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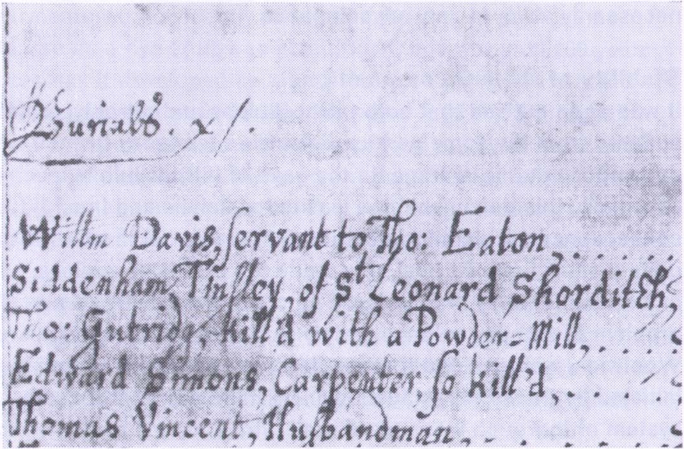

Burialls. x/.

Willm Davis, servant to Tho: Eaton

Siddenham Tinsley of St Leonard Shorditch,

Tho: Gutridg, kill'd with a Powder-Mill,

Edward Simons, Carpenter, so kill'd,

Thomas Vincent, Husbandman,

1

nitrocellulose immediately after the reaction stage; this,

Quest

The journal of The City University, London

Number 12 March 1970

Quest

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Quest, the Journal of The City University, exists to provide a regular forum for discussion between staff, students and friends of the University, and to facilitate two-way communication with the schools and industry. As well as providing this forum, the Journal reports events within and outside the University.

Decisions on the balance and approach of the Journal are the responsibility of the Editorial Board, with the Editor directly responsible for the production of the Journal. In exercising this responsibility the Board and Editor are particularly mindful of the objectives of the University as laid down in its Royal Charter.

The Journal is interested in all educational matters relating to the University in particular and the world of education in general. The contents have a special relevance for The City University and its development, but also have a wider significance among educationists, industrialists and industrial training organisations. In general, the Journal does not necessarily seek to be the official voice of the University but to provide an opportunity for the free exchange of ideas.

Quest appeared first in 1967 and is published quarterly.

Contents

Advertisements

Front Cover
The Students' Union float leads the Lord Mayor's Procession past St Paul's Cathedral, November 1969.

Editorial

Universities in the 70s

727,000 students qualified for higher education in England and Wales in 1981–82 and—if proportions similar to those of the present time are maintained—380,000 students in Universities is the result of a projection by the Department of Education and Science. The comparable figures in 1962–63 were 216,000 for higher education generally and in 1961–62 some 113,000 for Universities.

Assuming that the projection is reliable and the proportion in Universities does in fact remain the same, the Universities will be faced with a challenge even greater than that which they met in the mid 1960s to deal with the post-war 'bulge'.

Comment on this academic explosion could be lengthy and diffuse.

A document issued by the Committee of Vice-Chancellors and Principals sets out the fundamental dilemma.

A basic question posed for the Government is whether it is to continue with policies based on the assumption that all those qualified and wishing to enter full-time higher education should have the opportunity to do so. If so, the cost implications are substantial. If not, the political and social implications are no less severe.

If it is accepted that the political decision will ultimately be that all those who are qualified should have the opportunity to proceed with higher education, it immediately becomes important to determine the structure of the various institutions which will offer it. Two choices appear open.

The first is the 'comprehensivisation' of higher education—to use current jargon—with all types of institution—universities, polytechnics, colleges of education—working to a similar level and for the same qualification of a degree; with research, too, spread thinly across the board, resulting in the inevitable duplication of accommodation and expensive equipment. If this happens, the possession of a degree will become (even more than at the present time) a qualification very different from what has been traditional in this country.

The second choice is the limited expansion of universities with most of the additional students going to other institutions which will offer new and different courses more appropriate to those whose ceiling may be more limited academically. The Universities would remain or become centres of excellence —a more acceptable definition than an elite—and they would offer the combination of teaching and research which has in the past proved beneficial to the advancement of learning and the fostering of highly intellectual ability.

Is it such a heresy to suggest in these egalitarian days that the second choice may offer returns to the nation and to the individual which would not accrue from the first?

London's history and the law

His Honour Judge Bernard Gillis, QC, recently spoke to a small group of students and staff on The Legal History of London. The title in itself might have indicated a dry-as-dust legal dissertation but in fact provided Judge Gillis with the basis for a fascinating glimpse of the part London has played in developing throughout the country and all over the world the pattern of justice on which our civilisation rests. Prince William of Normandy (the City never refers to him as William the Conqueror because he never conquered London!), the Slave Trade, Pickwick *v.* Bardell, William Penn, Newgate, the Mayor's Courts in Guildhall, all helped him to illustrate vividly the way in which the law in London has preserved its independence of government and its fight for individual liberty.

Talks such as this inevitably reinforce the University's recognition of the value to the students of its close association with London and its traditions, whether one's interest lies in municipal government, or the early development of craft and industry through the City Livery Companies, or ecclesiastical history or architecture or commerce. In our discussions on liberal or general studies we must never forget that we have a heritage in so many fields going back 2,000 years almost literally on our doorstep.

Automation Engineering's new computer system

During this year the Department of Engineering is progressively commissioning its Ferranti Argus 500 computer system which was delivered at the end of 1969. Apart from playing a central role in the Department's teaching programme it will serve both as a general on-line data processor and controller for the experiments and research in the several laboratories and as a research rig or 'intelligent robot' in its own right.

The newly delivered system consists of an 8K digital computer, 32 digital inputs, 16 digital outputs, 32 analog inputs and six analog outputs. The store, as well as the digital and analog inputs and outputs, can be expanded if the need arises in the future. The peripherals are ICL 300 Ch/sec tape reader, Facit punch, and on-line and off-line ASR33 teletypes.

The Department of Automation Engineering already has a TR48 analog computer. In addition, of course, in common with every other Department of the University, the Department can call on the services of the Computer Unit and its uniquely powerful hybrid system consisting of an ICL 1905 digital computer linked with an EAL analog 680 computer. Readers of *Quest* will recall the opening of the latter by Lord Penney in 1968*.

Cooperation with local school

For a number of years the Department of Physics has enjoyed close contact with nearby Owen's School. An example of the closeness of this contact has been the fact that during the past term Mr R Jowitt, a lecturer in the Department, has spent a considerable portion of his time standing in for the School's Senior Physics Master to free the latter to take an in-service training course. Mr Jowitt has also kept very much in touch with his tutoring and lecturing responsibilities at the University and has found himself burning the midnight oil marking both School and University examination papers.

Another recent example of University/School contact bearing fruit is that two Owen's boys who received special coaching during last Autumn term from another member of the University, Mr A Seville, have both been awarded Exhibitions at Cambridge University.

'The City University and You' Exhibition

Last month 'The City University and You' Exhibition at the City of London Exhibition Hall came to the end of its three-month run. Several members of staff went to a great deal of trouble in an attempt at conveying to the public at large an idea of the scope and nature of the University's work. It is difficult to quantify the effect of this or any other exhibition but some measure of the interest aroused may be that something like 3,000 copies of the different issues of *Quest* and several hundred copies of the Prospectus were taken away by visitors to the Exhibition.

The most concentrated period of activity in the Exhibition Hall was undoubtedly the 'Physics Fortnight' staged by the Department of Physics from 19 to 30 January when there were several visits by parties from schools in the London area. There were times during this period when the Exhibition Hall was packed to the doors.

Lunchtime Lectures at Gresham College

In conjunction with 'The City University and You' Exhibition (above), a series of public Lunchtime Lectures has been given, mainly on Wednesdays, at Gresham College, the home of the University's Graduate Business Centre in Basinghall Street, close to Guildhall.

Professors and other members of the University have given lectures to sandwich-munching City workers on scientific subjects of popular interest and on aspects of University life. Both the Vice-Chancellor and the President of the Students' Union Society have been among the Lunchtime Lecturers to date.

**Quest* No 5, page 4.

Old N'Ions Jubilee Dinner

The City Livery Club was the impressive venue for the Jubilee Dinner, early in December, of the Old N'Ions, the association of former students of the University and the original Northampton College. It was a convivial evening.

Mr D B Johnson (1947) came down from the North West branch to propose the toast to the guests and Sir Frederick Snow, senior partner of Sir Frederick Snow and Partners, responded. Mrs Barbara Gilbert, the Old N'Ions Honorary Secretary, proposed the toast to the University and the Students' Union and there were responses from the Vice-Chancellor, Sir James Tait, and the Union President, Mr John Withnall, who also proposed the toast to the Old N'Ions. The response, and climax of the evening, was the speech of the Old N'Ions President, Mr E W Herrington (1923), senior partner of E W Herrington and Partners.

On the stroke of ten o'clock, in a dining hall lit only by the central candelabrum, the traditional toast to absent friends was proposed by the immediate Past President, Mr R T Beazley (1940), of the Glacier Metal Company.

Former students' view of present students

The older generations sometimes find a great deal to commend in today's students, contrary perhaps to some popular reports. At the meeting of Convocation held at the University on Wednesday 10 December the following motion was proposed by Mr H D Watson and seconded by Mr H W Grimmitt:

'The Union Society of The City University have for the past three years raised money through Carrot Rags and other activities which they have used on projects for Task Force. This has involved much work on fund raising and enabled them to spend many hours at weekends and during their evenings decorating old people's homes, etc., in the local areas in which they themselves live. The image of The City University student in the Islington area is a favourable one and in marked contrast to that of some student bodies which have been widely reported in the press and on television.'

The motion was passed unanimously.

Mr John Withnall, president of the Union and a member of Convocation, responded, thanking Mr Watson for the motion.

1,000 years on

On 1 February, at an impressive service in Ely Cathedral at which the Archbishop of Canterbury preached, the King's School, Ely, celebrated the 1,000th anniversary of the foundation of the school in AD 970. At a time when the values of tradition and even the basis of education are being challenged so vigorously in many quarters, it is worth reflecting that some of our schools have survived so long a period of political and social upheaval and are still making—side by side with those which have been founded in our times—a valuable contribution to the educational needs of the age.

The research open days

by Professor R N Cox
Chairman, Senate Research Committee

As Chairman of the organising committee, Professor Cox describes the wide range of research work that was on display for the thousand-plus visitors to the University's Research Open Days in November.

The first Research Open Days to be held in the University took place on 13 and 14 November 1969. They were preceded on the evening of 12 November by a pre-view to which had been invited about 120 guests who were connected with the University Appeal, and for whom the occasion provided an opportunity to see something of what had been achieved with money already donated. This evidence of our research activities and use of resources might hopefully promote further donations to the Development Fund and support for specific research projects.

A central theme running through the exhibits was the link between much of the research going on in the University and the needs of industry. This theme was a natural one for this University, and had been emphasised from the outset by the Research Committee because we had been aware of the criticism—often levelled against universities in recent years—of tending to indulge in too much 'ivory tower' research. However, although we chose to emphasise applied work, the Research Committee fully recognise that there is still an important part to be played by fundamental research, and there are many examples where the applied research would not have been possible without the basic research which preceded it.

Growth of research

The Open Days have shown the enormous growth in research which has taken place since we became a university, and have enabled many people both inside and outside the University to see what is being done. Much of the University's research had already attracted the support and interest of industry, as is indicated in the outline below of exhibits displayed by the various departments. Well over a thousand visitors came, and many useful contacts were made, some of which have resulted in further negotiations for research grants and contracts.

The Open Days also enabled us to take stock of our own position. There is a vast difference between reading the title of an item on a list of research topics and actually seeing that item demonstrated as an exhibit. Not the least of the benefits to the research workers involved is that they had to explain their research in terms which were intelligible to the layman, and yet also had to be prepared to answer a barrage of highly technical questions.

For some of our younger research workers it was the first time that they had realised that any outside person might take an interest in their work, and this was summed up by one research student who was reported to have said 'somebody cares'!

In order to exhibit our research, we decided that it was important for visitors to see as much as possible of the 'sharp end' of the activities, and we tried to achieve this by getting them to start in a Central Display Area, in which the work of the Departments was shown in outline, and from which they could be directed to the individual research items located round the buildings. As an alternative, a number of tours were mapped out which enabled visitors to follow a particular theme or subject round the University.

All nine Engineering and Science Departments were on display, together with the Social Science and Humanities Department, the Graduate Business Centre, and the Library. These last three, together with the Ophthalmic Optics Department, had their exhibits concentrated in the Central Display Area. All the other Departments had, in addition, work on display in their laboratories.

Civil Engineering

The Department of Civil Engineering showed the work of their three Divisions—Structures, Geotechnics, and Hydraulics and Hydrology.

In the Central Display Area was shown work, sponsored by the Water Resources Board, on the application of computer techniques to the solution of hydrological problems, and a study, sponsored by Sir Alexander Gibb & Partners, on the hydrology of rivers flowing into Morecambe Bay. Also shown was an acoustic-wire pressure cell as used for the instrumentation of raft foundations on certain tall buildings in London.

Professor R N Cox is Professor of Aerodynamics in the Department of Aeronautics

In their laboratories, the Geotechnics Division had on display the results of an electron microscope investigation of the microstructure of clay, and work on the identification of clay minerals by differential thermal analysis. Development of instrumentation was represented by exhibits showing applications of photogrammetry and the use of a geodimeter in the precise location of highways, the determination of three-dimensional strains by optical methods, and the application of time-lapse photography to storing data and checking traffic surveys.

The Structures Division showed work on the stress characteristics of bridges and folded plate structures, and on stress distributions in tall buildings. There were also exhibits dealing with the strains in the circular end plates of pre-stressed concrete pressure vessels for nuclear reactors, and on the bond stresses in concrete arising from deformed reinforcement.

Now that a new building has been promised for the Department, it is to be expected that the research work will be able to grow further, and in particular that the experimental side of the Hydraulics and Hydrology Division will be developed.

Mechanical Engineering
The Department of Mechanical Engineering is engaged in a wide range of applied research problems and an increasing proportion of the projects is being supported by industry and by organisations such as Research Associations.

Work on fluids was represented by exhibits on the transport of solid-fluid suspensions in pipes, on pressure transients in pipelines for aircraft fuel systems, and on a study of boiling and two-phase flow. There was also an exhibit on fluidics which showed work on proportional fluid amplifiers, on position control on machine tools, and on fluid switching. Some studies on heat transfer analogues were shown, with an application to traction motor armatures.

There were two exhibits on metal fatigue—one on the development of instruments to measure the fatigue damage accumulated in structural components, while the other showed the effects of cumulative damage in the fatigue of thin-walled cylindrical tubes under biaxial stress.

The Department's work on creep was represented by a demonstration of the use of a lead alloy replica technique to give the creep strain patterns around holes.

Work in acoustic noise associated with grinding processes and its correlation with forces in the work piece and with the properties of the grinding wheel was also on display. Another exhibit demonstrated the dynamic behaviour of automobile transmissions and its relation to the problem of body-boom.

There were several exhibits on stress and strain analysis: some applications of photo-elastic analysis, work associated with the preparation of European standards for strain gauges, the solution of a torsion problem by electric network analogues, and the effects of strain wave propagation in helical springs.

A project which may have a practical application in turbine blade root fastenings was some research being shown on slip damping at machine element interfaces.

Electrical and Electronic Engineering
The Department of Electrical and Electronic Engineering has been fortunate in being the first of the University's Departments to be housed in a large new building. As a result it will become possible to expand the work on high voltage engineering and of the present small groups working on machine control power systems, on applied electronics, and on communications, in addition to the work of the three well-established groups concerned with signal and circuit theory, with laser engineering, and with dielectrics.

The Power Systems Group showed work on the application of diakoptics to network behaviour, and on the effect of residual flux and instant of energisation on the magnetising current and hysteresis loop. They also had on display a popular exhibit on the physiological effects of magnetic fields on human reaction time, a study aimed at obtaining an understanding of how dowsers operate.

The Laser Group had a number of exhibits including a low voltage electro-optic modulator, solid state light switches for subnanosecond time resolution, a solid state null detector, and an 18 GHz bandwidth travelling wave light modulator.

The Signal and Circuit Theory Group were represented by an exhibit on a second order non-recursive digital filter.

The High Voltage and Dielectric Group showed work on electromagnetic interference* and on liquid insulants as well as some studies of HV measurement techniques**.

Automation Engineering
The Automation Engineering Department's displays illustrated the development of the systems approach, and the spread of automation in technological and industrial processes. A particular feature was made of the recent formation of an Instrument Systems Centre, jointly managed by the Scientific Instrument Research Association and the Department.

The work shown included the optimal design of nuclear boilers, a study of an active suspension system for fast trains (in cooperation with British Railways) and research into the identification and control of process plant. Modern methods of systems modelling were also shown applied to the study of some biological problems (in cooperation with teams at a number of London hospitals).

The basic concepts of measurement and instrumentation as a systematic science are under study in the Department, and a critical examination is being made of the effects of the advent of computers on the design and performance of instruments. Some of this work was on display, together with a study of the mathematical modelling of instruments.

A subject of considerable industrial significance is automatic inspection, and the SIRA work on this is being supplemented by investigations in the Department of the application of various methods to the detection of defects on metal sheet.

A selection of ad hoc projects being undertaken by the Department was also on view, including a study of hydraulic turbine governing.

The Department will benefit greatly in the future by an Argus 500 computer system which has been installed recently and which will aid both the teaching and the research in the Department.

* *Quest* No. 10, pp 28–32.
** *Quest* No. 4, pp 19–22.

Aeronautics
The Department of Aeronautics displayed the work of its divisions of Aerodynamics, Aircraft Structures and Air Transport Engineering.

Two exhibits in the Aerodynamics Division were related to work on transonic speeds—a study on the drag of blunt-nosed bodies of revolution at low supersonic speeds (supported by the Ministry of Technology) and a study of the flow over afterbodies with gas ejection (supported by the Ministry of Defence (Army)).

Car aerodynamics was represented by a display showing aerodynamic effects on the control and stability of motor cars.

A link with space research was a study of the basic physical processes occurring in a model of an ion-electric rocket engine.

Some novel work which was demonstrated is on the natural convective air flow patterns round the human body. This work is being done in collaboration with the National Institute for Medical Research at Hampstead, as described in an earlier issue of *Quest**.

Work in Aircraft Structures being shown included a study of structural optimisation using the methods of non-linear mathematical programming, tests on joints in carbon reinforced plastics, and an investigation of fatigue strength under complex wave loadings. The two last items are supported by the Royal Aircraft Establishment, the Science Research Council and the aircraft industry.

The new field of Air Transport Engineering was represented by two exhibits, one a study of aircraft component life and reliability and the other the utilisation of airport terminal areas.

Mathematics and Computing
In the Department of Mathematics, in addition to the work of the Computer Unit (centred around an ICL 1905 digital machine linked to an EAL 690 hybrid computer), there is a small group investigating statistical reliability, and the numerical solution of various problems in theoretical mechanics.

One exhibit showed studies of the reliability of large systems, and another the optimisation of mathematically definable industrial processes using the hybrid computer.

Theoretical mechanics was represented by work on the transverse deflection of thin plates, and on the finite element method of structural analysis.

A study related to the medical field involved the statistical use of a digital computer in the diagnosis of intracranial tumours (in collaboration with St Bartholomew's Hospital).

Work on a standard interface to link dissimilar digital computers was shown, and another exhibit showed the compilation of a data bank of stock prices for investment analysis.

Physics
The research work in the Department of Physics is mainly in the field of materials, but there is also interest in fields relating to computing, to biology and to chemistry.

Work on metallic materials was illustrated by exhibits on the magneto-Seebeck effect in iron, on cyclic quench techniques, and on the measurement of the changes of resistivity of certain metals as a function of mechanical deformation and heat treatment.

In another exhibit, newly developed ultrasonic pulse techniques were shown being used for the inspection of metal products to determine the shape of subsurface defects.

The properties of metallic films, so thin as to be continuous, are also under investigation in the Department, and details of the work were shown, including the apparatus for producing the films.

Two items showed research on non-metallic materials—a display of work on the electrical and optical properties of ionic crystals, and an item showing the interdisciplinary and interdepartmental aspects of crystallography.

An interdepartmental service provided by the Department is the electron microscope laboratory which has three electron microscopes. An exhibit showed current research in ophthalmic optics, engineering, chemistry and physics. There were also three examples of research on the interaction of heavily ionizing particles with matter.

A topic of industrial importance was work on the pre-insulation of pipes for the distribution of liquid methane at $-164°C$.
A link with a number of other Departments was the work shown on an automated Liebmann resistive analogue network being used for a study of transients in heat transfer.

Chemistry
The Department of Chemistry has the largest research effort of any of the University Departments and covers a broad field

* *Quest* No. 9, pp 9–13.

of fundamental and applied chemical research.

Among the exhibits was one on chemical engineering showing work on the dynamics and control of distillation columns, and a study of the theoretical principles of comminution, mixing and packing in powder technology.

The work of the Department on the combustion of hydrocarbons was on display; of particular significance was a study of flame retardant additives for polymers, and research on the addition of anti-oxidants to solid propellants.

Some work aimed at an understanding of the basic mechanism of adhesion was shown, with a number of examples of current investigations, including the effects of absorbed films on surfaces, and on the mechanism of adhesion between cement paste and glass surfaces.

There was considerable interest in some research on fuel cell electrocatalysts which has led to the development of inexpensive electrocatalysts to replace the precious metals usually employed. A biological fuel cell using the body's oxygen which could have an application to powering heart pacers was also shown.

A means for studying solid surfaces is the low energy electron diffraction technique. Its use to investigate surface reactions and hydrogenation reactions on single crystal surfaces was shown.

Some more fundamental work on organic chemistry was represented by exhibits on heterocyclic compounds, and on organic electron transfer reactions.

Inorganic structures are being studied by a group involved in work on the synthesis, structure, reactivity and the commercial exploitation of various inorganic compounds. Work on synthetic zeolite, and on anhydrous metal nitrates and nitrate compounds was also on display.

Ophthalmic optics
The Department of Ophthalmic Optics, which occupies the Cranwood Annexe a mile or so from the University, had a stand on the Central Display illustrating some of the wide range of work undertaken by this Department.

Research in progress was represented by exhibits on the subjective scaling of hue and saturations, and on the autonomic nervous system. Various test methods developed in the Department were demonstrated showing the analysis of visual field defects, the use of a Lovibond Tintometer for colour vision testing, and the development of a new colour vision test apparatus. The MAVIS Industrial Vision Screener for the rapid testing of visual performance was also shown.

Management Studies
The Graduate Business Centre, sited in the Gresham College in the heart of the City, is engaged on a wide range of research extending from Behavioural Science to Operational Research.
The items on display in the exhibition included the preparation of a tape data bank for investment analysis (in collaboration with the Mathematics Department), a project on the problems of increasing the efficiency of small firms, an analysis of growth trends in the electronics industry, a study of the decline of coal as a product, and a simulation of the sensitivity of the economic life of equipment to various economic factors. Two mathematical studies were on display—a new algorithm for solution of the 'constrained multiple newsboy problem', and a study of cash flows in networks.

Finally, an item was shown on some implications for small engineering firms of the Industrial Training Act of 1964.

Social science and humanities
The Department of Social Science and Humanities probably has the greatest diversification of research interests, although a common thread through most of the studies is that they bring in links with physical science and technology.

Some idea of the range of subjects may be obtained from the following list of titles of current research in the Department:
Demand for currency
Credit flows
Capital accumulation
Under-developed countries
Human values and understanding
Meaning and criteria
Foundations of mathematics
The concept of a physical process
The application of the results of scientific research
Ethnic minorities in Britain
Religion as a key variable
The new left in the United States
Imperfectly acquired vocabulary
Effects of doubling on the recall of word lists
Children's social and motivational awareness

Library
The Library was one of the first university libraries to develop an information service, and it aims to incorporate the retrieval methods used in industrial and special libraries.
There has also been a rapid growth of research into the techniques of library science, and two interlocking factors were illustrated by the Library exhibit on the Central Display:
(a) The Library as a centre for research—which gave examples of retrospective searching, a personal service to assist research workers to keep abreast of their work.
(b) Research in library science—which showed the use of the computer in library applications, and, in particular, the participation of the Library in the MARC (Machine Readable Catalogue) Project.

More open days?
On the whole our first Research Open Days were extremely successful, and I would like to pay tribute to all those who helped. For the future, the Research Committee feels that this is an exercise which should be repeated at intervals of two or possibly three years.

The Canon's Yeoman rides again

by Mr I Priestnall
Undergraduate in the Department of Chemistry

l. 663 ' "Now," quod oure Host, "yit lat me talke to the.
Why artow so discoloured of thy face?"
"Peter!" quod he, "God yeve it harde grace,
l. 666 I am so used in the fyr to blowe
That it hath chaunged my colour, I trowe." '
Chaucer. The Prologue of the Chaunon's Yemannes Tale. (Ref. 1).

'If employers employ men on this dangerous work for their own profit they must take proper steps to protect them, even if they are expensive.'
Per Lord Justice Denning, in a case involving an injured window cleaner. (Ref. 2).

Chaucer's character, suffering, it appears, from an occupational illness, lived in 1395 (in the author's mind, at least, if not in fact). The window cleaner, suffering from an occupational injury, sued his employers in 1952. Over the intervening five hundred and fifty years, little happened to improve the lot of the worker in hazardous trades. In fact, the first Act of Parliament to deal specifically with industrial safety was the Act of 1864, which enjoined employers in such trades as were specified (eg, lucifer manufacture) to install ventilation '. . . in such a manner as to render harmless, so far as is practicable, any gases, dust, or other impurity . . . that might be injurious to health.' (Refs 4, 7.)

What, however, of the medical advances which enabled Parliament to recognise industrial hazards as such? With present-day hindsight we can clearly say, thanks to Chaucer's accurate description, that the Canon's Yeoman is sick, and may hazard a shrewd guess at his having contracted mercury poisoning, as evidenced by his 'wan and ledden face'. He may well be affected also by the 'Arsenyk, sal armonyak and brymstoon;' (l. 798) or even the '. . . asshes, donge, pisse and clay' (l. 807) with which his master and his fellow alchemists were wont to charge their pots. The Yeoman himself certainly attributes his pallor to the fumes rising from the fire, and so certainly realises that his is a hazardous profession. That he accepted this, in large measure, is interesting, for this is just the problem we have today.

The factory floor, however, is a haven of peace in comparison with the potentially lethal conditions obtaining in schools and colleges in this country. Makeshift apparatus, lack of adequate ventilation in areas where toxic vapours are handled, lack of good electrical screening, poor or non-existent facilities for immediate flushing of corrosive substances from the skin or clothing, and poor facilities for disposal of harmful compounds or contaminated clothing are the rule, rather than the exception. The staff, also, tend to be unaware of the precautions to be taken, or the first-aid treatment to be given, when handling such substances as bromine or sulphuric acid. Of course, as increasingly esoteric substances are handled, so safety precautions must become more exhaustive. Nevertheless, accidents can and do happen. In a laboratory group-photograph, taken around the turn of the century, Mme Marie Curie appeared out of focus. It is thought that radiation from her body fogged the plate. Madame Curie died of leukaemia. The Nazis, during the war, experimented with radiation as a means of sterilization, yet until quite recently, at my own school, a working X-Ray apparatus was demonstrated regularly to sixth-form pupils. The fact is that every operation carried out in an advanced research programme should be regarded as having potentially lethal results. It is only after medical science has linked leukaemia, byssinosis, pneumonoconiosis, etc. with hazardous materials that legislation has sought to protect the worker from the material.

Like the Canon's Yeoman, too many people nowadays accept the fact that they work in a hazardous profession, and remain sublimely unaware that they can protect themselves from the hazards. They ascribe to Fate, God, or other supernatural agency, the death from cancer of Old Joe, who always scorned gloves, breathing apparatus and similar 'Cissy stuff'. The employers combat this as best they can, protecting their employees, '. . . even if [the steps they take] are expensive.' (Ref. 2.) Thus armoured safety-glasses (ground to the employee's prescription), steel toecap shoes and boots, protective garments, helmets, visors, etc., are all provided free of charge, or at greatly subsidised prices. Lavish and gruesome displays are mounted: the safety-spectacles, now shattered; a cold chisel tip embedded in the pupil of the eye; the three-ton safe mounted on a steel-toed boot; the hot rivet shot at a steel helmet; all are employed. Educational films on such topics as dermatitis are shown, and in some companies, at least a period of suspension is imposed on anyone found abusing or ignoring safety regulations.

It is fantastic that such drastic measures have to be imposed upon the employee before he will protect himself. The picture of a modern laboratory assistant, no longer an Alchemist's Yeoman, is one of a man with a considerable protective apparatus available to him. It is one of a man who fails to use a fume-hood to draw off mercury vapours, who leaves the residual mercury in an unstoppered bottle beside him, who fails to mop up spillages as soon as they occur, who drinks tea in the laboratory, and who (in all probability) stirs it with his favourite mercury-amalgamated spatula.
Doubtless this man will have a compulsory medical examination once a fortnight; but this merely ensures that medical treatment will be swift—it may very well be necessary.

Mr Priestnall, a fourth semester student in the Department of Chemistry, based this article on an essay written for Mr R G Stansfield, his tutor in the Department of Social Science and Humanities who pointed out that Chaucer described the physical and mental symptoms of mercury poisoning.

[1] **Robinson, F. N.** (Ed.): *The Complete Works of Geoffrey Chaucer* (2nd edn), OUP, 1957.
[2] General Cleaning Contractors *v.* Christmas: C. A. 1952, 1 AER. 42. Quoted in:
[3] **Williams, J. L.**: *Accidents and Ill Health at Work.* Staples Press, 1960.
[4] 17 & 28 Vict., c 48: The Factory Acts Extension Act (1864, repealed 1878).
[5] 30 & 31 Vict., c 103: The Factory Acts Extension Act (1867, repealed 1878).
[6] 41 & 42 Vict., c 16: An Act to Consolidate and Amend the Law Relating to Factories and Workshops. These Acts are quoted in:
[7] **Hutchins & Harrison**: *A History of Factory Legislation* (3rd edn), Frank Cass & Co. Ltd, 1966.

Mathematical models and computer simulation of personality

by Mr B F Wright
Department of Social Science and Humanities

The new psychology laboratories in Drysdale House are now nearing completion and the Psychology Unit of the Department of Social Science and Humanities is holding an Open Day in May to give the rest of the University an opportunity to see the activities going on there. The unit tries to cover a wide range of behavioural studies, covering fundamental studies of the genetic factors in behaviour, physiological mechanisms and brain function; behaviour (in particular learning processes) in small animals; growth and development; examination of the basic nature of such topics as maturation, motivation and emotion, perception, learning and thinking, language. Knowledge of these fundamental processes is then integrated in study of personality and behaviour, human interaction and behaviour in small groups, and social interaction. These are of great relevance to the education of the technologist. A branch which it is hoped will be developed in conjunction with other departments is the aspect of the interaction of man and machine in ergonomic studies. It is hoped that this article will show some of the potential of cooperative ventures between the psychologist and technologist.

Psychology, as a behavioural science, now makes considerable use of mathematics. Just as in the physical sciences, the importance of mathematics in psychology is that it is a formal, logical, symbolic system. The particular virtue of mathematics is its capacity to serve as a model for events and relations in the empirical world. In mathematical psychology, it is this relationship between events and the behaving organism, between stimulus and response, which is the focus of attention, this being the aspect most amenable to mathematical treatment since its elements can be expressed in physical terms. Before considering the development of complex mathematical and computer models of this stimulus–response relationship, it might be wise to look at the basis of the system in more detail.

This stimulus–response system, known as behaviourism, was essentially a reaction against the prevalent psychological tradition at the turn of the century, of psychology being an introspective study of conscious experience. The assertion was that the new system could be defined in physical terms which could be examined through the scientific method

1 A rat in an apparatus which provides information about learning processes. The results of such simple experiments have been shown to have great relevance to the learning process in humans and the outcome has been greater efficiency in teaching techniques. These experiments provide a practical test of the ideas generated from the use of models.

without any need to make assertions about consciousness. In this way, a pattern would be set up for the study of behaviouu to develop as a science. In stimulus–response (S–R) psychology, an event is defined as beginning with a stimulus and ending with a response. S–R theory asserts that all behaviour is in response to a stimulus and consists of a causal chain of events terminating in the response. Thus, in these terms, one can relate psychological principles to events of the same nature as in the physical sciences. While the system achieves this aim, experimental work has shown that responses to given stimuli differ with different subjects, and with separate testings of the same subject. This showed that a simple S–R system was an incomplete statement of the chain of events. Modification by the introduction of a term covering intermediate processes that depend on the state of

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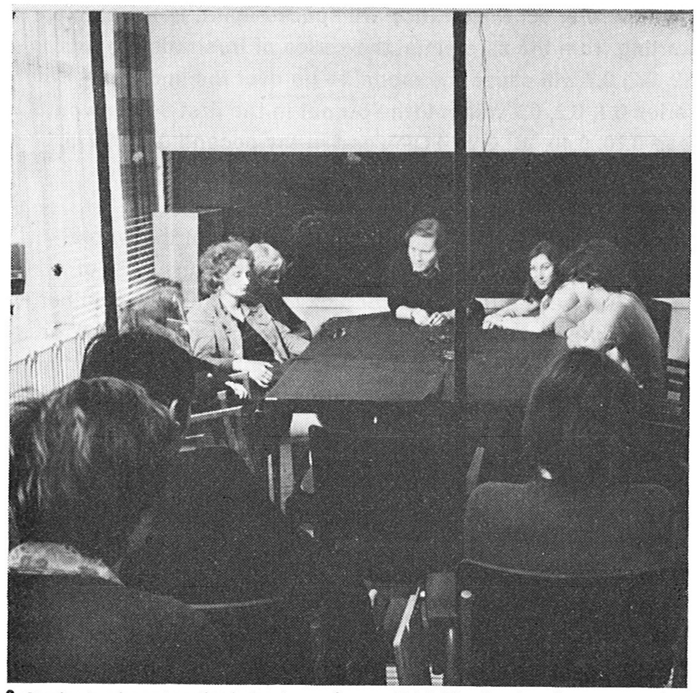
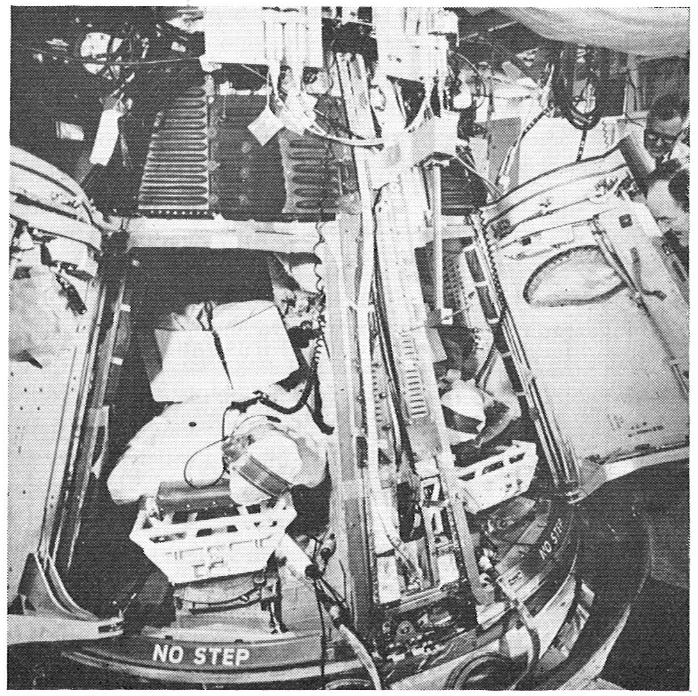
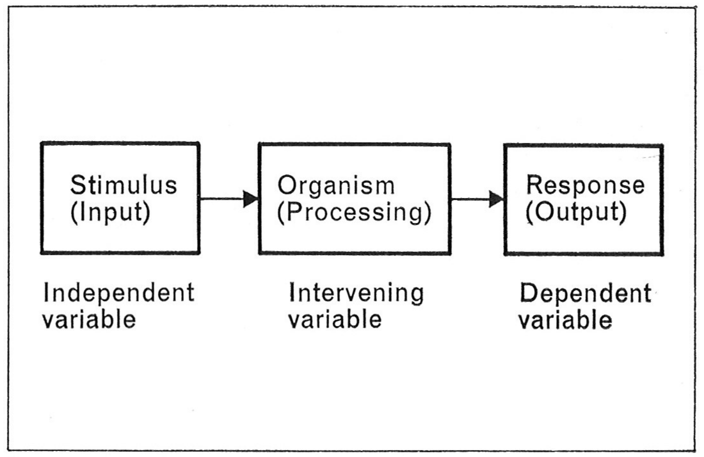


2 Students observing the behaviour of a small, highly structured group, such as one finds in committee meetings. Observation is through one-way screens in the wall of the room permitting the students to observe without being observed. Such direct observation is sometimes supplemented by closed-circuit television.



3 Psychological factors are of great importance in ergonomic studies of the interaction of man and machine, an area of increasing significance in a technological age.

the behaving organism, which are inferred, resolved this difficulty. The system then became one of independent and dependent variables with intervening variables, as in **4**.



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One can readily see from this model, in which behaviour is treated as events and processes, that these can be expressed mathematically, the most common approach being to view the relationship as a stochastic process (which is simply as a sequence of events which can be analysed in probability terms).

Example from learning theory

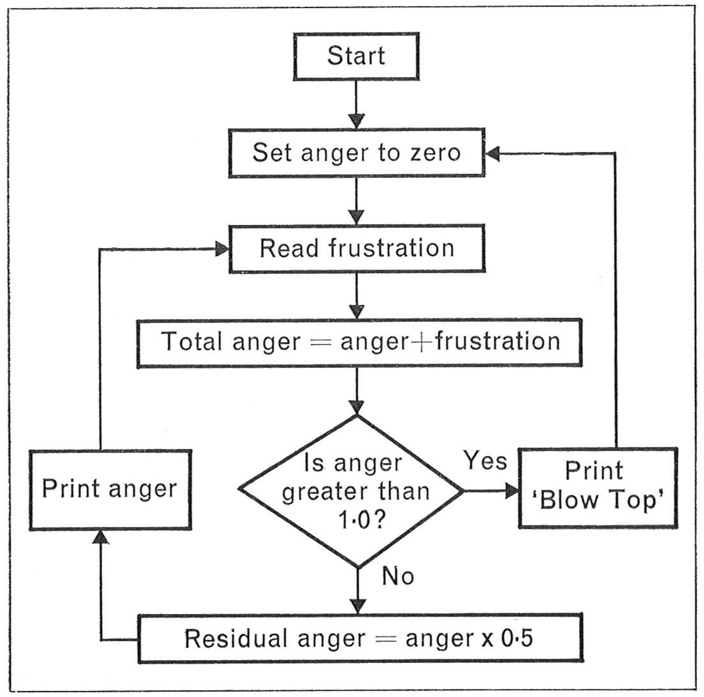
An interesting example of such a stochastic model can be given from learning theory. In such a model, the main dependent variable is the probability of various responses from the subject at any particular point in time, given his particular learning history. As the learning performance improves through successive trials, the model might then consist of a set of assumptions about how this response probability changes from trial to trial during the learning process, as a result of the outcomes the subject experiences on each trial. Given this representation of learning and performance as a trial sequence of response probabilities, the business of predicting statistics of the data then consists only of mathematical work within the probability calculus which, in itself, has no psychological content or significance. Thus, beginning with these assumptions, the mathematical development of the theory is straightforward. The basic equation for the change in probability of a response from trial n to trial $n+1$ is

$$p_{n+1}=p_n+\theta(1-p_n)$$

or in words, the probability of a response on the next trial (denoted p_{n+1}) will equal the probability on the previous trial (p_n) plus a fraction (θ) of the remaining possible increase which is $(1-p_n)$. From this difference equation expressing changes in probability from one trial to the next, one can develop mathematically a further expression for what happens when the difference equation is applied over and over again, beginning with the probability at trial 1 and ending at trial n, thus;

$$p_n=1-(1-p_1)(1-\theta)^{n-1}$$

where p_1 is the probability of the response on the initial trial of the experiment and p_n is the probability on any arbitrary trial n. We have obtained a theoretically devised curve based on a mathematical model representing the learning process and predictions from this have been found to fit the experimental findings remarkably closely. From such an early step in model building, highly complex stochastic models can be constructed, not only in learning theory, but in other areas such as perception and cognition up to as complex a system as personality.



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Value of computers

It is when one is taking these mathematical models into areas of considerable complexity that the computer provides a tool to supplement the mathematical model. Providing a concrete embodiment of a theory about the operation of the system and running it in a computer is a method of determining what the theory predicts under specified sets of conditions. If the theory is complicated, as it is in the simulation of cognitive processes such as problem-solving, creative thinking and computer models of personality, this may be the only practical way of generating unequivocal predictions from it.

For a basic element in a computer simulation of personality, let us take a simple model of an emotional trait, temper, for the purpose of illustration, presenting it in the form of a flow-diagram, which is a useful way of displaying the logical organisation of the system. The rectangles represent operations, the diamond-shapes indicate choice-points, and the arrows show the direction of movement through the system. Thus we might represent the model of the psychological processes involved in temper as in **5**.

The statement of the diagram (or program in computer terminology) obviously represents some simple psychological hypotheses about anger; that its level is increased by the impact of frustrating events; that if it exceeds a certain level, it is expressed explosively and is then reduced to zero; and that, otherwise, it dissipates to some extent between frustrations.

This particular model is simple enough for a number of its properties to be easily inferred without running it on a computer. For example, it is apparent that the frequency with which the model 'blows its top' will depend on how large the frustrating inputs are, as well as on their distribution and sequence: several major frustrations coming together will have more effect than if they are spaced apart. For example, starting from the zero state, the series of frustration inputs 0.2, 0.7, 0.7 will cause the model to go over the limit; the series 0.7, 0.2, 0.7 will not (the output in the first series would read 0.10, 0.40, 'BLOW TOP'; and in the second 0.35, 0.275, 0.4875).

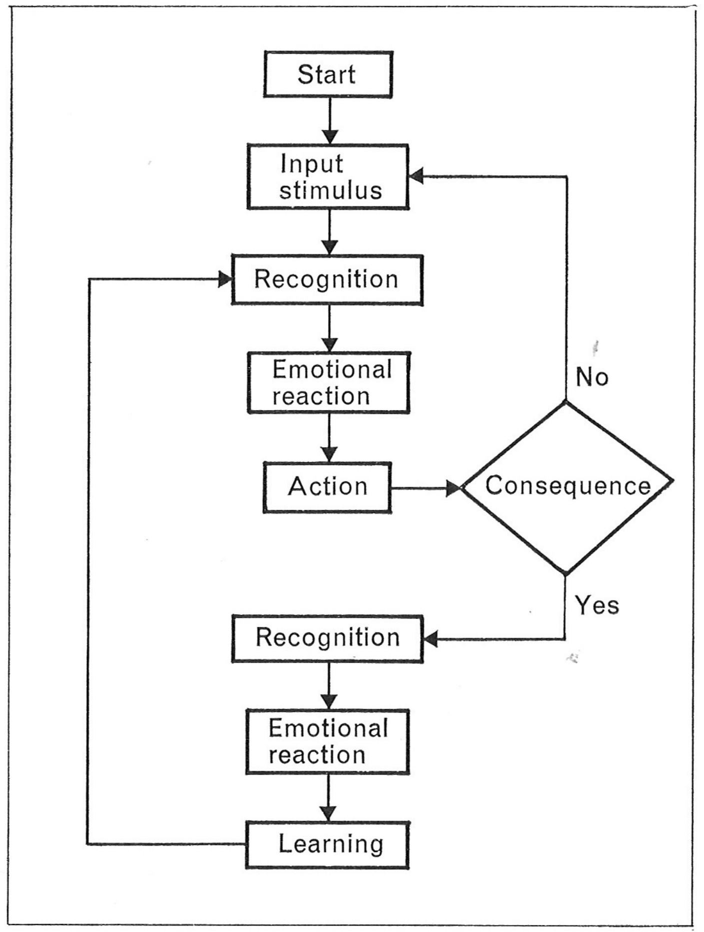
However, the environmental stimuli input is not the whole story. Our model will respond differently to a given set of inputs (i.e. have different 'personality traits') if we vary either of the two present constants in the program; the limit 1.0, or the multiplier 0.5. The first may be thought of as representing something like a frustration tolerance; the second the extent to which anger persists over a period of time. Thus a model with a high frustration tolerance (high limit) and low persistence of anger (small multiplier) will rarely 'blow its top'; while one with low tolerance and high persistence of anger will frequently do so. Models with both constants low or both high will fall in between, but with distinctively different styles of response—the former will be easily provoked to wrath by individual frustrations but will not hold a grudge; the latter will tend to cumulate its resentments towards periodic explosions which will on occasion be touched off by relatively minor events.

Personality models

One can incorporate a simple system representing such a psychological process into a much larger scheme, such as a personality model which has, for example, three emotions: one which is positive—call it love, attraction or what you will—and two negative, anger and fear. Any or all of these emotions can be aroused by a given stimulus input. In this relatively simple model, the repertoire of the model's actions is small: if the emotional response is predominantly attraction it advances towards the stimulus; if it is predominantly anger, it attacks; if it is predominantly fear, it retreats. There is a threshold and ceiling for action. If the emotion is below a certain level it is indifferent; if it exceeds a maximum, paralysis ensues. In addition, if the strongest emotions aroused by the stimulus are above threshold and approximately equal it displays conflict behaviour.

One can describe a general plan for incorporating emotions in a flow-diagram in **6**.

This flow-diagram shows how, when the stimulus provides an input, it is first recognised—that is, the relevant information in the model's memory is located. The object is then reacted to emotionally by a sub-routine, such as has been outlined, which takes into account both previous experience and the model's current state. Then a suitable action is selected. Following this, another sub-routine determines what the outcome will be, given the model's action and the realistic properties of the stimulus, and there may or may not be further emotional reaction, plus appropriate learning. Such models are, of course, over-simplified, but they illustrate well the principles upon which they are constructed. They also show readily how it is possible to use the computer to explore systematically the effects of changes in the assumptions incorporated in a theory



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and thus obtain theoretical data to compare with experimental findings. In this way the computer model has an important function as a critique for examination of a theory which in the traditional verbal form might appear rather suspect. Indeed, such models have not only clarified the weaknesses of some of the elements of earlier theories, but have helped to discover some additional concepts.

Interacting models

Now that the single personality computer model has been looked at sufficiently to obtain a reasonable idea of the principles operating in the system, it might be useful to consider briefly the reaction of the model to two standard environments and later to interpersonal interactions where two such models are interacting with one another.

When such a computer model is subjected to standard environments, such as one which is relatively hostile and one which is relatively benign, it is interesting to follow the course of attitude development and change. This can be followed with models having different parameters (different 'personalities') and interesting comparative studies can be carried out contrasting the behaviour of the various models to the same sequence of standard stimuli.

The usual procedure is to expose the models to something between 100 and 1,000 experiences of the hostile environment and then switch without notice to the benign environment, meanwhile keeping a record of the responses, attitudes and adjustment as it progressively tries to cope with the environment. One can thus have measures of the model's level of fearfulness, hostility and attraction; the appropriateness of attitudes given the environment it has been exposed to; and the direction of his deviations from realistic adjustment—whether these represent rashness in its approach to injurious and frustrating situations, or overcautiousness in its approach to satisfying ones. This particular sequence has a parallel to the behaviour of a personality brought up in a disturbed environment and then exposed to a benign environment in later life. One can also, of course, run the program through with the first standard environment being the benign and the second the hostile, and thus simulate the reactions of various personality types brought up in a well-adjusted environment and then exposed to a hostile situation.

The principal results of these types of experiments can be easily summarised. All the versions showed improving adjustment to their environments with increasing experience and were able to readjust when it changed. The longer the exposure to the initial environment had been, the slower was the readjustment. Fairly marked behavioural differences were shown among the different models, but the differences in the degree and the course of their adjustment were on the whole not great. Thus, in general, the similarities among the models were more striking than the differences.

Experimental runs of two of these types of models, run with one interacting with the other, that is with the responses of one model serving as a stimulus to the other, provide interesting material. As one would expect, where the two models started out with blank memories, nothing happened, except mutual indifference. Consequently the models had to be provided with more or less random sets of beginning attitudes, fairly positive in some experiments, negative in others. Interaction then took place.

An unexpected finding was that the relationship of the two models often appeared to develop in a series of distinctly different phases, rather than continuously towards some final state. For example, where both models started out with fairly positive initial attitudes, the relationship tended to develop in three distinct phases—(1) the 'honeymoon'—interaction almost wholly positive, affection increasing, hostility and fear diminishing; (2) a period of intermittent 'quarrels'—occasional sequences in which cycles of attack, affection and conflict occurred leading to a general worsening of relations; and (3) recovery—movement of behaviour and attitudes towards a final strongly positive equilibrium.

Relations between computer models can, at times, become moderately complex and may bear at least certain faint resemblances to events in human interaction sequences. One speculates whether, with more refined models of interaction, one could use computer models in personnel selection to obtain particular outcomes under specified conditions. This raises a host of social, political and ethical implications.

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South African universities

by Professor Sir Robert Birley, KCMG
Department of Social Science and Humanities

Sir Robert outlines the nature and development of the different kinds of university in South Africa. From 1964 to 1966 he was Visiting Professor of Education at the University of the Witwatersrand in South Africa, and in 1966 he made the report commissioned by the British Government on the University of Rhodesia.

In South Africa one of the commonest of metaphorical symbols is the laager. The Afrikaner Nationalists of today prefer to think of themselves as being in a defensive encampment of white civilisation just as their ancestors stood within a fortress of wagons when attacked during their trek across the veldt to found the Republics of the Orange Free State and the Transvaal.

But, in fact, no people have a greater genius for division. The Dutch Reformed Church, the bulwark of Afrikanerdom, is divided into three separate churches. When the Nationalist government came into power in 1948, representing especially the Afrikaners and with a policy of white supremacy in South Africa, its first measure before it began to carry out an educational policy for the 'non-whites' was to put an end, as far as it could, to the white 'dual medium' schools where teaching was given in both English and Afrikaans and children of the two white races could be taught together, and to insist on all instruction being given in the 'mother tongue'. And the first point to notice about the white universities in South Africa is the extraordinary sharpness of the division between the English speaking universities—the Witwatersrand in Johannesburg, Cape Town, Natal divided between Durban and Pietermaritzburg, and Rhodes at Grahamstown—and the Afrikaans speaking—Stellenbosch, Pretoria, the Orange Free State at Bloemfontein, and Potchefstroom. (There is also a Correspondence University, the University of South Africa; recently a 'dual medium' University was started at Port Elizabeth, which seems to be making slow progress, and very recently an Afrikaans University in Johannesburg.)

The English speaking and the Afrikaans speaking universities have very little to do with one another. The former, especially the students, are strongly opposed to the government's racial policy; the latter are its most vehement supporters. (There are, of course, some contradictory voices in each.)
The white universities are clearly in the Western European educational tradition. An Englishman going as a lecturer to one of the English speaking universities will find himself quickly at home. In some ways the influence of Scottish Universities seems a strong one, especially in the number of subjects studied by each student. At the University of the Witwatersrand, for instance, the majority of the Engineering students (the Department of Engineering has very high standards) spend some of their time taking Political Science. The main difficulty for these universities lies in the schools from which their students come. The policy of Job Reservation, reserving all the skilled jobs for the Whites, forces an unusually large number to stay on to the end of the Secondary School course, a considerably higher proportion than in this country. Their final examination, which serves both as a school leaving examination and as a Matriculation examination for university entry, is one for which the pupils are too often prepared by being crammed not only with facts but with judgements. Most of them are, in consequence, singularly ill prepared for a true university education, which is what they will receive. Also they come up to the universities young, at an average age of seventeen and a half. It is not very surprising that about half fail their first examination at the end of their first year.

Professor Sir Robert Birley has been Head of the Department of Social Science and Humanities since 1967

Except in one most important respect to be considered later the universities are free, though much of their revenue comes from the Government. Every now and then threats are made against their academic freedom, but these have never been carried out. There can be no doubt that such attacks are resented also by the Afrikaans speaking universities and the Government naturally pays attention to their views.

It is significant of the conditions of South African education that nearly all students coming to the University of the Witwatersrand to study Biology will not have come across the theory of evolution, since it may not be taught in the government schools of the Transvaal as being contrary to the word of God in the Bible. It is equally significant that at the Afrikaner University of Potchefstroom this does not matter, for it has a university test for teachers to ensure that no teaching is given there contrary to the Bible. It is significant of much more than the situation in South Africa that this does not prevent the standard of other scientific subjects, Physics and Chemistry, being, in the opinion of some good judges, higher at Potchefstroom than elsewhere in South Africa.

Until 1959 'non-whites', that is Africans, Coloureds or, as we would say, half-castes, and Indians went to the English speaking universities. None ever went to the Afrikaans speaking ones. At the Universities of Cape Town and the Witwatersrand there was no segregation in the lecture rooms, the students' common rooms or on the campus. At the University of Natal the non-white students were taught in separate lecture rooms. Non-white Medical students went to a separate Medical School in Durban, with a white academic staff, which was part of the University of Natal. There were no non-white students at Rhodes University, but the University College of Fort Hare, founded in 1916 for non-whites, was affiliated to it and took its degrees. This was one of the most remarkable educational institutions in the world. Africans used to come to it from all over the continent. The present Minister of Education in Uganda and the Principal of Makerere University College in that country are both graduates of Fort Hare. (In 1950 the Government prohibited Africans from outside South Africa coming to Fort Hare.)

Ten years ago there were 27,988 white university students in South Africa and 619 African students, 300 at the three English speaking universities, of whom nearly a hundred were at the Medical School at Durban, and 319 at Fort Hare. There were 815 Indian students at the three white universities, more than half at Durban, and 541 Coloureds—over 450 at Cape Town —and about 100 Indians and 70 Coloureds at Fort Hare.
(68 per cent of the population is African, 18 per cent European, 11 per cent Coloured and 3 per cent Indian.)

In 1959 the Government passed the so-called 'Extension of University Education' Act which forced the principle of Apartheid on the English speaking universities. No non-white may attend one of these universities now without special leave from the Government authorities, which is only granted in exceptional circumstances. Fort Hare was taken over. The Bill included the taking over of the non-European Medical School at Durban, but, when 29 out of the 31 members of the academic staff said they would resign if this were done, the Government gave in and it remains an integral part of the University of Natal and, therefore, independent. The stand made by these university teachers should not be forgotten.

At the same time the Government founded two new University Colleges for Africans at Turfloop in the Northern Transvaal and Ngoya in Zululand, as well as colleges for the Coloureds and the Indians. In accordance with their instinct for separation and their wish to divide the Africans on a tribal basis, African students have to go to the college of their own 'ethnic group.' In 1960 there were four African students at the University of the Witwatersrand (studying Engineering, which is not taught in any of the African colleges), three at Cape Town and 161 at Natal, of whom 130 were at the Medical School. The three African colleges have now about 1,500 students, which means that the total number of African university students has gone up in ten years from rather over 600 to about 1,670, which seems a great advance. But one third of the students at the African Colleges are studying for diplomas, not for degrees, so the advance is not as great as it seems at first sight.

The Government sets great store by these university colleges and feels its prestige bound up with them. The cost per student to the State at Fort Hare is about £930 a year, at a white university about £270. (The African students pay fees which amount to about £100 a year, which are low in comparison with the fees at white universities.) In 1969 there were 26,064 students in the Afrikaans speaking universities, 22,457 in the English speaking, so in the ten years the number of white students has increased by 70 per cent.

The non-white students take the degree and diploma examinations of the Correspondence University of South Africa. It is difficult to judge their academic standard; it seems to vary a great deal between one subject and another. The great majority of the professors and lecturers are whites and all, of course, have to support the Government's educational policy. There is no hint of academic freedom. The students are kept on a very tight rein. Demonstrations against the restrictions are very common. In October 1968 over 200 students were expelled from Fort Hare at the same time.

The great difficulty for the African university colleges is the paucity and the low standard of African Secondary Education, much the most serious weakness in the educational system for the Africans. Only about 4 per cent of the children at school are in the Secondary Schools. The standard of the teachers in these schools is falling. In 1948 half the teachers in the African Secondary Schools had university degrees; not only about a quarter have this qualification. Only about 30 teachers a year leave the African university colleges with university degrees and a Diploma in Education. No great improvement can be expected in African university education until the standard of the secondary schools is raised and to do this it will certainly be necessary to raise the salary scale for the African teachers. It is equally necessary to give them greater security. An African teacher can be dismissed from the service without notice or any reasons given or any right of appeal.

It is difficult to see how the English speaking white universities could have done more by way of protest and argument to prevent the passing of the 1959 Act. Staff and students showed complete solidarity together in their resistance to it. They have never relaxed their opposition to social segregation in the universities. Demonstrations against the Act last year on its tenth anniversary at the University of the Witwatersrand culminated in a great meeting addressed by the Chairman of the Council, the Vice-Chancellor and the President of the Students' Representative Council. At this University there is a plaque outside the entrance to the Great Hall reading,

'We affirm in the name of the University of the Witwatersrand that it is our duty to uphold the principle that a university is a place where men and women, without regard to race and colour are welcome to join in the acquisition and advancement of knowledge; and to continue faithfully to defend the ideal against all those who have sought by legislative enactment to curtail the autonomy of the University. Now therefore we dedicate ourselves to the maintenance of this ideal and to the restoration of the autonomy of our University.'

The history and development of explosives

by Lieutenant Commander G N Butters
Department of Chemistry

Commander Butters describes the developments, sometimes surprising and unexpected, in the history of chemical explosives and propellants from mediaeval times to the present day. He lectured on this topic just before Christmas in one of the current series of Lunchtime Lectures at Gresham College

It is inevitable that the history of explosive and propellant compositions should be closely associated with military activities. From the early use of arrows and other projectiles, it was a natural step to impregnate these devices with some incendiary material which would add considerably to the lethal effect of the attack. The need to pre-ignite this material divided the hazard about equally between the users and the intended victims, and the sublime unconcern of the inventors and designers for the safety of those destined to operate the various weapons of warfare was astonishing to say the least. The first large-scale use of incendiary compositions was probably in the seventh and eighth centuries AD, when Greek Fire, or Sea Fire, played an important part in driving the Arab ships from Constantinople. From a fleet of 1,800 only five returned to Alexandria, due to the devastation caused by the 'flying balls of fire'. The ingredients of Greek Fire were kept secret by the Byzantine rulers, but were probably sulphur, naphtha, pitch and lime. The latter may have been slaked with water to provide the heat for ignition, but this theory is not supported by more recent experiments.

The development of the saltpetre industry from the ninth to the twelfth centuries inspired a significant advance in the quality and effectiveness of incendiary compositions; the Arab climate is ideal for natural crystallisation, and it was soon found that the addition of the right quantity of saltpetre led to easier ignition and fiercer burning. A number of useful looking recipes were published, including Wild Fire, which was a great favourite of the Moslems during the Crusades. The Chinese were also skilled in the production of saltpetre, but at this time, curiously enough, used it only in cooking or as table salt.

With sulphur and saltpetre involved in these compositions, gunpowder was clearly not far away; the search for additional and alternative combustibles soon led to the incorporation of charcoal, and the first genuine explosive had arrived.

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Gunpowder

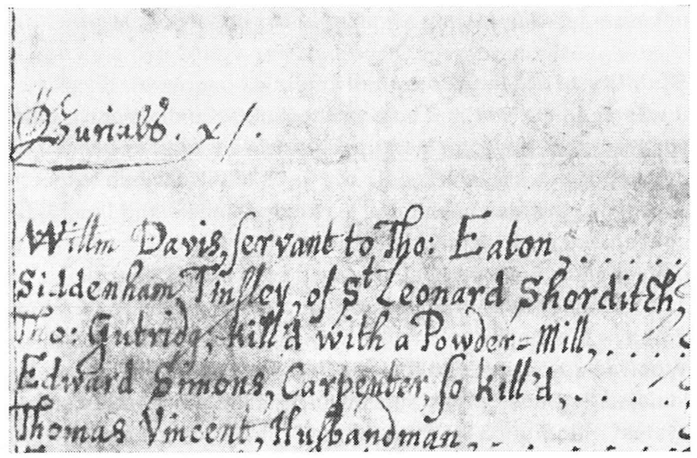
Gunpowder, or Black Powder, was probably first introduced to this country by Roger Bacon in 1252. Its original source is uncertain although India has been credited with producing it in the eleventh and twelfth centuries. Its exceptional propulsive power was immediately recognised, and this, together with corresponding developments in gun design, led to a dramatic increase in the range, if not the accuracy, of missile systems. At Crecy in 1346, both the English and French used gunpowder extensively, although the latter, in the excitement of the chase, left their guns behind.

The three constituents of gunpowder—saltpetre as the oxygen provider, carbon and sulphur as the combustibles—were all readily obtainable at that time, and by the fifteenth and sixteenth centuries production was in progress at a number of sites in England, notably Faversham, Waltham Abbey, Portchester Castle and the Tower of London. Some of the monasteries had also been quietly turning their hands to this very profitable industry, which involved little more than the careful operation of a milling process, in which the three components were mixed and ground to a fine powder. Naturally there were occasional accidents, but on the whole production was maintained at a high level, to satisfy both the legal and illegal outlets. Regarding the latter, there was at one time a theory that Guy Fawkes obtained his gunpowder supply from Waltham Abbey, whence it was shipped down the Lea into the Thames, and hence to its intended destination. In more conventional fields, from the fifteenth century onwards, the ability of gunpowder to detonate when compressed was utilised in the mining industry, notably in Cornwall; ignition was achieved by means of a long slow-burning fuse—usually paper impregnated with saltpetre. The idea of using gunpowder as an explosive charge in projectiles came much later, since there were certain difficulties over time-fuses.

Perhaps the most remarkable thing about gunpowder is that it held an unchallenged position for almost 600 years, as both a propellant and a fairly powerful detonating explosive. This was despite its many faults, including irregular burning, dirty residue, smokiness, tendency to absorb moisture, and general unpredictability (misfires were common).

The tremendous advance of science in the nineteenth

1 Waltham Holy Cross Parish Register, October 1665
2 Royal Gunpowder Factory cordite extrusion, circa 1918
3 An early sulphur refinery



Burialls. x/.
Willm Davis, servant to Tho: Eaton
Siddenham Tinsley, of St Leonard Shorditch,
Tho: Gutridge, kill'd with a Powder-Mill, . . .
Edward Simons, Carpenter, so kill'd, . . .
Thomas Vincent, Husbandman, . . .

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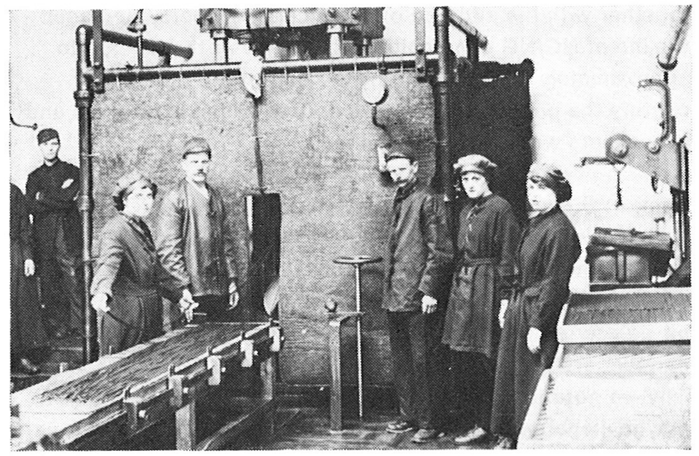

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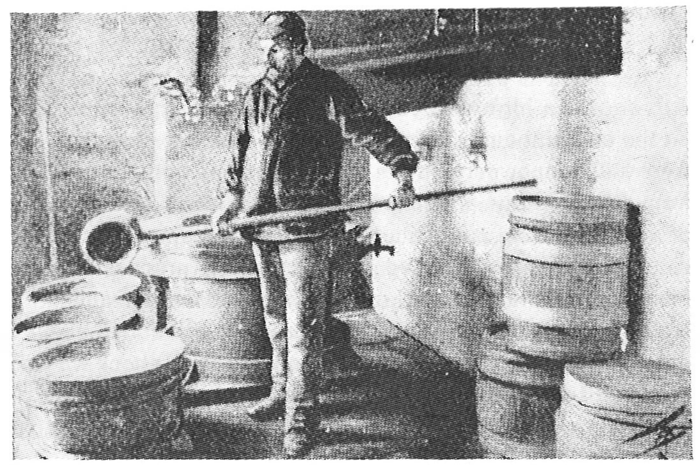

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century, coupled with increasing awareness of the applications of scientific discovery for practical industrial purposes, provided both the opportunity and incentive for the preparation and investigation of new substances. It is interesting, however, that so far as explosives are concerned, many of these discoveries were to a degree accidental and unexpected—a factor which has particular piquancy when dealing with sensitive and dangerous materials. One such material, mercury fulminate, was first prepared in 1805, and was widely used by street entertainers for various tricks. The chemist Liebig, noticing its extreme sensitivity, suggested that it might be used in very small quantities to initiate a larger amount of a more powerful, but less sensitive explosive. This idea was eventually adopted, and gave rise to the typical structure of explosive charges still in use today, whereby the main charge is detonated after a chain of events commencing with the ignition, electrically or otherwise, of a small quantity of highly sensitive material. For this latter purpose, mercury fulminate was still used well into the twentieth century, but has now been replaced by more climatically stable compounds like lead azide, lead styphnate and lead dinitroresorcinate.

While the exploitation of the properties of mercury fulminate, and the subsequent development of initiators, were important steps in the construction of more sophisticated types of explosive charge, there still remained the problem of safer and more powerful detonating explosives to act as the main agent of destruction. Gunpowder had served its purpose fairly well as a multi-purpose explosive and propellant, but the military authorities especially were becoming rapidly disenchanted with its unreliability and other bad features. Suitable replacements were a matter of urgency, and as luck would have it, a series of experiments in an entirely different field led eventually, after many mishaps, to the desired goal.

One of the many matters attracting the interest of industrialists in the early nineteenth century was the search for new fibres—or rather, the modification of existing natural fibres to produce better looking and more durable materials. These modifications were achieved by means of various chemicals, and it was soon found that by using nitric acid in conjunction with cellulose fibres, a range of products could be obtained, depending on the concentration of the acid and the relative quantities used for the reaction. All the products were excellent fibres, but those with high nitrogen content were also extremely inflammable, and their usefulness thereby severely restricted. However, in 1840 Schonbein in Switzerland was quick to realise the possibilities of the situation, and set out to investigate these products more thoroughly. He discovered that they would not only burn at a much faster rate than gunpowder, but under certain conditions would also detonate with great power. These products were always referred to as 'nitrocellulose',—and still are, although strictly speaking they are cellulose nitrates. Nitrocellulose clearly possessed great commercial potential, and Schonbein was anxious to exploit this. He therefore hastily built a small production plant in his own country, but this blew up in less than a fortnight. He then came across to England, took out a British Patent under an assumed name, and set up a factory at Faversham; this lasted six months before it was destroyed by explosion. A similar fate befell two other factories erected in France, but not before Schonbein had manufactured sufficient nitrocellulose to sell large quantities to the Austrian Army who used it in the dry state (!) as a gun propellant, with disastrous consequences. Undaunted, he returned to England, and commenced production at Stowmarket. Unfortunately, this factory went the same way as its predecessors, and Schonbein then retired.

Meanwhile, the interesting effect of nitric acid on cellulose had started a chain of enquiry into the action of this acid on other similar organic substances. In 1846, the Italian Sobrero isolated a pale yellow oil by a controlled reaction between glycerol and a mixture of nitric and sulphuric acids; this liquid was not only an extremely powerful explosive, but was also highly sensitive and unusually dangerous to handle. It has always been known as nitroglycerine, although like nitrocellulose, it is strictly speaking a nitrate. Again, as with nitrocellulose the commercial exploitation of this new material fast outstripped the full investigation of its properties. Austria was a willing customer for nitroglycerine, and several train loads of it were sent from Italy, of which over a quarter blew up before reaching their destination.

Sobrero then had the idea of freezing the oil, which is easily done, and sending it in the solid state to avoid movement in the containers. Unfortunately, the casualty rate was even higher, since the now well known fact that nitroglycerine is even more sensitive in the frozen state was not appreciated at that time. These accidents inevitably put a damper on the use of nitroglycerine as an explosive, but nevertheless interest was aroused in a number of countries, notably Russia. It was, in fact, the Russians who first approached the Swedish chemist, Nobel, with a proposition for the supply of large quantities of nitroglycerine, and Nobel accordingly set up three factories for this purpose. Unhappily, this venture was as disastrous as Schonbein's experiences with nitrocellulose, and in the course of five years Nobel lost not only his three factories, but also his father and brother-in-law in serious explosions. It seemed there was no future for 'Nobel's Oil', as nitroglycerine was often called. However, in 1871, a major breakthrough was achieved, when Nobel found that nitroglycerine could be absorbed by an earth, Kieselguhr, and the resulting mixture was comparatively insensitive to shock, and yet retained most of the power of nitroglycerine. This mixture was known as 'dynamite', and is, of course, still a major explosive. It was the first powerful detonating explosive that could be handled and transported with reasonable safety.

Nobel, however, was still not satisfied; the Kieselguhr in dynamite was inert and made no contribution to the energy derived from the explosion of the charge. He therefore experimented with other absorbents, and was delighted to find that nitrocellulose itself could, in certain proportions, form a homogeneous mixture with nitroglycerine; thus one could obtain a composition which retained the full explosive effectiveness of both components, but which was also reasonably comfortable to deal with, since its sensitivity was considerably less than that of nitroglycerine. By varying the amounts of the two main constituents, and with the use of various minor additives, a large number of commercial explosives were developed, all based on the NC/NG partnership. Most of them are still used, and include collodion cotton, gelignite, blasting gelatine, and various double based propellants known for so long as 'cordites'. One particular advantage of the NC/NG system is that of oxygen compensation. Nitrocellulose has insufficient oxygen for complete combustion of its combustible elements, whereas nitroglycerine has excess oxygen. Hence it is possible, by using the right proportions of each, to strike a balance and ensure complete combustion. This is often—though not necessarily always—very advantageous.

Stability of NC/NG compositions

It was soon noticed that both nitrocellulose and nitroglycerine suffered from the same serious defects—a tendency to decompose during storage. In the case of nitrocellulose especially, this decomposition was autocatalytic and in consequence accelerating deterioration would set in after quite a short time. At best, this made the explosive useless, and at worst highly dangerous. The credit for solving this problem of stability belongs mainly to Captain Abel at Woolwich, who decided that the decomposition was probably initiated by traces of residual acid. He therefore introduced a system of thorough washing of both nitroglycerine and nitrocellulose immediately after the reaction stage; this, together with the addition of chemical stabilisers, increased the life of NC/NG compositions from two or three years to approximately 15 years, and by the end of the nineteenth century the production of these double-based explosives and propellants was firmly established.

Besides the question of the chemical stability of NC/NG systems, other problems can arise. One of these concerns the separation, under certain conditions, of the two components. Even today this occasionally happens, and as the nitroglycerine will tend to migrate to the outside surface, the dangers are obvious. In gelignite, this gives rise to 'weeping jelly'—a notorious operational hazard for the uninitiated (and maybe illegal) users. It is not normally possible for this process to be reversed, and the offending batches must be destroyed in an explosive waste pond, or by some other safe method.

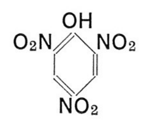
Advances in high explosives in the twentieth century

At the end of the nineteenth century, the main explosives were still gunpowder and the various compositions formed from nitroglycerine and nitrocellulose. With improved methods of production and purification, these had become firmly established, while increased sophistication in processing, blending and the control of operational conditions enabled a clear distinction to be made between high explosives and propellants. The former would detonate giving a shock wave of speed several thousand feet per second, while the latter would simply burn steadily at a slower rate, providing, for example, the push needed to fire a projectile from a gun.

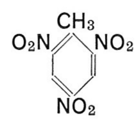
By the turn of the century cordite had already replaced gunpowder as the major propellant, and remained virtually unchallenged until recent times. In the field of high explosives, however, the last 70 or 80 years have seen the advance of several rivals to the NC/NG compositions; at least two of these have become supremely important.

Although now obsolete as a main explosive, *Picric Acid* has an interesting history. Discovered originally in 1775, its properties as a yellow dye stuff were attractive to clothing manufacturers, and a factory near Leeds produced large quantities for this purpose. Needless to say, the inflammable nature of picric acid was something of a disadvantage, to say nothing of its toxicity, of which the wearers of the gay garments were evidently blissfully ignorant. In due course, its use as a dye stuff was abandoned, and not until 100 years later was it developed as an explosive. A plant was erected at Lydd, whence was derived the name 'Lyddite' for one of the earliest picric acid explosives. Picric acid was used quite extensively as a shell filling up and to including World War I, but it has an unfortunate habit of reacting with heavy metals such as lead, forming highly sensitive metallic picrates.

At about the same time as the development of picric acid as an explosive, another yellow crystalline compound was discovered. This was *Trinitrotoluene*, which is in some respects similar chemically to picric acid, as their formulae show:



Picric acid

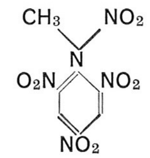


TNT

TNT is universally accepted as a leading high explosive, but in the early days its manufacture was attended by many difficulties. Although the process would appear to be fairly easy, involving the reaction of toluene with a mixture of nitric and sulphuric acids under carefully controlled conditions, the subsequent separation of the required TNT from closely allied but unwanted by-products proved very difficult; the attempts to introduce a continuous, rather than a batch system of production made this problem, if anything, even more acute. Besides this, the toxic nature of TNT and the comparative lack of precautions made the industry very unpopular with the operatives, and in 1917 production was almost brought to a halt. However, improvements in plant control, and stricter safety regulations, eventually solved most of the problems, and production after 1930 was reasonably trouble-free.

One of the great advantages of TNT is its insensitivity; a considerable threshold energy must be reached to achieve detonation, and it is therefore a comparatively safe explosive, even in large quantities. On the other hand, it is not particularly powerful. The methods of deciding the power of explosives are, for the most part, steeped in tradition. Even the old lead block test is still used in some places. In this, a weighed amount of explosive is placed in a hole drilled in a lead block. After tamping, the explosive is fired, and the expansion of the cavity measured by pouring in water (or more lazily, by visual inspection). The performance of one explosive is taken as standard. On this basis, TNT is slightly less powerful than picric acid, and only two-thirds as powerful as nitroglycerine. Nevertheless, its advantages in handling and reliability make it a popular choice.

In view of the energy needed to detonate TNT and some of the other high explosives, it was often found that the initiators (mercury fulminate, lead azide and similar sensitive compounds) were inadequate by themselves. In constructing an explosive charge, therefore, it became customary to insert an intermediate or boosting stage between the initiator and the main high explosive. An ideal substance for this purpose was found in *Tetryl*, known for a long time as 'Composition Exploder' or CE. This also has some chemical similarity to picric acid and TNT:

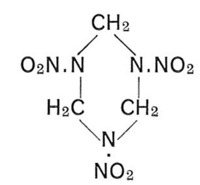


Tetryl

Tetryl is a yellow, extremely inflammable and very toxic material. Its production in the past was frequently hampered by fires, and especially by the incidence of a dermatitis known as 'CE Itch', which caused an irreversible yellow pigmentation of the skin. Young women drafted into explosive factories during the war years soon discovered this.

An interesting component of many explosive mixtures is *Ammonium Nitrate*. In combination with TNT, ammonium nitrate has given rise to a series of useful commercial high explosives, such as ammonal and amatol. The latter also includes aluminium which invariably has a significant effect on the rate of detonation, due largely to its great affinity for oxygen. Ammonium nitrate, though not strictly an explosive in its own right, decomposes to yield large volumes of gas. This decomposition can be spontaneous in the presence of even small amounts of combustible impurities, and it is interesting to note that the two most disastrous accidental explosions in the twentieth century, at Oppau and San Francisco, were caused by the detonation of large cargoes of ammonium nitrate.

Undoubtedly the most important new high explosive to have emerged in the last 40 years is *RDX*. The initials stand simply for 'Research Department Explosive', and it is sometimes also known as 'Cyclonite'. RDX is prepared basically from hexamine and nitric acid, and its chemical structure is as follows:



RDX

Early attempts at the large-scale production of RDX were not very successful, and with the first rumblings of World War II at the end of the thirties, reliable manufacturing methods became a top priority. Such was the position in 1939 that a small pilot plant at Woolwich was moved to Bridgwater, where it was operated in excess of the design capacity to keep the national supply of RDX somewhere near the required level. Shortly afterwards, full scale plant began to come on stream at a number of sites, and RDX rapidly assumed undisputed leadership in the field of high explosives. Its exceptional power made it first choice whenever an extensive shattering effect was needed, and in most respects it was superior to any of the established explosives. However, its early applications suffered from the disadvantages inherent in a situation where a new material is used before its properties are fully appreciated. For instance, one of the favoured methods of filling shells or other explosive containers is by melting and pouring. The melting point of RDX is 204°C, and its ignition point, at which it may detonate, is 208°C. The margin is slender, to say the least. Mechanical filling in the solid state was also found to be hazardous, due to the fact that RDX is rather sensitive for severe handling in bulk. The sensitivity of an explosive is assessed by allowing a weight to fall from various heights onto weighed samples of the explosive under test. The detonation behaviour is then analysed and compared with a standard. On this basis, RDX is twice as sensitive as TNT.

Because of the high melting point and unacceptable sensitivity of RDX, it is now invariably used in conjunction with some other material. The best-known partnership is with TNT, which itself melts at 81°C. The two explosives form a homogeneous blend of convenient melting point and low sensitivity. RDX/TNT mixtures are among the most popular explosives in present use. Alternatively, RDX may be treated with oils, and converted into a variety of pliable, easily manipulated materials all of which are referred to as 'plastic explosive'. Plastic explosive is widely used for demolition work, in which a series of charges can often be fired simultaneously by means of a long detonating fuse known as 'cordtex', which contains another explosive, penta-erythritol tetranitrate, or PETN.

In the early days of RDX production, much trouble was caused by the presence of a somewhat refractory by-product called HMX (high melting explosive) which has subsequently been developed as a useful material in its own right.

Modern propellants

After the replacement of gunpowder by cordite in the late nineteenth century, there were few developments of fundamental significance in the propellant field for at least 50 years. Improvements were made to various process stages in the production of both nitrocellulose and nitroglycerine, and the smooth mixing of these two components to form cordite was assisted by solvents such as acetone, and by better methods of controlling the drying and final extrusion. Stabilisers, combustion catalysts, smoke reducers and other additives were all introduced to make the end product more serviceable, but basically the standard propellant still remained the same double-based oxygen-balanced NC/NG blend. However, in recent years the advent of rocketry has necessitated research for different types of propulsive systems, some solid, some liquid. Even so, the NC/NG propellants, occasionally boosted with aluminium, have almost held their own until very recently. However, the extrusion process traditionally used for the final stage of cordite production is often unsuitable for the size of propellant 'grain' needed for a rocket. Consequently, it is common practice to cast the propellant in a mould which will subsequently form the protective sheath for the grain. Basically, this process consists of adding desensitised nitroglycerine in vacuo to the nitrocellulose, and then curing the mixture cautiously.

Other solid propellants now in use are in most respects an advance on the double-based NC/NG mixtures. The best known of these are the plastic and rubber propellants based on ammonium perchlorate and various polymers. The former supplies the oxygen, while the latter acts both as fuel and 'binder'. Surface-active agents and combustion catalysts are also included, and in many cases the polymerisation is achieved in the rocket tube itself, thus ensuring good bonding. Among the problems arising with these propellants is the question of stress and deformation during flight.

Liquid systems are, of course, very picturesque, and also occasionally unreliable. The standard system is a straight-forward oxidiser/fuel partnership, with both components fed simultaneously as fine droplets to the combustion chamber, where they ignite spontaneously. High in importance among several vital factors are the regulation of the rate of feed to the chamber, and the transfer of heat from the latter. Even before operation, the handling and storage of several of the liquids used have presented many difficulties, since some are unstable.

Since the old days of the V2 rocket, which used liquid oxygen and alcohol, many other oxidiser/fuel combinations have been developed. Among these are liquid oxygen/kerosene, hydrogen peroxide/kerosene, nitric acid/liquid ammonia, and others. The very desirable marriage of liquid oxygen and liquid hydrogen was frustrated for many years by the uncertain behaviour of the latter. Liquid hydrogen and liquid fluorine is another very high energy system, the practical realisation of which is perhaps not far away. There is no doubt that in terms of thrust, the best liquid systems have the edge on anything the solid propellants can produce.

This brief review has been confined to the conventional chemical types of explosive and propellant systems, and space has prevented any reference to developments in the nuclear field. So far as conventional materials are concerned, it is probably unlikely that any dramatic new discoveries will be made in the area of high explosives; however, if the space programmes are to be maintained and fulfilled, some further developments in the propellant field are almost certain to occur, since a number of promising reactions have yet to be thoroughly investigated.

Vico and Dilthey's methodology of the human studies

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In the twelve massive volumes of Dilthey's collected works[1] there are about a dozen brief references to Vico; and though respectfully appreciative they are rather vague and perfunctory. The latest of them, in a fragment from the last years of Dilthey's life, consists of a single sentence, 'Vico relates his research into the history of religion and law to the ultimate depths of human insight,'[2] and is characteristic of the others. Beside this sentence Dilthey scribbed on the margin of the manuscript, 'Look up'.

Nowhere does Dilthey acknowledge personal indebtedness to Vico's work or explicitly draw attention to the parallels in their approach. Expositors of the two authors have been equally reticent. Professor Hodges, though well acquainted with Vico's work, does not mention him when he discusses the sources of Dilthey's ideas in some detail.[3] Max H Fisch and Thomas G Bergin,[4] Benedetto Croce,[5] and Isaiah Berlin[6] all discuss the influence of Vico's work without referring to Dilthey.

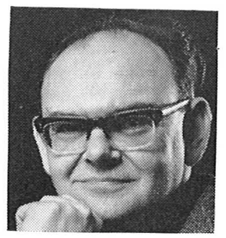
Clearly Dilthey would not have referred to Vico several times if he had not had some knowledge of, and sympathy with, his work. After all, Weber's translation of Vico's *New Science* had been available in German since 1822, and a monograph on Vico by K Werner appeared in 1881. But indirect influences were probably more important. We know that Dilthey was familiar with, and influenced by, such German writers as Hamann, Herder, Goethe, and Jacobi, philologists like Wolf, and historians of law like Savigny, all of whom knew Vico, were affected by him, or, at least, had affinities to him.

There are even less tangible connections, such as shared traditions and common problems producing similar lines of thought in the history of ideas, and it has been argued that Vico anticipated ideas developed by Kant and Hegel without, apparently, influencing them directly. Once we accept this we need not be surprised that Dilthey, who was directly indebted to these two German thinkers, should also have affinities with the Italian. This point was made forcibly by R G Collingwood when talking about history, though he did not mention Dilthey.

'The extraordinary merit of his (Vico's) work was not recognised until, two generations later, German thought had reached on its own account a point much akin to his own, through the great blossoming of historical studies which took place in Germany in the late eighteenth century. When that happened German scholars rediscovered Vico and attached a great value to him, thus exemplifying his own doctrine that ideas are propagated not by diffusion like articles of commerce, but by the independent discovery by each nation of what it needs at any given stage in its own development.'[7]

However, more important than the tracing of the labyrinthine ways in which ideas pass from person to person is the relation between the ideas themselves. In commemorating a thinker of the past we want to assure ourselves, above all, of the continued vitality of his thought. In the story of Vico's persisting importance Dilthey plays a crucial role, for he—probably more than any other single thinker—faithfully reflects the essential train of thought which makes the Italian's work relevant today. But what in Vico were aphorisms, hints, and implications hidden in attempts to reconstruct the past (often factually inaccurate) became in Dilthey a coherent philosophy.

To gain a proper appreciation of Vico's ideas and of their development in Dilthey's hands we must consider the contemporary problems to which they offer solutions. One of the major intellectual issues of our time, which is also of the most urgent practical importance, is the understanding of the human world. In range and precision our knowledge of the physical world exceeds our knowledge of mental, social, and cultural phenomena, and, as a result, the predominant theories of knowledge today take physical science as the paradigm of the cognitive process and look askance at the elusive way in which we gain insight into mental processes. Students of human nature, overawed by the fashionable philosophical models and dazzled by the triumphs of the physical sciences, have tried to imitate the methods of the latter by concentrating on how people behave and on problems that can be approached in terms of strict experiment and statistical analysis. However, though they have achieved some positive results, the social sciences have suffered by comparison with physics or chemistry. Precise observation and experiment



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[1] **Wilhelm Dilthey:** *Gesammelte Werke*, 2d ed. (Stuttgart, 1958).

[2] Ibid., vol. VII.

[3] **H A Hodges:** *The Philosophy of Dilthey* (London, 1952), chap. I.

[4] **Max H Fisch** and **Thomas G Bergin:** trans., *The Autobiography of Giambattista Vico* (New York, 1944), Introduction.

are often impossible or morally objectionable. (You can't look through bedroom keyholes or precipitate marital conflicts artificially.) Qualitative differences frequently defy quantification. For example, classifying thefts in terms of the amount stolen may be meaningless if it submerges the differences between theft for gain and theft for excitement or to gain attention. Sampling also may be misleading because of the variety of human manifestations. The results of an experiment in aerodynamics in Japan can be relevant in Britain, but a study of the attitudes of first-year students at MIT may lack significance in Britain because it tells us something only about *those* students, without helping us to understand English students. Thus, social researchers who imitate the methods of the physical sciences instead of using lines of approach appropriate to their subject matter are pursuing a will-of-the-wisp. They could take advantage of the fact that it is possible to have a much clearer insight into how human beings work than they can ever have about how the physical world works. Instead, they ignore the methods this insight places at their disposal and produce results that fall short of those of their chosen models.

Behind these methodological inadequacies lie deficiencies in theoretical grasp which result, for example, in the absence of a grand strategy for interdisciplinary co-operation. Behaviourist psychology, for instance, can neither receive help from, nor give help to, history. These weaknesses are of more than philosophical interest because they account for the failure of the social sciences to guide our social actions. History, sociology, psychology, economics, and criminology provide us with insufficient help for the solution of the moral, social, organisational, and political problems that confront us today.[8]

It is only against the background of these unsolved problems that we can appreciate Vico's and Dilthey's contributions to a conception of the social sciences. In their work they defined the nature of the human world and showed how it could form the empirical subject matter of the human studies. Rejecting a narrow and dogmatic definition which confines experience to sense impressions only, they developed an epistemology of the social sciences which showed the kind of knowledge revealed by them.

Vico's[9] subject matter is the 'world of nations', or 'civil world', which presents itself to us in terms of deeds, thoughts, ideas, languages, religions, customs, institutions, and myths. All these are manifestations and products of the human mind, though they may have originated in response to biological necessity and external circumstances. The civil world is the creation of men, and so we can understand and know it more intimately than we can understand physical nature. Indeed, these manifestations are more real than such abstractions as circles and lines.

By looking into himself and observing the working of his mind the researcher gains invaluable clues about human nature, and they, in turn, help him to understand the world men have created. This, however, is not an effortless process. It may require a great intellectual and imaginative effort to

1 Vico, from the cover of *Giambattista Vico—an International Symposium*

grasp the purposes behind deeds or words (which are physical manifestations), particularly where people of a very different age are involved. However, we do not simply move from knowledge of human nature to an understanding of civil society. A kind of circle which deepens our knowledge is involved. We do not know human nature merely from introspection. As we study languages, religions, or social institutions, which are all products of human nature, our knowledge of human nature is enriched and we even come to understand *ourselves* better. This deeper insight in its turn leads us to a greater appreciation of the human world.

Here we must introduce the historical perspective so characteristic of Vico. We cannot treat the world of nations, religions, institutions, languages, and, for that matter, human nature itself, as timeless entities with fixed natures. (This was the mistake of the rationalists.) They are all involved in change and development and have quite specific characteristics at different times and in different places. Any explanation must therefore be genetic, that is, refer to origins and preceding causes. It must also make cross-references to the conditioning circumstances—physical or cultural—of a particular period. Vico applied these principles to his own autobiography; he said that he wrote 'as a philosopher meditating causes both natural and moral as well as the occasions of fortune'.

Vico called the empirical study of the history 'of the languages, customs and deeds of peoples in war and peace'[10] philology. But he did not let matters rest there. In his work he claims that, 'philosophy undertakes to examine philology . . . and reduces it to the form of a science by discovering in it the design of an ideal, eternal history traversed in time by the history of all nations'.[11] This new science, he adds, studies 'the common nature of nations in the light of divine providence, discovers the origins of institutions, religious and secular, among the gentile nations, and thereby establishes a system

[5] **Benedetto Croce**, *The Philosophy of G Vico* (London, 1913), app. on 'The Later History of Vico's Thought'.
[6] **Isaiah Berlin**: 'The Philosophical Ideas of G Vico', in *Art and Ideas in Eighteenth Century Italy* (Rome: Edizioni di storia e letteratura, 1960).
[7] **R G Collingwood**: *The Idea of History* (Oxford, 1946).
[8] **H P Rickman**: *Understanding and the Human Studies* (London, 1967), contains a critical examination of approaches to the human studies which try to imitate the physical sciences.
[9] *The New Science of Giambattista Vico*, trans. Thomas G Bergin and Max H Fisch, Anchor Books ed. (Garden City, NY, 1961), pars. 31, 34, 138–40, 237, 314, 331, 332, 342, 345–47, 349, 368, 374, and ibid. (Ithaca, NY: Cornell University Press, 1948), pars. 9 and 1108, contain the bulk of the arguments presented in my essay.

of the natural law of the gentes'.[12] This idea of laws and ideal patterns underlying human affairs is profoundly ambiguous. On the one hand Vico seems to be propounding a scientific programme, but on the other he appears to speak as a Christian convinced of divine providence, or even as a Platonist believing in an a priori order of things which manifests itself in time. I shall concentrate, however, on the interpretation that is relevant to the establishment of the social sciences.

For a discipline to achieve the status of a science it must be able to make successful generalisations and to establish laws about the way things follow each other and are causally connected. In the case of the human studies it is not unreasonable to seek a starting point in certain constant features of human nature. For example, men have physical needs and sexual impulses, suffer from fear, and are capable of using symbols. Vico made use of these facts and argued, for instance, that he was establishing his science of human affairs by analysing 'human thoughts about the human necessities or utilities of social life, which are the two perennial springs of the natural law of nations'.[13] Common needs, then, give rise to universal institutions and, from these, universal principles can be derived. In other words, human beings everywhere and at all times become aware of needing or wanting such things as food, shelter, security, and sexual satisfaction. This gives rise to agriculture, the institution of marriage, and civil society. On this basis we can make generalisations about social life. But, of course, we cannot relate all that happens in history to the deliberate intentions of individuals. Social interaction may have consequences—and serve ends—that none of the participants intended or even foresaw. We may not wish to follow Vico in calling this Providence, but as social scientists we must certainly consider the occurrence of regular patterns.

Insofar as Vico believed that by means of the laws governing human life it was possible to trace the over-all pattern of universal history, he was undoubtedly mistaken. (Indeed, it contradicts his own acute sense of the concrete differences produced by time and circumstances.) Although many distinguished thinkers, such as Hegel, Comte, Marx, and, today, Toynbee, have followed him in this enterprise, most contemporary philosophers and historians would think that such schemes obscure historical research rather than illuminate it. However, Vico's conviction that there are general laws and genetic patterns to be discovered in particular spheres of human life has proved immensely fruitful. It has made him a pioneer of such disciplines as sociology, social anthropology, philology, comparative religion and jurisprudence, psychology, and the history of ideas, in all of which regularities can be established. Although these do not provide a pattern for the whole of history, they can throw light on connections between particular historical events.

These views, elaborated with great philosophical acumen and stripped of any theological bias—and thus more unambiguously empiricist—are found again in Dilthey.[14] He distinguished the human studies from the physical sciences in terms of their subject matter, the former exploring humanity or human socio-historical reality, the latter dealing with physical nature. This means that they are concerned with human nature and its products, with individuals, families, nations, historical movements, social organisations, and cultural systems (the mind-affected world). As in Vico, this world is historical; it presents itself concretely as a process of changes and developments in which every manifestation is determined by its place in time.

Dilthey saw very clearly what Vico had already suggested (for example, in his reference to words), that every feature of this mind-affected world has a dual aspect. It is both a physical fact or event and the expression of thoughts, feelings, or aspirations. A sentence is a series of sounds or of marks on paper and, at the same time, a communication; an action is movement as well as the execution of a purpose. This dual nature gives meaning to these entities which Dilthey called 'expressions'. They form the concrete subject matter of the social studies which aim to extrapolate their meaning. The same idea must have been in Vico's mind when he used the term 'philology'—usually confined to the study of language—for every kind of empirical study of human affairs.

Dilthey called the cognitive process by which we grasp the meaning of expressions understanding—to distinguish it from the quite different process of taking in the physical aspects of expressions or any other physical facts. In practice the two processes may often be hard to distinguish—as when we hear and understand a word simultaneously. They are, however, always *logically* distinguishable. We can hear a Chinese word as clearly as an English one and yet not understand it.

Understanding is a perfectly ordinary and familiar process which occurs constantly in everyday life. It is no more a matter of intuition, hunches, or flashes of insight than is the observation of objects. These forms of illumination can occur in any type of inquiry. Nor is understanding a mystical or mysterious process. We grasp what is in people's minds by watching their expressions and not by looking through their skulls, which would indeed be a peculiar achievement.

Basically we can understand expressions because we experience the connection between external manifestations and their content in ourselves. As we utter sounds we are aware of the thoughts we wish to convey; when we clench our teeth we also know that we are in pain; thus we can recognise what it means when someone else speaks or clenches his teeth. Basically Dilthey's fundamental epistemological point is the same as Vico's. Because we have a common human nature we can understand each other, and because the human world is the product of that human nature we can understand all its manifestations.

This does not mean that understanding is always a simple, immediate process. In most cases we must know or learn about the rules that govern the use of expressions (the linguistic conventions, for example, if the expressions are verbal) and the context in which they occur. When we deal

[10] Letter to Porcia, September, 1725, quoted in Fisch and Bergin's *Autobiography*.
[11] **Bergin** and **Fisch**: *New Science* (1961 ed), par. 9.
[12] Ibid. (1948 ed), par. 31.
[13] Ibid., par. 347.
[14] **H P Rickman**: *Meaning in History: W. Dilthey's Thoughts on History and Society* (London, 1961), contains a selection of translated passages from vol. VII of Dilthey's collected works and a general introduction which explains his approach and places it in the context of modern discussions. It also explains the translation of key terms. All the material on which the present exposition of Dilthey is based can be found in this book.

with complex expressions or with those of a different age this can be an exacting business. It is the task to which Vico applied himself when he tried to recapture the mentality of early men, and he claimed that it took him many years of deep thought to reach his goal.

In pursuing this aim Vico was fully aware that he could not confine himself to the study of verbal expressions and their intended meanings. Actions speak louder than words, and the products of men bear the hallmark of the minds that created them. Even words can communicate a mental content, such as fear or prejudice, which the speaker did not intend to convey or of which he was unconscious. Vico, therefore, tried to

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2 The picture is the frontispiece of G. Vico's main work, *The New Science.* The lady with the winged temples is 'Metaphysic'. She surmounts the celestial globe and in turn rests—partly, mind you—on an altar. The bearded gentleman is Homer. The objects displayed include a sword, a plough and a rudder. By these symbols the main themes of work are allegorically conveyed, but an explanation would take too long. Vico gave some 20 pages to it.

recapture the spirit of nations from their deeds, language, religion, institution, laws, mythologies, and literature. He saw clearly that both a language developed merely to serve practical needs and a poem written to celebrate some heroic action reveal the beliefs, conditions, and problems of a past age. In doing so he pioneered methods that enriched the study of history and prepared the ground for such disciplines as social anthropology and psychoanalysis.

Dilthey shared Vico's clear perception of the nature of the evidence with which the social sciences have to work. He carefully defined and distinguished different types of expressions and considered the value and limitations of each of them for an understanding of human nature.

However, we cannot rest content with the understanding of individual expressions. We want explanations, and in the human sphere, as well as in the physical, this means the discovery of general laws that govern the connections between events. Indeed, we cannot claim even to have properly understood an individual expression until we know why it came about, that is, how it follows from others in accordance with some established generalization. The social sciences are therefore committed to two different lines of inquiry which depend on each other. On the one hand they have to establish individual facts and the actual relations between them; on the other they must discover the laws that govern these relations.

We have already seen how Vico conceptualised this interdependence of approaches in terms of the co-operation between philology and philosophy. Dilthey, like the Neo-Kantians Windelband and Rickert, distinguished between history and the systematic human studies such as psychology or comparative religion. History he saw as the study of individual events occurring in time and thus providing *all* the evidence for our understanding of human nature. For example, the material of psychology consists of biographies, case histories, and accounts of particular experiments; that of economics is derived from economic history. Because, according to this definition, history is not a generalizing discipline, Dilthey concluded that there can be no historical laws as such. It is the systematic disciplines which establish laws and regularities and they repay their debt to history by

throwing light on the connections between historical events in terms of these laws.

Here, once again, we must emphasise the difference, noted by Vico and carefully spelled out by Dilthey, between the physical sciences and the human studies. The former proceed from marshalling the facts—which is a kind of history—to explaining them, by means of hypothetical constructions, in terms of generalisations about their connections. In the human studies the connections that can form the basis for genetic explanations are themselves part of our experience. We see patterns in our lives which we recognise, more uncertainly, in history and which form the subject matter of the systematic disciplines.

Dilthey listed a number of typical relationships, such as that between means and ends, parts and wholes (for instance, the links between the constituents of a configuration or of a developmental process), outer and inner (that is, between overt expression and what it expresses), a situation and the value attributed to it, and that between an individual and his environment, which he affects and by which he is affected. We actually experience all these relationships and make judgments in terms of them, which is why life presents itself as meaningful.

He then analysed our experience of time, for we certainly do not live only through a succession of moments. Every instant is enriched by recollection of the past and anticipation of the future. I could not appreciate a song if I simply concentrated on each sound as it occurred. Instead, each note takes its place in a context formed by my memory of preceding sounds and my expectation of others to come. I could not write this sentence if I did not remember what I had said before or had no idea of what I wanted to say next. Thus, because we look both backward and forward while experiencing the present, we are aware of continuity, and the movement through time becomes meaningful. This experience of time as something meaningful is the growing point of history. We are essentially historical creatures equipped not only to act in historical contexts but also to understand them.

Dilthey also showed how specific contexts are formed in a person's mental life. Seeing something may lead to our wanting it and resolving to get it. Thinking about how to do this will follow, and these various mental processes will produce an action. This need not be a continuous process. An abiding interest, feeling, or aspiration may link activities far apart in time although covering a man's lifetime (for instance, occasional visits to a museum, periodic meetings with a friend, or the step-by-step approach to a goal). In this way a person's life forms a pattern which becomes particularly obvious in retrospect. We see him—or he sees himself—gradually becoming what he ultimately was or achieving what he did.

From these converging insights Dilthey argued the importance of autobiography and biography. In them we discover genetic patterns that we can apply to the more complex field of history.

Here, too, Dilthey justified something Vico anticipated when he described his approach to his autobiography. However, in Dilthey, as in Vico, the process is not all in one direction, from the study of the individual to that of humanity. The individual is himself a historical product. He is moulded by historical forces and is affected by the conditions and prevailing opinions of his age. As a thinker, soldier, or politician he may contribute to the historical context. Thus there is a point at which every adequate autobiography or biography must expand into general history.

In setting out the striking parallels between Vico's and Dilthey's thoughts I have also, I believe, presented a viable theory of the human studies which is a relevant contribution to current discussions about the future of these disciplines. Their subject matter is socio-historical reality, which is meaningful because it consists of expressions of men's thoughts, intentions, feelings, and valuations. Because these are all produced by men their meaning can be understood by the human mind. In the social sciences understanding, which recurs in everyday life, is refined and combined with such intellectual processes as analysis, classification, and generalisation to produce two types of knowledge. On the one hand it gives rise to history, that is, to the grasp of the rich variety of individual human manifestations and their relations to one another in time. On the other hand it leads to the development of systematic human studies that examine the causal and genetic laws behind the development of individuals as well as the patterns of interaction within and between social and cultural systems. The two main types of knowledge are interdependent and so are the different systematic disciplines.

This general view, based on a clearly articulated epistemology and worked out, as we have seen, in rich detail, provides the philosophical justification for a variety of theoretical concepts and research procedures that have proved, and are proving, their fruitfulness. Psychoanalysis has reached its conclusions by interpreting unconscious expressions; Gestalt psychology concentrated on configurations; sociology, social anthropology, and social psychology have used genetic and functional explanations; they have accounted for actions in terms of norms, rules, and purposes and have explored the connection between personality structure and social systems. Historicism, which rejects the application of non-historical criteria to historical phenomena and insists that each must be explained in terms of its own context, has greatly influenced the practice of historians. In all these fields we can see the impact of Vico's and Dilthey's thought on modern developments.

Over and above this influence on different spheres of research, such a philosophy of the human studies brings home to us the fact that each discipline acquires its subject matter by abstracting an aspect from concrete socio-historical reality, a fact which warns us not to regard the division into separate subjects as absolute and which should encourage constructive interdisciplinary co-operation.[15]

Rickman: *Understanding and the Human Studies*, presents a theory of knowledge and methodology of the social sciences along the lines developed by Dilthey.

The City University Africa Expedition—the road to Freetown

by Mo Watfa, Graduate in Mechanical Engineering

Fresh from their final examinations in the Department of Mechanical Engineering four students departed at the end of August on The City University Africa Expedition, returning at the end of November. One of them, Mo Watfa, tells the story of their eventful journey by second-hand Land Rover through Europe and West Africa to Freetown in Sierra Leone.

The objectives of the Expedition were:
(a) to make a survey of the technological, economic and social aspects of the Guma Valley Water Scheme in Sierra Leone;
(b) to study the technological and economic aspects of the Hydro-electric Schemes in the Atlas Mountains of Morocco;
(c) to form a link between the University of Sierra Leone and The City University;
(d) to make detailed reports and films on the overland journey and the project work in Morocco and Sierra Leone, and to make these reports and films available to staff, students and friends of the University through the University Library.

Financial support was given to the Expedition by the Old N'Ions Association, the Students' Union Society, the charitable fund of the Worshipful Company of Goldsmiths and World University Services. Of the £1,150 budget for the Expedition some £360 was provided through grants from the above sources.

Generous support in the form of supplies and equipment came from Tate and Lyle Ltd, Weetabix Ltd, the Nestle Co Ltd, Heinz Ltd, Millets Ltd, and Nicholas Laboratories Ltd. Assistance was also given by Kodak Ltd whose films were used for all photographic work, and photographic equipment was supplied by the University's Department of Mechanical Engineering. The travellers were helped by Mr M H Heppenstall, of the Department of Mechanical Engineering, and by the Rover Car Company and Wrigleys.

We all grinned happily as we drove down St John Street from The City University with a 10,000 miles round trip in front of us including 3,000 miles of desert.

The day was 25 August 1969. We had just been given a good send off by the press. It had seemed impossible at times during the previous months to convince people that we were serious about our expedition. The sight of four young men dressed in tattered gear turning up for a press conference in a 15-year-old Land Rover did not improve our image.

The four members of the expedition were: Pat Reynolds, Nick Turnbull, Chris Wilson and myself; there was also Benjamin the Faithful, our Land Rover.

The St John Street part of the journey was uneventful, as you will have gathered, and so was the journey across France and Spain. In Paris Pat was convinced that something was wrong with the steering and with a true engineer's spirit he set about taking the steering to pieces. Fortunately, a French mechanic came to the rescue. In Madrid Nick conducted us on a grand tour round the shanty town part of the city, and in his effort to find his way out nearly drove us all the way back to England.

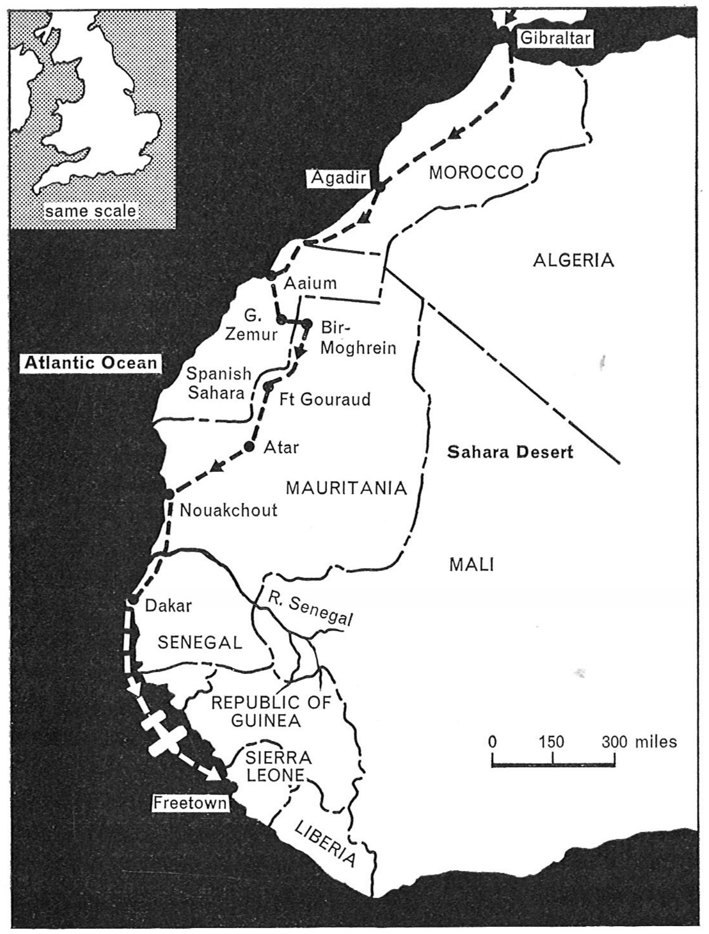
In the Atlas Mountains
A week after setting off we reached Morocco. We travelled inland across the Atlas Mountains where we conducted two surveys on the hydroelectric schemes in the area. After two and a half weeks we arrived at Agadir, the last town before setting off along the Moroccan part of the Sahara.

In Agadir we sat down and planned our desert crossing. The locals were of no help. In answer to our enquiries the Tourist Office sent us to the Police Headquarters who in turn sent us to the Provincial Governor's Office. There we were directed to the Army headquarters and the only help they offered was to direct us back to the Tourist Office. It seemed fantastic, with the desert only 100 miles away, that no one was qualified to answer our enquiries.

Undeterred, and with the comforting feeling that T E Lawrence was an Englishman too, we set off towards the desert on the morning of Monday, 15 September. We had planned that the crossing would last eight days, but were soon to be very relieved that we had brought sixteen days' supplies with us. We had to cover 160 miles of Moroccan desert before reaching the Spanish Sahara. Tracks and tyre marks seemed to converge and diverge in every direction. The earth at first was dry and

Mo Watfa, having graduated with a first class honours degree (BSc) in Mechanical Engineering, is now working for Tracked Hovercraft Limited at Cambridge.

Pat Reynolds



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hard and stones, rocks and wild cactus bushes littered the whole scenery.

The going was very rough indeed and our speed dropped to a mere walking pace. Our spirits were still very high at this stage and we were very excited when the first sand dunes appeared. The first dune we reached was a giant, 150 ft in height, and in our excitement we climbed to its top and surveyed the desert around us. Tyre marks seemed to appear from nowhere and then disappear under the dunes. Two hours of travelling in sand dune country and we were hopelessly lost. We tried to follow a compass reading but the dunes dictated our direction of travel. We stopped and I climbed to the top of a giant dune and looked around. I spotted a camel rider a fair distance away to our right so I headed towards him. He turned out to be a young boy about eight years old.

'Good afternoon brother' I said.
'Good afternoon brother' he answered.
'May peace envelop you.'
'May peace envelop you, too.'
'Do you know the sands around here?' I asked.
He nodded, amused.
'Then you can tell me the way to Tarfaya?'
'It is this way or this way or this way.' With his forefinger he swept an arc of approximately half a circle. He appeared to be concerned over the puzzled look on my face.
'But brother, which way is the best way?' I enquired again.
'Yesterday it was this way,' he said pointing in a certain direction, 'but that was yesterday. Today, well, God has all the knowledge.' His answer seemed to please him and his camel seconded his master's statement with a loud groan.

Three inquisitive faces welcomed me on my return.

'Well, which is the best way?' asked Chris.
'God has all the knowledge.'

We decided to retrace our steps, and luckily enough we made the decision in time for the wind had made our tracks barely visible. Three hours later we managed to make our way back to a spot where we could pinpoint our position on the map and from there we set off in a different direction which led us to safety.

The Spanish Sahara
Two huts in the middle of nowhere made up the border between Morocco and Spanish Sahara. The hut flying the Moroccan flag was fittingly enough deserted and a shepherd who was making himself at home inside was not too pleased when I woke him up. Three Bedouin soldiers, guns slung over their shoulders, met us at the Spanish hut.

'Passports please.'

One of them flicked through the pages of my passport and then straightened the passport the right way up when he came to the page containing my picture. They were really confused and did not know what to do with us. They could neither read nor write and spoke Arabic only. Their officer was chasing females somewhere in a distant oasis. They were very relieved indeed when I made myself at home behind the officer's desk and filled in all the relevant information in the first file I laid my hands on, and after many handshakes and back pattings we were off again.

The Spanish Sahara is flat and bare, and at this time of the year very hot. Not even wild cactuses fancied growing there. The place is a military fortress. The entrance and exit routes from all the settlements are guarded and a 'Territorial Policia' would accompany us to the headquarters. We were often made to wait till the morning before we could proceed again, after being made to sign declarations saying that the Spaniards bore no responsibility for whatever happened to us.

At Guelta Semmur, our passports were withheld until the morning. We were forbidden from speaking with the locals and were given a cell to use for the night. We were warned against wandering around at night. The neurotic captain's pastime was shooting at anything that moved at night. That night the captain was on target and another donkey bit the dust.

I found some difficulty in sleeping. The heat was intolerable and Pat's snoring, Chris's turning and Nick's murmuring did not help either. At 3 o'clock in the morning I heard a noise outside our cell, then I saw the door open slowly. I reached for the axe under my sleeping bag but my hand froze before

Nick Turnbull

Chris Wilson

I reached it. The nozzle of a gun appeared in the doorway and two soldiers walked in. One of them switched on a torch and the light beam travelled from one face to the other. They went back the same way, being satisfied all was well.

We were very relieved when we drove out of the Spanish Sahara the following morning into the great expanses of Mauritania. However our relief was very short lived.

Sand storm in Mauritania
Chris was the first to spot it. A big black patch which appeared over the horizon and sped towards us. According to our mileage we should have reached Bir Mogherein, a camel watering settlement, and we were worried because nothing could be seen for miles. Soon we were enveloped by darkness as sand, pebbles and bushes flew at us. We parked Benjamin with its back to the wind. I got out with my collection of cameras, but I was soon driven back in with my nose and ears full of sand. The storm lasted for three hours, and the quietness that descended after the roar of the storm was frightening.

We were really worried now for we had covered an extra 15 miles, yet there were no signs of Bir Mogherein. Someone had the theory that we were still in the Spanish Sahara, and drew a few circles on the map to prove his point.

'The storm contains electric charges, right? It must have mucked up all our compass readings, right? . . .' he added. We were all beginning to believe our 'Einstein' when we saw a flock of camels and a shepherd coming towards us.

'Is this Mauritania?' I asked him.
'Mauritania?' he enquired back. Evidently someone had forgotten to tell him that they gained independence 10 years ago.
'Bir Mogherein?' I tried again.
'Over there.'

We could not see anything. However, 15 minutes later we were there and a new chapter in our journey started.

Missing passports
Our passports were collected by the military governor, and 15 minutes later were mislaid somewhere. The man who last had them was last seen heading in full stride towards the Harem quarters. Four hours were lost searching, and after they were found we were kept for another hour answering useless questions.

'Your father's name? . . . Your grandfather's name? . . .
Your great grandfather's name? . . .'
I was doing all the interpreting
'What is your great grandfather's name?' I asked Nick.
'Why on earth does he want to know? I don't bloody know.'
'Robin Hood' I said to the gentleman behind the desk.
'Good, what is your address?' was his next question.
'Piccadilly.'
'Oh yes' he said and wrote PIKDLY.

Two hours later we had set up camp six miles outside the settlement and we were enjoying another Pat special—corned beef with mashed potatoes (and bits of crunchy sand of of course). We were a happy and satisfied crowd when we turned in. Little did we know what the following day had for us.

The Sahara flooded
It was Sunday, 21 September, an insignificant date perhaps, but a day certainly to be remembered in North Africa. This area had been suffering from drought for the past seven years, then on this particular date 'someone up there' took the plug out. I never even dreamt of seeing the Sahara under 2 ft of water.

The morning was dark and cloudy when I woke up at about 6 o'clock. Chris helped me with the breakfast, and with a cup of coffee and some Weetabix we succeeded in coaxing Nick out of his sleeping bag. It was also Pat's birthday and to celebrate the occasion we gave him an extra drop of coffee. We had only covered about 80 miles of the 250 miles' journey to Fort Gourand when it started to rain. The storm lasted for a whole day.

'Is it raining outside, or am I seeing one of those mirages again?' I broke the silence.
'Go back to sleep, Watfa.' So I went back to sleep. Our mileage dropped from 20 mph to 5 mph. The going was getting harder all the time as the sand became soft and treacherous.

1 Among sand dunes in the Moroccan desert

2 Among new-found friends in Fort Gouraud


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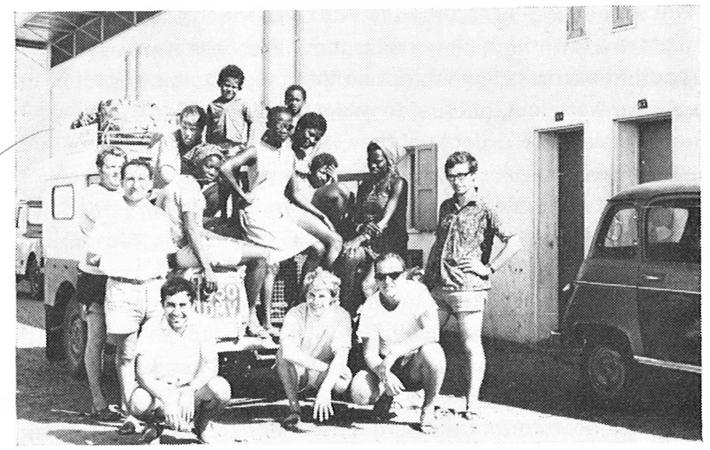
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Inevitably, we were soon stuck in soft wet sand, and we got out and pushed. We spent the following three hours digging and pushing; as soon as we cleared a soft spot we landed in another. We passed two open mouthed and wide eyed Bedouins. I think they were suffering from shock.

'Allah is generous' said one of them
'Speak for yourself, old man' I answered.

We were already four days behind schedule so we ploughed on. Two more hours of hard work and the result was a 100 yard long trench, $1\frac{1}{2}$ ft deep, to show for our effort. And it was pouring down all the time.

We were wet, tired and hungry, so we steered Benjamin to an 'island' and called it a day.

The lightning and thunder had ceased in the morning but the sky was still overcast. We waited for the sun to appear and dry the sand, but after a few hours we gave up waiting and decided to push on. The whole scenery around us was littered with lakes which seemed to interlink and bar our way. I stopped counting the number of times we were stuck after I ran out of fingers. We pushed and dug Benjamin out many times. In some places the differentials, axle, and the suspension all sank into the sand and we only just managed to open the door. Late in the afternoon the sun appeared and the sky cleared up, and to make up for earlier lapses it was unbearably hot. We pushed and dug and drank several gallons of water.

All the settlements in the Sahara seemed to be built in the middle of sand dunes, and Fort Gouraud was no exception. We saw the lights of the settlement just before midnight. Sand dunes barred our way for the last few miles and we had to make a long detour and approach the town from the south.

Guests at Zouerate
There was the customary enquiry about our family trees. We then drove through the night 20 miles east of Fort Gouraud to a place called Zouerate. This is the headquarters of MFIRMA, which mines the biggest iron deposits in the world. A train 2 km long and driven by four engines carried the mined rocks 500 miles across the desert to the sea. Zouerate offers all modern facilities for the large French community.

The French community were very hospitable indeed and we stayed for two nights as guests of the deputy mines inspector. We were very sorry to leave the comforts of Zouerate and head to the open desert. Atar, our next destination, was 200 miles south of Fort Gouraud, and soft treacherous sand covered most of the way.

It was a very hot day indeed, 60°C or so. We had to stop a few times and allow the water in the radiator to cool down as the temperature zoomed towards 100°C. Many times we got out and pushed Benjamin across soft patches of sand. Before leaving Zouerate we were given two cartons filled with beer and soft drinks bottles. Soon we had polished off the whole lot and started on our water supply.

The heat made us dizzy and short tempered. Just before sunset we lost our way and the track we were following just vanished. We spent three hours in the dark searching for it with no success. We knew we were very close to a maintenance station on the railway line, 100 miles south of Fort Gouraud. At 10 pm we spotted the station lights and headed towards it across the roughest country I have ever known. Rocks and boulders embedded in soft sand barred our way. However, with the thought of a cold beer in our minds we reached the station without any grumble. We had our beer and camped there for the night.

The second half of the road to Atar was much easier and we made the town in the early afternoon. We were warned to report at each settlement, not so that they would search for us if we were lost, but just to make life difficult for us. They never seemed to expect us, they were neither interested in where we had come from or where we were going. The only thing that interested them was our grandfathers', great grandfathers' and great grandmothers' names, etc. We called at the customs office, and there they kept us for an hour asking the now very familiar questions. We were then escorted to the Gendarme Nationale office where we repeated the performance and wasted another hour; then they conducted us to the police headquarters. I think we were the first strangers they had seen for months and they were enjoying themselves.

Meeting with authority

In the police quarters they sat us in a long corridor with doors on either side. The police quarters seemed to serve as a local government office. Most of the doors carried names such as 'Camel Control Department' and 'Date Marketing Department' and none was relevant to our function. We sat and watched the procession as our passports went from one door to the other. At one point a high ranking officer came marching down the corridor. Everyone seemed to stand and salute. He slowed down as he drew in line with me, taking apparent interest. I got up and gave him a 'two finger' sign. He grinned happily and saluted back.

We were getting worried now. We had been at the police station for three hours and the passports were on their fifth cycle round the corridor. Finally, I got up and followed them as they were taken again into one of the rooms. I grabbed them from the hands of the bearer before they were placed on the desk. An Arab in full glorified dress sat behind the desk and I shook his outstretched hand which was meant to pick the passports and said:

'Thank you, I see you have finished with the passports. I must apologise for all the trouble we have caused you and, as an Arab, I am very proud and impressed by your efficiency. Keep it up.'
'Wait a minute' he said, 'one last question.'
'Of course, I'll only be too pleased.' The passports were nestling safely in my back pocket.

'Who is the leader of the caravan?' he asked.
'God is the leader' I answered. He was satisfied. We all crowded in Benjamin and drove at top speed out of Atar, six hours after our arrival. We vowed never to call at any police station in the next settlements.

Across the River Senegal

The desert for the next stage was firm and we made good time. We drove through Akjojt and Nouakchout without a glance at the police station, and two days after leaving Atar we were approaching the River Senegal. The River Senegal forms the boundary between desert and jungle.

Rosso is the town on the river and the last point in Mauritania. We were not challenged by any customs officials so we did not bother to search for them or have our passports stamped. We just drove on to the ferry and waved goodbye to the Sahara as we crossed to the opposite bank. It was exactly 15 days since we had left Agadir.

What a luxury to drive again on tarred roads. Soon Nick was speeding at 50 mph towards the capital.

'Not bad going, Nick' I said. 'We've covered 13 miles in the last 15 minutes.'
'Go back to sleep Watfa.' So I shut up and went to sleep, and when I woke up again we were in Dakar.

Fortunately I have nearly 500 cousins and some of them live in Dakar. We made ourselves at home there and it was quite a change to sleep on soft beds between clean sheets again. For three days we ate like savages, and slept like mules, the sound of our snoring echoing round the house.

Into Freetown

We eventually gave up hope of getting permission to travel across Guinea to Sierra Leone, so we flew on the last stage of the journey. We landed in Freetown on Wednesday, 1 October. Freetown is my birthplace and a good proportion of my 500 cousins live there. We had a good reception from the press, my cousins, and everybody. It was really worth it and soon we got on with the work and study we came for.

This is not the end.

For of course there is the return journey along nearly the same road.

And the customs officials at Rosso who could not understand how we were entering the country yet we were supposed to be in it.

And the desert, green and beautiful after the floods.

And Benjamin breaking down, slap bang in the middle of nowhere.

And how can we forget the bandits that ambushed us 20 miles south of Bir Mogherein?*

* This appears to have been rather a hair raising incident. The *Islington Gazette* of 28 November, interviewing the four travellers on their return, reported them as saying, '... and once we were stopped by Arab bandits. There were about seven of them.
'We were travelling along at night when we spotted a single headlamp ahead. We decided to stop, thinking it might be someone needing help. Afterwards we were told you should never stop in the desert at night.
'We were very lucky because Mo, who comes from the Lebanon, can speak Arabic ... we managed to bluff our way out. We told them we had another two vehicles following on behind and they seemed apprehensive and let us go.'

First symposium on car aerodynamics

by Mr A J Scibor-Rylski
Department of Aeronautics

Last November, for two days, the first international Symposium on Road Vehicle Aerodynamics was held at the University. Of approximately 125 delegates, several from overseas, some 30 per cent were from industry, including the motor racing industry, 60 per cent from universities and research establishments, and 10 per cent from the press and other interests.

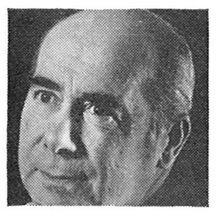
The Department of Aeronautics has been engaged for a considerable time on developments in the field of industrial, or non-aeronautical, aerodynamics. The aerodynamics of road vehicles has attracted the Department's special attention. In 1968 the Worshipful Company of Goldsmiths, recognising the possible implications of a scientific approach to industrial aerodynamics, granted me a travelling fellowship to study the progress in this field in all western European countries. An account of what I saw has already been published in *Quest**.

This survey of European centres of research and road vehicle industries indicated that there is great need, not only for exchange of technological information, but for direct and personal contact between road vehicle specialists, stylists, designers and manufacturers. Problems of road vehicle aerodynamics are the subject of serious study in national research institutes, universities and some industrial research centres, but in practically all cases these centres work alone.

The vehicle industry is to a certain extent indifferent to aerodynamic problems, and stylists, especially those of big manufacturers, often work without even fundamental information on the relationship between aerodynamic characteristics and a given car shape.

The field of industrial aerodynamics, and in particular the aerodynamics of road vehicles, requires a considerable amount of theoretical and experimental work. It requires, too, a fair amount of coordinating of ideas and great effort in popularising these ideas in the industrial world.

Road vehicle aerodynamics is one of the fields in which The City University can fulfil its role as a technological university. It was appropriate that it should be the initiator, last November, of an international symposium that provided a focal point for activities in this field.



Mr Scibor-Rylski, a Lecturer in the Department of Aeronautics, was Organising Secretary of the Symposium on Road Vehicle Aerodynamics.

The Symposium Advisory Committee was composed of representatives of British institutions prominent in the field of industrial aerodynamics. These included the Motor Industry Research Association, the Institution of Mechanical Engineers, the National Physical Laboratory (Ministry of Technology), the Royal Aeronautical Society, the Loughborough University of Technology, the Imperial College of Science and Technology, and The City University Department of Aeronautics.

The Symposium was opened by the Vice Chancellor of The City University, Sir James Tait, in the Great Hall. Sir James, welcoming the delegates to the University, underlined the importance of the Symposium both to the industrial and to the academic worlds, and commended it as a pioneering effort.

The first session included five papers, related to general aerodynamic problems, and was chaired by Professor R N Cox from the Department of Aeronautics of this University.

The first, very fundamental and interesting paper was read by Mr J L Stollery and Mr W K Burns of the Department of Aeronautics at the Imperial College of Science and Technology. It dealt with the most basic problem of aerodynamic forces acting on bodies moving in the proximity of the ground, and presented results of wind tunnel experimental investigations showing that the presence of the ground, when clearance between the ground and the underside is comparable to that in the case of a road vehicle, caused the aerodynamic lift force to be reversed and turn positive, ie, act upwards. The problem of aerodynamic lifting of cars is very important because it is related to the effectiveness of driving and steering wheels.

Mr F G Maccabee of the Department of Transport Technology, Loughborough University of Technology, presented the results of his study on the effect of shear flow caused by atmospheric wind on the flow patterns around a road vehicle. This investigation is again of a very practical value. In real life, vehicles move in an air atmosphere which is seldom at rest with respect to the ground; that is, there is usually a wind. In such a case, the velocities of wind vary considerably with the distance from the ground due to air–ground viscosity effect. This phenomenon is currently called 'wind gradient'.

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The wind gradient affects in turn the air flow patterns around the car and consequently its aerodynamic characteristics.

Mr D M Sykes, of our Department of Aeronautics, presented an interesting paper giving results of his investigations into the effects of low flow rate gas ejection into the wakes behind vehicle shaped bodies moving in the proximity of the ground. It is known that, due to the phenomenon of air viscosity, a moving vehicle drags behind it a volume of air, which is turbulent and which opposes the motion of the vehicle by creating at its rear surfaces negative pressure distribution. When a certain amount of air or gas is injected into the region of such a wake, its mean pressure can be raised, thus positively affecting the so called 'base drag'. Mr Sykes produced valuable diagrams showing car designers how much the aerodynamic drag of vehicles can be reduced by this method. As the gas injected into wakes can be either air scooped in front and used in internal working or ventilation flows, or can be the mass of exhaust gases from the engine, the whole problem has a definite practical value.

Mr D M Waters of the Department of Transport Technology, Loughborough University of Technology, produced a paper giving results of his wind tunnel investigations of the aerodynamic behaviour of car–caravan combinations. He found that car–caravan combinations, as complex-bluff bodies in motion with respect to air and ground, produce strong interactions between transverse vorticity associated with the aerodynamic lift force.

Professor Alberto Morelli of the University of Turin presented a highly original and valuable paper on the aerodynamic actions of an automobile wheel. This work is, to my knowledge, the first attempt to present in documentary form the aerodynamic characteristics of car wheels.

In the chair for the second session was Mr R Hills, Chairman of the Aircraft Research Association. This session discussed the aerodynamic aspects of road vehicle stability and road holding. These are the most important problems in the whole field. While aerodynamic drag is important to the vehicle economy of power, the aerodynamic effects on stability and steering are important to safety of motoring.

This session was composed of three fundamental papers. Mr Tetu of the French Research and Application Association CD of Paris, the author of the first paper, could not attend the Symposium and his paper was read for him by Professor L Romani. The paper discussed aerodynamic effects on road traffic and stability of automobiles in general. Mr J B Russell and I, presented jointly a paper on the aerodynamic effects on the lateral control and stability of motor vehicles. This paper considered the relation between the stability of a vehicle and its aerodynamic characteristics. Mr Russell presented computer program results showing these relations. My part was to discuss the effect on resultant trajectory of a vehicle turning into and with a side wind.

In a valuable paper, Professor F D Hales of the Department of Transport Technology, the Loughborough University of Technology, gave a thorough survey of problems related to stability of vehicles.

All these papers presented results obtained recently and were to a considerable extent 'trend-setting' papers, which will probably affect future directions of research.

The chairman of the third session was Dr E W E Rogers of the Division of Aerodynamics, the National Physical Laboratory (Ministry of Technology). This session dealt with some special problems of road vehicle aerodynamics grouped in three papers. Mr C Deutch, president of the Automobile Society of France and Director of the Research and Application Association CD, presented a paper, again read by Professor L Romani, on environmental aerodynamic effect on vehicles in motion. The paper discussed estimation of the effect of certain details of road and ground profiles, and the effect of other structures near the road in the case of a cross wind.

Mr F N Beauvais, of Aerodynamic Advanced Systems Research, Ford Motor Co, USA., presented a well documented and very comprehensive paper on the transient aerodynamic effects on a parked vehicle caused by another vehicle passing at speed. This paper showed the thorough American experimental methods applied to the problem. It was one of the most interesting papers and provoked considerable discussion. Although the Americans were seeking information on aerodynamic transient forces to design a practical car jacking system, these experimental results are of great practical value in all problems where the phenomenon of a buffet of one vehicle by another occurs.

The chairman of the fourth session was Mr R H Macmillan, Director of the Motor Industry Research Association in Great Britain. This session dealt with test facilities and with experimental techniques, and was covered by authors from West Germany, France and from this country.

In one of the key papers of the Symposium, Dr J Potthoff of the Institute of Automobile Technology, Stuttgart, was concerned with experimental methods used in measuring aerodynamic drag and lift of modern motor vehicles. He discussed in precise detail the limits of the validity of practical measurements of aerodynamic forces on vehicle models in a wind tunnel, and the extent of possible errors due to incomplete simulation of real conditions.

The achievements of Britain's Motor Industry Research Association in the experimental field were covered by Mr R G S White, who discussed their full scale aerodynamic tests on vehicles in the large wind tunnel and on test tracks. These tests, carried out on full sized vehicles, have produced results which serve among other uses to check the validity of scale model testing. Also, a whole new kind of experimental technique is being developed with aerodynamic tests on full sized vehicles on the test track.

Mr G W Carr of MIRA completed the presentation of the paper on road vehicle aerodynamics by his study of scale models in a smaller wind tunnel. He discussed the experiences and measuring techniques used in wind tunnel work, and the validity and practicability of different methods of simulation of real road conditions.

Professor L Romani, the Technical Director of the Eiffel Laboratory in Paris, presented a paper related to the measurements of the aerodynamic drag of a full sized vehicle on the test track. He analysed in detail the method used at present in France consisting of 'dynamometric rod' by which the tested vehicle is pushed by another vehicle from behind. The force acting on the rod is measured by means of strain gauges and recorded together with the speed.

Mr G G Lucas and Mr J D Britton, Department of Transport Technology, Loughborough University of Technology, discussed the method of measuring aerodynamic drag of a full sized vehicle by means of measuring its deceleration and speed along the test track. The method, and the instrumentation system involved, were critically discussed. A new method, using continuous wave doppler radar, was practically assessed.

The fifth session of the Symposium was concerned with aerodynamics of racing cars. The chairman was Mr J L Stollery.

Professor Romani presented a paper on aerodynamics of racing cars, dealing with the maximum possible reduction of vehicle drag with a view to optimising the speed. It discussed the generated lift at high speeds and an application of negative lift ailerons. To facilitate turning, Professor Romani considered the use of stabilising fins at the rear.

Mr A D Sussex and Mr R Northcote Smith of the Department of Mechanical and Aeronautical Engineering, Kingston Polytechnic, presented a paper on the development work of a racing car (Piper GTR Group 6 prototype). Experimental methods used in obtaining aerodynamic characteristics from wind tunnel model tests, and application of these in the development work on the racing car prototype are of great practical value to all concerned with car design.

Finally, there was a 'round table discussion' on racing cars. Mr A C Rudd, Chief Engineer, Lotus Car Ltd, was the chairman of this meeting, with a panel from the racing car industry consisting of Mr Colin Chapman, Chief Designer, Lotus Cars Ltd; Mr J Marquart, Chief Engineer, Bruce Maclaren Motor Racing Ltd; Mr L Bailey, Chief Designer, Alan Mann Racing Ltd (Ford); and Mr D A White, Surtees Racing Cars Ltd. Academic representatives on the panel were Mr J L Stollery of Imperial College, Mr R G S White of MIRA, Mr E W E Rogers of NPL, and myself.

The exchange of ideas on racing car problems between the industry, research institutes and universities proved fruitful. The discussion began when I presented briefly my ideas about negative lift devices on racing cars. As a result of this discussion, two main problems were pinpointed by the racing car industry representatives. More information and eventually solution of these problems is pressing. These are: first a study of the air flow underneath the road vehicle and the aerodynamic lift affecting steering and stability; second, a study of the aerodynamic effect of rotating car wheels. At the time of the Symposium, the Department of Aeronautics at The City University was already engaged in research into the air flow on the underside of the vehicle, and to my knowledge one of the tyre manufacturers recently decided to give a research grant for the study of aerodynamics of rotating wheels to another university.

Apart from the nineteen authors of papers, the Symposium assembled more than 125 designers, engineers, research workers and manufacturers of road vehicles. During lunches and teas, and during a successful evening reception, these specialists mixed together and interchanged ideas.

Further meetings?

The general opinion of participants was that further meetings should be organised regularly. A comparatively large percentage of delegates came from overseas (six from U.S.A.; six from West Germany; four from Italy; three from France; two from Holland; one each from Belgium and Austria). Vehicle manufacturers from overseas, like Porsche, Daimler-Benz, Volkswagen, Fiat, Ford, DAF, General Motors, were represented. In addition to the centres of vehicle research mentioned earlier, like the Universities of Stuttgart and Turin, other foreign universities represented included Naples, Munich, Vienna and Paris. Among other overseas research institutes, General Motors Research Laboratory, Michigan, USA, the Belgian Von Karman Institute for Fluid Dynamics, and the Aerospace Association of California should be noted. Most strongly represented, of course, were the British academic and industrial worlds.

British car manufacturers represented included Rover, Vauxhall, British Leyland Motors, Ford, Lotus, and major racing car firms like BRM, Bruce Maclaren Racing Ltd, Motor Racing Development, Costin Automotive Racing, Lenham Motors, IBEC Racing. There were many representatives of the car accessory industry such as tyre manufacturers. British universities were represented including, apart from the universities directly involved in presenting papers, the Universities of Nottingham and Southampton and the College of Aeronautics, Cranfield. British research institutions represented included the National Physical Laboratory, the Aircraft Research Association, the Royal Aeronautical Establishment and the Royal Aeronautical Society. There were also institutions directly involved in investigations of road vehicles, like the Automobile Division of the Institution of Mechanical Engineers, the BP Research Centre, the Road Research Laboratory and, of course, the Motor Industry Research Association.

All the papers read at the Symposium are now being edited and are to be published as the first 'Book of Proceedings of the Symposium on Road Vehicle Aerodynamics' as soon as posible.

Books

The Face of the Third Reich by Joachim C Fest, translated by Michael Bullock, Weidenfeld and Nicolson, 65s.

The best pages in this book are, perhaps, the first two. This is in no way intended to be an adverse criticism of the remainder for it is an extremely interesting work and, it should be added, very well translated. Here, at the very start, the author states first that 'what we call National Socialism is inconceivable without his (Hitler's) person. Any definition of this movement, this idealogy, this phenomenon, which did not contain the name of Hitler would miss the point.' This is true, but it is a conventional judgement. He then goes on to say, 'He was the incarnation of the average . . . in him the masses encountered themselves'. There follows a brief analysis of the society in which Hitler lived and 'the pathological factors which Hitler the individual shared with the post-war society that brought him to the top'. This is true and it needed saying. Hitler was so fantastic a character, so unspeakably evil, that it is difficult to realise that he represented the attitudes and ideals of thousands. That was the basis of his power.

It should be realised that Dr Fest has not written a history or a set of short biographies. Anyone who has read nothing on Germany of that period or on the life of Hitler would probably be rather at sea. But once he has read that history he would be well advised to turn to this book. It would force him to think about it; it would convince him that it all really happened. It takes some believing, that Himmler, for instance, nearly fainted with horror when he once witnessed an execution and that he was quite put off his food if he was reminded that animals had been slaughtered to provide it, that Höss, speaking of Auschwitz, could say, 'Believe me, it wasn't always a pleasure to see those mountains of corpses and smell the perpetual burning.' The book is full of stimulating observations and quotations. It is not a work of scholarship; there are many quotations from other studies of Nazism. But Dr Fest is scrupulous in giving his references, though it is a great pity that page references are supplied so seldom. Anyone wishing to make a more detailed study of Nazism would be well advised to read the notes of this book.

The author is concerned about the present and future more than the past. He believes that there is much to learn from history. Let us follow his example and consider one aspect of the Nazi phenomenon. Dr Fest when referring to it makes no attempt to point the moral nor shall any such attempt be made here. Perhaps there is no moral: the reader must decide. There is a brilliant description of Hitler's life in Vienna for six years from when he was nineteen. As one reads it, one realises that it is a most vivid picture of a hippy, even down to Hitler's appearance in those days as described by one who knew him then: 'his hair long over his coat collar and a thick ruff of fluffy beard encircled his chin'.

Much later in the book, in the chapter on Baldur von Schirach, we read of the Wandervögel movement of pre-Nazi days, which 'was fundamentally escapist. What purported to be a revolt against the dullness and dreariness of the bourgeois world was at bottom a retreat into a special state of mind, not seeking to change the world but despising it.' The author shows how much the Hitler Youth owed to this movement. He analyses 'the question gap' of those days, that is under the Nazis. 'On closer inspection' we see that it had merely undergone a remarkable process of reversal and that now it was the adults who had been largely forced into a condition of dependence. In this form the division was often deliberately kept alive and turned above all against the rival authority of parents, churches and teachers. Schirach once accused these of forgetting 'that in a higher sense the young are always right'.

And the conclusion? It was expressed in Hitler's words, 'I want a violent, domineering, undismayed, cruel youth. Youth must be all that. It must bear pain. There must be nothing weak or gentle about it. The full, splendid beast of prey must once more flash from its eyes. I want my young strong and beautiful. In this way I can create the new.'

The book tells us of that combination of romanticism and brutality, 'steely romanticism' as Goebbels styled it, which created the Nazi outlook, and we meet again and again two phenomena which played so large a part in the formation and development of Nazism. One was the reaction against the intellect. Science, Hitler once said, had a 'devastating effect', because 'it leads away from instinct'. The other was the wish of death. 'We wish to give meaning to our lives', Schirach once wrote, speaking of the Germans too young to have fought in the First World War, 'the war spared us for war!' Over the entrance to one Hitler Youth Centre were the words, 'We were born to die for Germany'. One is reminded of the Spanish general in the Civil War who used to end his speeches with the shout, 'Down with Intellect! Long live Death!'

There are points in the book which can be criticised. The writer of this review would give a different picture of the guilt of the German universities. The author expresses it in this way. Speaking of a 'long process reaching back into nineteenth century', he claims that in the cause of this 'the mind turned away from itself in the name of a philosophy of life, of the will to power, of rough dynamic vitality, and continually renounced the European rationalist tradition'. It might be held that the weakness of the German university tradition was expressed better and very cogently in some words by

Friedrich Paulsen, one of the greatest of all writers on Education. 'Scholars cannot and should not engage in politics. They cannot do so if they have developed their capacities in accordance with the demands of their calling. Their business is scientific research, and scientific research calls for constant examination of thoughts and theories to harmonise them with the facts. Hence they are bound to develop a habit of theoretical indifference towards opposing sides, a readiness to take any path in case it promises to lead to a theory more in accordance with the facts. Now, every form of political activity, and practical politics particularly, demands above everything else a determination to follow one path that one has chosen. Political activity produces a habit of mind that would prove fatal to the theorist, the habit of opportunism.'

Never was the principle of the Ivory Tower more brilliantly expressed. But it led to the general adoption by the universities of complete political irresponsibility. It meant that the professors and teachers at the universities felt no call to criticise political tenets which they knew to be false or, which was even more disastrous, which they knew to be morally wrong.

The author never quite makes up his mind whether the society of which Hitler was a representative was a specifically German one or, rather, Western civilisation as a whole. The book is primarily a warning to the German people. But warning is not quite enough; some inspiration from examples is needed too. The Face of the Third Reich was not quite wholly Nazi. Something should have been said of those, few though they were, who resisted Nazism, Pastor Niemöller for instance, or Bishop von Gallen or the Kreisau Circle or, above all, the group of students at Munich University, known as the White Rose, who were all beheaded. The plotters of 20 July 1944 are given only a passing mention. But this is a courageous and a stimulating book which says things that needed saying, and it is a very readable one.

Robert Birley

The Flowering City by F E Cleary, MBE, published by The City Press, 25s.

Visitors to the City often comment on the impact that is made upon them by the colourful window-boxes in the buildings of its narrow streets and many would be surprised at the total effort to bring natural beauty into the City which is made not only by the business houses but by the Corporation and the City Livery Companies.

Mr Cleary, the Chairman of the Corporation's Trees, Gardens and Open Spaces Sub-Committee and Master of the Gardeners' Company in the past year, has brought together in this volume the remarkable efforts and success of those dedicated to preserving and extending these oases of tranquillity and charm within the Square Mile.

The book is a pleasure to browse through. The many illustrations—in colour and in black and white—drive home their point that even on a small scale and in the turmoil of a city, the natural beauty of trees and grass and flowers enhances its surroundings out of all recognition and slows down for a short time the ceaseless rush of modern life. And the absence of litter is either a tribute to the citizen's reaction to his surroundings or to the care with which the gardens are maintained!

All who have an affection for the City will appreciate the illustrations and the interesting historical and even horticultural information which they will find in the text. It seems entirely appropriate that the profits from a book such as this should at the author's wish be devoted to a charitable cause.

C W Trow

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