect in demands made on the building's designer: the LIU found that the most frequent sop to the future is to overprovide services—sinks, gas outlets—rather than to think out a fundamentally adaptable design.

Part of the LIU's research programme was a study of growth and change in laboratory activity at the Battersea Polytechnic from its foundation in 1894 until its move to Guildford as the University of Surrey in the 1960s. This study covered a history of growth and change in the total institution; a territorial analysis which examined organisation and development of research activity; a study of laboratory activity, primarily research, with particular emphasis on growth and change of work at the individual user level and its implications for the adaptability of facilities; and an inquiry into the utilisation of laboratory space and equipment. Figures 2a and 2b provide just one indication of how a laboratory can suddenly undergo change. What is more often likely to happen is that change will be slow. The distribution of personal space in a research laboratory can then develop in odd patterns as shown in Figure 3.

Aggravating the problems of change is the scientists' propensity to hoard. As an earlier LIU report remarks: "The acquisition of new or substitute apparatus in the course of an experiment usually means that old apparatus tends to accumulate. Much apparatus has little resale value as it was originally made for a unique purpose, but the scientist is usually unwilling to discard it since he will sometimes be able to 'cannibalise' it for adaptation to some future purpose. It could in theory be stored in some central depository, but then the scientist feels he would lose track of it."

Consequently, labs become overcrowded. The permanent benching, where it exists, hinders the accumulation of material in an orderly fashion, because it creates fixed areas of gangway, and generally incorporates under-bench storage which, the LIU has found, is inefficient and often grossly under-used.

The fixed bench laboratory projects an image of science and scientific work which imposes on, rather than corresponds with, reality. Thus, the unit feels that too little attention is paid in laboratory design to analysing the social structure of a laboratory. Scientists are not automata, who turn up at the bench, perform a few repetitive operations, and then depart. In the research or progressive teaching lab, socialising, thinking, reading and writing are activities of comparable importance to practical experimentation.

Another myth about scientific activity which the LIU has exploded is that what a scientist primarily needs is a good allocation of bench space. It is, in fact, working volume that is more important than the two-dimensional area of bench allotted. Office desk work is described by the LIU as a "thin" activity: it occurs only within a small distance above the worktop. Scientific rigs, on the other hand, may stretch well above the top of the bench: in which case, working volume may be use-

fully increased by a lower bench height.

The results of the LIU's investigations have been to develop—in conjunction with an outside manufacturer, Sintacel Ltd—a system of laboratory fittings which not only takes into account the need to change the purpose of a laboratory building during its lifetime, but also to allow the occupants of a laboratory to fit it up, in the first place, for a particular type of work.

Like most solutions to long-standing problems, the LIU's system is simple. The research conducted by the unit, which is more extensive than has been described here and has included an enormous amount of data collecting on ergonomic topics as well as discussions with potential users in a range of fields, has got down to the basic laboratory concept. From this, the unit decided that it was the joint service/bench element in laboratories which interferes with their flexibility. Consequently, the basis of its system is the dissociation of services and surfaces.

Tony Branton, an architect with LIU, points out that, in old factory buildings—where steam was the form of motive power, usually supplied from a fixed boiler—power was provided throughout the building by overhead pulleys, from which individual units within the building tapped off their requirements. When gas and electricity were first introduced, they were piped through buildings in an exposed position. When piped services became commonplace, it was established, according to Branton, as part of the prevailing aesthetic criteria that services should be available, but not be obtrusive. The present aesthetic criteria are different, and everything does not have to be neatly tucked away.

Consequently, from the services angle, the LIU system uses an overhead boom, fitted into the building during construction, at a specific height (about 7½ feet above floor level), with tap-off points for services at regular intervals. According to the size of the laboratory, it may have one or more such service ducts. Given that laboratory furniture, because it no longer has as one of its functions the hiding of service piping, need not be

fixed, the Scope range—as LIU/Sintacel call their system—is based on easily movable modules: benches, storage racks, fume cupboards.

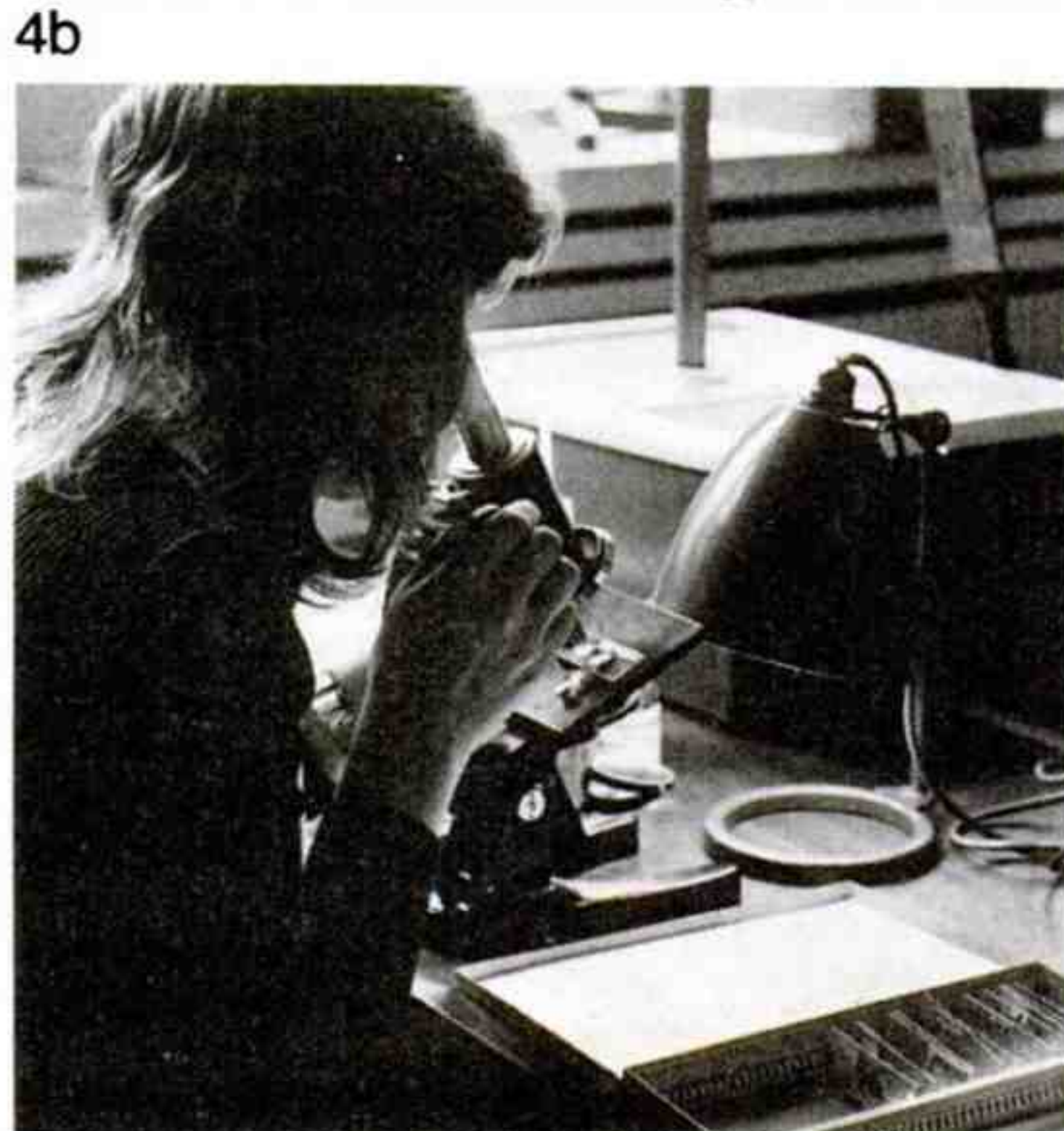
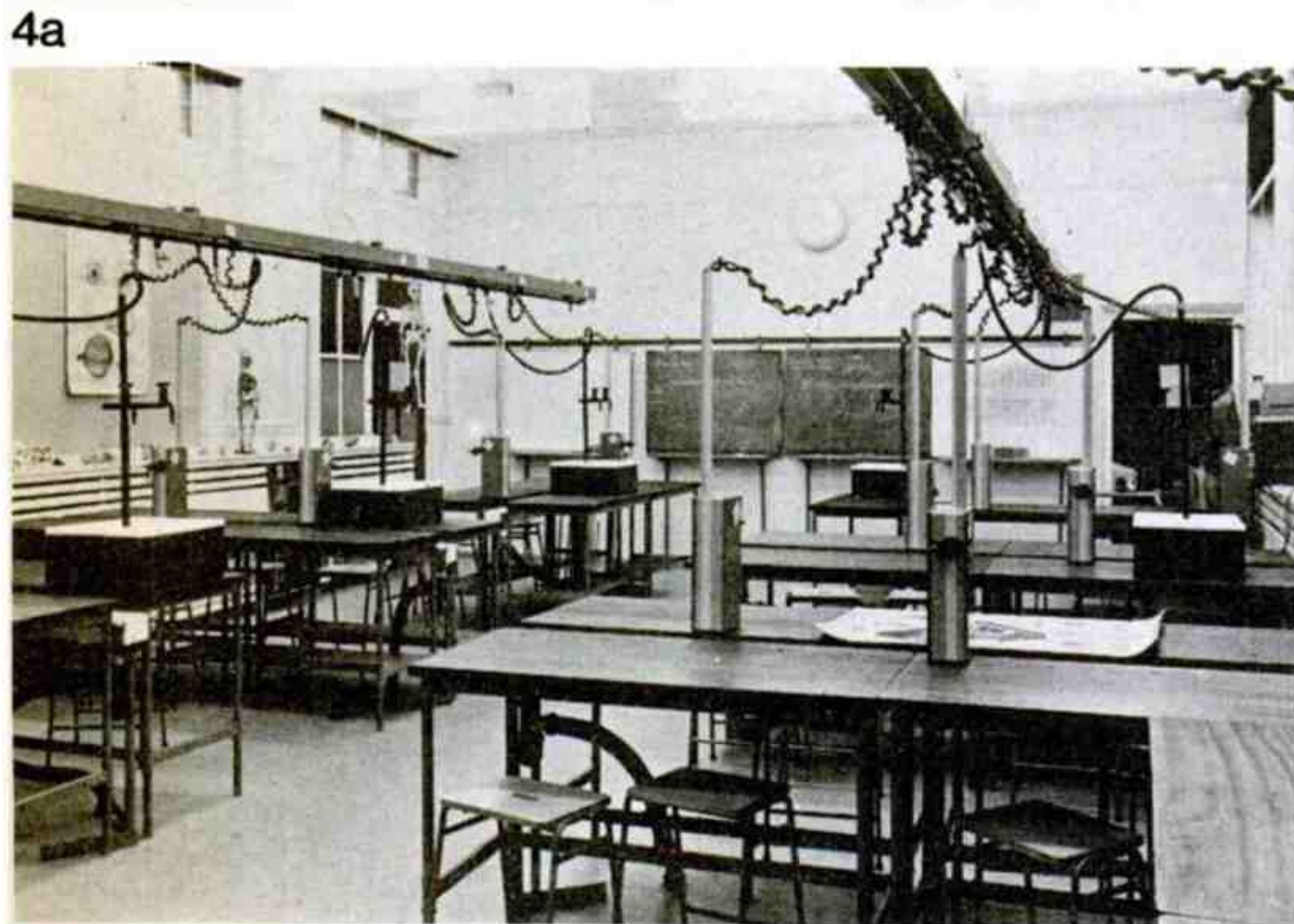
In this ideal system, there is, of course, one drawback. One commonly used service—water—needs not only a supply system, but also a takeaway. This problem has been coped with in an ingenious fashion. When a building is erected, a laboratory is fitted with a number of drainage points, which can be sealed flush with the floor when not required.

In use, flexible feeds from troughs can be connected with these takeaways, and bench-fitting sinks can feed into the troughs. As Figure 4 shows, "dry" services are piped off the overhead booms to bollards which can be fitted to the bench units, and water to similarly fixed sink units.

The entire system—already in operation at Harpurhey High School (Manchester), Pembroke Comprehensive School, Leicester Polytechnic (biology) and Glamorgan Polytechnic (civil engineering)—is characterised by long-term flexibility, which means that a lab can be adapted to a different purpose cheaply. The entire ground-based system can be thrown out and new units brought in with only the labour to move the furniture required. Because a new design plugs in to the same service system, there is no need for rewiring or replumbing—specialist services which run at high cost levels. This facet of the system has aroused interest among less-developed countries, such as Portugal, where there is a shortage of specialist skills but not of labour force.

The LIU believes that its system has a number of other advantages. For example, it believes that the ease with which floor space can be cleared should prove useful in hospital laboratories for satisfactory sterilisation procedures, currently hindered by fixed furniture. Also, since overhead booms can supply services, such as electricity, required in modern offices, the Scope system can be applied to a building in such a way that a particular area can be designated as an office with a view to later conversion to a laboratory, or vice-versa.

Figure 4 a The LIU/Sintacel Scope system, showing overhead beams carrying services, which are tapped off to bench height at regular intervals; b Close-up of a gas/electricity bollard and sink unit from the system



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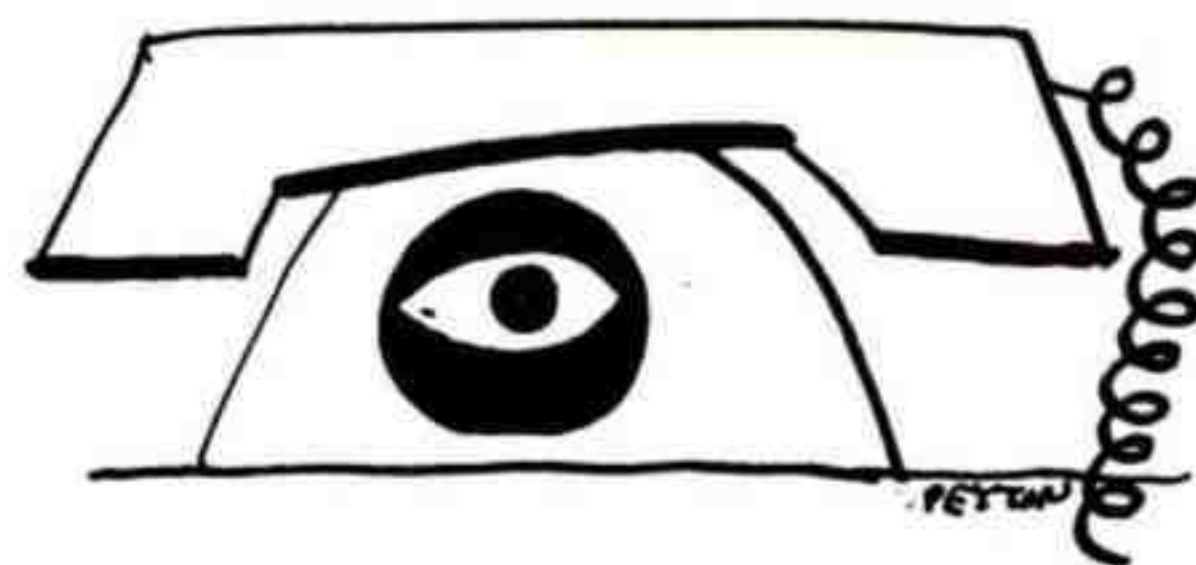
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Growth points

Fax invades the mail market



"Possibly one of the land-mark achievements in 20th century technology" . . . is how some forecasters describe the growing business of facsimile transmission. With its origins surprisingly in the 19th century, this new technology involving the transmission of documents electronically over telephone lines has experienced nothing short of phenomenal growth over the past few years, particularly in the US. All the indications are that we will now see this expansion speed up. The principal reason is that the rapidly falling costs of electronic microcircuits in the 1960s have enabled designers to produce facsimile transmitters and receivers at prices which look as though they are—or will soon become—low enough to allow facsimile equipment to penetrate into every office. It is not too fanciful to imagine that, within a few years, every business executive, or, at any rate, each group of executives, will have their own facsimile equipment plugged into the public telephone network, and will be able to send all their business letters, memos, drawings and other documents in a minute or so to other people within their own organisation, to customers and suppliers, and to the offices of all other organisations with which they work.

Business and other organisations and the general public, too, will also benefit from electronic mail services, almost certainly operated by the Post Office, which will replace today's first class postal services and will guarantee overnight delivery of letters. One estimate is that the US electronic facsimile market, at present valued at \$33 million, will reach \$470 million by 1977 and \$600 million by 1980. The market for cheap desk-top "dial-up" units for the executive will increase from today's \$17 million to \$110 million by 1980. Progress in the UK is much slower, with facsimile installations still consisting primarily of expensive units used for the transmission of newspaper photographs and weather charts. But the half-dozen or so manufacturers in this field in Britain are now making a big push. Sales are beginning to move up and there are predictions of an eventual market of as many as 10 000 a year, which could mean something like £10 million per annum.

Ron Brown

All the facsimile machines currently on the market work on the same basic principle—an idea that dates back to the 1850s. But the new machines are highly refined versions and, moreover, each embodies some variation which greatly affects its economics and ease of use and strongly influence the right choice of machine for any particular application.

In operation, a document is inserted in the machine and the number of the office to which it is to be transmitted is then dialled in the normal way. When the person at the other end answers, a switch is operated to transfer the telephone line from the handsets to the facsimile machines which are then switched on. At the sending end, the docu-

ment is scanned one line at a time from left to right, usually by a lens system which focuses light reflected from the document on to a photoelectric detector. The mechanical movement of the document to achieve this scanning is carried out either by wrapping the paper round a cylinder which both rotates and moves from left to right, or by a flat bed technique in which the paper moves slowly through the machine while the photodetector sweeps across it. Standards vary, but in most business facsimile machines the document is divided into about 100 lines to the inch, and 180 lines are scanned each minute. The focusing arrangements for the photodetector are such that the resolution across the page is very roughly the same.

The signal from the photodetector, which varies in strength according to the variations in the tonal value of the point in the document being scanned at any instant, is transmitted by either frequency or amplitude modulating a carrier tone on a frequency within the normal telephone channel bandwidth. In one system this carrier is on a frequency of 1800 hertz.

At the receiver, a cylinder or flat bed arrangement moves suitably prepared recording paper in synchronism with the movements of the document at the sending end. The incoming signals are demodulated and the resulting current used to darken the paper to a degree dependent upon the strength of the received current which, in turn, depends upon the tonal value of the equivalent area on the original document. A reasonably faithful reproduction of the original document is thus produced.

The time taken to transmit a complete document depends upon such factors as the size of the document, the rate at which it is scanned, and the desired resolution. However, the key factor is really the available bandwidth—the greater the bandwidth, the more information can be transmitted in a given time. In the case of the expensive facsimile equipment used in the past (still with a place in the future) the bandwidth is limited only by the fact that it is very expensive. Business facsimile machines, on the other hand, are designed for the very restricted bandwidth of the public telephone network—somewhat less than 3 kilohertz. By normal communications standards, this is insufficient to transmit a document of reasonable resolution in the six minute period for which most business facsimile machines are designed. However, by making a series of judicious compromises, a document measuring roughly 8½ inches by 11 inches can be adequately transmitted over

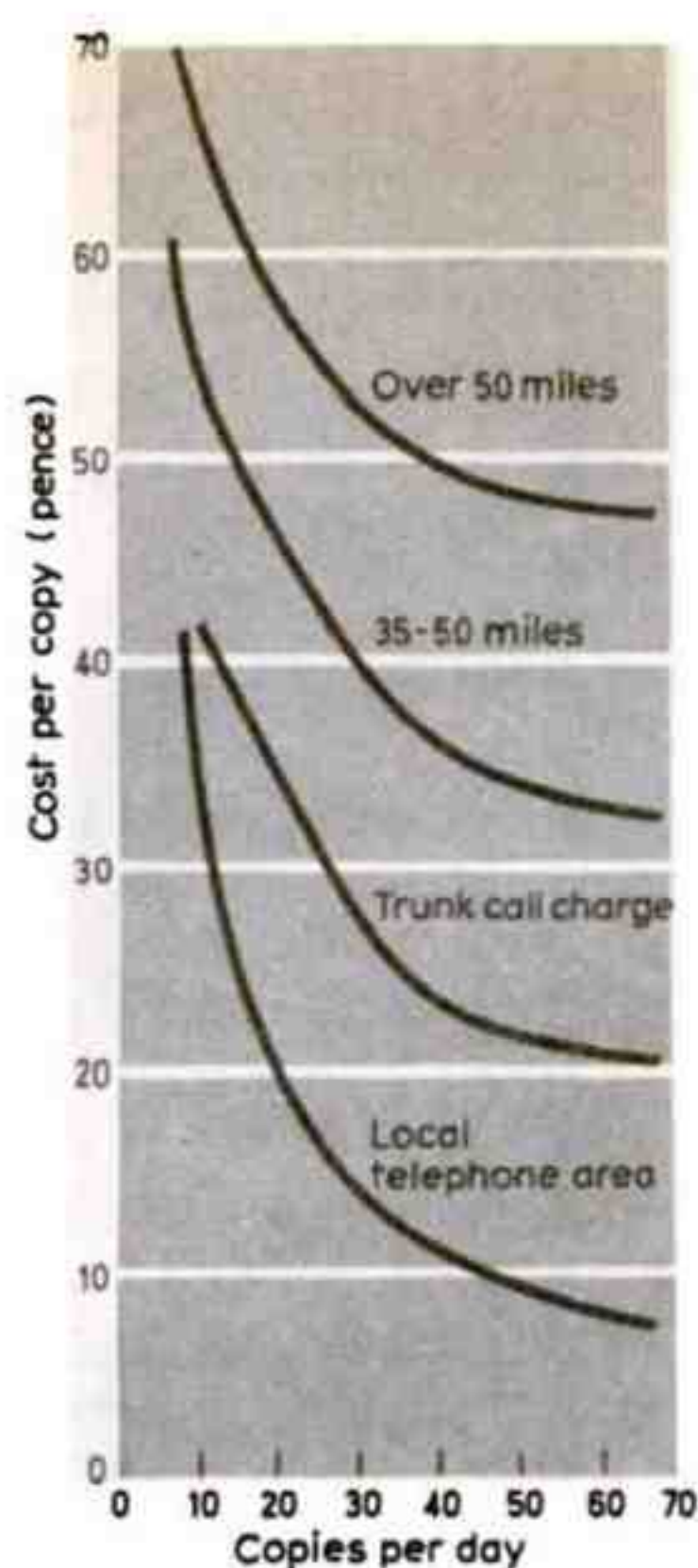


Figure 1 Variation in costs per facsimile copy according to the number of copies transmitted per day. Machine rental is assumed to be £30 per month and paper 2p per sheet

this limited bandwidth in the six minute period.

There is no single simple answer to what a facsimile system costs and whether it is worth installing such a system on economic grounds alone. It depends upon the costs of the alternative mail, Telex or hand-delivery methods (in cases where the facsimile system is to replace one of these). The situation is even more complex in the case of most business facsimile systems, because once an executive has one on his desk and knows that those with whom he communicates also have them, a great deal of extra traffic is likely to be generated.

Rental charges

It is, nevertheless, possible to work out the cost per document for a wide range of systems, varying according to transmission distance and the number of documents transmitted each day (see Figure 1). Among the factors to be taken into consideration are the rental charges of the machine, the cost of the paper, the rental of an extra telephone line (if the amount of documents to be sent justifies it) and the telephone charges.

The relative importance of these different factors varies enormously with different systems. For a system working within the local telephone area, for example, the telephone charges are not particularly significant. Much more important are the rental charges for the machine and, to a lesser extent, the cost of the special recording paper. Where the workload is very light—say, 10 copies per day—the cost per copy varies from 6p, which is not a great deal more expensive than first

class post, to 50p as the rental cost increases from £10 to £50 per month. Clearly, the user with this sort of application should go for the cheapest possible machine—although, it should be pointed out, the £10 per month machine is not yet with us.

A similar sharp variation in cost per copy as the rental charge increases is found with a long distance trunk system of similar workload. But here the minimum and maximum costs per copy are very much greater—ranging from 48p per copy for a £10 per month machine to 86p per copy for a £50 per month machine.

For heavier traffic loads, particularly when some or all of the documents can be transmitted during the night when telephone charges are at a minimum, costs per copy fall quite dramatically. The most extreme example of this is a system working flat out throughout the 24 hours and between just two offices. Here, a private leased line is considerably cheaper than using the public telephone network, and it is possible to send up to 200 documents a day. If we assume paper costs of 2p per sheet and a machine renting at £30 per month, the cost per copy, even over a 200 mile link, is only 6.65p. The difference between this and the cost of first class mail is already very narrow, and with sharp postal increases imminent and with the cost of business facsimile almost certain to fall, the time when it will be cheaper to send mail by facsimile is not very distant. The Post Office, understandably excited, clearly sees an increasing amount of today's business mail being transferred from the loss making labour intensive postal section to the

Business facsimile machines available in Britain

Manufacturer	Product name or number	Input size	Transmission time	Transmission mode	Scan resolution	Scan rate	Scanner type	Recorder type	Recording technique	Rental or cost	Remarks
Plessey Communications Systems Ltd	Remotecopier KD III	9½in x 270 ft (roll fed)	4 and 6 mins	FM	96 LPI	180, 240 or 300 LPM	flat bed	flat bed	electrostatic	£36 to £50 per month depending on period	separate transmitter and receiver; can be used simultaneously or for local copying
Hell (represented by Maritronic (UK) Ltd and EMI-SE Labs Ltd)	Hellfax 146	8½in x 11½in or roll	5 to 6 mins	FM	100 LPI	180 LPM	cylinder	cylinder	wet ink offset on ordinary paper	£17.50 to £50 per month depending on period	
Computer Instrumentation Ltd	Dex I and Dex IV	8½in x 11in and 9in x 14in	6 mins	AM	88 LPI	180 LPM	cylinder	cylinder	electrothermal	£30 per month	compatible with more expensive models with 12, 3 and 2 minute transmission times
International Scanatron (represented by Cinortcele Facsimile Systems Ltd)	M4 series	9in x 400 ft (roll)	3 and 6 mins	AM and FM	100 LPI	180 and 360 LPM	flat bed	flat bed	electrolytic	£75 per month	compatible with higher speed machines
Rank Xerox	Telecopier III	8½in x any length	4 and 6 mins	FM	64 and 96 LPI	180 LPM	flat bed	flat bed	electro-percussive		
Rank Xerox	Telecopier 400	8½in x 11in	4 and 6 mins	FM	64 and 96 LPI	180 LPM	cylinder	cylinder	electrothermal		

LPI = lines per inch LPM = lines per minute

Other manufacturers prominent in this field include Muirhead & Co., which makes a wide range of facsimile equipment, most of which is more expensive, of higher resolution and higher speed than those listed above, but the company does produce some devices directly competitive with those listed. The American company, Magnavox, which has a large number of installations in the US, expects to begin marketing in Britain shortly.

profit making largely automatic telecommunications section.

Facsimile has a number of advantages over Telex, including the fact that a message can be sent direct to the executive's desk without it having to go through the Telex room, and the fact that the information transmitted can be laid out in the normal format, broken down into sections, headings, sub-headings along with handwritten comments and signatures.

Again, direct cost comparisons are difficult to make. The simplest case is where an effort is made to transmit the maximum possible information via the facsimile system. This is done by ensuring that the original document is completely filled with typewritten material. Here, the telecommunications costs of sending that information by facsimile are the same as for sending it by Telex within the local telephone area. For longer distances, the costs for facsimile become progressively less than for Telex. The much lower labour costs of facsimile must also be taken into consideration.

Few operators

One of the best cost comparisons has been made by H. Camrath in connection with a rationalisation project at the Hamburg Telegraph Office. Replacing Telex by facsimile there has reduced the average number of operators required from 10.6 to 3.2, and these can each be trained in one day compared with the three and a half months needed to train a Telex operator. The overall cost, including equipment, paper, running and training, of a system sending an average weekday load of 1140 telegrams has been reduced from DM272 194 to DM105 359.

Savings can thus be very impressive, but this factor alone may not necessarily be the most important one in the coming boom in facsimile. Indeed, systems will almost certainly be installed for the *other* benefits they bring. A good example here is that of Grieve-son Grant, one of the City's half-dozen largest stockbroking concerns. Soaring property prices in central London, where all the staff were previously located, drove the company to move 220 of its administrative staff 40 miles to Tunbridge Wells where offices rent for only £1.25 a square foot compared with the £10 a square foot common in the city. Such a move would have been impossible without facsimile communication because of the need to exchange documents continuously with the company's dealing room which must remain in the City. Savings of as much as £150 000 a year are expected, and yet the cost of the extra communications service will be only between £12 000 and £20 000 a year.

Grieve-son Grant's adoption of facsimile seems to be a good example of the way in which facsimile will be introduced on a much wider scale in Britain. Most manufacturers see business facsimile being adopted initially for this type of application—where a clear cut economic or convenience advantage is offered. This could then lead to full scale company facsimile networks being developed within the Fords and ICIs of the world. The

next step would be to see companies, professional houses and others who use or supply the corporation joining in its network. Finally, these corporation networks might coalesce to form a single national—eventually international—network linking all users.

Reading the writing

An important factor governing the speed that facsimile will be accepted is the legibility of the received copy. This is very much a subjective matter; nevertheless, one important factor is the size of the smallest letter or word which can be deciphered. Quite different standards apply to the two. Tests have shown that for each individual letter of a word to be positively identified, it must be scanned by at least 10 lines. However, it is a readily observable fact that whole words and sentences can be read, even when some of the letters cannot on their own be identified. It is generally accepted that in this case each letter needs to be scanned by only five lines. Applying these criteria to business facsimile equipment shows that the smallest individual letters that can be identified are in 14 to 18 point type, and that, provided it is necessary to identify only complete words and not individual letters, type as small as 8 to 10 point can be used (the text on this page is printed in 9 point type). However, an IBM study indicates that, over the far from uncommon "noisy" lines, legibility is lost much more quickly in the latter case than in the former.

It has been accepted for some years now that handwritten signatures can be accurately identified provided that there are at least 80 lines to the inch, which is lower than that used in business facsimile equipment currently on the market. Fingerprints, on the other hand, need a resolution of about 200 lines to the inch (at least double that of business facsimile equipment) and thus here more expensive equipment can be used. However, business facsimile equipment can be used to transmit traditional weather maps containing no fine detail, but a typical road map needs a resolution similar to that required for transmitting fingerprints. Newspaper photographs are transmitted on a similar standard to that of business facsimile machines. In more general terms, a business facsimile recording is about four times more detailed than a TV picture and contains somewhat over half the detail of a 35 mm professional movie frame.

Some facsimile machines use papers which darken by electrolytic action, some use papers which darken by thermal processes, some use electrostatic processes, some use ordinary paper with ink printing, and some use ordinary paper which is marked by impact on an overlying carbon paper. Some electrolytic papers darken to black, some to dark brown, some to violet and some to soft brown. The images are reasonably long-lasting but do fade with time, especially if left in strong sunlight (unless special so-called archival papers are used). The electrolytic process is a wet one and, although the documents come out dry, they are difficult to file. Thermal

paper gives a more durable and higher contrast recording but is slightly more expensive, gives off a pungent smell and leaves a mark when folded. Impact recording through carbon paper gives a surprisingly good contrast and several copies can be produced at once. The paper used in the electrostatic process is easy to handle and file, and gives a good quality print without producing any obnoxious smell. Machines that print on ordinary paper are particularly useful in applications where there is a heavy traffic load and where the cheapness of ordinary paper does therefore give it the edge.

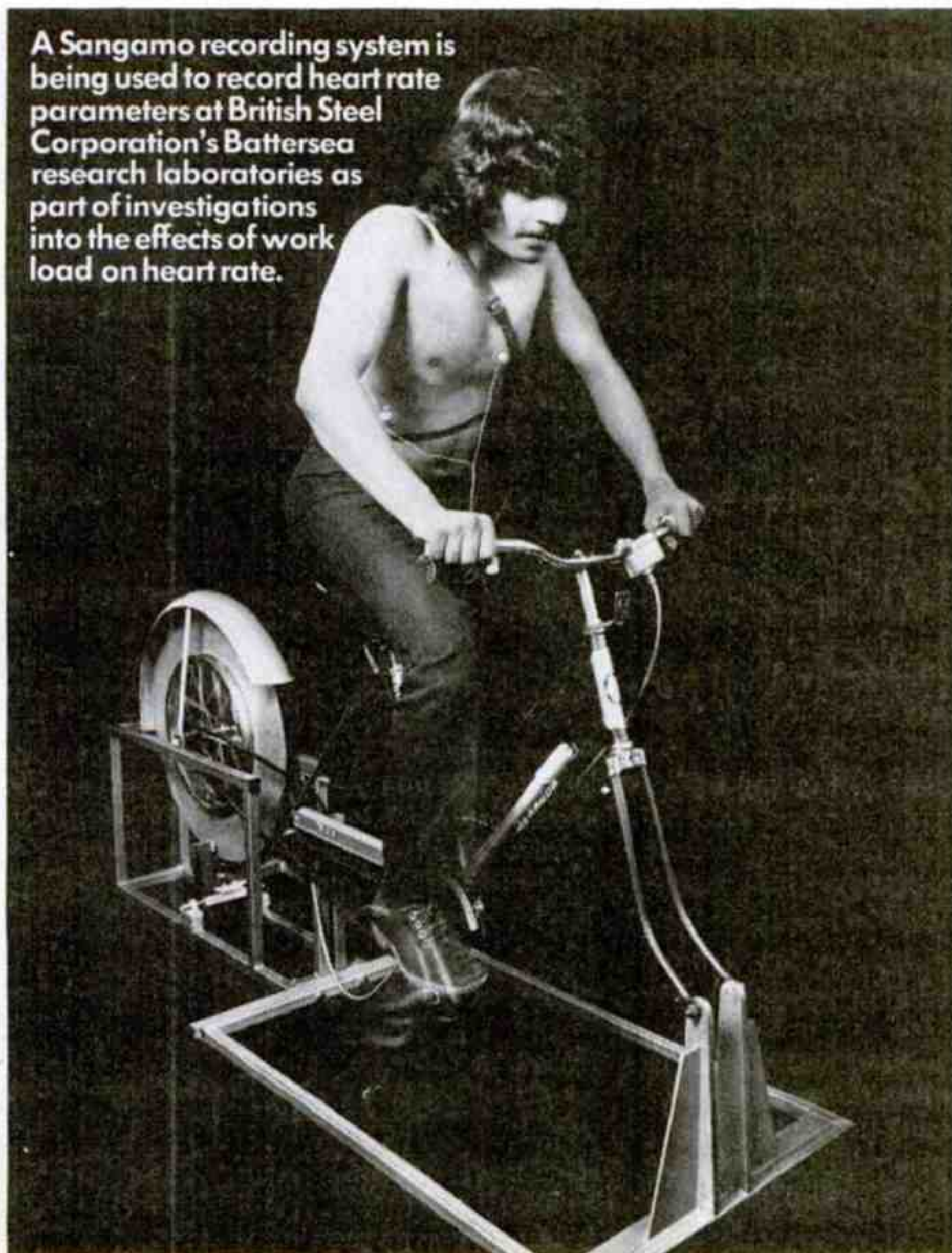
Probably the most vexed question at the present time is that of compatibility between machines made by different manufacturers. Some use frequency modulation (FM) and some amplitude modulation (AM). The number of scanning lines per inch and the number of lines scanned per minute varies slightly from manufacturer to manufacturer, and methods of synchronising the transmitter and receiver also vary.

A few months ago it looked as though the British Post Office was about to impose a fixed set of standards for the UK. Now, however, the decision has been made to wait upon the market forces—which means that the Post Office will sit back for at least 18 months to see which of the different manufacturers, or group of them, gains the major slice of the market. The standards used by the most successful manufacturers, or something very close to them, will then be chosen



as the national standard for Britain. By then the Post Office will also, almost certainly, put a machine of its own on the market. This may seem a somewhat unsatisfactory way of going about things, but this is a field in which a key factor—the acceptability of the recorded copy—is a highly subjective matter. It is also a field in which a number of very drastic technical compromises have been made. For both these reasons it is difficult to lay down hard technical criteria for judging which standards are best. A too early imposition of stringent standards by the Post Office—or, indeed, any other body—could freeze development at quite the wrong point.

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Feedback

Physicists and society

The convulsions of anxiety which have been a feature of American physicists' meetings in recent years found their echo, though a more muted one, in the second general conference of the European Physical Society at Wiesbaden earlier this month. The society's bulletin, *Europhysics News*, in its July and August issues had aired the views of the society's advisory committee on physics and society which could be summed up as: improved communications with society; a shift in emphasis towards society's problems; more relevant organisation and training. In the August issue Professor Eric Burhop of University College, London, a member of the European Physical Society's council, writing on the problems of science in contemporary society, told of attending a high energy physics conference in Milan four years ago at which the participants agreed to talk with students who had been occupying the physics department at the time. The confrontation occurred at the end of the conference, during which students had listened attentively to the discussions. Their spokesman referred to an experiment which had been discussed in which it was proposed to examine some 40 000 examples of the interactions of neutrinos with nucleons. "He asked what was the relevance of the work? Did we realise that this was about the number of people

dying each day throughout the world owing to effects of malnutrition and hunger?" Professor Burhop adds that he doubts whether the explanation convinced the young revolutionaries.

At the evening session in Wiesbaden devoted to science and society, Professor H. B. G. Casimir (president of the European Physical Society) made the key



speech, making it clear, however, that he spoke purely for himself in this matter. He described the relationship between physics and technology as a spiral in which each advanced in turn upon the achievements of the other. "If we believe that technological progress is essentially a good thing and that increasing knowledge is a good thing and that whatever hardships or sufferings are only passing childhood diseases that will be cured by science and technology itself, then we should rejoice because of the astounding efficiency of the science technology spiral

... We may also regard this spiral ominous monster as a force that is getting out of control and that will lead to havoc and destruction ... And once we take this point of view there is no escape!" The pure scientist might admire laser physics for the insights it provided but he could not forget "that lasers are being used to assist in the callous and cowardly destruction of life and property and in the engineering of irreparable damage to the human habitat."

While expressing his love of physics over a lifetime Professor Casimir said he was increasingly inclined to view the spiral not as efficient and fruitful but as ominous and inexorable (the latter adjective borrowed from a 1950 television address by Einstein on nuclear war). He was not able clearly to define his position but he offered a few recommendations: a physicist should remember that his position does not put him beyond all responsibility; the best chance of gaining some control over the ominous spiral lies in a plurality of controls "and in openness", universities should maintain their independence versus industry and industry should respect this. Professor Casimir went further when it came to working for the military. Academic scientists, he thought, should refuse. It might be merely a symbolic gesture but a symbolic gesture could be meaningful.

Selecting the new session men

Although the House of Commons has returned from its summer holidays, it is at present finishing off business for the old session. The new session does not begin until after the Queen's Speech on 31 October. Because of the highways and byways of Britain's unwritten constitution, the Select Committee on Science and Technology can only, for the moment, put its house in order, tidying up loose ends from its mammoth studies on government R & D. The reason for this is that the committee, technically, has to be reappointed by the House in the new session.

There seems no doubt, as there was when the Tories took office just over two years ago, that the committee will be reappointed. And committee members have already been talking among themselves about likely topics. Energy conservation is one possibility, although there seems to be support for a searching look into possibilities for scientific and technological collaboration in the enlarged Common Market — a subject which some members had hoped to consider in the current session.

It also seems likely that there will be few, if any changes, in the membership of the committee, although, again technically, once the committee is reappointed, its members also have to be reappointed. Earlier this year, Roger

Williams ("Towards the scientific ombudsman", *New Scientist*, vol 55, p 13), pointed out that the Select Committee has lost most of its earlier members through promotion to ministerial rank or electoral defeat. Only eight of the 31 who have served on the committee since its inception in 1966 have left voluntarily. Perhaps it is time for one or two more

Quote

"We talk about conducting a television experiment in this place. Experiment indeed! I had something of a scientific education. I thought that before one conducted an experiment one had clearly in mind what one was to do, the manner in which it would be done, its objective and on what standards one would judge the results which flowed from it. I have heard nothing of that today. As an experiment, this one ranks with the sort of experiment which a young chap would propose to a girl when he took her to Brighton for the weekend, and the results are nearly as unpredictable in terms of what happens to those who participate in it."

— Norman Tebbit MP, arguing in the House of Commons last week against the televising of Parliament.

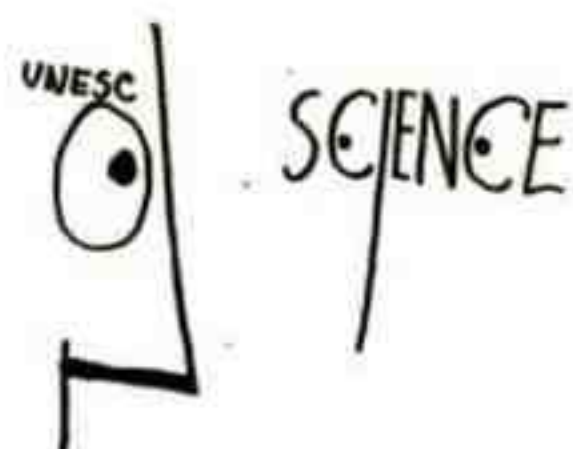
resignations. On recent performances, Sir Harry Legge-Bourke and Arthur Palmer would not be missed by many parliamentarians. But, who would replace them?

Part of the committee's survival record may be due to the fact that the majority of MPs are not interested in science and technology and are happy to have it hived off to one of the upstairs rooms. Well, if looking for new blood, there is one possibility. Current Whitehall rumour has it that Mr Wedgwood Benn may soon find himself off the Shadow Cabinet. What better background could a man have than his experience at Mintech to qualify for a place on the committee?

Unesco study of science problems

In the controversy over the future of science a body such as Unesco might be forgiven for perching however uncomfortably on the fence. Several of its richer member countries are centres of the new philosophy which doubts the value of economic growth through technological advance while, on the other hand, the majority are developing nations quite willing to risk the attendant dangers so long as they get their share of the benefit.

The organisation, however, has decided to ensure that the dialogue continues. The trend away from science is to be the



subject of continuous study, starting next year with the publication of *Science in the 70s*, a volume which will review recent scientific advances and the problems they pose. An "on-going seminar" will be initiated to bring leading thinkers to Unesco headquarters to "stimulate the debate within the Secretariat." Then, in 1974, a symposium will be held on the cultural, ethical and aesthetic issues raised by the impact of science and technology.

Environmental research within the organisation has, over the past two years, been focused on 13 projects covering such topics as the influence of human activities on tropical and subtropical ecosystems and the ecological aspects of energy utilisation in urban and industrial systems." During 1973-74 an international geological correlation programme is to be undertaken in cooperation with the International Union of Geological Sciences. Such correlation is expected to be of help in prospecting for natural resources, a matter of supreme importance to developing countries.

Also RANN

A quick glimpse of the different modes by which scientific research is screened and funded came out of the recent visit to

Britain of Guyford Stever, the newly appointed director of the US National Science Foundation (NSF) which, since 1970 provides the bulk of American civil research money now running at \$650 million a year and rising.

He had only to spend 24 hours in France to catch up on how that highly centralised nation manages these things—essentially through one agency, the CNRS (Centre Nationale pour Recherche Scientifique). Despite "Lord Rothschild and all that", three separate London discussions and a trip to Cambridge were required to sort out the picture here, namely, The Royal Society, the Science Research Council, and the Council for Scientific Policy (plus Churchill College, Cambridge).

Back in Washington, Dr Stever and his agency are faced with becoming part of the White House Executive through the provisions of the Kennedy Bill (S72) which, despite an election year, has passed the Senate by 70 votes to 6. Were this measure to be finally endorsed the NSF would intervene on all US science spending somewhere between the Bureau of the budget and the President . . . rather overdoing things in Dr Stever's view, though arguably taking the point of the Mansfield Amendment of 1970 (seeking more community control over the distribution of research funds including those huge sums mediated by the Department of Defence) to its conclusion.

Despite the flattering elevation implied in this proposal, Dr Stever is against it, though in favour of more research applied to national needs—RANN—the current preoccupation of Washington politicians.



Britain's Ministry of Agriculture last week appointed its first Chief Scientist, in line with the recent White Paper proposals to strengthen the central scientific capability in the various government departments. The Minister of Agriculture's appointee is Dr H. C. Pereira, director of the East Malling Research Station (Kent) since 1969. Dr Pereira had a distinguished career in the Colonial Research Service. From 1955 to 1961 he served as deputy director of the East African Agriculture and Forestry Organisation, working in Kenya, Uganda, and Tanzania. In 1961 he was appointed founding director of the Agricultural Research Council of Rhodesia and Nyasaland. In 1966 he was awarded the Haile Selassie Prize for Research in Africa. He returned to Britain in 1968 and in 1969 was elected a fellow of the Royal Society, becoming a member of the Natural Environment Research Council in 1971. His main studies in Africa were on soil structure as affected by tillage and grazing and the water requirements of crops, pastures and tree plantations. Later he studied land use changes on complete valleys as these affected river flow.

The last word on . . .

Tossing the gauntlet

In embroiling his fellow-ministers in European politics, Mr Rippon may have overlooked the fact that he could be adding to their present occupational hazards, the occasional danger of being challenged to a duel. Every now and again over on the emotional mainland, an aggrieved and atavistic elector invites some member of the reigning oligarchy to pistols-for-two and coffee-for-one at a most ungracious hour of the morning. The latest subscription to this belief that disputes of fact are affected by blood-letting, has just occurred in Belgium where the chairman of the Tobacco Retailers Association, M Edouard Lekeux has challenged M Vlerick, the Finance Minister, to a duel on the battlefield of Waterloo. The latest report to hand indicates that the minister is refusing the challenge on the grounds that M Lekeux is more concerned with the certainty of publicity than the possibility of death, and that duelling is illegal under Belgian law. There is, however, no confirmation that M Vlerick also questioned whether, since M Lekeux represents tobacco retailers, he should not more loyally have chosen the cigarette as his weapon and

demand a trial by chain-smoking at 12 paces, the outcome to be decided by which contestant first died of lung cancer.

Although the decline of duelling has been considered as some evidence of the advancing civilisation of naked apes, the decay of this barbarity is more likely due to the scientific progress in ballistics. It's not so much the sweetening of the human id that has discouraged recourse to pistols, as the doomful improvement in the accuracy of the honourable iron-mongery. In the days of muzzle-loaders and hand-picked powder, the courage of challengers was fortified by the knowledge that it was long odds against being fatally hit, providing you didn't pick on a pro. But, as hand-guns grew more deadly, so that a tyro given a weekend for practice could expect to hit a playing card at 12 paces with regularity, it became safer to swallow your pride than to risk evens on the hereafter.

Other scientific aids were adopted in the 18th century by Cagliostro in deflecting the challenge of a physician whom he had called a quack. Having choice of weapons, the pedlar of eternal youth proposed that such a medical dispute

should be settled medicinally and chose pills. Each antagonist would have two identical pills, one harmless and one poisonous, from which each should make his selection and swallow it in a form of pharmaceutical Russian roulette. A later man of medicine, Henry Howarth, MP for Evesham and also a surgeon, knew from professional experience that simple gunshot wounds were often aggravated by pieces of cloth driven in with the ball. In 1806, therefore, he presented himself in the grey dawn for a duel with Lord Barrymore stark naked. No blood was shed because his lordship took the view that such strip-tease made an affair of honour ridiculous, and he refused to fire on a man in his birthday suit. Two years later in Paris, aeronautics were invoked when M de Grandpré caught his ballet dancer mistress in the very act with M de Pique, and the contending lovers decided to settle the affair in balloons. Taking off from the Tuileries, they opened fire with blunderbusses at 2000ft, when M de Grandpré punctured his opponent's gasbag and M de Pique, doubtless full of the same, went down with his foolhardy second to an untimely end sur les toits de Paris. And let all good Common Marketeers pray that no such continental retribution should ever attend on M Rippon.

Patrick Ryan

Forum

New York view

Peter Gwynne

Computerising elections

One notable feature of the 1964 and 1968 Presidential election campaigns was the involvement of scientists and engineers, who joined formal and informal groups in large numbers to raise money for the candidates of their choice and to publicise their stands on such science-based issues as nuclear armaments, disarmament, and expenditure on basic research. By contrast, political activity by scientists in this year's campaign, which reaches its climax on Tuesday, 7 November, has been so low key as to be hardly noticeable. But while the politicians have found little use for scientists and technologists in person, they have found a great deal of work for the fruits of their endeavour. This year, computer technology has contributed as never before to the traditional electoral task of identifying the people who will vote for a particular candidate.

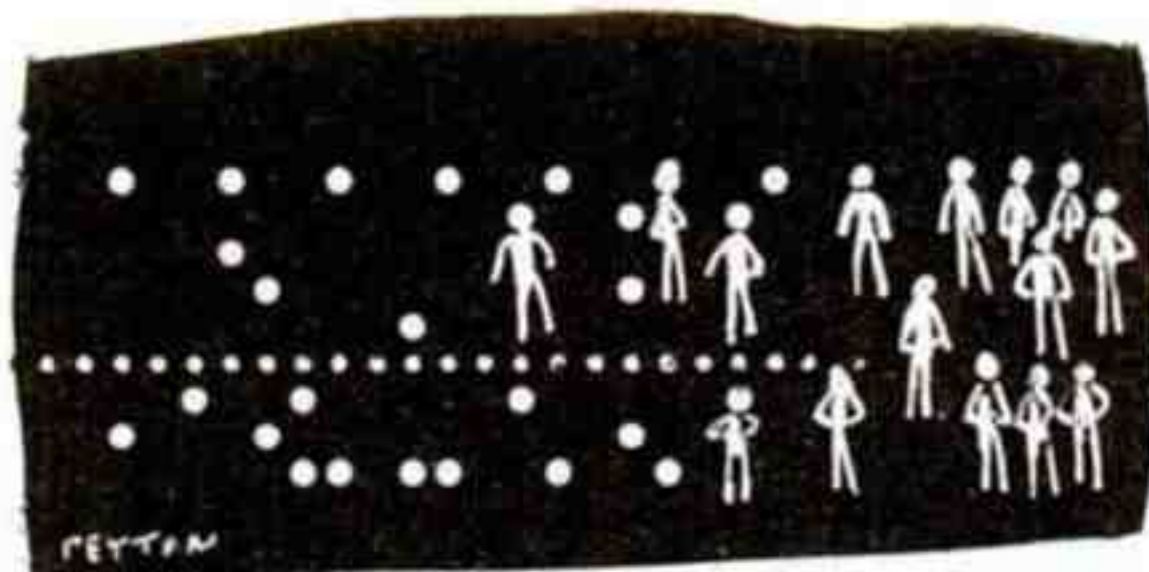
While both Democrats and Republicans have formed scientists' and engineers' groups in previous campaigns, the Democrats have generally succeeded in attracting more of the nation's scientific stars in this year's relatively muted political effort. An organisation named Scientists for George McGovern has been soliciting funds and doing a little political missionary work among the scientific, technological and academic communities for a number of months now, and has attracted an impressive line-up of notables. Among the organisation's sponsors are Nobel Laureates Hans Bethe, Owen Chamberlain, Salvador Luria, Edward Purcell, Albert Szent-Gyorgyi and George Wald. Other prominent members are co-chairman Herbert York, a former scientific adviser to the Department of Defense, George Kistiakowsky, once science adviser to President Eisenhower, and Victor Weisskopf, formerly head of CERN. The issues on which the group has been most vocal are largely predictable—increased funding for research and development directed towards civilian needs, the need for active efforts to retrain workers in the aerospace and defence industries to work aimed at more basic needs of society, and calls for greater emphasis to be placed on new methods of providing energy. Such politicking seems, however, to have had little effect on the other side. The science men in the Nixon administration appeared content to rest on their record in office in serving the scientific community.

A more fertile battleground for scientists appears to be that provided by environmental issues. Groups of Environmentalists for McGovern-Shriver have already formed in 20 States, and some of the more optimistic spokesmen are suggesting that 5-10 million votes are avail-

able for the asking on issues related to the environment. One late issue that might affect such votes is President Nixon's veto last week, on the grounds of economy, of a \$24.6 thousand million Bill to reduce water pollution. (Congress later reversed the veto.)

If the scientists have been slow to launch themselves this year, the politicians have been downright eager to bring new technology to the aid of the party. Specific ethnic groups—the so-called hyphenated Americans, such as citizens of Italian, Polish, and Mexican origin—and less specific categories of voters such as suburban dwellers, Roman Catholics, and Jewish voters have been particular targets for both parties, and computers have come into prominence in the attempt to contact such personages and sound them out on their attitudes towards the major issues of the campaign.

Among the examples of computerised electioneering have been computer-written letters to undecided voters identified by the McGovern canvassing effort, similar letters aimed at raising money for the Nixon re-election campaign, and demographic wizardry designed to send tape-recorded telephone messages by Hubert Humphrey—while he was still a candidate for the Democratic nomination—to voters in selected areas deemed centres of his strength. The Democratic party has also used computers to compare voters' lists with various other lists of names to identify unregistered voters—a major problem in a country in which registering to vote is a somewhat more difficult procedure than it is in Britain.



Mindful of the poor image of machine technology the candidates' computer operators do all they can to give their computerised message the personal touch, even to the extent of using water-soluble ink for the signatures beneath the letters: such signatures will smear like the genuine article.

The success of these enterprises will not, of course, be fully obvious until the election results are put through the mill of the demographic analysts, but indications suggest that computerised letters asking for money are producing well above the 4 per cent response expected of such ventures. However, one hopeful

sign for the human side of politics has been noted by the campaign staff of Democratic Senator Walter Mondale, who is running for re-election in Minnesota. They discovered that a fund-raising appeal sent out by computer and addressed to individual voters produced less revenue than a printed letter, identically worded that contained no name and address and started simply: "Dear Friend".

Westminster scene

Tam Dalyell MP

The Chinese delegation

I spent a fascinating day in the company of the Chinese science delegation during its Scottish visit. The first call of the morning was to Professor Martin Pollock at the Molecular Biology Unit in Edinburgh. The visitors, whose leader, Professor Pei-Shih, is director of the Institute of Biophysics in Peking said they were impressed by the use they saw being made of viruses and micro-organisms to elucidate the secrets of the living cell. The methods of mapping genes, and of high-powered electron-microscopy appeared to be new to them. That they found difficulty in understanding the distinction between work done for the Medical Research Council and that done for the University of Edinburgh is not surprising, since teaching and research have become intertwined, and are done for both organisations.

The Chinese agreed that molecular biology has immediate applications in medicine and industry, and is not just a theoretical subject. An interesting aside was that a greater understanding of molecular biology might give some clue to the theory behind their own successful use of acupuncture techniques.

The next visit was to the Royal Observatory, Edinburgh, shortly to celebrate its 150th anniversary. The Astronomer Royal for Scotland, Professor Bruck, showed his visitors the galaxy luminosity measuring machine, the most modern of its kind in the world. They seemed impressed that it was designed in the Observatory itself. On my visit to China last year, it was clear that the Chinese set great store by the amount of design work done inside an establishment itself.

They also revealed interest in work being done on dust clouds between stars, which are studied by infrared techniques. Astronomy is clearly one of the fields in which cooperation with China is both practical and desirable. Particularly when decisions are made about the new Northern Hemisphere Observatory, it would be fruitful to coordinate work

with progress in China where there is a long tradition of observation. Exchange of postgraduates would be the first step.

★ ★ ★

One of the Chinese delegation, Professor Cheng wen-yu, director of the high energy physics laboratory, was at Jesus College, Cambridge, for four years in the 1930s, and has happy memories of working with Lord Rutherford. It was fitting that he should spend the afternoon at the factory of Nuclear Enterprises at Sighthill, suppliers to the Rutherford Laboratory, to which the Chinese are due to go. The Pringle Brothers, the dynamic young scientists who have built up this go-ahead firm, employing 150 graduates in a staff of 600 employees, have already done business with China.

At the factory, the Chinese seemed interested in devices for the detection of pollution, and in medical instrumentation. A sulphur analyser for oil pollution caught their eyes. So did the use of tracer technology applied to the human body. They were particularly impressed with a renography set, and the use of radioactive vitamin B to diagnose anaemia and other ailments. They admired blood sampling techniques to diagnose serum hepatitis. Above all, they expressed themselves fascinated by new cameras which revealed how well or badly an organ was working in a patient, giving details of such difficulties as the distribution of gas in the lungs.

Professor Cheng said cheerfully, "If only we'd had all this in the Cavendish in the 1930s!" The Royal Society, and the Royal Society of Edinburgh, who are their hosts, are hoping that regular contact will now be re-established between scientists in Britain and their professional colleagues in China. The way looks clear.

★ ★ ★

A significant event this year is the surge forward of the World Development Movement, under its recently appointed general secretary, John Tanner. They now have 126 branches up and down the country. Unlike Oxfam and Christian Aid, with whom they have good relations, they are not a fund-raising body as such, but a pressure group urging governmental action. At their Edinburgh meeting, I was glad to hear Frank Judd MP say that it was understood by WDM that the poorest people in the developed countries must not be allowed to be disadvantaged by the cause of overseas aid, both on moral grounds and because, if they are there will be an inevitable political backlash. For example, if this country is liberal in its imports of cotton textiles from India, it behoves us to do something for the areas of Lancashire which will be most affected.

One immediate situation which WDM would like to draw to the attention of politicians is the fact that, in spite of the recent Stockholm Conference, the current UN Session in New York has not found room on the agenda for discussion of the environment.

What goes on at the UN is pathetically underscrutinised by the British and most European Parliaments. Ask most MPs what position the British delegation has taken on important international ques-

tions in New York and there would be an embarrassed shrug of the shoulder. There really ought to be a permanent Select Committee of the House established to monitor what our country is up to, not only at the UN itself, but also in the specialised agencies.

★ ★ ★

During the recess, MPs have been visiting units of the engineering industry and other training boards. Staff are concerned about their future. With plans afoot to allow smaller and medium sized firms to opt out of the levy, a number of instructors are expressing fears that the training position will simply revert to what it was in the early 1960s. This would be a pity as MPs making local visits, as far apart as Edinburgh and the south of England, agree that the standard of work, by intakes of increasingly less-gifted pupils, is good.

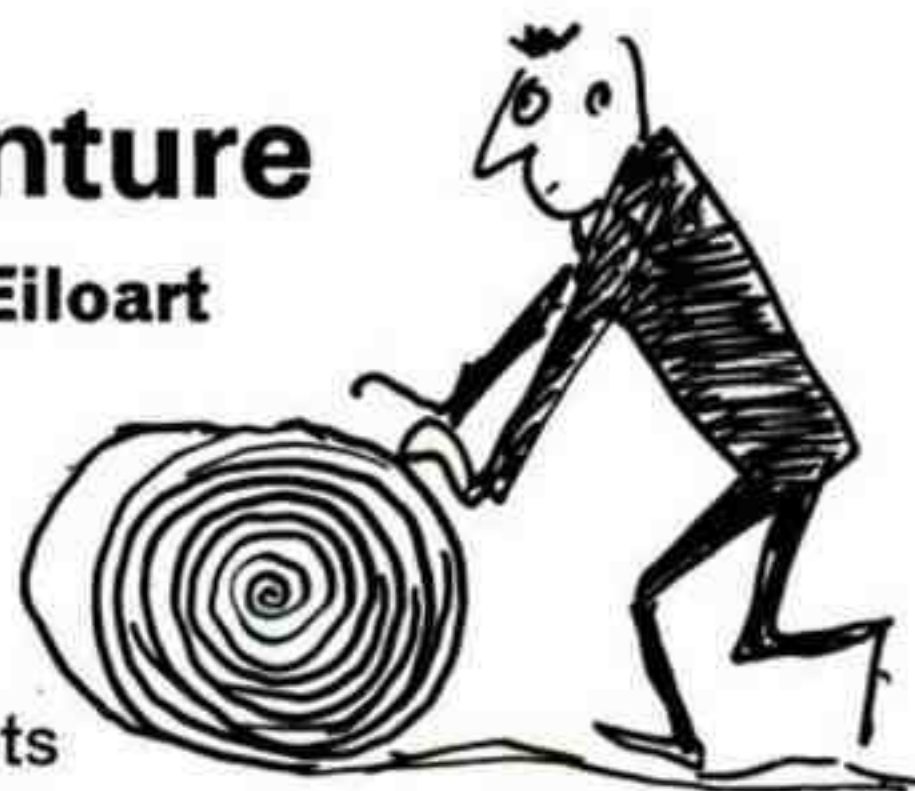
One damaging charge made against the training boards is that they have been indulging in "training for training's sake". This they deny. A major current difficulty seems to stem from the Departmental idea that one can distinguish between those skills which can be termed "transferrable", for which employers should not be made to pay as heavily as for "peculiar skills", which will benefit a single or a small group of firms. The fact that no criteria have been established for "peculiar skills" may partly account for the fact that not only is the new scheme not operational, but that it does not look like becoming operational in the foreseeable future. If the government is wise, it will allow more time for the training boards to take root, before making radical changes.

Venture

Tim Eiloart

Carpets

A carpet factory holds delights for anyone who has been apprenticed in his youth to the pleasures of Meccano. Giant machines clank and wheeze at speeds that can be followed by the eye, the pattern is selected by a huge and ungainly precursor of the punched card, and a mild wool sprinkling is one of the least offensive of industrial dusts. The machinery has a zany Heath Robinson air and the peripheral activities can have equal charm. Patterning is a tedious hand process, although a German machine is



claimed to have partly automated this. Huge swiss rolls of wool with each slice a different colour, and each roll corresponding to a single line of the carpet are used in the spool-Axminster process.

Total production of carpets in Great Britain doubled during the decade before 1970. The level was about 150 million square yards, worth £230 million in 1971. About 60 per cent of these acres are tufted carpet but tufted's value is only around 40 per cent. Nevertheless in 10 years tufted has grown from a limping poorer cousin with a negligible share of the market, helped on the way by the Cyril Lord company which mushroomed and then went spectacularly broke in the late '60s.

The United Kingdom's imports of carpets are £19 million, about half of which comes from the far and middle east and a quarter from Ireland. Almost all the oriental carpet is re-exported so that net imports are only £10 million. In fact British manufacturers appear to be very well placed to increase their overseas sales when we join Europe. At present exports amount to only just over 2 per cent of output. So investors should be chary of backing carpet companies on these grounds alone. Our sales to Efta countries which are not joining Europe are almost exactly the same as sales to the Six.

The traditional patterning processes for carpet weaving are Axminster and Wilton. Both were well established decades ago and neither owes much to modern technology. In Wilton the coloured tufts run in the warp and are drawn up as needed to form the pattern. This limits the number of colours although it provides a springy carpet. Face-to-face Wilton divides the colours between two sets of warp and each tuft is incorporated in both carpets one of which is a mirror image of the other. Axminster uses a set of beak-like grippers which pick one colour of wool from an array of ends. Each of these ends leads to a cone of wool on a creel which may have many thousand cones. A break in the wool means stopping the machine and may possibly require hand repair of the faulty strip of carpet.

A tufted loom is like a sewing process. Hundreds of needles side by side insert tufts into a preformed backing. This is not normally susceptible to colour patterns, although two sets of needles make two colours possible and stripes are relatively simple. Attempts are being made to change this procedure. In one system the wool is predyed in little segments of different colour, which are then sewn in with very careful control of register so the coloured lengths do not get out of phase. A pattern may be much more easily imparted by eight-colour screen-printing, with vacuum-boxes sucking the dye down through the tufts. Alternative attempts to achieve the patterns of a woven carpet and the economy of tufting have been made by the Shorrocks and Durcam processes, both at the prototype stage.

Eventually the cost of a carpet loom is only a small proportion of the massive investment needed in stocks of wool, finished carpet, creel, and building. Any-

one who would like to innovate in this field should become well aware of the whole process before starting to streamline a segment.

Britain's carpet industry has a considerable number of public companies with sales between £3 and £30 million, making it one of the least concentrated that I have reviewed.

Tomkinsons (Holdings) is a strongly innovative company with an excellent record of growth. It introduced the spool-Axminster loom, has recently contributed to the growth of foam-backed tufted carpets and has other new developments in the pipeline. The price of the shares looks very low with a p-e ratio of only 10.

Blackwood Morton is another company with a depressed share price. It has a very patchy record but seems likely to maintain or improve its position now. The p-e ratio is 6.

Bury and Masco has a p-e ratio of 14. This seems reasonable and is about the average for the textile industry. The company makes a number of products such as felts, filters, moulded carpets for cars, and engineering products. The first half of 1972 shows a recovery from lowered profits in 1971.

A.W. Securities is a second notably innovative company, having pioneered the screen printing of tufted carpets with its "Conquest" range and recently launched a new printed brand "Mayfair". The company has had a good first half year with turnover up 36 per cent and reports that the second half will also be bright. The shares look cheap on a p-e of 14.

Hugh Mackay is a very steady company indeed but may have an ace up its sleeve if the Durcam process takes off. The results have been rather dull but a p-e of 13 is fair.

Shaw Carpets is a company with a highly aggressive management. It skilfully rode the crest of the tufted boom and may now repeat this success with a new printed carpet plant. The company was among the first to spot the possibilities for holding low stock and achieving a quick turnaround of capital which tufting looms make possible. The p-e is fair at 9.

Perspective

Adrian Hope

Tackling telephone bills

Some advances in telephone technology have a sting in the tail. As the recent outcry against so-called "phone preaching" has shown (see Technology Review, last week), the electronically inclined can use their knowledge to outwit the system. But for most people the problem is the other way around in preventing themselves from becoming unwitting victims of the system. STD not only makes it difficult for subscribers to check the accuracy of their quarterly bills, it also makes it only too easy for their au pairs or babysitters to dial home to Europe for a chat. Friends with friends in Scotland are also a problem

and children playing with a telephone can now easily and inadvertently dial a US number and cost their parents a small fortune at the rate of 1.2 seconds per new pence. Some people are also plain dishonest. Only the other day someone drinking in a London pub was caught talking to New York over the bar phone —on the strength of 3p paid over the counter for a local call.

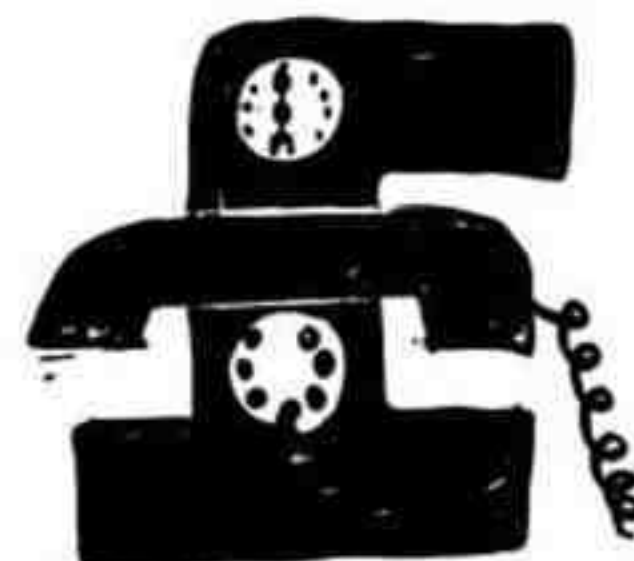
Not surprisingly many subscribers have become paranoid over their phones and their bills. In fact everyone has a pet horror story to tell. Ironically it was a German, talking recently about how domestic phones may be key-locked and metered at source back home in Germany, who triggered a far off memory that something similar was once available here. A check in the green pages section of the A-D London directory threw no light on the matter. Items like loudspeaking telephones, waterproof telephones and very pretty telephones are all advertised, along with automatic answering phones. But there is no sign of anything about subscriber's private meters. However, a phone call to the London Telephone Sales Office revealed that meters, although not advertised, are indeed available and will be fitted, for no connection charge, at a quarterly rental of 75p for a minimum of one year. This contrasts favourably with the £3 connection fee and £6.7 per quarter rental for loudspeaking and answering gadgets. But although the latter gadgets can be installed at virtually no notice, there is a three to six month wait on the telltale meters. Why should this be, one may ask?

The first answer given by the Post Office sales people smacks of Catch 22. There is little demand (hardly surprising as the meters are not advertised) and thus stocks are kept low. Therefore, there is a several months wait. To be fair, this comment was later modified along the lines that demand is small and stocks are low, the one not necessarily following from the other. It was also confirmed that the demand for gadgets like loudspeaking telephones and answering machines is high (remember these are advertised), and the ventures are commercially rewarding for the Post Office, and that delivery is still virtually immediate.

Cynics may observe that loudspeaking telephones and automatic answering gadgetry (or their equivalents or cheap imitations) are available for purchase or rental virtually over the counter or via the classified ads columns of most newspapers. Domestic meters, on the other hand, are available only through the Post Office and then only to those who crack their code of secrecy to find out about them and can wait patiently for up to six months.

Of course, the Post Office must make money and of course the profit margin on meters is low compared to the margin on more expensive telephone accessories; but as any businessman will tell you, even a few pence profit per item mounts up if enough items are sold. And with present day paranoia over telephone billing what it is, the meters, if advertised in the green pages, could well go like

hot cakes. For, provided that care is taken to coincide domestic meter reading dates with telephone exchange reading dates, a subscriber can easily keep a rigid check on what he should be paying for the quarter. That way calls made illegitimately (for instance by a caller giving another subscriber's number instead of his own) could be shown up, along with common or garden accounting errors. And of course there is that heart-warming facility to check on what calls have been made while one is out for the evening.



The official Post Office reasoning behind failing to advertise meters is hard to tie down. In general it seems to be based on the fact that when STD was first introduced, meter availability was publicised and the response was poor. So stocks were run down and adverts curtailed. What everyone seems to have forgotten is that when STD was first introduced, it applied virtually only to local calls and trunk calls between major British cities. It is only over the last few years that nearly every dot on the map in this country and most other countries in the world has become only too easily dialable. It could also be argued that Post Office accounting has not actually enhanced its reputation for accuracy.

Voyeur

Michael O'Donnell

In memoriam

A dignified posse of doctors, including a brace of peers and a sprinkling of knights, was due to assemble last Monday at the Royal Society of Medicine to sip cocktails in honour of one of their colleagues.

The honour was posthumous and accorded to a man who, in his lifetime, received few accolades from the medical establishment. He was never appointed consultant at a London teaching hospital, nor did he hold one of those historic offices beloved of Royal Colleges. And much of his best writing was rejected by medicine's "learned journals".

Yet, every doctor who heard him lecture, and many who knew him only through his writing, rated him as one of the most inspiring and articulate teachers of his generation. When his papers did appear in the *Lancet* and the *BMJ*, they reminded those of us who had almost given up hope, that scientific writing can be both lively and informative and that scientific papers need not

be over-referenced catalogues of ill-digested information.

His tragedy was that he lived and worked in an era when iconoclasm was ill-received in medicine's marble halls and eccentricity was acceptable only when assumed after a dedicated climb up the conformist ladder. In 1964, medical bureaucracy decreed that because he hadn't got the right letters after his name he had to relinquish the job that had given him greatest satisfaction and had been the source of some of his best work. In disgust, he resigned from the staff of the hospital where he had been a consultant for 25 years, and retreated into isolation and eventual despair. In 1969, at the age of 57, he committed suicide.

His name was Richard Asher.

One of his friends was David Dickens, now managing director of Pitman Publishing, who has had the happy notion of publishing a selection of Asher's medical articles, and last Monday's cocktails were sipped to launch "Richard Asher talking sense" (Pitman Medical, hard-back £2.50, paperback £1.50).

Reading it is a disquieting experience for anyone like me who admired the author to the point of near idolatry. To read his words is to hear his voice again and to remember how he used humour to illuminate truth, to diminish hypocrisy and to undermine ill-used authority.

The book also reminds us why the medical establishment found him too prickly to devour. In a paper called "Medical salesmanship", he wrote: "To rise quickly in your profession you must learn to sell your ideas by acquiring the technique of 'pseudo-profundity' or high falution. Remember that the harder anything is to understand, the more readily will committees allocate money to it. Much sensible medicine is obvious, but the obvious does not impress. If only you will trouble to learn the art of putting obvious or trite things in a quasi-profound way then the world will be at your feet."

And a few eyebrows must have shot up in pre-NHS Harley Street when he listed his Seven Sins of Medicine: obscurity, cruelty, bad manners, over-specialisation, spanophilia (love of the rare), common stupidity and sloth. Cruelty, he said, was the most serious and most prevalent and too often arose from doctors' thoughtlessness.

He was a constant questioner of received truths. In 1947, when everyone assumed that going to hospital meant going to bed and nurses were trained to tuck their patients neatly between starched sheets, he wrote one of his best remembered papers in the BMJ: "The dangers of going to bed". In it he listed hazards that, 25 years later, are so well recognised that surgeons often get their patients out of bed within 24 hours of their operations.

He summarised his arguments in writing of characteristic precision and simplicity. "Look at a patient lying long in bed. What a pathetic picture he makes. The blood clotting in his veins, the lime draining from his bones, the scybala stacking up in his colon, the flesh rotting from his seat, the urine leaking from his

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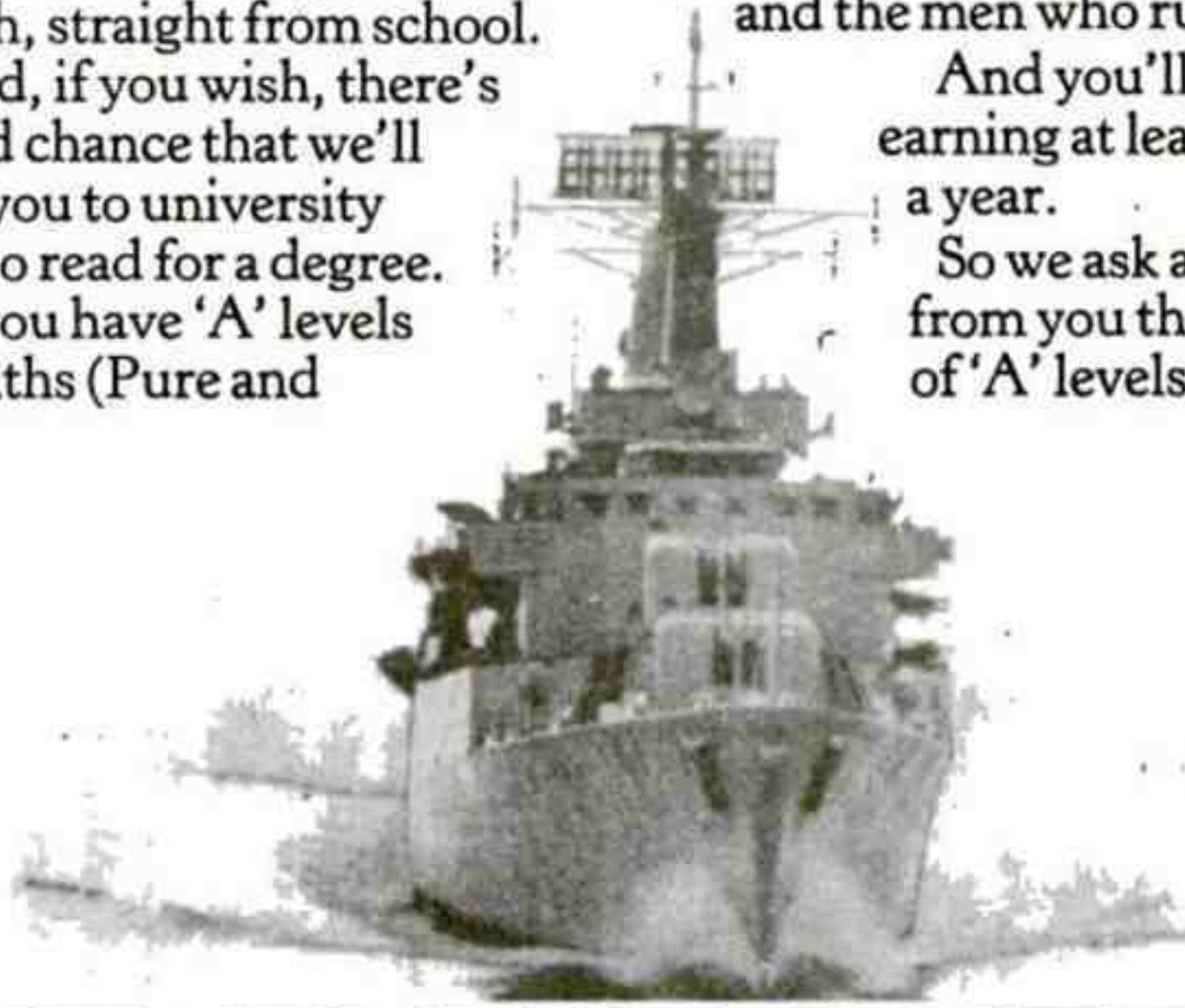
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distended bladder and the spirit evaporating from his soul."

That paragraph is vintage Asher. "Words," he wrote elsewhere, "not only provide a vehicle for conveying thought but even provide wings for its flight which make it travel either straight or crooked."

And when the thought was crooked his response was devastating. Those who used words to disguise their lack of thought were a constant target for his anger. "It is easy to take a small idea and wrap it around with such a glittering mantle of language that it can dazzle the unwary into applause."

His hatred of imprecise language often led him into conflict with psychiatrists. Reviewing psychiatric views on depersonalisation, he wrote: "Schilder stresses the shift of the libido and its partial concentration on a scrutinising tendency. Here I find myself asking how one can tell if a libido has shifted and what means there are of assessing its scrutinising tendency. Sodger says it may be an attempt to escape psychic castration. Perhaps it may, but for a physician the phenomenon of psychic castration is much harder to understand than is its physical counterpart." In 1959 he warned us against committee jargon "whose cotton wool coils are being wrapped closer around us every day".

"In this malignant hypertrophy of language nobody says anything, they 'state', or worse still they 'intimate that'. They never think, they 'are of the opinion that'; nobody finishes anything, it is 'duly completed'; nobody ever looks ahead, they 'envisage a long-term policy'. This language is a waste of duplicating paper and a waste of time. Incompetence can hide behind its opacity and activity be smothered by its voluminous folds. May I warn you of this deadly and contagious miasma. May I personally intimate to you that after due consideration I am of the opinion that it should be an integral part of your basic policy to take due precautionary measures against the obnoxious prolixity."

Thirteen years later, as journalists and doctors struggle to understand the effusions of BMA committees and Sir Keith Joseph's management consultants, oh how we long, dear Richard, that you were still with us to do battle against all men who seek to debase our language.

The week ahead

Saturday

Hailed as "pretentious and socially irresponsible" (B. Dixon, *New Scientist*), the Burke Special is a reshaping of the series that the Beeb wittily calls "science without the stodge" (BBC-2, 5.10 pm). Television Doctor (BBC-2, 6.55 pm) includes Grand National winner Graham Thorner on the new Medical Record Book which all National Hunt jockeys must now carry as proof of their fitness to ride. Also featured: decay in children's teeth and why group practice is good for the nation.

Sunday

If your tv blew a tube last night under the strain of Burke's reflections on the revolution in science, have no fear. Radio is the one to watch out for tonight. At 7.30 pm on Radio 3, in stereo, you can hear a dramatic presentation of the latest Gunter Grass novel, *Local Anaesthetic*. A student who plans to set fire to his dog as a Vietnam protest, and his tutor who tries to dissuade him, are sardonically manipulated by a ruthless dentist (representing scientific orthodoxy) whose patients are encouraged to dream out their fantasies on a blank tv screen.

Stay tuned to Radio 3 and, at 9.40 pm, you can hear Francis Crick and James Watson talk to Paul Vaughan about "The double helix", Nobel prizes and their consequences, and the role of the scientist in politics.

On Radio 4, at 10.10 pm, it's motorways and their influence on landscape and wildlife in Britain. Compiled and introduced by Jon Tinker.

Monday

At The Adams Arms (Conway St, London, W1, 8 pm), George Macrobie of the Intermediate Technology Group will tell the BSSRS about the challenge of intermediate technology. Non-members welcome at 15p per head.

Meanwhile, Radio 3 continues its scientific bent. At 9.30 pm, Dr Christopher Ward talks to Professor David Premack about his breakthrough in teaching language usage to chimpanzees via plastic symbols.

Tuesday

Project 84 (13a Prince of Wales Crescent, London, NW1) is holding an open discussion meeting on political aspects of art and science. Non-members can get in for 10p.

Wednesday

Radio 3 again. Tonight at 9.55 pm, Arthur Jensen, Hans Eysenck, Walter Bodmer and A. H. Halsey discuss the extent to which intelligence is inherited and how education should be organised to meet the situation.

Thursday

Perhaps, but then perhaps not. Film version of Kurt Vonnegut's "Slaughterhouse 5" may open at Shaftesbury Avenue's ABC2. When asked, the distributors were not sure. So it goes.

On BBC-2, science strikes twice, but in different ways. Horizon (9.25 pm) tries to break down the barriers between high energy physics and the common understanding. In a programme called "Shadows of bliss", Jeremy Newson, an actor with no special interest in physics or science, is confronted with the world of HEP.

Immediately following is "Ten Torrey Canyons", a 30-minute theatre presentation set on the bridge of a 250 000 ton oil tanker. The size and speed of the tanker prevent effective

action being taken to avoid a collision and the play analyses the actions and feelings of the captain, crew and a company representative as they vainly try to avert technological disaster.

Friday

At 7.30 pm, the London branch of UMIST assembles at the Polytechnic of Central London to hear Professor T. Allibone talk about "Rutherford, the father of nuclear energy".

A 9 pm, Royal Institution discourse-goers will be able to see and hear Robert Cundall talk about explosives.

Items for inclusion should be sent to *The week ahead*, *New Scientist*, 128 Long Acre, London WC2E 9QH.

Martin Sherwood

Tantalizer No 266

The light of the world

Our local Save Our Sinners campaign has had a mixed year. On the plus side there have been four donations—a copy of the Light of the World, a crate of purity medals, a book of temperance hymns and a parrot which asks, "Are you saved?" On the other hand these gifts were made by our President, Chairman, Secretary and Treasurer, who have had to admit publicly to a failing each—bigamy, drunken driving, embezzlement and the writing of pornography.

Since we believe in baring our bosoms in public up to a point, here are five statements about it all, each of which is exactly half true:

1 The Chairman is not the bigamist and the President is not the drunken driver.

2 The Secretary is not the embezzler and the President is not the pornographer.

3 The Treasurer gave the Light of the World and the drunken driver gave the hymnbooks.

4 The pornographer gave the purity medals and the Secretary gave the parrot.

5 The President is not the embezzler and the bigamist did not give the parrot.

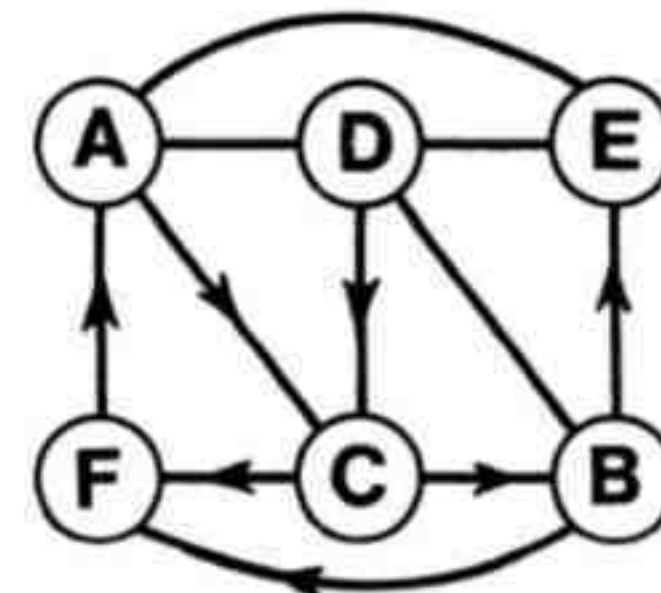
Who gave the Light of the World and in expiation of what? *Martin Hollis*

Solution to Tantalizer No 265

Hot breath of passion

Miss Frumshaw

If you make a map of the list and then trace it in a single line, obeying the arrows, you must start with E and end with F.



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1. Review methods and organisation of educational research.

2. Discuss original educational research results and their applicability.

Speakers:

1. H. J. Butcher, L. R. B. Elton, D. C. Fraser, R. Hoste, D. G. Lewis, P. E. Richmond, J. A. Sandbach, C. Selmes, R. Sumner, Mrs. J. Thompson, A. S. Willmott.

2. Twenty shorter contributions have been accepted.

Fee:
£12.50.

Further details are available from the Academic Registrar, Thames Polytechnic, London, SE18 6PF.

DEC 72 — JAN 73

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Contact: For registration and further information contact ILTAM Corporation for Planning and Research, P.O. Box 7170, Jerusalem, Israel.

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Review

What future for urban man?

by Colin Moorcraft

The cybernation of megalomania is not a process peculiar to Britain. California now has its very own Blueprint For Survival: a disturbing fantasy labelled The California Tomorrow Plan. It is clearly a well intentioned document—but equally clearly it is a dangerous document. Like Limits to Growth, it is quick to point out that it is based on "proven techniques of systems analysis". If this is the case, then those techniques are rapidly disproved or at least shown to be far more limited in their application than some systems theorists would like to believe.

The analysis produces conclusions with a familiar ring. Society is faced by a complex range of interconnected problems. If these are left to politicians and to the other existing piecemeal decision-making processes, the consequences will

The California tomorrow plan, edited by Alfred Heller, *William Kaufman Inc*, pp 120, Cloth \$7.95, Paper \$2.50; Human identity in the urban environment, edited by Gwen Bell and Jaqueline Tyrwhitt, *Pelican*, pp 656, £1.85; The economy of cities, by Jane Jacobs, *Pelican*, pp 252, 40p; The death and life of great American cities, by Jane Jacobs, *Pelican*, pp 474, 75p; After the planners, by Robert Goodman, *Pelican*, pp 270, 75p

be dire. What's needed is a comprehensive plan and some comprehensive planners—and here we are to sit back and "vote for us and we'll sort it all out". Politics is too important for politicians but just fine for systems theorists. . . .

The political coyness ("neutrality") of systems theorists leads to serious distortions and inadequacies in their analyses of systems containing human beings. The California Tomorrow Plan concentrates on the interaction of neutral, quantifiable factors and carefully sidesteps inconvenient, warty, unquantifiable factors of far greater importance. The increasing oligopolisation (as opposed to monopolisation) of economic and political power in corporate capitalist states is, one might suspect, particularly well exemplified in California. Yet the process is not even investigated in the plan, let alone condemned or praised (it's easier to play numbers games with population distribution figures and to mystify people with the resultant flow charts). The action proposals of the comprehensive plan run directly counter to enormously powerful elements of Californian society, yet the plan contains

no tactics for overcoming their influence. Maybe this is because a violent revolution would be necessary and that's the last thing the plan wants (it's a patently unlikely occurrence though).

The spurious objectivity of systems theorists, comprehensive planners and their ilk conceals a partisan sympathy for the perpetuation of situations in which a minority controls the majority. Considering the generally low level of argument they use, they are surprisingly adept at dressing up their control fantasies as apparently humanistic freedom-enhancing plans. Human Identity in the Urban Environment, edited by Gwen Bell and Jaqueline Tyrwhitt, contains a fascinating array of carefully disguised, surrogate freedoms. Many of the contributions show a concern for individual freedom but all except one manage to pervert this concern. The exception is "Architecture That Works"—a fine essay in which John Turner describes the development of squatter communities and shows what people can do for themselves—if they are not prevented from so doing by planners and others. The more perverse contributions analyse situations (for example slum communities) where people, left to themselves, have developed more enjoyable, more stable (ie lower crime rate) communities than planners have ever managed to generate. Instead of concluding that it might be better not to destroy (redevelop) the community but rather to give it the resources to change and to grow in its own way and at its own pace, the new-style planners flatten everything and attempt to contrive new situations which will reproduce the spontaneously generated structures of old societies. They fail, dismally.

Despite its outrageous price the book is a good deal. Its 45 contributions include many ideas of more than negative interest. In addition to John Turner's contribution, two other essays stand out as being of special interest. John McHale's "Global Ecology: Towards the Planetary Society" contains one of the best expressions I have seen of the argument that there are no longer local problems and that the sooner we realise that the planet is the only rational unit for planning the better. Even if, like me, you disagree with the conclusions you may enjoy seeing them well expressed. Christopher Alexander's "A City Is Not A Tree" will be welcomed by English readers.

Pelican have done a far greater service to the public by publishing in cheap paperback form Jane Jacobs's two classics The Economy of Cities (a bargain buy) and The Death and Life of Great

American Cities—The Failure of Town Planning (worth every penny of its price). Both these books present complex arguments with which, once again, many readers may well disagree—both in general and in detail—but the disagreement is likely to be productive. Jane Jacobs is enthusiastic about her subjects and blissfully free of mystifying jargon.

Robert Goodman's After the Planners (another Pelican) is not such a good deal. Like Jane Jacobs's books, it deals with the American situation but unlike hers it seems none too applicable to the UK scene. Robert Goodman uses what some might see as an extremist, overtly political vocabulary: however, its impact is weirdly buffered because it is used to support a rather mild position. His belief that the interests of small urban communities are ignored and suppressed by business interests aided by local government and planners can hardly be news to many Americans. Those who remain to be convinced are unlikely to be by Goodman's skimpy evidence (though they might enjoy the numerous photographs).

None of these books puts forward any plausible proposals for the future of urban man. Some of them furnish interesting suggestions as to what might be wrong. But they are all fairly desperate when it comes to suggestions for ways of putting it right. Maybe hope lies in the unspectacular processes that make for boring books and are too subtle to receive the simplistic attentions of systems theorists, or to translate into existing political vocabularies. The planners certainly don't seem to know what they are doing, so the sooner they stop doing it the better.

Colin Moorcraft is a freelance writer on design and environmental affairs

The UFO experience

by J. Allen Hynek

Abelard-Schuman, pp 276, £2.50

The present anti-science wave in the western world has been explained by many sociologists, giving as many different reasons. I can add a new one—namely, the biased attitude of the scientific establishment towards the whole phenomenon of unidentified flying objects (UFOs), which have appeared in the skies and occasionally also on the ground, during the past decades. Instead of sharing the feelings of the ordinary man and woman, of wonder, perhaps some hope or fear, and bringing all the powers of modern science to the problem to see if an explanation might be forthcoming, UFOs have been treated by scientists with laughter, derision and ridicule and reports on them rejected as not worthy of their attention.

"A scientist who finds something in his laboratory that he can't explain is

no scientist if he labels it 'unknown' and files it away and spends the rest of his time in routine matters", writes Dr Allen Hynek in his excellent book *The UFO Experience*, which certainly tries hard to show (and succeeds) that not all scientists are prejudiced in their opinions.

Dr Hynek is a professional astronomer, the director of the Astronomical Research Centre at the Northwestern University, Chicago, and was for the past 20 years the astronomical consultant to the US Air Force's Project "Blue Book" charged with the official investigation of all American UFO reports. He is therefore better qualified than any Western scientist to write about UFOs, and he certainly is outspoken. (We still know nothing about the official Russian investigation into UFOs, announced in November 1967, with Air Force General A. Stolterov in charge.)

In addition to Hynek, the US Air Force called in Dr E. U. Condon in 1966, giving the latter a grant of more than £200 000, and asked Condon and his project administrator Mr Robert Low, to make a report on the accumulated UFO cases in Blue Book and elsewhere. The now famous Condon report, stating that all further UFO investigations would be unjustified, appeared in 1969. As I found out myself when I interviewed Dr Condon and Mr Low in Boulder in January 1968, they were doubtful, even before completing their study, that there was anything to investigate. Dr Hynek considers the Condon report to be a masterpiece of an insincere statement and loose compilation of partially related subjects. Hynek concludes that the study by the Condon group was incorrectly defined and that they studied the wrong problem.

Hynek's book then is an empathetic plea to subject the physically unexplained cases of UFO sightings to strict scientific analysis—a rebuttal of the Condon report, its official endorsement by the National Academy of Science, and of the entirely spurious attitude of the Air Force's Project Blue Book. But the most challenging part of the book consists of quotations in detail of UFO cases which were buried among the 23 000 Blue Book cases and have not hitherto been known to the outside world.

Let me quote just one, which I found particularly intriguing. It is a classified document (classified, that is, so far as name, location and mission of the US naval vessel is concerned) but its contents are not classified. It states that both by visual sightings of the Commanding Officer, all bridge personnel and numerous hands topside, as well as by air search radar, four objects were seen at ranges up to 22 miles. They remained over the ship for three minutes in circular formation and were tracked at 3000 knots. The radar IFF (Identify Friend or Foe) challenge went unanswered. The standard reply to all UFO sightings: "Put more water into your next whisky, old boy", cannot possibly apply here—the US Navy is dry! Hynek brought this particular report more than once to the attention of the director of Project Blue Book but it was dismissed with boredom and summarily evaluated as "aircraft".

Hynek is adamant in his conclusion

that the UFO phenomenon is worthy of systematic rigorous study, and that the data point to an aspect or domain of the natural world yet to be explored by science. He asserts that the data which are available for study require major organisation and systematisation, and that a uniform terminology must be adopted. In his eyes, the Condon report and Blue Book failed to make a case against UFOs. New empirical observations exist, he claims, that describe a new fact and further work of an unbiased character is clearly the next step.

I believe that if such further unbiased research were now started, then the public, from whom the support for all scientific endeavour ultimately must come, would be given a chance to see science as an adventure, pursued with humility of spirit, with dignity and respect, and for the benefit of all.

Anthony Michaelis

The legacy of George Ellery Hale

edited by Helen Wright, Joan N. Warnow and Charles Weiner

MIT Press, pp 294, £7.90

Science occasionally takes a leap forward due to the foresight and energy of one individual. George Ellery Hale was such a man. He couldn't wait but had to act himself and act quickly; his father is reputed to have said of him that George always wanted things yesterday. His impatience produced results; his legacy includes the world's largest optical telescope—the 200 inch at Mount Palomar—the *Astrophysical Journal*, and the American Astronomical Society.

For years he dreamed of building very large telescopes; the first, the 40 inch refractor at Chicago, then the 60 inch and 100 inch telescopes at Mount Wilson and finally the 200 inch at Mount Palomar. In his writing there is an admiration for Lord Ross, who, as long ago in 1845, built his 72-inch telescope in Ireland and discovered the spiral nature of the nebulae, and Hale dreamed of a 300-inch telescope, indeed with his encouragement Pearce at Mount Wilson designed a mounting for such an instrument. In the event his largest project was the 200-inch telescope at Palomar finished in 1949—11 years after his death. Yet this is still the largest optical telescope in the world, and will only be surpassed by the Russian 236 inch at present under construction. Hale's faith and inspiration have been fully justified by the results. Edwin Hubble using the 100 inch discovered the expansion of the Universe, and Marteen Schmidt using the 200 inch discovered the enormous red shift of the quasars.

Hale's view on optical telescopes and his wider views on science would be particularly valuable in Britain today while the debate goes on about the future of British Optical Astronomy. What would he have made of the pressure to build a 240 inch telescope because it would be a few inches bigger than the Russians'? What advice would he give to British Astronomers wanting to rebuild optical astronomy in this country? He

surely would have seized the opportunity offered by space research and pressed for a very large orbiting telescope; not of 200 or 300 inches but of 1000 inches, something that could really penetrate to the depths of the Universe, that could range over all the wavelengths unhindered by the Earth's atmosphere. He surely would not tamely copy the example of others. Hale was an innovator not an imitator.

Hale was much more than telescope builder. He was an educator, organiser and inspirator within science. It has long been my personal view, and I was delighted to find that it had been Hale's, that university science courses should begin with a general course on what Hale calls evolution, but could perhaps better be described as "Man's place in the Universe", "... beginning with an account of the constitution of matter, the formation of the elements, and the electron theory; picturing the heavenly bodies and the structure of the Universe, the evolution of stars and planets and the origin of the Earth; outlining the various stages of the Earth's history, the formation and change of its surface features, the beginning and development of plant and animal life; explaining modern biological problems, the study of variation and mutation and the various theories of organic evolution; summarising our knowledge of earliest man, his first differentiation from anthropoid ancestors, and the crude origins of civilisation, and connecting with our own day by an account of early Oriental people, the rise of the Egyptian dynasties and their influence on modern progress ...". Such vision is sadly lacking today. University departments jealously guard their own subjects and insist that it is imperative that such and such a course be given in the first year and cannot possibly be postponed to the second year to allow room for a course of the width envisaged by Hale. My own timid experiments in this direction have suffered from just such reaction.

Hale was also a great believer in popularising science and an admirer of the Royal Institution's attempt to do this. We now have the mass media and had Hale been alive today he must surely have been heavily involved in popularising science through television and radio, and not just superficial science but the real stuff.

The Legacy itself contains biographical material, reprinted papers and "perspective" articles on Hale and science; it has been made rather than written and only succeeds because Hale shines through it as a fascinating character. The world of science and astronomy lost a great figure when Hale died and there has been no successor to him. This book should be compulsory reading to those who wish to inherit his mantle and I hope it finds its way to the Royal Observatories, both in Herstmonceux and Edinburgh, as well as to Imperial College and Cambridge. If it could find its way into the Science Research Council and its members would read it, then perhaps at last British optical astronomy would take that leap forward they claim to desire.

Ian Roxburgh

World markets of tomorrow

by Fremont Felix

Harper and Row, pp 364, £6.00

Fremont Felix provides, in *World Markets of Tomorrow*, a mine of information about almost all the countries of the world. Lists and charts cover population, GNP, electricity consumption, and their growth rates over the past 20 years. So, if you want to know the number of hospital beds in Laos, educational places in Hong Kong, cars in Japan, television sets in Saudi Arabia, GNP per head or per unit area of Algeria, capital investment of the United States and many other features of civilisation—it's all there.

Besides saying where we are and how we got there, though, the book makes predictions for the future. Beware! These are often very suspect and could be misleading. For example the chapter about population stabilisation assumes that the world's population will grow at a steadily reducing rate. It ignores, however, the fact that the present population of the world is likely to start to have more children as it matures, and the growth rate may well rise. Again, when Felix projects the electricity consumption of American citizens it levels off in 230 years at more than 20 times the present level. This greed does not seem to concern him and, indeed, he frequently asks for the readers' approval of growth and scorns the fears of the doom brigade.

His book is described on its wrapper as "A documented rebuttal to the theories of exponential growth". It's a

bit like using nude illustrations to sell the novels of Jane Austen! There's worse to come. The book does not consider which types of growth are desirable, nor does it consider whether population will be stabilised by a massive growth in death rates. An interesting set of curves shows the growth rate of electricity consumption declining as a community consumes more. Yet the graph runs out of evidence when the consumption per head is still doubling every 24 years.

Provided one ignores the claims of the wrapper and the shallow line of some predictions, it is still a very interesting book.

Tim Eiloart

Who will eat?

by Michael Allaby

Tom Stacey, pp 252, £2.90

If Michael Allaby had written a shorter book it would probably have been very valuable, for he has many sensible things to say. He points out, in *Who Will Eat*, that population cannot increase indefinitely, therefore we ought now to start thinking seriously about how to limit it and to whom the restrictions should apply. He sees the folly of putting more fertiliser on to land than the crops growing on it can use. He sees the antithetical folly of trying to flush the manurially valuable excreta of farm animals into rivers or sewage works. He argues that the Food and Agriculture Organisation is not as useful as it might be because its connections are with governments rather

than with the scientific community. He explains that, although the new high-response cereals that are the basis of the "green revolution" have done much nutritional good, they have had some harmful social effects. He sees that "primitive" people often get a better diet than the poor in supposedly more civilised communities and may have a preferable ethical outlook. As a result of that, he argues that we should wonder whether our contemporary panaceas—large-scale industry and the worship of GNP—really work before we try to foist them on others. He puts in some useful publicity for the Intermediate Technology Development Group. And he recognises what seems to be a valid historical generalisation: that all the now affluent countries had first of all to organise prosperous agriculture, and suggests that developing countries will probably have to do the same.

These opinions are reasonable, or at any rate tenable. But Allaby has enough space to allow his hobby-horses a canter, and he did not devote enough time to proof reading. He has an obsession about the value of soil organic matter and the alleged structural deterioration of our farmland. Oddly enough, at one point, he seems to suggest that the application of animal excreta will increase the loss. He does not like chemical fertilisers and even invents a new one—*ionic nitrate*, listed in addition to ammonium, potassium and sodium nitrates. He gets so carried away by his dislike that he gets three extra 0s on to the figure for annual production. These 0s seem to have migrated from the axes of some of the diagrams. An informed reader may be able to work out what some of the contractions mean, but I fear they will fox most of the readers at whom the book is aimed. These readers may be readier than I am to be carried along with the flow and not worry about phrases like "... it would suggest that the fertilisers are replacing nutrients extracted from the soil by cropping but that they are adding little beyond this". What else were they expected to do? Besides obsessions and ambiguities, there are too many simple mistakes: animal feeds do not contain "pure phosphorous", cereals seldom contain more protein than grass, broilers are not now expensive as meats go, typhus is not the same thing as typhoid, and Rothamsted is not a "government agricultural research station".

N. W. Pirie FRS

Psychological probability or the art of doubt

by John Cohen

George Allen & Unwin, pp 142, £2.95

In the 1920s, so it is said, the great English statistician Karl Pearson in a quest for a fund of random numbers decided to make use of the lists of numbers called at the roulette tables in Monte Carlo. These, as any gambling addict will be able to say, are published at regular intervals in curious yellow booklets and it is from them that the enthusiasts compile their lists and devise



CHAPMAN & HALL

The Scientific Division of
Associated Book Publishers
11 New Fetter Lane, London, EC4P 4EE.

Ecology of Heathlands

C. H. Gimingham

Professor of Botany at the University of Aberdeen

Heathlands have always attracted the attention of ecologists and this book outlines the remarkably comprehensive picture that is beginning to emerge from research into the dwarf-shrub heathland ecosystem. The book integrates the findings of numerous workers, although emphasis is given to research on the heathlands of Western Europe.

Almost every aspect of ecological theory and technique finds a place in the interpretation of dwarf-shrub heaths and *Ecology of Heathlands* offers an example of the application of these ecological principles to a particular practical problem.

Contents: Preface; Introduction; Environment and ecological history of European heathlands; Community structure; The composition of heath communities, and their seral relationships; The physiological ecology of *Calluna vulgaris* and some associated species; Growth-form in relation to community structure and composition; Cyclical processes in heath communities; Biomass and production; Heathlands as grazing land; Heathland management by the use of fire; The nutrient budget; Land use and conservation.

October 1972: 240 x 159 mm: approx 300 pp: 34 plates and 51 line illus: hardback: 412 10460 1: £4.75

"winning systems". Pearson's hope was not to find any regularities suitable for basing a system, but that the hundreds of thousands of numbers called would provide the most prolific source of random numbers known to man. Once he came to analyse the tables however he was staggered to find that his great trawl contained sequences and strings of numbers which he wouldn't have expected to find "by chance" even if the tables had been clicking away at Monte Carlo non-stop since the Jurassic Age. On the assumption that the printed numbers accurately reflected the winning calls, Pearson therefore dryly concluded that roulette, as played at Monte Carlo, was "not a game of chance".

In this anecdote lies the kernel of a problem which besets all students of probability theory, whether they operate at the level of the high-powered mathematician or the most junior psychology student inspecting the tangled results of his first reaction time experiment—what is the nature of chance? How does one assess the "significance", or otherwise, of the numbers thrown up as experimental data? How sure can one be that a new drug really does have analgesic properties, an aerofoil improved lift features, a human being telepathic ability? To help sort order out of chaos, mathematicians have devised ingenious statistical tests, of varying sophistication and power, and an understanding of the nature and operation of these tests is supposed—quite rightly—to be a necessary part of the basic training of most science students. Unfortunately, statistics is one of the

hardest subjects to teach and the most boring to acquire, and most scientists recall with anguish the stupefying horrors of their undergraduate "stats" course.

John Cohen's new book *Psychological Probability*, while not a conscious attempt at an introduction to statistical theory, to my mind could easily and usefully be cast in this role. Wittily subtitled "The Art of Doubt", the book is particularly strong on explaining, in painless doses, the elusive concepts of independence and its half-brother randomness—two ideas which are central to any understanding of probability theory, and hence of statistics as a whole.

Professor Cohen has for years been fascinated by probabilities and the peculiar tricks humans get up to in attempting to assess them, and this book is one of the many fruits of this fascination. The chapter headings—"The Nature of Gambling", "Uncertainty in Medicine", "Chance and Doubt in Art and Love," etc—should give some idea of his relaxed and wide-ranging approach to the subject and even if the aim of the book is to consider human decision-making strategies rather than statistical theory itself, it succeeds, by chance perhaps, in throwing fresh light on both. If I have a moan it is about the inclusion of two pages of dull and superfluous photographs which can only serve to bump up the price and nothing more, and to be quite frank the book seems a trifle pricy at almost £3 for about 140 pages of rather simply laid-out text. Nevertheless, I wish it had been around when I was a student.

Chris Evans

Film in teaching

by Keith Kennedy

B. T. Batsford, pp 128, £2

Keith Kennedy's book *Film in Teaching* indeed rates as one of the best yet of the glossy publications on the un-dying uses of film as a creative, or beneficial, medium in teaching. A vision seen through sepia toned glasses.

It emphasises imaginative use, is liberally illustrated, and comforts the reader by ignoring any reference to the major dictator governing usage of all media in education—cost. The author does consider, however, that the suggestion that a child taking personal responsibility for using film in school-time may be neither practical nor economically viable. This moment of realism is then drowned by one from a great distance from the classroom today. It seems that Kennedy "had a dream . . . that the personal use of film in schools offers the opportunity to the individual to follow his own inclinations."

Throughout the book there is comprehensive guidance on equipment for, and practical use of, film in teaching. Film as a teacher's aid is used still comparatively seldom in British schools. Even rarer is the pupil use of film, because of material consumption of allowances. Teachers in the fortunate schools which possess the means, may find this book an inspiration—in as much as it is a well illustrated diary of an enterprising teacher with funds at his disposal. It proves that children of different age groups have used film in a variety of social, dramatic



October Books from Chapman and Hall

The Scientific Division of Associated Book Publishers,
11 New Fetter Lane, London, EC4P 4EE

Principles and Processes of Biology

M. J. Hollingsworth, Lecturer in Genetics at St. Bartholomew's Hospital Medical College, London, and K. Bowler, Reader in Animal Physiology at the University of Durham.

October 1972: 240 × 159mm: 400pp: 33 tone and 214 line illus: 412 11000 8: £5.00

The approach to teaching biology has changed radically in recent years, an understanding of the basic principles and processes being of much greater importance than a superficial knowledge of various plant and animal types. In this book these basic principles have been taken in a logical sequence and treated to a depth which leads to a true understanding of biology, as well as providing students with an opportunity to develop an analytical rather than a descriptive approach to the study of living organisms.

Biology of Earthworms

C. A. Edwards, Principal Scientific Officer at Rothamsted Experimental Station, Harpenden, and J. R. Lofty, Higher Scientific Officer at the same institution.

October 1972: 222 × 141mm: 230pp: 13 tone and 62 line illus: 412 11060 1: £3.25

Since Darwin's pioneering work at the end of the last century, there have been very few studies on earthworm biology and, so far as is known, this is the only up to date English-language text covering all aspects of the subject currently available. The text deals with species all over the world, and will meet the needs of undergraduates and postgraduate research workers alike; proving also to be an effective reference text and an eminently readable account of the entire subject. This book will also be useful for the comprehensive list of references that is given.

and exploratory situations.

It leaves one asking the question, though, does this attitude towards using film as a basic school material act as an added stimulant to further studies, or does it draw students away from essential reading and writing?

Caroline Cooper

Art

Cognition and control project

Museum of Modern Art, Pembroke Street, Oxford, until 5 November

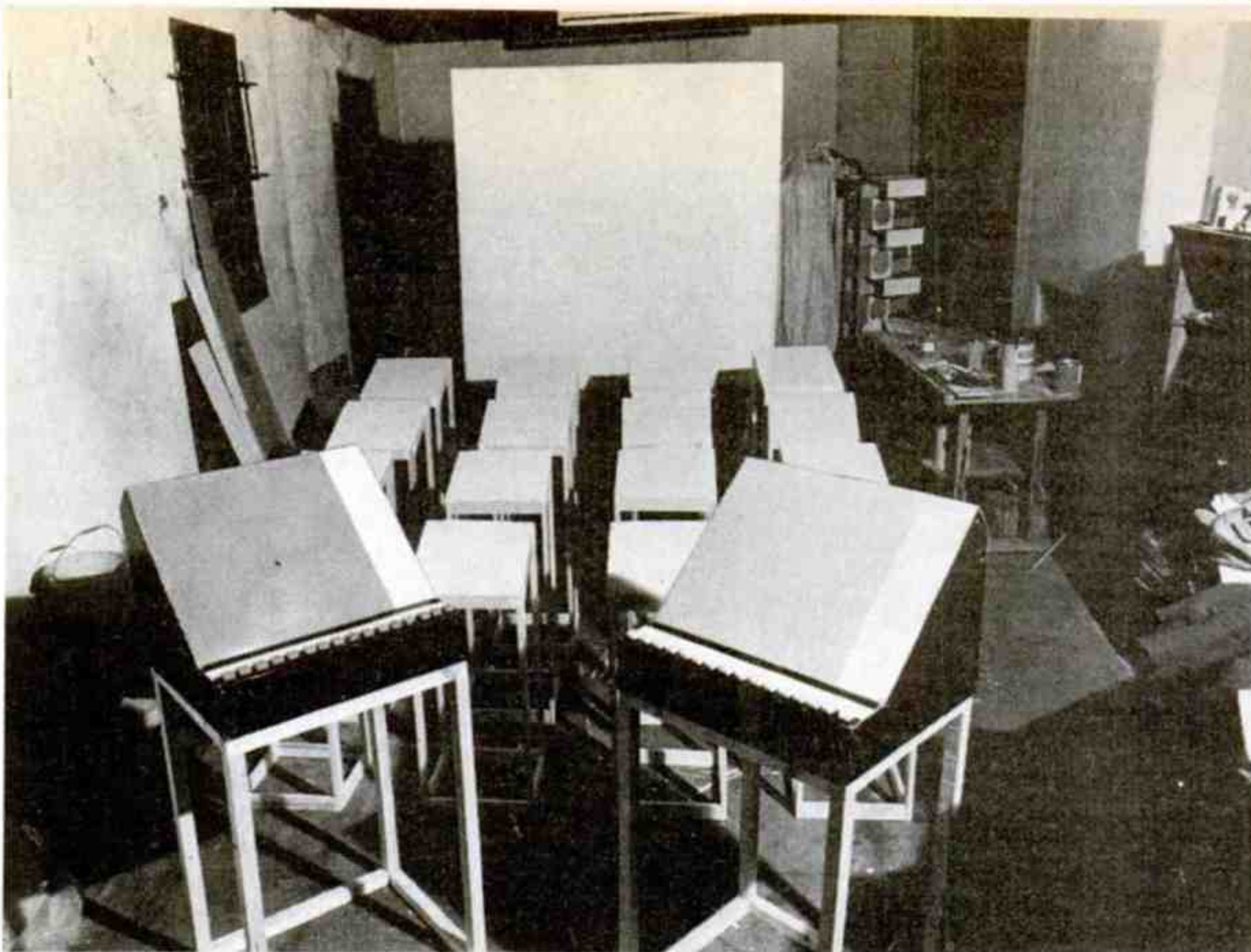
Over the past few years artists have increasingly tried to find alternatives to the gallery exhibition as a means of expression. This is motivated partly by a mistrust of the commercial gallery and partly by a wish to find a new audience. Steve Willats, the chief organiser of the Cognition and Control Project, has been involved for the past 10 years with a form of art, best described as behavioural, which uses the art context to study people's reactions to abstract problem situations.

This research has culminated in the Visual Meta Language Simulation, a complex electronic game for two players. It has been constructed by the artist with help from the Motorola Semiconductor Company, and uses their TTL 74 series logic. Each player starts out with an equal score, shown by coloured light boxes in the "Environment". The "Problem Display" then offers the players a cue—partial reproductions of one of a set of shapes. Each player may then choose the best fit as the full range of shapes is displayed on his "Decision Box". If one player is successful, he wins one lightbox from the other. But at the same time the rate at which possible solutions are offered to him decreases, thereby increasing the other player's chances.

The machine therefore has two functions. First, it tests each player's power of visual imagination. There is no logical system linking the cues and the shapes: one either tries at random or has to guess. It becomes a matter of intuition. The machine is also homeostatic in operation, for the odds on successive wins by one player continually decline. In a subtle fashion the game tests the willingness of the players to cooperate, for if one wants to continue playing, it is necessary to let the other win from time to time.

Willats has also been involved in planning the Social Resources Project, a study based on interviews, of how the citizens of Oxford regard their city and neighbourhood. Its aim is not political—to produce some kind of public mandate—but to increase at a popular level neighbourhood consciousness and interaction. How people answer it is as important as what they say. Similar projects have been carried out in Nottingham and West London.

Neither of these events relate to normal conceptions of the artist's function. Art in them is used as a catalyst: the Social Resources Project deliberately juxtaposes items of, to most people, high personal priority (the way they live) with



Steve Willats's Visual Meta Language Simulation during construction. The "Problem" is displayed on the large panel (background) and the players at each of the "Decision" boxes (foreground) select buttons for possible solutions. The centre set of boxes represents the "Environment", which records the score

low (art). The fact that it is conducted as an art event gives it much of its validity. In the same way, people approach the Visual Meta Language Simulation as an entertainment rather than a test. However, as the problem in it could be converted from their present specifically visual content to others, it is a learning device as well as a social model.

Other artists participating in the exhibition include Don Mason, Colston Sanger, George Mullen and David Budgen. Their unusual approach may be one method of placing art in a higher priority and a wider social context.

Conway Lloyd Morgan

Kurt Schwitters

Marlborough Fine Art, Albemarle Street, London, until 28 October

As you rotate the kaleidoscope at Marlborough Fine Art you touch on what C. H. Waddington refers to as the scientific basis of modern art at every turn. Kurt Schwitters was born in Hanover in 1887 and buried in Ambleside in 1948, and is known mainly for his collages. However, he started as a very academic painter with shades of Corot, Cézanne, and of black shadows in sun-lit landscapes and sombre portraiture. Then there is Mondrian and perhaps an obviously early Picasso. But Kurt Schwitters, all but following the onomatopoeia of his name, flitters past these influences without so much as a halt. But Braque, that's another matter. Braque glued materials and that was his break-through. Schwitters used largely rubbish and, in opposition to the Second Law (order out of disorder, that is), glued it unfailingly into design. When he used oil-paint to cover it the design survived in its pristine form as it ought and the shape in which

the artist had first seen it.

The despair of his generation is expressed in the candle-stub, tickets, shreds, cigarette, washers, coins, a broken gas stop-cock, a torn playing-card, a bent part of a broken pram-wheel, bits of wood, bits of wood, wooden bits, more tickets, paper, cloth, a post-card, a woman, perhaps two women, but not a gun, who cares about what caused it all, a match, some hemispheres, a marble, Mondrian colours, tickets (second class) and rust and dust and craquelure, and did Victor Pasmore see this and did Ben Nicholson?

The primitiveness of the means, though, jars in a peculiar sort of way. Who knows whether there were gaps between the ill-fitting pieces of wood, whether the timber was warped to begin with, whether the nails were rusty? These factors endow the artefacts with a kind of Jacobean mustiness: oak which is three-hundred years old is not expected to hang together as well as when it is new, but then—it has the grease of the centuries to compensate for flaws. Here we have only dust of the decades. But if Mr Stephen Spender is right in his view that at present a generation (of ideas) lasts only five years, then—give or take an order of magnitude—the comparison is valid. The rust generates a nostalgia and the dust . . . ah but I don't want to get entangled in a discussion of the pros and cons of varnish on oil paintings and its removal therefrom.

That Schwitters was above all an experimenter and a technologist in addition to being a real artist is obvious. But his mini-sculptures and macro-metalwork show that he was also a wizard. Even I, who have hated cats ever since they all but cleared out my goldfish pond, have to admit it: Schwitters's cats are tolerable.

Robert Weale

Ariadne

Except when they are being held up as a threat to society you don't hear so much gossip about computers these days. Even the jokes about them seem to have died away along with the belief that they were things to make an instant fortune with. I am glad to record a story of quite another order which features what New Scientist used to call the "friendly computer". It was told me by a woman journalist who had found herself put down at Frankfurt when flying between Copenhagen and Vienna one Sunday recently. She wandered into the duty-free shop and bought a few things. She had no English, French or German currency, only an odd assortment of Scandinavian moneys. "That's OK," said the counter lady, "we haff computer." She rang up the purchases—33.50 DM and my friend handed over 40 Swedish kroner. The machine clicked: "You still owe 10.26 Swedish or 7.10 DM." The customer fished around in her bag and came out with two 10-kroner Danish notes. The machine whirled again. In Danish, 4.31 kroner would be enough. The German lady handed her 2 DM change. "I may have lost a few pence on the currency exchanges," my friend said, "but I was delighted and they had made a sale that otherwise wouldn't have happened."

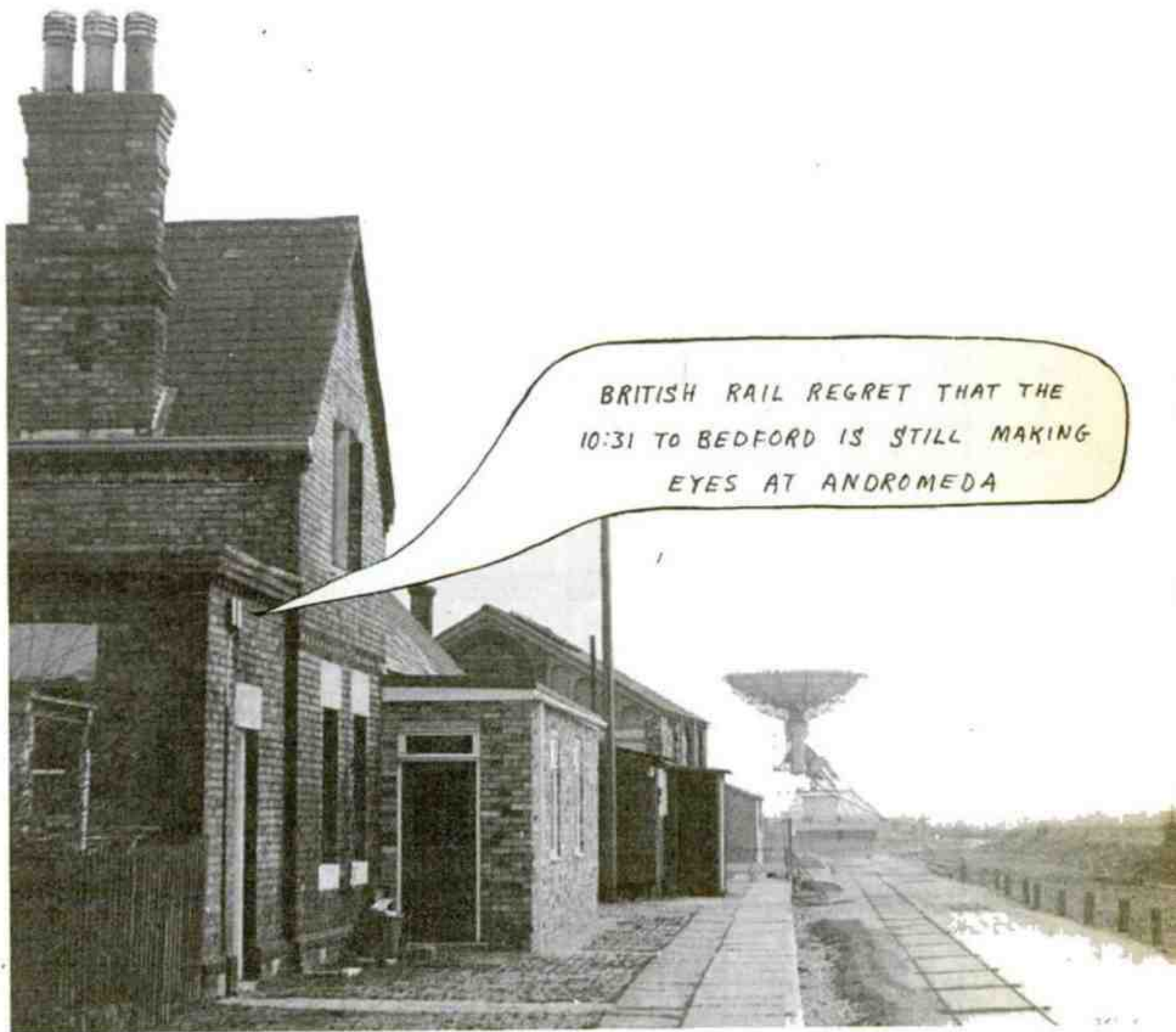
Just as well the Apollo programme is coming to a halt. The astronauts are getting too big for their LRVs—and if you think that's a rude word for lunar boots, you haven't been paying proper attention. LRV, as all good lunar pundits know, is short for Lunar Roving vehicle, the last of which leg-saving, all-American mini-jeeps will accompany Messrs Eugene Cernan and Harrison Schmitt to a landing in the Moon's Taurus mountain on 11 December. But with a difference. For, among sundry modifications—including preparations to trundle the first gravimeter across the lunar rubble—NASA states that the LRV's "foot rests" (it has four wheels, surely?) have been moved "so that the adjustment range will fit the Apollo 17 astronauts". Ah bliss! No more the awful ague of the outgrown pedal-car. No more the terrible tension of the too-taut spacesuit. Indeed, no more that scarey kneebone steering round those teetering crater rims. The Last astronaut can bid farewell to rille and mare driving *upright* like a man.

One member of New Scientist's staff is particularly pleased to hear that ICI is trying to track down stinks at its Billingham works. He worked there some 15 years ago and still recalls with loathing the stench that filled the air. It was not a single stench, but a mixed one consisting of both acrid and putrid vapours, which varied in different parts of the Billingham complex. For those who preferred to lunch outside in summer time, there was

a threefold choice. Some enjoyed eating their sandwiches amid ammoniacal fumes from the massive ammonia plant. Others had a liking for the bracing tang of the nitric acid drizzle which descended on the opposite side of the factory (rumour had it that a car left outside there for some months simply disintegrated). A few hardy employees developed a perverse tolerance to the effluvia of the amine plant—neither strikingly acidic nor alkaline, just plain vile. Each group grew accustomed to its preferred odours, and there was trouble only when the wind changed and ICI's ammonia sniffers found themselves neutralised by nitric acid, or the acidophiles were forced to inhale ammonia. And the New Scientist man? He lunched in the canteen. The steak pie had a marvellous smell.

My osteotelepathic friend Daedalus is intrigued by the fact that certain nocturnal moths are strongly attracted by specific far infrared laser frequencies, making possible the laser-baited moth-trap. It seems that the moths' antennae resonate electrically at these frequencies. Daedalus reckons that humans should also be sensitive to particular bands in the radio spectrum. He reasons that since bone is piezo-electric, each part of the skeleton must have a characteristic set of vibrational modes which could resonate at the appropriate radio-frequency. The kinaesthetic nerves which report our bone-dispositions should react to such resonations, although we would probably

have to learn to interpret their signals. Those experiments in which people learn to control their brain alpha-rhythm or blood-pressure, without knowing how they manage it, suggests to Daedalus that other sensory extensions are well worth looking for. So DREADCO volunteers are being exposed to single frequencies in various wavebands to see if they can be trained to detect them. Frequencies from those corresponding to low torsional modes of the pelvis at a few hundred Hz right up to high-order harmonies of individual teeth at many MHz are being examined, with the volunteers trying to guess which part of their anatomy is responding. Daedalus hopes to identify wavebands common to all the volunteers, which might then be used for broadcasting. It would be useful if audio-modulated radio could be subconsciously decoded and interpreted, so that one could become aware of the football results via one's elbows, for example; but probably only simple on-off patterns of pulses will be perceptible. Even so, a pulse-coding system could enable weather-forecasts, traffic information, stock prices, the time, etc., to be broadcast for people to "feel in their bones". More interesting is the possibility of learning to excite vibrational resonances in one's own bones by muscular tension, thus radiating messages to others nearby. This novel theory of telepathy explains the frequent occurrence of this faculty in identical twins—they have an identical set of bone-resonances.



Letters

Jensen's views

Sir,—I much enjoyed Professor Arthur Jensen's closely argued article on "Genetics and education" (12 October, p 96). However I would like to point out that one of his statements is as dogmatic, and possibly as arbitrary, as any of those of his debating partners. This is that "Intellectuals should be concerned with men's purposes and the uses to which knowledge will be put; they should never think in terms of suppressing knowledge or the quest for it". I would like to ask what an intellectual does if, after an objective assessment of the external situation, he concludes that his knowledge is likely to be put to an end which he regards as socially undesirable, however hard he tries to prevent this. Such cases do occur. One example was in nuclear physics before the last war. Possibly a second faces brain research workers in the Soviet Union now. It is certainly conceivable that a third confronts education psychologists. I think that truth at any price is as inappropriate to science as it is to other aspects of life.

R. A. Yeates

Biochemistry Laboratory
University of Amsterdam
Amsterdam-C

Sir,—David Cohen, in his review of Genetics and education (19 October, p 168), has implied that its author, Professor Arthur B. Jensen is irresponsible and has drawn unwarranted conclusions. I ask, just what is wrong with Jensen's conclusion mentioned in the review, that some children aren't cut out for academic education?

Cohen has not convinced me that Jensen is irresponsible, but he has convinced me that Cohen may be. In reference to the failure of programmes to raise the IQ levels he wrote: "Because 1000 wrong formulae don't solve Quadratic equations, it does not mean quadratic equations can't be solved. Given Jensen's logic, mathematicians would have given up years ago."

Cohen's allusion smacks of wishful thinking. Words that are required learning for all US schoolchildren: that all men have been created equal, may have coloured his thinking and made it difficult for him to accept realistic concepts such as: All men are not of equal height, equal IQ, or equal learning ability.

Richard T. Barrett

6 Solmdale
Sidmouth
Devon

Tidal power costs

Sir,—Dr Wilson of Salford University (Letters, 12 October, p 119) refers to some of the side benefits from tidal power generation which he feels should be included in any cost-benefit appraisal. He specifically mentioned new road links, coastal protection and navigational facilities, but there are others.

Tidal power is inexhaustible and its utilisation can help to reduce the rate of depletion of non-renewable energy resources at a time when there is growing concern about the availability of reserves. Tidal power is also an indigenous resource. It is politically safe and can contribute to import saving. Such considerations are important when we expect that political and economic forces are likely to drive up prices and undermine security of supply.

Finally, tidal power creates no dereliction, no atmospheric pollution and no problems of waste disposal. One must accept that large engineering schemes of enclosure in our estuaries would have an impact on local ecology but any threat to amenity this might constitute needs to be weighed against the damage caused when mining fossil or fissile fuels. The winning of coal, oil or uranium in Britain cannot be done without some environmental reduction, nor can they be utilised without producing pollution problems.

In my view, resources conservation and pollution abatement alone make a re-examination of the potentiality worthwhile.

Laurance Reed

House of Commons
London

Music as an antidote

Sir,—I was very interested by Michael O'Donnell's piece on the use of music (Forum, 12 October, p 108) as an antidote for depression. I use music to enable me to work. (Some psychologists, no doubt, fail to distinguish between these uses.) Confronted, as I usually am most evenings, by a pile of marking, manuscript, committee papers or whatever, I have found that the only way to get rid of it at a relatively sane hour is to tune a VHF portable to Radio 3. (And when they start chatting, a quick flip round the medium wave invariably turns up something.)

In spite of the scorn Professor Brian Trowell pours on those addicted to "aural wallpaper", I have found my appreciation of music extending both ways from a natural base to about 1800; so that now I know at least something about most

composers from Lassus to Cage. And didn't you report a year or two ago that some Americans had established that people could concentrate better when subjected to sound of mild intensity?

I write this to the accompaniment of some rather good Verdi.

Martyn Berry

Kynance
Sandy Lane
Addington
Maidstone, Kent

Sir,—Michael O'Donnell might like to try Mozart's wood wind music especially the Clarinet and Bassoon Concerti or, to a lesser extent, Beethoven's sixth or eighth symphonies for the therapy he mentions. Especially the first two.

R. G. Hill

Lisvane
Poplar Avenue
Windlesham
Surrey

Patterns of chance

Sir,—I am engaged in collecting data relating to apparent deviations from probability theory in such varied fields as the emergence of structured patterns in random tables, anomalies in statistically oriented ESP experiments and in related phenomena, including personal anecdotes of improbable chance coincidences.

I should be grateful if readers of New Scientist with a guilty inclination towards such recondite fields of research would communicate to me their "coincidental" experiences with a view to later publication (under safeguard of anonymity if so requested). Supporting documentary evidence would be welcomed but is not a condition.

Arthur Koestler

8 Montpelier Square
London SW7

Zuckerman report

Sir,—The review of the Zuckerman Commission report by Jon Tinker (21 September, p 496) as well as other press and radio commentary, has highlighted the deficiencies of the report. The principal shortcomings, according to reviewers, are first that it was commissioned by mining finance houses and secondly, stemming from the first, that the terms of reference were too restricted. Those views may be valid, but they do not offer any hint of progress in resolving the dilemma facing society of reconciling conservation of the natural environment with advanced standards of living.

The Zuckerman Commission, on the other hand, has attempted to point the way forward and there are many constructive suggestions and arguments which deserve proper study. Little can be gained by polarising the argument into those for and against mining in areas of natural beauty, because the ultimate extreme views of both sides are unsustainable in practice. It is a pity that the discovery of copper at Coed-y-Brenan is in danger of being elevated into a test case to decide whether or not mining should be allowed in such an area. Each and every case should be decided on its own merits, including even the continuation and expansion of existing operations such as china clay on Dartmoor, or limestone or fluorspar in the Pennines. Whichever way the decision eventually goes over Snowdonia, it would make bad case law to apply it to every application to mine in areas of beauty.

If public opinion is to influence these decisions then it should be aware of what is at stake in each case. The alternative sources of supply and the environmental problems associated with them must be considered, or the consequences of going without or using substitutes investigated. The possibilities of restoration or rehabilitation must be weighed and consideration given to whether the cost of such work is likely to fall on the producer, the consumer or the community as a whole.

Constructive dialogue is required between the various professional groups involved in the supply of minerals and the preservation of the countryside, in order to clarify the complexities of some of the problems. For example, it has been alleged in broadcasts that metal mining produces toxic metals that poison flora and fauna and hence damages the environment. The fact is that mining does not add metals to an area; it takes them away for sale. In doing so it disturbs the area and may expose minerals previously buried deeply to surface actions of water and air. But such action is also a natural phenomenon of outcrops and sub outcrops. Searching natural stream beds and soils for anomalously high metal contents is an established method

of prospecting. Careful planning can do much to prevent the spread of undesirable elements, but clearly the acceptable concentration levels within the mining area itself can only be defined after the fullest investigation by all concerned.

We put forward these views as a group which is professionally involved in the science and art of obtaining minerals, and sensitive to the social responsibilities regarding supply of minerals, both in quality and quantity, safety, working conditions and environmental consequences, but not directly involved commercially in the exploitation of any particular mineral or minerals.

John Blunden (geographer), Sydney Brealey (mining engineer), Geoffrey Cox (mining engineer), Geoffrey Dove (medical practitioner and mining geologist), Robert Pryor (mining engineer), John Sutton (geologist) and John Webb (applied geochemist)

*Heatherfield Cottage
Queen's Road
Weybridge
Surrey*

Controlling drug plants

Sir,—I was interested to learn from Dr Simmonds (Letters, 12 October, p 120) that all the points raised in my article (13 April, p 51) had been considered before research into the biological control of drug plants was started. Dr Simmonds attempts to demolish my arguments against the UN/CIBC project by suggesting that it was based on "glaring misconceptions" about biological control, although his exposition of some of the elements of the technique does nothing to invalidate my conclusions. The ultimate object of the research is to destroy the opium poppy and cannabis by releasing biological control agents, and it is immaterial whether governments, no doubt influenced by impressive expert advice, sanction any eventual control schemes that might be proposed.

Dr Simmonds claims that there was no secrecy about the project. My suggestion that there was derived from reports in *The Times* (28 March, p 7) and the *Guardian* (28 March, p 1), both of which

stated that the UN fund for drug abuse control had wanted its contract with the CIBC to be kept secret, but that a leak had occurred. This may or may not be true, but surely Dr Simmonds realises that this publicity does not prove the opposite, which is what he implies in his letter.

The impossibility of distinguishing between licit and illicit crops in a scheme of biological control is acknowledged by Dr Simmonds. He claims that control would not be attempted in areas where licit crops were grown, but this does not square with the original reports that the aim was "global control". I doubt whether even Dr Simmonds would be prepared to guarantee that licit crops would run no risk of being damaged, even if release sites were exclusively in areas of illicit growing. One possible outcome of a biological control programme would be the extensive protection of both licit and illicit crops by cheap pesticides such as DDT.

Time will tell whether biological control of drug plants becomes practicable in less than the 10 years of my estimate. If it does, it is to be hoped that the socio-economic implications for the cultivators, to which Dr Simmonds is apparently indifferent, will also have been adequately studied.

In his concluding paragraph, Dr Simmonds implies that my advocacy of research into the possibility of growing profitable alternative crops is out of place, although it is gratifying that he agrees with the idea. Perhaps it is not too much to ask him to agree also that the possibilities of biological control of drug plants, and of the cultivation of alternative crops, are but reverse sides of the same coin.

*Walter Ryder
Pitlochry
Perthshire*

Pornography and science

Sir,—David Holbrook's letter (12 October, p 118), like his books and articles elsewhere, seems to me to fail to maintain precisely the logical distinction which he suggests. Of course the scientist is not in a position to demonstrate that pornography is or is not "harmful". No

Grimbledon Down

Bill Tidy



ethical consequence follows from any fact. But what the scientist can do is to attempt to discover exactly what effects pornography does have on behaviour, leaving us to make our ethical judgments of those effects. Now there are two ethical views that are taken up on pornography—there are those who argue, like Mr Holbrook, that it is “itself, in its meaning, degrading, debasing, cruel, dehumanising”, and there are those who say that whether or not pornography is evil depends on whether it makes individuals behave unpleasantly. This latter is the (quite sensible) view that Dr Dixon (Comment, 21 September, p 467) seemed to me to be espousing.

But Mr Holbrook's view seems to me a lot less sensible. What exactly does it mean to assert of something that it is “in its meaning” degrading (or anything else)? Whatever your view of mind, is it not reasonable to argue that we can only speak of a man as being degraded if he differs in some respect from a man who is not? That given, either it is possible to show some behavioural modification (which is the Dixon plan), or we take the Holbrook view that the very fact that a man has read pornography makes him degraded (para 4 of his letter)—but then the original assertion becomes tautologous. Philosophers (taking to the New Scientist after its brave plunge into mathematical logic) will be familiar with the problem in this form—“If, by definition, an act is good (ought to be done) because it is God's will, then to say that something should be done ‘because it is God's will’ is not a justification but a

repetition of the definition.”

Mr Allan Adair (Letters, 12 October, p 118) is also rather unfair to Dr Dixon. Of course it is not the case that “all the facts are known, are dependable”—but no one was really suggesting that they are. But then it is also true that some things are known and it is surely sensible to consider what effects pornography does have—yes, measurable, observable effects—and then ask whether we approve or disapprove of these effects.

There is, I think, another important point which relates to arguments like those of Messrs Holbrook and Adair and the argument for anti-pornographic legislation; the law is concerned with the protection of society from the socially unacceptable consequences of individual or group behaviour. We cannot scientifically show that the metaphysical element of Mr Holbrook's theory is false—though I personally am inclined to doubt whether it is particularly meaningful—but we can assert on logical grounds that it is irrelevant as far as the law is concerned; for all those metaphysical elements of his theory have (on his own definition) no behavioural consequences.

Anthony Appiah

Thirkill Court
Clare College
Cambridge

Computer societies

Sir,—Now that I am a Past President of the British Computer Society I can express my views without feeling I am committing anyone else. Permit me,

therefore, to tell you how much I regret that you of all people should have given prominence in your normally admirable columns to the views about the BCS and ACM expressed by Miss Nancy Foy (Dismembering the computer societies, 28 September, p 569). These are, in my view, inconsistent, tendentious and inaccurate, giving a completely false impression of our problems. Moreover, the emotional language used and the innuendos made tend to obscure the one or two valuable comments she does have to make.

On consistency, she really cannot have it every way at once. If Council is open with members about the problems and there is public discussion, it seems the society is “noisily wallowing in trouble.” If Council doesn't tell everyone everything immediately—to save postage, for example—it is accused of conducting its business in an “aura of secrecy”! If Council asks for a 43 per cent increase in subscription but, after a lively discussion, ends up getting the members to agree to 25 per cent, it is, apparently, a “fiasco”. If it doesn't ask for an increase (as it didn't for three years) no doubt it is attempting “to gloss over the difficulties on the premise that they might go away when times are better”!

On tendentiousness, SHA and COSBA are held up to us as examples because they are 1. small, 2. have professional managers, 3. have lobbied government successfully and 4. are talking to their European counterparts. The advantages of being small are obvious. So are the disadvantages. The number of members you have depends on how you define membership and how important the class of possible members regard belonging. It is easy to form “rich men's clubs” and keep them small and their success can be measured by the extent to which their activities contribute to the riches of their members. Societies such as BCS and ACM have other, and we think, more laudable aims, not capable of such easy measurement. That we are both sizeable organisations attests both to the size of the market we serve and the importance attached to our activities by it. We could not be small and retain our character.

On the other points, the BCS has had professional management for over four years, longer than either SHA or COSBA. It has good reason to feel that the government has taken more account in its policy of the BCS submissions to, for example, Sub-Committee A and the Younger Committee than of the views expressed by SHA or COSBA.

Consultations with our counterparts in Europe have been going on for more than 15 months and recently resulted in significant agreements on the exchange of publications, coordination of conferences and other forms of cooperation. We have, I submit, nothing to learn from SHA or COSBA—or, indeed, Miss Foy—on these matters.

Miss Foy claims that neither society has done a very good job of handling its finances. I do not agree. It is surely a tribute to past management that the BCS has had the reserves available to tide over the period between the start of the recession and when it was possible

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to change direction after full consultation with the membership.

She mentioned several specific budgetary matters, which are supposed to show our incompetence at handling the members' money. First, our premises; liabilities for dilapidations at the end of a lease are, I can assure her, quite normal trading practice in this country. That they are somewhat higher today than was estimated three years ago is regrettable from the society point of view, but not surprising to anyone familiar with London property values. As a consequence, what appeared a sound decision three years ago is more questionable today with the advantage of hindsight. Happily it has proved possible to find a satisfactory solution, with the details of which I need not bother you, whereby the society can choose to stay or leave after the end of next year, and is not at risk of having to pay a large capital sum.

Our travel budget of £1000 is modest, considering that there are no less than eight society representatives to IFIP who are entitled to make claims on it, each of whom may be called on to attend at least two meetings a year, one of which is, nowadays, normally held outside Europe. We are indeed fortunate that many of our representatives are supported in their travels by their employers, and claim no expenses, as was

the case on my recent trip to Australia, etc!

She mentions the question of "selling" the society's publications to commercial publishers. We have recently concluded an agreement with the Haymarket Press to cooperate in producing a new publication. This agreement is not dissimilar from those concluded by other societies with publishers, and retains society control over the editorial board and arranges to share any future profits. As a result of this arrangement, the Computer Bulletin will cease publication in its present form. The Computer Journal remains unaffected.

Miss Foy currently writes for the Bulletin. No one I am sure would be so uncharitable as to suggest that this had any effect on her views, but perhaps it led her to overestimate the nature and size of opposition to rearranging our affairs this way.

As a result of these and other measures, Council has been able to assure the membership that the overdraft referred to by Miss Foy will be repaid by the end of 1973, and that there is a good chance that a further increase in subscriptions will not be needed in the immediate future. Hardly a record of incompetence on the part of the society's administration, you may feel, in the face of continued relentless inflation of costs.

Where I can agree with Miss Foy,

contrary to her supposition that we of the society believe in being august, eminent, etc, is in feeling that the old professional forms may not be well suited to the problems of today. Tradition is useful as a guide, but must not be made a fetish. We can and should adapt tradition to our needs. This is already being studied by a Council Committee.

I can also agree that our branches and specialist groups are of vital relevance to our future and should be fostered and strengthened. Our problem in getting at grass roots opinion is *not* in learning the views of our *active* members who participate in such local or specialist group activity, but in getting through to the "silent majority", who pay their fees, receive their publications, and are not otherwise apparently concerned how or by whom the society is run.

If Miss Foy or, indeed, any of your readers has any suggestions to offer on how the views of these people can be ascertained and how they can be stimulated to contribute to our activities, they will be received with the greatest pleasure by Council and they would be doing a *real* service to computing.

A. S. Douglas

London School of Economics
and Political Science
Houghton Street
London WC2

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DEPARTMENT OF ANIMAL PHYSIOLOGY AND NUTRITION

Applications are invited from graduates in Agriculture, Agricultural Science or related subjects, for an immediate appointment as **RESEARCH ASSISTANT in SHEEP PRODUCTION**, to work on a programme which is being carried out jointly with the Agricultural Research Council.

The appointment is for one year in the first instance, possibly renewable for two further years. Salary £810 - £890. The successful candidate may be permitted to register for a higher degree.

Application forms and further particulars from the Registrar, The University, Leeds, LS2 9JT (please quote 41/23/E). Closing date 10 November 1972.

GK BUREAU specialises in the recruitment of junior and senior technicians for posts in hospitals, medical schools and industry. For further details write or telephone: G.K. Bureau, 17 Shaftesbury Avenue, London, W.1. 01-734 7232. Interviews by appointment.

THE QUEEN'S UNIVERSITY OF BELFAST

Institute of Education

DIRECTOR

SCHOOLS PROJECT IN COMMUNITY RELATIONS

The Institute of Education of The Queen's University of Belfast has undertaken a schools project in community relations, of about three years' duration, sponsored by the Community Relations Commission of Northern Ireland. The project will attempt to discover to what extent the schools' curriculum influences community relations and how far schools may contribute to the improvement of community relations in Northern Ireland. The project will be primarily concerned with the development and assessment of curricular materials and methods and will not be confined to any particular subjects or disciplines of the curriculum.

The post of director of the project is tenable from 1st January 1973, or such other date as may be arranged. Experience of working on a Schools Council project would be desirable. The salary, according to qualifications and experience will be up to a maximum of £5,088 per annum with appropriate pension rights.

Application forms and further information may be obtained from The Senior Assistant Secretary (Personnel), The Queen's University of Belfast, BT7 INN, Northern Ireland, to whom completed application forms should be returned by 17th November 1972. (Please quote Ref. 72/SOC.)

RESEARCH IN COMPOSITE MATERIALS

University of Surrey
DEPARTMENT OF
METALLURGY AND
MATERIALS TECHNOLOGY

Research Fellows and Research Officers are required to join an active research group working on various aspects of fibre science and composite materials technology. The work is concerned with the development of practical fibre reinforced polymer systems for uses in aerospace, weapons systems and general engineering.

The group operates in extensive and well-equipped laboratories, and there are prospects of expansion within the next 12 months.

Qualifications: (i) Research Fellow: Ph.D. or equivalent qualification in Physics, Engineering, Metallurgy, etc.—also a proven record of successful research—must be self-motivated.

(ii) Research Officer: Degree or equivalent in appropriate discipline and post degree research experience—should be familiar with either sophisticated mechanical testing techniques or polymer technology—experience of microstructural analysis advantageous.

Salary: According to qualifications and experience within the ranges—(i) Research Fellow: £1764—£2556; (ii) Research Officer: £1686—£2502.

Further details and application forms can be obtained from: Professor J. E. Bailey, Department of Metallurgy and Materials Technology, University of Surrey, Guildford, Surrey.

Successful candidates would be required to take up their posts not later than January 1973.

Assistant Information Manager for World-Wide Packaging Service

Unilever, world-wide producers of consumer goods including foods, detergents, toilet preparations, has a Centralised Packaging Unit providing an intelligence and documentation service to its international packaging specialists.

The head of the Information Section at our Blackfriars Head Office requires someone to assist with this service to these specialists, making use of a wide range of up-to-date information techniques.

The successful candidate will have a scientific background (at least 2 'A' levels), commercial experience and be capable of supervising staff. Knowledge of the packaging industry would be an advantage.

Please send details of your qualifications and experience to:

Miss E. M. McErlain,
Staff Department,
Unilever Limited,
31 Unilever House,
London EC4P 4BQ.



LINTAS 732012378



THE EUROPEAN SPACE RESEARCH ORGANISATION ESRO

SCIENTIFIC INFORMATION

The SPACE DOCUMENTATION SERVICE which is to move to Frascati (near Rome) early in 1973 is looking for:

A DOCUMENTALIST- ENGINEER

(Post SDS(72)2) whose duties will include

- acquisition of the European aerospace literature
- cataloguing, abstracting and indexing this literature for entry into a large computer based system
- acquisition and data preparation of information for entry onto the ESRO electronic components databank.

Applicants should have a university degree or equivalent in electronics, electrical engineering or the physical sciences and experience in scientific information work. A knowledge of electronic component production processes and quality control and assurance procedures is desirable.

We offer: Competitive salaries with generous family and living allowances - international working conditions good social security scheme - provident fund.

Write for detailed job description and curriculum vitae form to:

Assistant Director for Personnel, European Space Research Organisation 114 avenue Charles-de-Gaulle, 92200 Neuilly/Seine (France)

quoting référence SDS (72)2.

Leeds Polytechnic

Department of Life
Sciences

FOOD SCIENCE/ NUTRITION

Lecturer I or II

To teach in the large and expanding Dietetics section of the above Department. Candidates will preferably have teaching and research experience and should be prepared to teach at undergraduate level and conduct research.

Salary:

Lecturer I—£1500—£2687

Lecturer II—£2355—£3083

Details and application forms from the Academic Office, Leeds Polytechnic, Calverley Street, Leeds LS1 3HE. Applications should be submitted to the Academic Officer, to arrive not later than 30 November 1972.

MEDICAL RESEARCH COUNCIL unit requires Junior Technical Officer or Technician for work on cellular effects of radiation. Some biochemical and/or tissue culture experience would be an advantage. Salary according to age and qualifications. Apply to The Director, MRC Experimental Radiopathology Unit, Hammersmith Hospital, Duane Road, London, W12 0HS.



Regulatory Affairs

Smith Kline & French Laboratories Limited, the U.K. subsidiary of an international pharmaceutical company, require an additional graduate to join their Regulatory Affairs Department.

The basic requirements are:

- * A good honours degree in a biological science or pharmacy.
- Postgraduate experience in toxicological evaluation of drugs is desirable.
- * The ability to present information in coherent, precise reports.

The work will entail the evaluation and editing of data from within the Company's own research establishments and from other sources. Experience in the preparation of data for regulatory bodies would be advantageous.

Salary will be competitive and will reflect ability and experience. Conditions of employment are in line with those expected of a large international organisation.

Please write, giving brief relevant details to:

**THE PERSONNEL OFFICER, SMITH KLINE & FRENCH LABORATORIES LTD.
MUNDELLS, WELWYN GARDEN CITY, HERTS.**

UNIVERSITY OF SURREY

Department of
Biological Sciences

TECHNICIAN
£1740-£2100

Laboratory Technician Grade 5 required in the Human Biology section of the above Department. Duties will be partly to assist the Chief Technician in the running of undergraduate classes in physiology and partly to assist with a staff research project in endocrinology.

Candidates must be suitably qualified and have had experience of modern teaching methods in physiology.

Salary according to age and experience.

The post is superannuable with good holidays.

Application forms may be obtained from the Assistant Secretary (Personnel), University of Surrey, Guildford, Surrey, Tel: Guildford 71281 (Ext. 452). Closing date: 3 November, 1972.

LINCOLN UNIVERSITY COLLEGE OF AGRICULTURE

Canterbury, New Zealand
APPOINTMENT OF
PRINCIPAL

Council of the above-mentioned University Institution invites inquiries from persons interested in the appointment of the Principal in succession to Sir Malcolm Burns who will be retiring in 1974.

The Principal is the academic and administrative head, is a Member of the governing Council and Chairman of the Professorial Board.

Detailed particulars relating to this appointment are obtainable from the Secretary-General, Association of Commonwealth Universities (Appts), 36 Gordon Square, London WC1H 0PF (Tel: 01-387 8572), or from H. G. Hunt, Registrar, Lincoln College, Canterbury, New Zealand, with whom applications close on 31 January, 1973.

BIOCHEMICAL JOURNAL

EDITORIAL ASSISTANT required. Duties consist mainly in preparing papers for the printer and proof-reading. A degree in science is essential, preferably in biochemistry. Previous editorial experience, though desirable, is not essential, as training will be given. The commencing salary will be in the incremental range £1713-£1950, according to qualifications and experience. Please write, giving brief curriculum vitae and the names of two referees, to the Editorial Secretary, Biochemical Journal, 7 Warwick Court, London WC1 5DP.

UNIVERSITY OF KENT AT CANTERBURY RESEARCH ASSISTANT IN BIOCHEMISTRY

Applications are invited for the post of Research Assistant in the Biological Laboratory to assist in a study of amino-acids and hormonal interrelationships in mammalian systems. Salary in the range of £1260-£1440. Application forms and particulars from the Assistant Registrar, Faculty of Natural Sciences, Chemistry Building, The University, Canterbury, Kent. Closing date, 10 November. Please quote reference A.24/72.

Veterinary Associate Research Expert

TURKEY

£2,945-4,005

To help establish a meat laboratory and train personnel in Meat Evaluation.

Candidates must have experience in research and training and be prepared to learn Turkish.

Emoluments quoted above include a variable tax-free Overseas Allowance of £445-1,005 p.a. Appointment for 15 months.

Terms of service include free air passages, paid leave, and free accommodation. Appointment will be with the Overseas Development Administration.

Candidates should normally be citizens of, and permanently resident in the United Kingdom.

For more information about this vacancy write, giving your age and a brief statement of your qualifications and experience to:-

**The Appointments Officer,
Room E347 NSc,
Foreign & Commonwealth Office,
OVERSEAS DEVELOPMENT
ADMINISTRATION,
Eland House, Stag Place,
London SW1E 5DH**



UNIVERSITY COLLEGE, CAMBRIDGE

**GABRIEL HARRISON
RESEARCH FELLOWSHIP
IN LAND ECONOMY AND
ENVIRONMENTAL STUDIES**

Applications are invited for the above Research Fellowship tenable for three years at University College, Cambridge.

The Fellow will be expected to carry out research, as part of a project directed by the Scientific Committee of the College, into the effects of the urban environment as it bears on the individual. The Fellow will work in the Department of Land Economy. Preference will be given to applicants with interests in land economy with particular reference to the medical and psycho-social aspects of industrial and commercial development in urban areas. The Fellow will be expected to spend an initial period formulating a detailed plan of study.

An applicant for the Fellowship should have had at least three years research experience in a relevant field. The stipend will be either in the range £2,500-£2,750 (Senior Research Fellow) or in the range £1,800-£2,300 (Junior Research Fellow) according to age and status. Applications, which should be fully detailed and include the names of two persons to whom reference can be made, should be sent to the Bursar, University College, Cambridge CB3 9BB (from whom further particulars may be obtained) to arrive not later than Wednesday, 8 November. It is hoped that the successful candidate will be able to take up the Fellowship on 1 January, 1973.

POLYTECHNIC OF THE SOUTH BANK

Department of Physics
**GRADUATE SCIENTIFIC
ASSISTANT**

To work with Dr Haque on an MRC supported project to study the radiation dose to the respiratory system due to radon and its daughter products using experimental and computer methods. Candidates should possess a good Honours degree in Physics or equivalent qualifications and preferably post-graduate experience. The project is of three years' duration. The successful applicant will be expected to register for a PhD degree.

Salary offered is up to £1200 (x £50-£1300) p.a., depending on age and experience. The project will start as soon as possible.

Applications by letter, naming two referees, should be sent to the Secretary, Physics Department, Polytechnic of the South Bank, Borough Road, London SE1 0AA, from whom further particulars may be obtained.

THE UNITED SHEFFIELD HOSPITALS NON-MEDICAL BIOCHEMIST (Basic Grade)

Required for the Department of Neuropathology for investigation into isoenzymes in tumours of the nervous system.

Candidates should possess a Biochemistry Degree (with Honours).

Whitley Council Conditions of Service apply.

Salary scale £1350 to £1743 per annum.

Applications, giving details of age, qualifications, any previous experience and naming two referees, to the Chief Administrative Officer, United Sheffield Hospitals, 10 Beech Hill Road, Sheffield. S10 2RZ, by 11 November.

Bass Charrington

BIOCHEMIST/ MICROBIOLOGIST

to be

SECTION HEAD TO QUALITY CONTROL DEPARTMENT

The Burton-on-Trent brewery of the Bass Charrington Group require a Graduate to be responsible for the control of the Chemistry section, comprising 3 Technicians who monitor quality at all stages of production by means of a variety of techniques. Additionally, he will advise members of production departments on chemical aspects of the brewing process and initiate action where necessary. This is an expanding role and applicants should be capable of assuming increased responsibility relatively rapidly.

The successful applicant will possess a good degree in Biochemistry or Microbiology with substantial Chemical training. Newly qualified Graduates or Ph.D.'s could be considered. A lively personality, a meticulous attention to detail and a persuasive and competent reporting ability are essential.

An excellent salary, commensurate with age, qualifications and experience will be paid. The Company operates generous life Assurance and pension schemes in addition to providing sports and social facilities and other fringe benefits.

Applications, including details of education, career and interests should be forwarded to:

**The Personnel Manager,
Bass Production Limited,
High Street, Burton-on-Trent**



UNIVERSITY OF BIRMINGHAM MACROMOLECULAR ANALYSIS CENTRE

The Faculties of Science and Engineering and Medicine and Dentistry are presently equipping a new laboratory with a view to providing a complete service for automated amino acid and carbohydrate analyses within the University. It is envisaged that the Centre will ultimately be expanded to include services on peptide synthesis and sequencing. The person appointed, with the help of a Junior Technician, would be responsible for the organisation of the new laboratory and its day-to-day running, under the general direction of an Inter-Faculty Steering Committee.

Applicants should possess a good degree in chemistry or biochemistry and have some post-graduate experience, or hold suitable equivalent qualifications. Experience in automated amino acid and carbohydrate analyses and handling of computerised data would be an advantage.

Initial salary up to £2100 p.a. according to qualifications and experience.

Reference: 515/B/433.

Apply: Assistant Secretary (Personnel), University of Birmingham, P.O. Box 363, Birmingham B15 2TT.

UNIVERSITY OF SYDNEY LECTURESHIP IN AGRICULTURAL CHEMISTRY

Applicants should have training in Agricultural Chemistry or in Biochemistry and Chemistry. The University will be especially interested in plant biochemists with experience in enzymology and carbohydrate metabolism. The appointee will participate in teaching and research and supervise graduate students. The Department of Agricultural Chemistry is responsible for courses in both the Faculties of Science and Agriculture.

Initially, an appointment may be for a period of three years with possibility of subsequent permanent appointment.

Salary range: \$A6,697—\$A9,286 p.a.

Applications, including curriculum vitae, list of publications and names of three referees, by 13 November, 1972, to the Registrar, University of Sydney, N.S.W. 2006, Australia. Information about conditions of appointment and application procedure available from the Secretary-General, Association of Commonwealth Universities (Appts), 36 Gordon Square, London WC1H 0PF (Tel: 01-387 8572).



The Company of People

STERLING-WINTHROP GROUP

MALE AND FEMALE MEDICAL REPRESENTATIVES required by Winthrop Laboratories

Who are Winthrop Laboratories?

Winthrop Laboratories, a member of The Sterling-Winthrop Group of Companies, one of the largest pharmaceutical companies in the industry, in the forefront of research, rapidly expanding, and continuously introducing new products, need men or women to communicate these products to the medical profession in the following areas:

PART BUCKS/PART BERKS OXFORD
MIDDLESEX/BUCKS/HERTS BEDFORD
ESSEX/HERTS
SOUTH LONDON/EAST LONDON

Requirements

Ideally we would like your background to have a bias on the scientific side, with "O" and "A" levels in Biology/Chemistry, or nursing and medical auxiliary knowledge. You must be a self starter, able to use initiative, work without supervision, and make decisions. You will also need a current driving licence. So if you are between 23 and 40 years old. Male or female and can match up to our requirements, take the first step by deciding to apply right now.

Rewards

We will give you a thorough five to six weeks, training course, residential at the company's headquarters in Surbiton, with full pay and expenses, contributory pension, free life assurance, substantial salary supplemented by sundry incentive schemes, and a company car changed every two years. Salaries are constantly reviewed and successful progress is generously rewarded.

Please write or telephone for our application form to:

**Douglas Brewer, Field Selection
Manager, Training Department,
Winthrop Laboratories, Winthrop House,
Surbiton, Surrey. Tel: 01-546 7733.**

WINTHROP
WINTHROP LABORATORIES

The Natural Environment Research Council

Second Secretary

Applications are invited for the post of
SECOND SECRETARY of
THE NATURAL ENVIRONMENT
RESEARCH COUNCIL
at the London Headquarters.

The role of the Natural Environment
Research Council is to advance the sciences
that relate to the natural environment and its
resources, including geology, oceanography,
meteorology, ecology, marine and freshwater
biology, hydrology and other disciplines in
this field. The Council owns or grant-aids a
number of research institutes and awards
grants to universities for research and
post-graduate training.

The successful candidate will be responsible
to the Secretary of Council over the range of
functions that are undertaken by the staff of
Council Headquarters.

Applicants should have considerable
scientific experience, and an aptitude for
administration and negotiation with public
bodies and other organisations.

The post carries a salary of £8,250.

Superannuation arrangements.

Closing date 30th November 1972.

Application forms and further particulars
from Mr. A. A. T. Cunliffe,
Establishment Officer,
The Natural Environment Research Council,
Alhambra House,
27/33 Charing Cross Road,
London, WC2H 0AX.

Applied Psychology Unit

Director

The Medical Research Council is seeking a new Director
of the Applied Psychology Unit. Dr. D. E. Broadbent, the
present Director, will be relinquishing his post in October
1974 in order to take up other research activities within
the Council's service.

The Unit is at present situated in Cambridge and has a
number of small outstations elsewhere.

The Unit is engaged on a wide programme of work on the
observation and measurement of human behaviour
under controlled conditions similar to those met when
people perform tasks in everyday life. The aim is to
establish general principles governing healthy human
performance in various types of work and various
environments. The Council is anxious to maintain and
develop work in this field; how the Unit can best con-
tribute to this end in the future is at present under
consideration, and the precise scope and emphasis of
the future programme, and the organisational structure
of the Unit, will be a matter for discussion between the
new Director and the Medical Research Council.

The Council is seeking a scientist of wide interests who
has an established reputation as an investigator in his
own specialist field. A medical qualification is not
necessary.

The salary of the post will be at a point on the scale of the
Council's Special Appointments Grade, which is equi-
valent to the salary range for University professors, and
the appointment will be subject to the Council's con-
ditions of service. Superannuation provision will be made
under the FSSU.

Applications should be submitted not later than 31
December 1972, in the form of a short statement (not
exceeding 500 words) outlining in general terms the
scientific programme that the applicant would wish to
undertake and indicating the type of supporting facilities
required, together with a *curriculum vitae* and list of
publications and the names of two referees, to the
Secretary, Medical Research Council, 20 Park Crescent,
London, W1N 4AL.

Further particulars may be obtained from Miss N. S.
Jones at the same address (telephone 01-636 5422).

MEDICAL RESEARCH COUNCIL

ASSISTANT INFORMATION OFFICER

to work in the Brooke Bond Liebig
Information Centre at Sonning
Common.

The Information Centre is part
of a library and information ser-
vice for the Brooke Bond Liebig
Group, situated at the Group's
Research Centre the members do
scanning and indexing and perform
searches for those involved in
research, development, investment
analysis, planning and advisory ser-
vices. Applicants should preferably
be qualified in agricultural botany
with chemistry or bio-chemistry as
additional subjects.

Previous experience of informa-
tion work would be an advantage.

The Research Centre is situated
in attractive rural surroundings
and the Company offers excellent
conditions, including contributory
superannuation scheme, staff
restaurant and social club. Normal
hours of work are 9 a.m. to 5 p.m.
Monday to Friday inclusive.

Please apply in writing to the
Administrative Officer, at the
address below quoting reference
ACO.

Brooke Bond Liebig Research
Centre, Blounts Court, Sonning
Common, Reading, RG4 9NZ.

ABSTRACTORS. Science and Tech-
nology Agency, publishers of
specialist abstract journals on
modern instrumental analytical
techniques, require freelance ab-
stractors for their journals "Neu-
tron Activation Analysis Abstracts"
and "Liquid Chromatography Ab-
stracts". Knowledge of these tech-
niques preferred; foreign lan-
guages advantageous. Enquiries to
Dr P. R. Masek, Science & Tech-
nology Agency, 3 Dyer's Bldgs,
Holborn EC1, Tel: 01-405 9322.

TECHNICIAN required to assist
in Clinical Pharmacology research
laboratory. The work would involve
the use of electronic recording
equipment, some workshop prac-
tice and general laboratory duties.
Salary on the Whitley Council scale
according to age and experience
starting at £1335+£126 London
Weighting. Apply in writing to the
Secretary, University College Hos-
pital Medical School, University
Street, London WC1E 6JJ, quoting
reference PMU 10.

HUNTINGDON RESEARCH CENTRE

H R C, the largest independent laboratory in the medical and
biological sciences in Europe, is continually expanding its
direct research activities and has a vacancy for

RESEARCH OFFICER

A graduate in Biological Science is required in the Department
of Environmental Physiology. The applicant should have
experience in Physiology. The work involved is in the field of
inhalant toxicology with emphasis on physiological monitoring
and lung function.

Please apply to Mrs C. M. MacDonald, Personnel Department,
Huntingdon Research Centre, Huntingdon PE18 6ES quoting
reference NS/197.

OXFORD UNIVERSITY

Department of Engineering Science RESEARCH FELLOWSHIP

Research is to be conducted into
the Safe Usage of Tubular Scaffold-
ing, utilising new testing facilities
at the O.U. Osney Mead Laboratory
and the I.C.L. 1906A computer. The
research officer will be assisted by a
full-time technician and is required
to conduct model and full-scale
tests on scaffolding assemblies and
to develop appropriate computer
programs. The project is supported
by the Science Research Council
and will be closely related to a
parallel field investigation, spon-
sored by C.I.R.I.A., to be conducted
by John Laing Research and
Development Ltd.

Starting date: 1 December, 1972,
or as soon after as possible. Salary
on the Oxford University age-wage
scale, e.g. £1641 per annum at
under 25 years, £1788 at 25 years,
£2229 at 28 years, with FSSU
arrangements and a 7½ per cent
rise impending.

Applications, including brief cur-
riculum vitae and the names of
two referees, should be sent to
Dr E. Lightfoot, Department of
Engineering Science, Parks Road,
Oxford, before 10 November, 1972.



Pharmaceuticals Division

Research Biochemist

We are looking for a scientist to work on the biochemistry of asthma and other allergic diseases. Applications are invited from Ph.D. level Biochemists, preferably with post doctoral experience. A flexible and vigorous approach to research is considered more essential than previous experience in the field mentioned.

Our Research Laboratories are pleasantly situated in rural North Cheshire, offering a wide choice of housing and good road and rail links. Conditions of service, career prospects and assistance available to married men on moving home are designed to attract and retain

first rate scientists, in this case one who is attracted by the application of biochemistry to the further development of chemotherapy.

Applications, giving brief details of age, qualifications and experience, should be addressed to:

P. M. J. EYRE, Personnel Officer,
Imperial Chemical Industries Limited,
Pharmaceuticals Division,
Mersey, Alderley Park,
Nr. Macclesfield, Cheshire,



THE QUEEN'S AWARD
TO INDUSTRY
1966 1967 1968 1969 1970 1972

HUNTINGDON RESEARCH CENTRE

Huntingdon Research Centre, the largest independent laboratory in the medical and biological sciences in Europe, is continually expanding its activities and has a vacancy for a

RESEARCH OFFICER

The successful applicant will be required to organise the cytogenic screening of compounds and research into their mutagenic effects.

An attractive salary commensurate with age and experience will be paid. Applicants should possess H.N.C., A.I.M.L.T., B.Sc., or equivalent qualifications.

Please apply in the first instance to **Mrs C. M. MacDonald, Personnel Department, Huntingdon Research Centre, Huntingdon PE18 6ES** quoting reference NS/199.

Sheffield No. 3 Hospital Management Committee Regional Medical physics Department

PRINCIPAL PHYSICIST

Applications are invited for a post as Principal Physicist to lead the group working in the diagnostic and therapeutic uses of radioactive isotopes. The group provides an area service based at the Medical Physics Department in the Weston Park Hospital, with major units in the Royal Infirmary of the United Sheffield Hospitals and in the Northern General Hospital of the North Sheffield University Hospital Management Committee.

Further particulars may be obtained from the **Chief Physicist, Regional Medical Physics Department, Weston Park Hospital, Whitham Road, Sheffield, S10 2SJ**, to whom applications, naming two referees, should be sent not later than **November 17th, 1972.**

United Kingdom Atomic Energy Authority Aldermaston

We have the following vacancies in the Main Library:

(a) LIBRARIAN

To take over the operation and further development of the Aldermaston Mechanised Cataloguing and Ordering System (AMCOS). This system selects bibliographic data from British and American MARC tapes and generates orders, lists of additions and book-form catalogues in KWOC, author/series; and UDC sequences. Input to the computer is through an on-line teletype terminal and current developments include COM output. The post offers a unique opportunity to take part in an advanced library mechanisation project.

Qualifications

A degree in librarianship or Associateship of the Library Association, together with some scientific or technical background or experience in a scientific or technical library.

(b) INFORMATION SCIENTIST

To maintain close liaison with scientist working in a subject field related to his own qualifications, and to answer scientific and technical enquiries regarding the literature within this field. Current awareness services are provided by computer scanning several tape data bases and the post offers considerable opportunity to improve on and extend those services.

Qualifications

A degree (or equivalent) in a scientific subject together with some experience in a technical library or information service. Associateship of the Institute of Information Scientists would be an advantage.

Salaries

Depending on age, qualification and relevant experience within the grades of:—

Scientific Officer	£1,295 to £2,190
Higher Scientific Officer	£2,085 to £2,695

Contributory Superannuation Scheme.

A house or assistance with house purchase will become available for married men recruited from areas beyond daily travelling distance. Hostel accommodation is also available.

For an application form write to:—

**Chief Personnel Officer, UKAEA Aldermaston
READING RG7 4PR. Quoting reference 3914.**

COUNTY BOROUGH OF BARNSELY WATER DEPARTMENT

APPOINTMENT OF SENIOR LABORATORY ASSISTANT

Applications are invited from suitably qualified persons for this appointment for which the salary grading is A.P.1/2 (£1,140 to £1,653 per year). The commencing salary will be in accordance with qualifications and experience.

Applicants must have an O.N.C., or equivalent, in Chemistry, and a biological qualification would be an advantage. Experience in Analytical Chemistry is essential.

The Department supplies more than eight million gallons per day, and obtains water from a variety of sources. The laboratory is with the administrative offices at Jordan Hill.

The appointment will be subject to the usual Local Government Conditions of Service, including the passing of a medical examination. Consideration will be given to the provision of housing accommodation and the repayment of 50 per cent of transport removal expenses.

Applications, giving all relevant details, including the names of two referees, must be received not later than 8 November, 1972, by the Waterworks Engineer and Manager, Water Department, Jordan Hill, Gawber Road, Barnsley.

Canvassing will disqualify.

A. BLEASBY,
Town Clerk.

Town Hall,
Barnsley.
S70 2AG.

CRANFIELD RESEARCH IN COMBUSTION

The School of Mechanical Engineering has a vacancy for a Research Officer or Senior Research Officer in an expanding group currently studying combustion problems in gas turbine systems. The group is especially concerned both with experimental and theoretical studies of pollutant emissions, flame radiation, ignition and methods of fuel preparation. One objective of these studies is to serve directly the needs of the combustor designer.

Applications are invited from candidates who have had appreciable experience with the practical aspects of operating full-scale combustion systems and/or with computer-aided studies of practical combustion problems. They must also be prepared to accept a high level of responsibility and to conduct their activities in a professional manner. A good honours degree in a related discipline will be a definite advantage.

The appointment will be initially for a period of three years with salary in the ranges £1764-£2715 or £2874-£4299, with FSSU provisions.

Application forms from:

Assistant Registrar, Cranfield Institute of Technology, Cranfield, Bedford, quoting reference 101.

LABORATORY TECHNICIAN required to take charge of Biology laboratory. Salary according to Buckinghamshire Educational Committee recommended scale of £1194 to £1395 according to experience. The successful applicant will be eligible for housing allowance of £110 in addition or alternatively a house or flat may be available on a service tenancy with a small reduction of salary. New laboratories have just been opened. Apply to Senior Science Master, Stowe School, Buckingham, giving names and addresses of two referees.

The University of Leeds

Applications are invited for the post of Temporary LECTURER in the DEPARTMENT OF EXPERIMENTAL PATHOLOGY AND CANCER RESEARCH. Salary on the scale £1764-£4299. The appointment will be for one year in the first instance.

The Lecturer will be required to take charge of the Electron Microscopy Unit (the Unit has an AEI 6M and a Philips EM300 and the usual preparative and photographic ancillary services). Experience in electron microscopy is essential. The Lecturer will be responsible for the organisation of routine service work within the Department and for conducting a programme of research related to biological or biophysical aspects of cancer.

Application forms and further particulars from the Registrar, The University, Leeds, LS2 9JT (please quote 49/7/E). Closing date 10 November, 1972.

SENIOR LABORATORY TECHNICIAN REQUIRED

House available. State qualifications. Apply to Dr G. W. Shaw, Head of Science Department, Lancing College, Sussex.

JAMES COOK UNIVERSITY OF NORTH QUEENSLAND

SENIOR TUTOR IN ZOOLOGY

Applicants should have an Honours or higher Science degree with Zoology as a major subject. Previous teaching experience at undergraduate levels is desirable. The appointee's duties will include organising undergraduate laboratory classes and assisting with running of field classes. Research or higher degree studies will be encouraged.

Salary range: \$A5504-\$A6604 per annum plus locality allowance of \$A104 p.a. for a married male or \$A52 p.a. for a single appointee. Conditions include FSSU superannuation, housing assistance, invalid pension scheme, study leave and allowance for travelling and removal expenses on appointment.

Additional information and application forms may be obtained from the Secretary-General, Association of Commonwealth Universities (Appts), 36 Gordon Square, London WC1H 0PF (Tel: 01-387 8572).

Applications close on 24 November, 1972.

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ANIMAL TECHNICIANS

RHM Research Limited are engaged in a programme of research designed to discover and develop new food sources of value for human and animal nutrition on a national and world-wide scale.

Due to further development of the experimental programme, vacancies exist for a Senior Technician with qualification to AIT, and a trainee Animal Technician with "A" or "O" levels in biology or relevant subjects.

The animal house forms an integral part of the Nutrition Department which undertakes investigations into the nutritive value and safety of food materials.

The posts are progressive with attractive salaries and excellent working conditions. The Centre has good canteen facilities and an active Sports and Social Club. Staff are encouraged to continue with their studies for higher qualifications.

Please apply, quoting reference N279/261 to: The Assistant Director (Admin.), RHM Research Limited, The Lord Rank Research Centre, Lincoln Road, High Wycombe, Bucks.

THE UNIVERSITY OF SHEFFIELD DYSON CHAIR OF CERAMICS

Applications are invited for the Dyson Chair of Ceramics which will become vacant on the retirement of Professor J. White in September 1973. Preference will be given to candidates whose primary specialisation is in Ceramics but consideration will be given to applications from candidates with wider interests in Materials. The present department has made a notable contribution towards Refractories Technology and it is expected that this interest will be continued. A new Department of Ceramics and Polymers, under the Headship of Professor R. W. Douglas, is to be established from October 1973 by the amalgamation of the present Departments of Glass Technology and of Ceramics. Salary in the range approved for professorial appointments with F.S.S.U. provision. Further particulars may be obtained from the Registrar and Secretary, The University, Sheffield S10 2TN, to whom applications (one copy only) should be sent by 1 January, 1973. Quote Ref. R.9/H.

GRADUATE MICROBIOLOGIST

required to join the Technical Department laboratories of the British Bacon Curers' Federation at Tring. Work will entail investigation into the microbiology of the meat industry and associated processes with some quality control work. Previous industrial experience, while of some advantage, is not essential. Application forms obtainable from Miss K. Oakley, British Bacon Curers' Federation, Upper Icknield Way, Tring, Herts.

UNIVERSITY OF KEELE CHAIR OF PHYSICS

Applications are invited for the post of Professor and Head of the Department of Physics, vacant from 1 October, 1973, on the appointment of Professor Ingram as Principal of Chelsea College. Application forms and further particulars from The Registrar, The University, Keele, Staffs., ST5 5BG, to whom they should be returned by the 30 November, 1972.

ZOOLOGICAL SOCIETY OF LONDON

Assistant Librarian required.

The post is second in seniority to the Librarian in a library of over 120,000 volumes. Candidates should be Chartered Librarians with several years experience in a specialised library. Salary scale will be £2103 rising to £2406. Applications, giving the names of two referees, should be addressed to: **Establishment Officer, Zoological Society of London, Regent's Park, London, NW1 4RY.**

RESEARCH ASSISTANT

A research assistant is required to work on a project concerning the biochemistry of erythrocyte ageing in vitro. The project is a collaborative one between the University of York and the Leeds Regional Blood Transfusion Centre and the appointee would be based mainly in the Department of Biology at York.

Applicants should have a good honours degree in Biochemistry, Physiology or Biology (with a biochemical background). Further information can be obtained from Dr. M. G. Rumsby, Department of Biology, University of York.

Application forms obtainable from and returnable to the Acting Secretary, Leeds Regional Hospital Board, Park Parade, Harrogate, by 18 November, 1972.

HILL FARMING RESEARCH ORGANISATION

Higher Scientific Officer— Animal Studies Department

A Higher Scientific Officer is required for routine work in the investigation of aspects of animal health. Sound knowledge of haematology and parasitology required.

Duties include assistance in the experimental surgery unit. Qualifications:—HNC, Degree or equivalent with at least five years appropriate experience since qualifying. Salary scale: £1946—£2515. Superannuation scheme for which an allowance is paid.

Further particulars and application forms from the **Secretary, 29 Lauder Road, Edinburgh EH9 2JQ.** Closing date 24th November 1972.

UNIVERSITY OF ABERDEEN

RESEARCH ASSISTANT IN GENETICS

Applications are invited for above post. The work involves electrophoresis, ultracentrifugal analysis and quantitative estimation of plasma lipoproteins. Appropriate experience and qualifications in Biochemistry or Chemistry are desirable.

Salary on scale: £1509-£1734 with Superannuation (F.S.S.U.).

Further particulars from The Secretary, The University, Aberdeen, with whom applications (2 copies) should be lodged by 13 November, 1972.

GEOLOGISTS

(Regional Mapping; Mineral Resources)

GEOHYDROLOGISTS

(Ground Water)

ENGINEERING GEOLOGISTS

GEOFYSICISTS

(Electrical/Electromagnetic)

MINERALOGISTS

The South African Geological Survey, a division of the Government Department of Mines, invites applications from fully qualified persons in the above fields who are interested in contract appointments (minimum 3 years and renewable).

The minimum requirement is a degree with 1st or 2nd class Honours or an equivalent qualification. Appropriate post-graduate experience and/or higher qualifications will be taken into account when negotiating salaries.

Please write or phone for further information to: **Mr. G. P. Van Zyl, Civil Service Officer, Ref. NS, South Africa House, Trafalgar Square, London WC2N 5DP. Tel: 01-930 4488.**

Toxicologists

Graduate staff are required for our Toxicology Unit at the Medicinal Research Centre, Harlow.

Practical experience of drug safety assessment procedures is essential and a working knowledge of the requirements of the various regulating authorities would be an advantage.

New laboratories are being constructed and the Toxicology function is expanding rapidly. Applicants should be capable of working with the minimum of supervision and of taking responsibility for the work of one or more technicians.

Starting salary will be competitive and there are the usual fringe benefits which one associates with a large and expanding company. The Medicinal Research Centre is located near the Herts/Essex border and combines the facilities of a new town with proximity to London and pleasant surrounding countryside.

Please write, outlining your qualifications and career to date to:



The Personnel Officer,
Beecham Research Laboratories,
Fourth Avenue, Pinnacles,
Harlow, Essex.



MONASH UNIVERSITY

Melbourne, Australia

Department of Earth Sciences

SENIOR TEACHING FELLOW/TEACHING FELLOW

Applicants should normally have completed a MSc or PhD degree and will be responsible for the preparation and presentation of practical classes in Geology in various years of the science course. The successful applicant will be expected to start as early in 1973 as possible. Facilities will be available for the successful applicant to undertake research in collaboration with the staff members of the department.

SALARY RANGE (presently under review): Senior Teaching Fellow: \$A5441—\$A6556 per annum; Teaching Fellow: \$A4465—\$A5300 per annum.

BENEFITS: Travelling expenses for appointee and family, removal allowance, temporary housing for an initial period; repatriation after three years' appointment if desired.

Further general information and details of application procedure are available from Mr J. D. Butchart, Academic Registrar, Monash University, Wellington Road, Clayton, Victoria, 3168, Australia, or the Secretary-General, Association of Commonwealth Universities (Appts), 36 Gordon Square, London WC1H 0PF (Tel: 01-387 8572). Enquiries may be addressed to Professor B. E. Hobbs, Chairman of the Department in the University.

Closing date: 30 November, 1972.

The University reserves the right to make no appointment or to appoint by invitation.

KENT AND CANTERBURY HOSPITAL, CANTERBURY, KENT TECHNICIAN GRADE III (ELECTRONICS)

Medical Physics Technician Grade III required for a new post to provide electronics support to the Physics Department of the Radiotherapy Centre. The work will be involved with a wide range of medical equipment and cover from the development of digital circuitry to the servicing of simple electronic equipment. A minimum of three years electronics experience needed although not necessarily with medical equipment. Qualifications O.N.C. or equivalent and experience. Salary in range £1483—£1923. Applications, together with the names of two referees, to be addressed to the Hospital Secretary at the above Hospital.

UNIVERSITY OF ABERDEEN

RESEARCH ASSISTANTSHIP IN CHEMISTRY

Applications are invited for above post for work on Membrane desalination under combined electrical and pressure fields, under the direction of Professor P. Meares, and supported by a SRC research grant. Appointment is for two years in the first instance.

Salary on scale £1509—£2160 with initial placing according to qualifications and experience. Superannuation (F.S.S.U.).

Further particulars from The Secretary, The University, Aberdeen, with whom applications (two copies) should be lodged by 11 November, 1972.

CHLORIDE TECHNICAL CENTRE

SENIOR SECRETARY/ADMINISTRATIVE ASSISTANT

A vacancy exists for a Senior Technical Secretary to the Research Co-ordinator. In addition to her role as a confidential secretary she will be responsible for the administration of a project control system. This will involve liaison with scientists, engineers and accountants, particularly, at the project planning stage and this will occupy the major part of her time.

The job will be particularly attractive to a secretary with either a technical background or with some experience in computer programming, network analysis, or O. & M. who wishes to broaden her experience into the field of management. A logical mind, the ability to work on her own initiative and the personality to get on with technical personnel will however be more important than her specific experience.

An attractive salary will be offered to the successful applicant.

Chloride Technical Centre carries out research and development in the storage battery, plastics and engineering field, and provides a wide range of technical and planning services for the home and overseas companies of the Chloride Group.

Please reply stating experience and present salary to: L. F. Harper, CHLORIDE TECHNICAL CENTRE, Wynne Avenue, Clifton, Swinton, Manchester, M27 2HB.

MEDICAL RESEARCH COUNCIL

Clinical and Population Cytogenetics Unit SCIENTIST

A vacancy exists in the Cytogenetics Section of the above Unit for a research scientist. The research of the section is principally concerned with:- cytogenetic studies on human populations; the effects of environmental mutagens on human and other mammalian chromosomes; a variety of problems relating to chromosome structure and behaviour in man and other species.

The minimum qualification for this post is an honours degree 2 (1) in a biological science and preference will be given to applicants with post-graduate experience in cytogenetics. Salary, dependent upon age, qualifications and experience, will be on a scale £1641-£2970 with FSSU benefits.

Applications in writing, giving full personal particulars and names of two referees, to the Administrative Officer, MRC Clinical and Population Cytogenetics Unit, Western General Hospital, Crewe Road, Edinburgh, EH4 2XU, by 13 November, 1972.

GUY'S HOSPITAL MEDICAL SCHOOL

GRADUATE RESEARCH ASSISTANT

required to assist with a research project in cardio-vascular physiology in the Department of Clinical Physiology at Guy's. Some post-graduate experience is desirable, but not essential. Salary in range £1275 to £1671. For further information telephone 01-407 7600 Ext. 528. Apply in writing to the Secretary, Guy's Hospital Medical School, London Bridge, SE1 9RT, quoting Ref. CN.

APPOINTMENTS WANTED

AEROSOL SCIENTIST seeks consultancy. Box D671 New Scientist.

STUDENTSHIPS

THE ROYAL SOCIETY STUDENTSHIPS FOR POSTGRADUATE STUDIES OVERSEAS

Applications are invited by the Council of the Royal Society for Royal Society Leverhulme Studentships. Up to six a year are offered to young graduates of high quality from UK universities to gain practical experience of scientific problems outside Europe and North America, particularly in the environmental sciences (such as geology, geophysics, meteorology, oceanography and ecology) and in sciences concerned with animals, plants or the organisms of disease, and certain aspects of astronomy.

The Studentships will cover the cost of travel to and from the country of choice, as well as local travel within the country and maintenance at a rate based on the local cost of living. They will be tenable for a period between 6 and 12 months.

Applications should be made on forms obtainable from the Executive Secretary (ref. DJHG/NS), The Royal Society, 6 Carlton House Terrace, London SW1Y 5AG, and should be received not later than 15 January, 1973, but applicants are required by then to have secured the agreement of a scientist overseas to supervise their studies.

POLYTECHNIC OF THE SOUTH BANK

Department of Physics SRC/CAPS RESEARCH STUDENTSHIP

Applications are invited from candidates possessing 1st or Upper 2nd Class Honours degrees in Physics or equivalent qualifications for an SRC/CAPS studentship leading to the degree of Ph.D. for an investigation into the nature and extent of the window of silicon semiconductor detectors and the phenomena connected with it. This project is being carried out in conjunction with Nuclear Enterprises Ltd., Sighthill, Edinburgh.

Applications, naming two referees, should be sent as soon as possible to the Secretary, Physics Department, Polytechnic of the South Bank, Borough Road, London SE1 0AA, from whom further particulars may be obtained.

THE UNIVERSITY OF MANCHESTER INSTITUTE OF SCIENCE AND TECHNOLOGY

RESEARCH STUDENTSHIP IN METALLURGY

This research is industrially sponsored and is in the field of Hard Metal Technology. The main experimental approach will use a Quantimet 720 Image Analysing Computer for quantitative assessment of pore contents in tungsten carbide/cobalt alloys and modern fracture toughness testing techniques to investigate the dependence of strength on porosity. Remuneration will be at the S.R.C. studentship rate. Applicants should have a B.Sc. degree or equivalent and will be expected to register for the degree of M.Sc. Alternatively, the appointment would be suitable for someone who already has an M.Sc. and wishes to pursue a two-year Ph.D. course.

Candidates should apply in the first instance to Professor K. M. Entwistle, Department of Metallurgy, U.M.I.S.T., P.O. Box 88, Manchester, M60 1QD.

FELLOWSHIPS, GRANTS AND SCHOLARSHIPS

THE ANIMAL HEALTH TRUST

WOOLDRIDGE FARM LIVESTOCK RESEARCH FELLOWSHIPS

The Animal Health Trust has established a number of new fellowships for the promotion of research into the health problems of farm animals in the United Kingdom.

Applications are invited from veterinarians and scientists with post-graduate research experience who will design and undertake studies of the major factors, including epidemiology, influencing the health and productivity of cattle, sheep or pigs.

The fellowships are tenable for up to three years at an agreed place of work.

Stipends, depending on age and experience, are within the range £1750 to £3500 p.a. A reasonable sum will be allowed for approved expenditure.

Further details and application forms are obtainable from the Chief Executive Officer, The Animal Health Trust, 24 Portland Place, London, W1N 4HN. Closing date 25th November, 1972.

GIRTON COLLEGE CAMBRIDGE

Applications are invited for a Scientific Research Fellowship open to women graduates and tenable for three years from 1 October, 1973. The applications should be in the field of Mathematics, Natural Sciences, Geography and allied subjects.

Each Fellowship is of the value of £700 per annum, with free residence, pensionable under the F.S.S.U. Particulars are available from the Secretary to the Council, Girton College, Cambridge, to whom applications should be sent by the 8 January, 1973.

FRENCH GOVERNMENT SCHOLARSHIPS for further study and postgraduate research in France in Pure and Applied Science, Technology, Medicine, Social Sciences, Economics, Geography and Agriculture are offered for the academic year 1973-1974. Candidates, who must be United Kingdom citizens, should be university graduates or have equivalent qualifications. Closing date: December 31, 1972. Details from Scientific Department, French Embassy, 41 Parkside, Knightsbridge, London, SW1X 7JP. Citizens of the Commonwealth and of other countries should apply to French Embassies in their respective countries.

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SYMPOSIUM

THE UNIVERSITY OF MANCHESTER INSTITUTE OF SCIENCE AND TECHNOLOGY

ADVANCES IN CHEMISTRY SERIES

A review symposium on PHYSICAL METHODS FOR THE STUDY OF METAL IONS IN BIOLOGICAL SYSTEMS

will be held in the Institute on 8 and 9 January, 1973.

Speakers will include H. B. Gray (Electronic Spectroscopy), C. E. Johnson (Mössbauer Spectroscopy), D. R. Williams (Calorimetry), J. D. R. Thomas (Ion Selective Electrodes), T. Blundell (X-ray Techniques), J. Oakes (E. P. R. Spectroscopy) and R. Dwek (Proton Relaxation Techniques).

Short contributions relating to current research are invited.

Further information and form of application can be obtained from the Registrar, U.M.I.S.T., P.O. Box 88, Manchester M60 1QD.

HOLIDAYS

EXCURSIONS TO CAPE KENNEDY 1973

Special Excursions to observe the Lift-off of the U.S. Skylab space missions have been arranged departing April, July and October 1973. Boeing 707 flights to Florida and Luxury Beachside accommodation:—£138.00.

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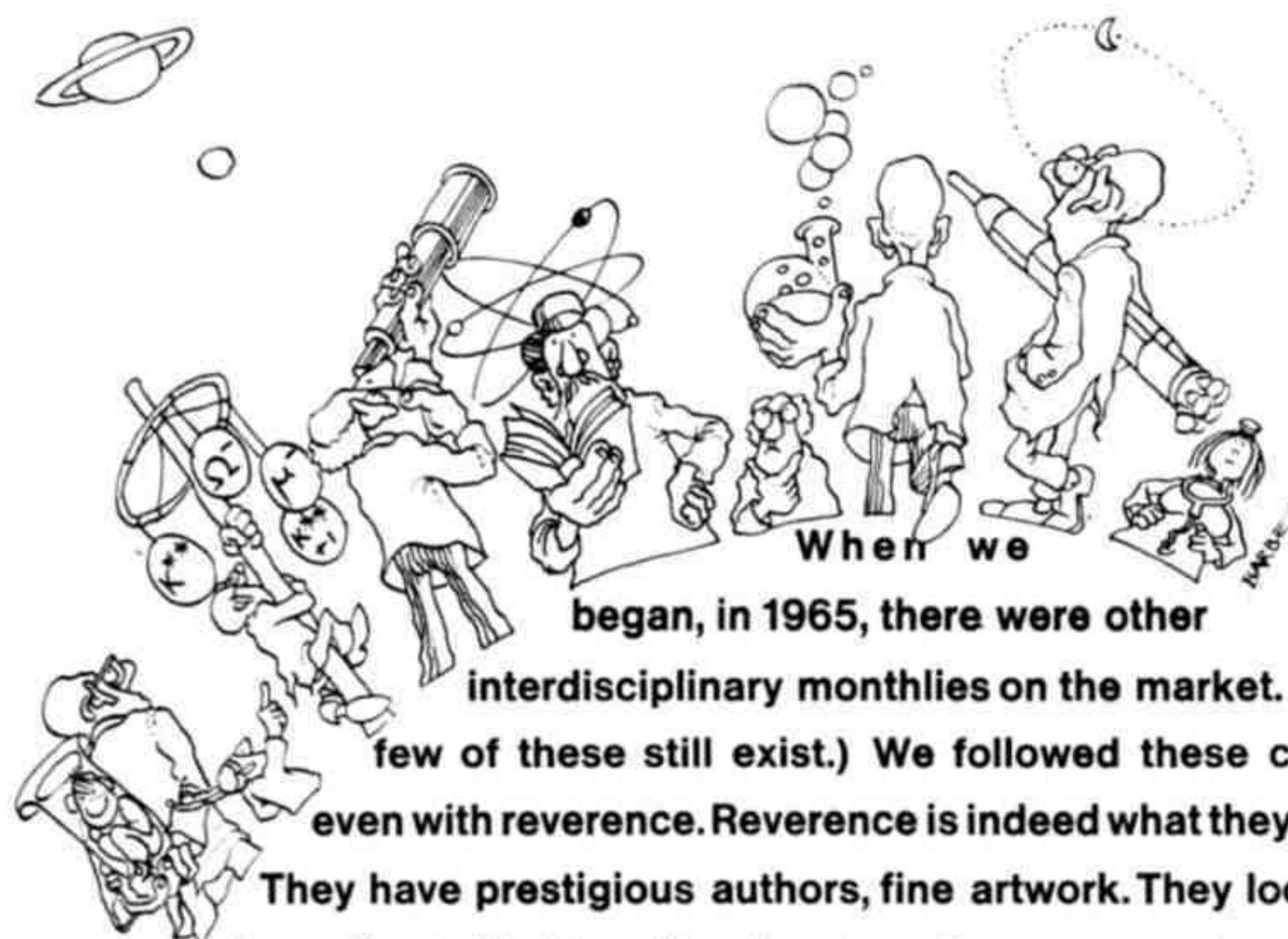
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SATELLITE NEWS: the weekly news bulletin of space activity. £3 per year: Geoffrey Falworth, 11 Wimbledon Avenue, Blackpool, Lancs.

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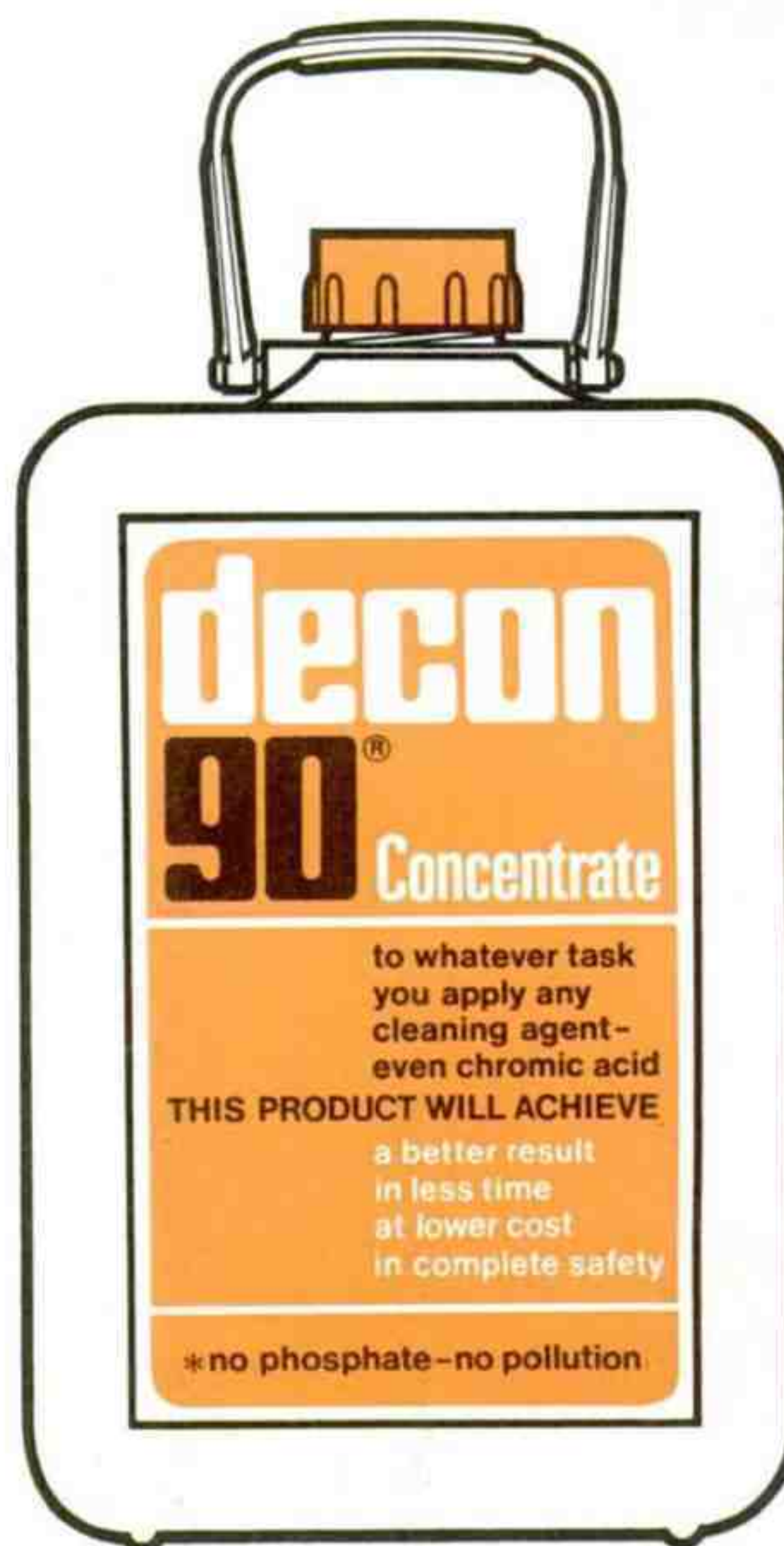
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