14th INTERNATIONAL CONGRESS OF PHOTOGRAMMETRY

BRITISH NATIONAL REPORT 1980

Compiled for and issued by THE BRITISH NATIONAL COMMITTEE FOR PHOTOGRAMMETRY

ABSTRACT

The report for the period 1976 to 1979 details British topographic and non-topographic photogrammetric activities, research, and education in photogrammetry, and includes a list of references and an index of contributors. A separate section deals with British remote sensing activities.

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BRITISH NATIONAL REPORT January 1st 1976 to December 31st 1979

INTRODUCTION

The period has seen a continued reliance on conventional photogrammetry for topographic, planning, and engineering surveys by government and commercial survey organisations. There has however been more emphasis on computer based methods, and in particular the production of spatial data in digital form. Interest in the specialist uses of photogrammetry has increased, exemplified by the publication of a journal on aerial archaeology and the establishment of a group involved with biostereometrics. There has been continuing growth in the field of remote sensing, supplementing rather than replacing traditional photogrammetric surveys. The increasing number of applications for remote sensing is reflected in the range of courses offered by universities and colleges, and the remote sensing services now offered by commercial survey organisations. The establishment of the National Point of Contact for Earthnet has also been of importance.

Sections 1 and 2 of this report deal with topographic and non-topographic photogrammetric activities in Britain during the period 1976 to 1979. Section 3 details research and development activities, and Section 4 educational establishments offering courses in photogrammetry. Papers published during the period on photogrammetry are listed in Section 6, and addresses of contributors indexed in Section 7. The sections are compiled in alphabetical order of organisations (of authors for Section 6).

As a tribute to Professor E H Thompson, who died on 9 April 1976, The Photogrammetric Society brought together a selection of his papers in a memorial volume. This was published by the Society in 1977 with the title Photogrammetry and Surveying, A Selection of Papers by E H Thompson 1910-1976.

This report has been compiled from information received from a large number of organisations, and thanks are due to all those who have contributed. Apologies are offered to any whose work in photogrammetry has inadvertently been omitted.

SECTION 1 : TOPOGRAPHIC OPERATIONS

Three volumes of the journal "Aerial Archaeology" have been published, the last two by the AERIAL ARCHAEOLOGY FOUNDATION. These volumes contain variously reports of the committees for archaeology air photography; articles on cartographic and photographic techniques, surveys, interpretation, and results; details of air photography archives and a gazetteer of published air photography; and reviews and bibliography. The volumes will be available on microfiche when out of print.

The Department of Civil Engineering at the UNIVERSITY OF ASTON IN BIRMINGHAM has carried out a number of topographical surveys as part of waste disposal and environmental surveys, mainly for local authorities within the United Kingdom. A study of tobacco growing in Jamaica has been made, using photogrammetry to determine the area under cultivation. The instruments used in these projects were either a Wild A7 or a B8.

Stereoscopes and a Wild B8S plotter are in use for vegetation mapping in the Department of Geography at the QUEEN'S UNIVERSITY OF BELFAST.

The BRITISH AIR SURVEY ASSOCIATION, which represents the leading air survey companies in the United Kingdom, has proposed specifications for 'Vertical Aerial Photography' and for 'Mapping at Scales between 1:1000 and 1:10 000'. Both these specifications are intended for general use worldwide, and both are being presented to the 14th Congress of ISP in Hamburg in 1980.

BRITISH PETROLEUM COMPANY LIMITED has undertaken air survey plots of limited areas for oil installation works, uncontrolled mosaics of oilfield areas and small scale photogeological/topographical compilations from conventional and Landsat photographic imagery.

The UNIVERSITY OF CAMBRIDGE Committee for Aerial Photography has continued to sponsor annual programmes of aerial photography to provide the University with aerial photographs for teaching and research. The subjects principally served are agriculture, archaeology, ecology, geography, geology, history, quaternary research and soil science. Vertical survey photographs are supplied for teaching in a course on photogrammetry, forming part of the University's teaching programme for the engineering tripos.

CARTOGRAPHICAL SERVICES (SOUTHAMPTON) LIMITED has continued its expansion in the United Kingdom as well as completing contracts in the Middle East and central Africa.

In the period under review, 350 survey projects have been completed in the United Kingdom, involving the exposure of over 75 000 frames of medium and low level black and white and colour photography. Block aerial photography at a scale of 1:10 000 has been successfully undertaken over the whole of the Greater Manchester conurbation. The main mapping requirements continue to be for new town development, the water industry, motorway and trunk road feasibility studies and design, land reclamation, waste disposal, housing development, opencast mining, and pipeline

construction, with scales of 1:500, 1:1250 and 1:2500 being specified. For flood prevention schemes, the firm has produced 0.25m contour and spot level information at 1:2500 scale covering over 240km^2, including the preparation of digital terrain models. The firm reports a considerable increase in the demand for digital map data. Photogrammetric capacity has been increased to 12 instruments with the addition of a Zeiss (Jena) Stereometrograph model G and a Topocart model B.

The CENTRAL ELECTRICITY GENERATING BOARD has used a Wild B8S for 1:500 scale surveys of power station sites as well as surveys for transmission line routes. Detailed surveys of up to 3km diameter have been carried out as aids to the production of topographical models of home and overseas sites for wind tunnel testing.

The Air Photographs Unit of the Scottish Development Department operates the CENTRAL REGISTER OF AIR PHOTOGRAPHY OF SCOTLAND which contains details of all known air photography of Scotland. The Unit also maintains a library of air photographs covering the whole of Scotland together with a microfilm reference file of imagery from the Landsat satellites.

The Department of the Environment continues to operate the CENTRAL REGISTER OF AIR PHOTOGRAPHY which contains particulars of all known air photography in England and Wales.

The DIRECTORATE OF MILITARY SURVEY has continued to employ photogrammetric methods to map new areas and to maintain existing mapping to support operational and training requirements. The actual methods used varied considerably according to the scale and required accuracy of the final product, and the availability of control and photography in the time allowed by production schedules. The Wild A8 continues to be the major instrument used for new mapping with supporting triangulation mainly from stereocomparators. Work is in hand on improving the capabilities of the current aerial triangulation software packages. A Zeiss (Oberkochen) DP1 has been acquired to assist the map revision tasks which are mainly solved by simple rectification and graphic methods, with non-survey photography still making a useful input. Evaluations have been made of the use of photographic data bases for single point co-ordination using simple measuring equipment such as the Zeiss Stereocord linked to a desktop calculator.

The DIRECTORATE OF OVERSEAS SURVEYS assists developing countries in basic land surveying and mapping. It has continued to produce new and revised topographical mapping by photogrammetric methods for countries in Africa, the Middle East, the Pacific, the Caribbean and central America, and for the British Antarctic Survey.

New contoured mapping has been produced at scales of 1:1000 to 1:250 000. The majority of map series now have metric contours. Vertical intervals have been at 2m or 5m on 1:2500 and 1:5000 scale mapping, and at 2.5m, 5m or 10m on 1:10 000 and 1:15 000. Most 1:50 000 series have a 20m vertical interval increasing to 40m in very steep areas. The specification is agreed with the country concerned.

Only about 15% of the Directorate's mapping output now comprises 1:50 000 series, and a third of these sheets are currently photomaps. Selected photomaps are contoured. A major single task during the period was the

production of 207 contoured maps at a scale of 1:5000 of southern Cyprus as the DOS contribution to a joint mapping project with that country. Larger scale mapping was undertaken in support of many different projects.

In addition to its continued use for the production of 1:250 000 monochrome photo bases, increasing use was made of Landsat imagery as a base for flight planning.

The Directorate does not operate a flying unit. Since the last report it has used photography flown by a variety of commercial and government agencies, both domestic and overseas. Cameras have included Wild RC10, RC9, RC8, Williamson F49, Zeiss (Oberkochen) RMK A15/23, and Fairchild KC 1B.

A Wild Aviotab TA unit has been added to the plotting equipment, and the acquisition of two Officine Galileo Orthophoto-Simplex units will enable the Directorate to produce orthophotographs and to extend its photo-mapping programme.

No significant changes in the equipment or methods of aerial triangulation have been introduced since the last report.

FAIREY SURVEYS LIMITED has flown vertical aerial photography for overseas projects covering a total of 256 000 km^2. The countries served included Bahrain, Brunei, Dubai, Egypt, Jordan, Kuwait, Nigeria, Oman, and Saudi Arabia. Wild RC8 wide angle and RC10 super wide angle survey cameras have been used, with contact scales ranging from 1:6000 to 1:40 000. The largest areas photographed were in Nigeria (142 000 km^2 at 1:25 000 contact scale, wide angle) and Saudi Arabia (89 000 km^2 at 1:40 000, super wide angle).

In the United Kingdom, photography of some 120 areas was taken at scales in the range 1:3000 to 1:15 000, the largest covered being Berkshire (1900 km^2) and the Forest of Dean (800 km^2), both of which were taken with wide angle cameras at 1:10 000 contact scale.

Photogrammetric mapping has been carried out for over 200 separate projects, plotting at scales from 1:500 to 1:50 000, for areas in the following countries: Bahrain, Botswana, Brunei, Canada, Cyprus, Eire, Egypt, Jordan, Kuwait, Nigeria, Oman, Saudi Arabia, and the United Kingdom. Some of the larger contracts were:

a complete resurvey of the State of Bahrain to produce series mapping at 1:500, 1:1000, 1:2000, 1:10 000, 1:25 000, 1:50 000, 1:100 000 and 1:200 000, with an orthophotomap series at 1:10 000.

series mapping at 1:50 000 scale, with photomap background, for 105 000 km^2 in Saudi Arabia.

series mapping for approximately 600 sheets at 1:2000 scale in Nigeria.

A number of digital ground models have been produced, including three areas amounting to a total of 720 km^2, as well as several more for highway design projects. Orthophotomapping for 10 projects has been

completed at scales ranging from 1:2500 to 1:50 000. Plotting instruments employed are Wild A8, B8, Zeiss (Jena) Stereometrograph, Topocart with Orthophot and Zeiss (Oberkochen) C8.

The main activities of FAIREY SURVEYS SCOTLAND LIMITED during the period 1976 to 1979 were aerial photography and photogrammetric mapping. 1976 and 1977 saw the completion of the Scottish coastal colour photography commenced in 1973. This amounts to some 1800 miles of vertical colour photography at 1:10 000 flown on behalf of the Scottish Development Department. The period 1978 to 1979 has seen additions to the Department's colour cover including Greater Edinburgh and Greater Glasgow as well as many other inland areas. The purpose of this photography is to provide coverage of these areas for multidisciplinary planning studies and a basis for assessing development impact, especially those areas subject to oil related development. Many of the target areas have been flown simultaneously in colour and false colour. Similarly, extensive coverage for other regional departments has been acquired.

Panchromatic cover at scales from 1:2000 to 1:20 000 has been taken of a number of targets for mapping purposes. Projects have included 1:1250 scale chemical plant redevelopment mapping, original mapping of new towns, preliminary route studies for power lines, large scale surveys for nuclear power stations, ski slope development plans, and plans for the reclamation of derelict land. Scottish operations have included contracts over the entire country including Shetland, Orkney and the Western Isles.

Plotting instruments used are a Zeiss (Jena) Stereometrograph, a Kelsh Plotter, and Multiplex.

The UNIVERSITY OF GLASGOW, Topographic Science, Department of Geography has continued its programme of thematic mapping using photogrammetric techniques with the production of glacier maps (in Switzerland), vegetation maps (north-west Scotland), and base maps for geological mapping (Eire and Rhum in Scotland). In each case, specialists in the relevant field science undertake the photointerpretation and field checking work, while the field survey and photogrammetric work is executed by the staff and students of the Department.

HUNTING SURVEYS LIMITED continues to provide a range of contract services for surveying, mapping, and remote sensing around the world. The main areas of operation during the last four years have been the United Kingdom, continental Europe, the Middle East, Africa, Iran, Sri Lanka, Nepal, Indonesia, Hong Kong, Fiji, Guatemala, Brazil, and the United States of America.

Aerial photography in black and white, colour, false colour, and infrared has been flown at all scales. The use of other types of imagery has increased considerably. Airborne radar, Landsat, Seasat, and Skylab are now used extensively for mosaicing, small scale mapping, and geological and land resource studies.

The Hunting digital mapping system with eight stereoplotters on-line to a DEC PDP 11-50 computer and flatbed plotter has been in operation throughout the period. Digital mapping has been produced at all scales between

1 500 and 1:50 000. Digital terrain models, profiles, and volumetric assessments for coal stocks, earthworks and reservoir capacities are particularly suited to the system.

In the last four years the facilities for observing and adjusting aerial triangulation have been extended considerably using a Zeiss (Jena) stereocomparator, precision stereoplotters, Wild PUG 4, and independent model block adjustment.

Orthophotomapping has been produced for various projects at scales ranging from 1:2000 to 1:10 000. Photomaps at 1:500 000 have been produced using Landsat imagery.

The Ministry of Defence HYDROGRAPHIC DEPARTMENT has used a Bausch and Lomb Stereo Zoom Transferscope for revising maps from aerial photography.

The School of Geography at the UNIVERSITY OF LEEDS has prepared a variety of photogrammetric plots for geographical research using Williamson Multiplex, Nistri Photocartograph, and Kern PG2L plotters.

MERIDIAN AIRMAPS LIMITED has undertaken photographic missions in African, Middle East, Asian, and Caribbean countries at scales ranging from 1:4000 to 1:50 000. A contract with the Directorate of Overseas Surveys involved a photographic mission in Tanzania to obtain 1:50 000 coverage of over 35 000 km^2. Photography has subsequently been used for mapping for engineering and development projects including highway location plans with a digital ground model in Oman, and township development and new roads in Nigeria and Senegal.

In the United Kingdom, a considerable amount of photography has been obtained at various scales for engineering development projects. Plans at various scales have been produced for the various phases of road design and, where required, digital ground model output, both square grid and stringline, was supplied. Additional engineering requirements have been plans to aid regional development, land reclamation and volumetric assessments of tips (coal, waste, and aggregate), and catchment areas for reservoirs. Beach profile projects have regularly been undertaken, involving photography and profile measurement of 341 km of coastline annually to determine shingle movement.

The NATIONAL COLLEGE OF AGRICULTURAL ENGINEERING has carried out a radial line plot of 50 000 hectares of the State of Santa Catarina in Brazil.

The NATURE CONSERVANCY COUNCIL has one Kern PG2-L plotting instrument at its Taunton office which is used on a wide range of medium and large scale plotting tasks connected with the acquisition, management, and recording of its 165 National Nature Reserves. The Council uses Wild and AGA electronic distance measurement equipment to supply ground control for its photogrammetric work.

The Department of Surveying at the UNIVERSITY OF NEWCASTLE UPON TYNE has undertaken a mapping project for the Nature Conservancy Council to produce a 1:5000 scale topographic map of the Muir of Dinnet Nature Reserve in Aberdeenshire, Scotland. Other mapping has been carried out in connection

with research projects of other departments within the University. Wild A7 and Kelsh stereoplotters have been employed.

The national mapping programme by the ORDNANCE SURVEY of Great Britain has continued, with completion expected in 1980. Surveys are made at the three basic scales of 1:1250 for major urban areas, 1:2500 for rural areas and small towns, and 1:10 000 for mountain and moorland areas.

At 1:1250 scale most of the work consists of upgrading the scale of survey in developing urban areas. During the period of this report over 250 km^2 have been mapped by precise stereoplotting instruments, using normal and wide angle photography at 1:5000 scale.

In rural areas, the old 1:2500 County Series Sheets have continued to be recast on the National Grid and revised where necessary. As the programme nears completion the volume of work is decreasing. Revision by graphical air survey has made use of some 16 000 rectified enlargements at approximately map scale. Only 2000 rectified enlargements were produced in 1979. In about 800 km^2 where dense revision was required or where the terrain was unsuitable for graphical methods, stereoplotting instruments provided a more economical solution. Normal angle photography at 1:7500 was used. In the 1:2500 revision areas, routine tests of accuracy are performed using points of detail co-ordinated by analytical aerial triangulation on small scale photography. Where suitable County Series maps are not available, rural areas are being resurveyed at 1:2500 scale using precise stereoplotting instruments with normal or wide angle photography at 1:7500 or 1:10 000 respectively. Some 1300 km^2 were resurveyed during the period.

The stereoplotting from 1:25 000 scale wide angle photography for the 1:10 000 scale resurvey of mountain and moorland areas has continued for most of the period until completion in May 1979. The resurvey was started in October 1956, and some 96 000 km^2 of detail and contours covering large areas of Scotland, northern England and Wales have been plotted. The 1:10 000 map series is the largest scale at which contours are shown. Where the basic scale is larger, the contours are added to 1:10 000 scale maps derived from the larger scales of survey using stereoplotting instruments. Metric contours have been provided for approximately 66 000 km^2 during the last four years, including the recontouring of 14 200 km^2 in areas previously contoured at 25 feet vertical interval.

With the national mapping resurvey and revision programme nearing completion, an increasing amount of continuous revision and periodic revision at the two largest basic scales is being carried out by air survey where developments are large enough to justify it.

In addition to its work on the national survey, the Ordnance Survey makes a small part of its resources available to other organisations and to the public on repayment. Apart from the supply of prints, diapositives, or enlargements of air photographs, existing photography can be used to supply non-standard products, such as contours at 2m vertical interval on 1:2500 scale maps.

The Department carries out all stages of the aerial survey, including flight planning, exposing and processing the photography (including infrared for tidal surveys), aerial triangulation where required, instrumental or graphical plotting, and field completion. Aircraft and crews are hired from commercial companies between March and October each year, but the Ordnance Survey provides its own camera operators and cameras. Three aircraft were employed during 1976, reducing to two aircraft for the rest of the period. Weather conditions during the last four years were below average, especially for high level photography. With the selection of targets reduced, acquisition of photography averaged only about 17 500 km^2, with each aircraft recording approximately 150 flying hours annually.

Three Zeiss (Oberkochen) RMK 30/23, one Wild RC10, and three Wild RC8R cameras are used. Processing is now generally performed using a Pakorol automatic film processor, although hand processing is still carried out occasionally. Other photographic equipment includes three Cintel electronic contact printers, a Kodak automatic paper processor, and two Zeiss (Oberkochen) rectifiers. Analytical aerial triangulation employs three Hilger and Watts stereocomparators, with preparation work by Wild PUG 4 and PUG 2 point transfer devices and various scanning stereoscopes. Stereoplotting equipment comprises 9 Thompson-Watts, 12 Wild A8, 2 Wild A10, 4 Zeiss (Oberkochen) Planicart, and 7 Kern PG2 plotters. One of the Wild A10 plotters is fitted with EK22 digitising equipment.

The main effort of the ORDNANCE SURVEY OF NORTHERN IRELAND continues to be directed to bringing the large scale mapping of the country onto Irish Grid sheet lines. This task, programmed to be completed by late 1980, is on schedule, and all remaining basic 1:10 000 sheets and a further 1030 km^2 of 1:2500 resurvey have been completed during the period of the report.

The 1:1250 programme is now largely complete, but because of movements in population some urban areas which had previously been resurveyed at 1:2500 scale now qualify for mapping at 1:1250. While the final extent is reasonably predictable, there will still be some developments where air survey will be the best means of dealing with the work. An additional 10 km^2 have been completed. Revision of some Belfast 1:1250 maps is being done by air survey.

Contouring at 10m intervals continues on derived 1:10 000 maps. The task of 13 500 km^2 is scheduled for completion over the next 15 years. A further 1705 km^2 have been plotted bringing the total so far completed to 2475 km^2.

A new series of 1:50 000 maps has been produced with contours at 10m vertical interval supplied from 1:40 000 aerial photography. Where contours are not already available at 1:10 000, additional contours are plotted directly at 1:50 000. About 75% of the required height control is obtained from available levelling. 1940 km^2 have been completed directly at 1:50 000.

From the beginning of 1978, approximately 50% of plotting instrument time has been allocated to work for other Government departments. Most of the work has been 1m contouring at 1:2500 scale for proposed works. Some additional 1:500 detail plotting and 0.5m contouring has also been carried out.

Control for plotting of 1:2500 resurvey areas is supplied by the independent model strip method, strips being formed on-line. Photography is at 1:10 000 scale with blocks consisting of 40 to 50 models and covering 60 km^2. The work is done on a Wild Aviomap AMH connected to an EK22 data acquisition system which in turn is interfaced to a Hewlett-Packard 9825 desktop computer. Block adjustment is done off-line. A bonus is the calculation of absolute orientation parameters derived from the independent model observations and the final adjustment results for setting up the models at plotting stage.

Ordnance Survey of Northern Ireland has a Wild RC5 aerial camera and a Zeiss NT1 navigation sight. Stereoplotting equipment consists of three Wild A8, one Wild B8, and a Wild AMH with TA table.

The Department of Civil Engineering at PAISLEY COLLEGE OF TECHNOLOGY is using photogrammetry to map mud-flats of part of the Clyde Estuary. The map will form back-up information for research into bird feeding habits.

PHOTOARC SURVEYS LIMITED has undertaken a wide range of topographic surveys for highway design and route location, redevelopment, and land reclamation, including provision of maps and plans at scales ranging from 1:500 to 1:5000, orthophotographs, digital ground models, and rectified mosaics. The company has a Zeiss (Jena) 15/23 aerial survey camera and two Zeiss (Jena) Topocart B plotters.

The POTATO MARKETING BOARD makes annual air photographic surveys at 1:7500 scale over certain arable areas of Great Britain to aid work already done on the ground in connection with the measurement of potato acreage.

The Department of the Environment PROPERTY SERVICES AGENCY does not carry out photogrammetric work, but has commissioned some 15 photogrammetric plots at scales of 1:500 and 1:1250, mainly in support of construction projects.

The Air Photographs Unit of the National Monuments Record is part of the ROYAL COMMISSION ON HISTORICAL MONUMENTS (ENGLAND). Large numbers of photographs from continuing reconnaissance flights by the Unit and others who deposit their material in the archive create a reservoir of archaeological evidence which is largely untapped. Nearly half a million photographs are held by the Unit. To deal with this volume of material, experimental work is in hand using computer methods of transformation and plotting. The aim is to produce map overlays of archaeological detail at scales of 1:10 000 and 1:2500 on sheet lines coincident with current maps and plans, the overlays being updated at suitable intervals.

During the period of the report SURVEY AND DEVELOPMENT SERVICES has flown some 9000 exposures of panchromatic vertical air photography in the United Kingdom at scales from 1:2000 to 1:10 000 using a Zeiss (Jena) MRB 15/2323 camera. Colour obliques have been taken for road studies. The firm has produced topographic mapping at 1:500, 1:1250, and 1:2500 scales and has revised Ordnance Survey maps at 1:1250 and 1:2500 scales. Orthophotomaps have been produced in both urban and rural areas at 1:1250 and 1:2500 scales respectively.

The TRANSPORT AND ROAD RESEARCH LABORATORY has continued the study and use of photogrammetric survey methods to determine the physical shape and quantity of landslides. Terrestrial photogrammetry using a Wild P32 camera was undertaken in Nepal during 1976. Further work using a Hasselblad camera fitted with a reseau plate was undertaken in Colombia.

The Department of Geography at the UNIVERSITY COLLEGE OF WALES, ABERYSTWYTH has continued work on river floodplains, inter-tidal areas, and upland river catchments in particular, although a variety of other mapping has been undertaken. Studies have been carried out in co-operation with the Nature Conservancy, the Forestry Commission, water authorities, and other similar organisations. Equipment includes a Kern PG2-L with ER1 and a Santoni Stereosimplex IIID.

WILTSHIRE COUNTY COUNCIL has used a Wild B8S plotter for revising 140 km^2 of Ordnance Survey 1:10 000 and 1:2500 maps of towns and villages in the county, and for 788 km^2 of contouring at 2m vertical interval. In addition areas have been contoured to determine capacities for refuse disposal and mineral extraction, and some archaeological sites have been surveyed and plotted. Low level photography at 1:3000 scale has been used to provide photogrammetric heights.

SECTION 2 : NON-TOPOGRAPHIC OPERATIONS

Mr L F H Beard, the Director of the Medical Photography and Illustration Service at ADDENBROOKE'S HOSPITAL has brought together representatives from universities, air survey companies, and other organisations interested in biostereometrics. Meetings are held to discuss developments in this field internationally and in the United Kingdom in particular.

The Department of Civil Engineering at the UNIVERSITY OF BRISTOL uses a Zeiss (Jena) Stecometer with digital readout for measuring overall strain fields in soil mechanics and foundation engineering research. The instrument is also used for measurements in electron microscopy and cosmic ray research.

For biological and geological studies, BRITISH ANTARCTIC SURVEY use photography from helicopters flying at heights of up to 6000 feet. Photography is interpreted using hand and mirror stereoscopes and Cartographic Engineering CP1 plotting equipment.

The Department of the Environment's BUILDING RESEARCH ESTABLISHMENT has used terrestrial photogrammetry to produce contoured plans and elevations of the failure scars of slides and falls from steep excavation faces in stiff clay and chalk. Photogrammetry has also been used to survey the changing geometry of large inflatable air structures at various internal pressures. Stereopairs were taken by the Building Research Establishment with a Wild P30 phototheodolite and analysed commercially in a Wild plotter for contoured plans and a Zeiss (Jena) Stecometer to determine the co-ordinates of spot heights.

The Planning Intelligence Directorate of the DEPARTMENT OF THE ENVIRONMENT acquired what is likely to remain a unique air survey of Great Britain flown by the Royal Air Force at a scale of 1:60 000. An initial study carried out by Hunting Surveys Ltd concluded that a classification of five main land uses could be mapped at five hectares and above. Interpretation of the five categories of 'developed areas' was carried out by Fairey Surveys Ltd, and plotted on transparent overlays to the 1:50 000 scale Ordnance Survey maps of England and Wales. The term 'developed areas' was preferred to 'urban areas' because the latter is strictly applicable only to areas of cities and towns. Three sets of overlays were produced, one set showing the developed areas, one showing developed areas and the five main land use groups, and a third set which had the administrative boundaries shown and was coded for digitising. The third set was digitised by Ferranti Cetec Graphics Ltd, and the resultant area measurements have been used with the Department's computer mapping system, Linmap. The results have been analysed by the Department and published.

The Department of Forestry and Natural Resources at the UNIVERSITY OF EDINBURGH has carried out studies of the area and density of the native woodlands of Scotland, yeilding maps at a scale of 1:10 000 showing the distributions of 27 categories of woodland together with estimates of their areas. The Department has also analysed aerial photography for changes in wildlife habitats in lowland Scotland up to 1977.

FAIREY SURVEYS LIMITED have used photogrammetry for a variety of tasks during the period. Two cooling tower shape surveys were carried out at 1:100 scale using photography taken with a ground based Wild RC5A air survey camera, and with results plotted on a Zeiss (Oberkochen) C8. The dome of a nuclear furnace in an electricity generating station was surveyed by photogrammetric methods, using Wild C40 stereometric photography with results plotted on a Zeiss (Jena) Stereometrograph. The work was for the production of templates for manufacturing insulation cladding for the surface of the dome. Similar surveys were mentioned in the British National Report for 1976.

A survey was carried out involving a damaged part of an underwater steel structure on an oil rig. The area of interest measuring 3m by 2m was photographed at a range of 1.5m, using a non-metric 35mm underwater camera to take seven strips of approximately ten overlapping frames which formed a block of sixty models. The photography was enlarged to produce diapositives of an equivalent focal length suitable for a Wild A8 which was then used to observe, on independent models, a close network of three dimensional co-ordinates. The whole block of photogrammetric observations was then adjusted to fit control data, using aerial triangulation methods. The grid of adjusted three dimensional co-ordinates was used by the client to prefabricate a steel patch which was subsequently lowered into position to repair the damaged area. The absolute accuracy of the measurement was estimated to be $\pm$ 10mm.

FAIREY SURVEYS SCOTLAND LIMITED has increased its involvement in well established techniques for medical photogrammetry. The continuing study of facial morphology in orthodontics carried out by Professor P H Burke of Sheffield University and by Addenbrooke's Hospital in Cambridge has called for sequential facial contour plots. The stereometric photography, taken in the clinics' own special cameras developed from multiplex equipment, is plotted by the company on standard multiplex equipment. As well as producing contour plots, sections and profiles and co-ordinate values can be provided for special features and the measurement of growth and volume.

The GRASSLAND RESEARCH INSTITUTE is carrying out in situ measurements of plant canopy structure and plant growth required for grazing research, using a pair of Officine Galileo stereometric cameras mounted on a rigid but mobile frame. Ground control consists of four permanent control points delimiting each 0.5m study area. Colour transparency film is used so that live and dead leaves can be distiguished. Photographs are analysed on a Zeiss (Jena) stereocomparator. The work is being carried out in close co-operation with the Department of Photogrammetry and Surveying at University College London.

The Department of Paediatrics at GUY'S HOSPITAL has used photogrammetric methods to identify facial abnormalities in children with a certain type of congenital heart disease known as pulmonary stenosis. By carrying out a detailed numerical and geometric form analysis using appropriate apparatus to provide contours and sections, it has been shown that the facial pattern in children with disease differs significantly from the normal.

A stereophotogrammetric system was assessed, consisting of a Multiplex APU plotting instrument in conjunction with a stereocamera. Its contouring capabilities depended on the skin surface texture of the subject. The disadvantage of incomplete facial coverage was eliminated by using a pair of oblique exposures instead of the conventional frontal exposure. Subsequently a contouring device invented at the Royal Aircraft Establishment was adopted and developed to make it suitable for use with children.

The Photogrammetry Unit at HM DOCKYARD at Portsmouth completed evaluation of photogrammetry applied to interior and exterior warship work. Projects included hull form and installation layouts, and were investigated using stereopairs produced from Zeiss (Jena) SMK40 and SMK120 cameras and plotted on a Zeiss (Jena) Technocart. The initial results showed potential in this field, and additional projects were undertaken to examine more closely the cost effectiveness. These were completed in 1978. A summary of the projects showed that while some savings could be achieved from the technique for individual jobs, the essential need for an adequate and continuous flow of such work to make the system viable was unlikely to be sustained.

HUNTING SURVEYS LIMITED have a Zeiss (Jena) stereocomparator, a Wild A10, and a Wild A7 for short range and architectural photogrammetry. Elevation drawings of historic buildings such as Brighton Pavilion, buildings being repaired or renovated, viaducts, and monuments have been plotted at scales between 1:20 and 1:100. Stress and deformation measurements for structural engineering are made both by analytical and analogue methods. Volumetric measurements of rock falls and demolitions have also been undertaken, and underwater photogrammetry used for the measurement and repair of a damaged oil production platform standing in 400 feet of water.

The Ministry of Defence HYDROGRAPHIC DEPARTMENT uses photogrammetry to assist both the work of the hydrographic surveyor and the task of updating marine navigational charts. More specialised applications include the heighting of drying banks and beaches, measurement of depth in shallow water, water movement surveys and the search for and plotting of underwater coral, rock, and other hazards to navigation. Equipment comprises one Wild A8 and one B8, both linked to an EK22 data acquisition system coupled to a desk top computer for on-line computations. Certain small tasks are undertaken using a Bausch and Lomb Stereo Zoom Transferscope.

In collaboration with the City University, the INSTITUTE OF HYDROLOGY has attempted to determine snow depth which, combined with density measurements and melt rates, would permit the estimation of snow pack water equivalent on the headwater catchments of the Rivers Severn and Wye, and consequently assist with the modelling of melt water runoff processes and water balance studies. Zeiss (Jena) UMK 10/1318, Wild P32 cameras and a Zeiss (Jena) Stecometer have been used to provide ground and snow surface co-ordinates in digital form.

Within the UNIVERSITY OF LONDON, the Department of Civil Engineering at the IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY has undertaken plotting from stereoscopic pairs of convergent photographs of portions

of grains used in filter beds. The grains have a maximum dimension of 1mm and contours were plotted at 0.1mm vertical interval. The photographs at approximately 1:1 scale were taken with a Leitz Aristophot camera fixed in a vertical position, the specimens being mounted on a microscope stage capable of being tilted to a selected angle. Plans were produced from negatives mounted in an Officine Galileo Stereosimplex II, and from paper print enlargements in a Cartographic Engineering CP1 plotter.

The velocity of currents generated by a jet directed into the water stored in a 5m model of a reservoir was deduced from the displacements of a large number of targets tethered to the floor of the model and held at the water surface by upthrust. These displacements were determined from a series of single vertical photographs of approximately 1:50 scale taken with a Hasselblad 500 ELM camera. Photo co-ordinates were measured monocularly on the negatives using a Pye Universal Measuring Microscope and a Zeiss (Jena) Stecometer.

The Department of Photogrammetry and Surveying at UNIVERSITY COLLEGE LONDON has traditionally been associated with close range and non-topographic photogrammetry, and the period under review has seen involvement in a number of projects. The North Sea oil industry has given rise to research into problems of measuring marine structures, and a project to measure the shape of a flare.

Medical work has continued, particularly orthodontic studies involving x-rays and conventional photogrammetry in conjunction with the Royal Dental Hospital of London. A new area of interest has been the study of grass growth for the Grassland Research Institute. Archaeological projects have included the plotting of the Bristol High Cross and the measurement of a small prehistoric tablet known as the Bush Barrow lozenge. Contour plots of prehistoric footprints have been prepared and compared with modern footprints photographed in a sand tray. Co-operation has continued with the Royal School of Mines on a number of projects.

LONGDIN AND BROWNING (SURVEYS) LIMITED has provided dimensional control for offshore structures, enabling manufacturers to improve their techniques to the extent that only nominal checking is necessary on the accuracy of construction.

The Department of Civil and Structural Engineering at the UNIVERSITY OF MANCHESTER INSTITUTE OF SCIENCE AND TECHNOLOGY uses close range photogrammetry in textile research projects to supply information on fabrics under double fold. Photogrammetry is also used for the measurement of structural deformations in laboratory investigation work. Deformation of soil models under centrifugal testing is recorded.

Equipment for centrifugal testing consists of a closed circuit TV, a powerful flash unit, and two Zeiss (Jena) UMK 10/1318 cameras assembled in a precisely constructed vertical frame which allows the cameras to travel up and down through the central shaft of the centrifuge. For industrial applications, the cameras are assembled on a stereometric frame specially constructed and operated by an hydraulic jack for height adjustments. Data reduction is based on the use of a Zeiss (Jena) digitised stereocomparator with output on punched tape, a Kelsh plotter, and a Zeiss (Jena) stereopantometer.

The MEAT RESEARCH INSTITUTE of the Agricultural Research Council has used moiré methods to obtain contours of equal depth on photographic records of living animals and carcasses. Devised to allow adjustment of the level at which contours are observed, a technique has been used to measure the surface co-ordinates of various transverse sections along the backs of pig carcasses. The data have been analysed using multivariate statistics.

MERIDIAN AIRMAPS LIMITED has used a Wild C120 camera and A40 stereoplotter for applications in engineering, architecture, and industry. Examples include the preparation of photogrammetric plans and elevations to assist in the restoration of Wells Cathedral, the monitoring of earth embankment movement, cliff face stabilisation, and tunnel alignment.

The NATIONAL COLLEGE OF AGRICULTURAL ENGINEERING has undertaken land form analysis in Wales and vegetation analysis in Santa Catarina and the Solimões Region in Amazonia, both in Brazil. Equipment includes a Wild mirror stereoscope and a Cartographic Engineering stereoplotter.

The Department of Surveying at the UNIVERSITY OF NEWCASTLE UPON TYNE has been involved in a photogrammetric survey at 1:50 of the façade of the Bruce Building of the University to assist in restoration. Work has continued on a major research project concerned with the general application of photogrammetry in medicine. Studies have included the measurement of palatal surface area, changes in facial shape following treatment by orthodontic and surgical means, and the measurement of expanded polyethylene foam footprints for use in the assessment of the development and progress of common foot deformities and of the results of surgery and treatment. Photography for use in the Department's work has been taken either with an Officine Galileo A Special stereocamera or with a stereocamera constructed from a pair of Multiplex projectors according to a design by Beard. Measurement has been by Wild A7 when contoured plots are needed, or by a Zeiss (Jena) stereocomparator when spatial co-ordinates only are required.

Photogrammetry has been used in the measurement of walls under load in laboratory conditions as part of a PhD thesis in the Department of Civil Engineering at PAISLEY COLLEGE OF TECHNOLOGY.

PHOTARC SURVEYS LIMITED has completed a variety of projects using terrestrial photogrammetry. Plans and elevations at scales from 1:10 to 1:100 have been provided for restoration, stability analysis, rebuilding, and architectural and archaeological study. Terrestrial photogrammetry has also been used for engineering surveys including projects on oil production platforms, and for geophysical surveys for applications in geological engineering. The latter have included sections and elevation drawings of cliff and rock faces for stability analysis, spatial co-ordinates of rock planes for stability surveys and opencast mining, and the detection of ground anomalies using a helicopter borne thermographic camera. The company has Zeiss (Jena) UMK 10/1318 and Wild C120 cameras. Plotting is carried out on Zeiss (Jena) Topocart B instruments.

The Department of the Environment PROPERTY SERVICES AGENCY has commissioned machine plotted and rectified photographic elevations of numerous public buildings and ancient monuments to scales of 1:50 and 1:100 for redevelopment or record purposes.

K A RYLANCE AND ASSOCIATES have undertaken metric photography of Welsh castles using a Zeiss (Jena) UMK 10/1318 camera, and non-metric photography of building interiors, construction sites, and for feasibility studies using a Hasselblad with 50mm Distagon wide angle lens and a Nikon 35mm camera with perspective control lens.

The Department of Chemical Engineering and Fuel Technology at the UNIVERSITY OF SHEFFIELD has undertaken non-topographic work including the measurement, on x-ray film, of the position of fine thermocouples in wood as part of a fire research project, the measurement of particle sizes in sprays by the automated analysis of spark photographs, and the use of photo-optical analysers to study high-speed cine-film records of vapour liquid interaction responsible for damaging vibrations in distillation and absorption columns.

The Department of Civil and Structural Engineering has carried out a variety of non-topographic projects including concrete fracture studies using a highspeed camera, monitoring of traffic movements with video and time lapse cameras, location of disused mineshafts with photography and other imagery, and determination of volumes of excavation and fill. The Department has provided a photogrammetric service using Wild C40 and P32 and non-metric and time lapse cameras, stereocomparators, and a Wild A5 plotter. Work has included surveys for the measurement of excavation of overburden in opencast coal workings, monitoring landslips, deflection of beams, and the configuration of sandmodel surfaces.

The Department of Dental Health is carrying out a serial clinical study of changes in facial morphology produced by growth or surgery using a portable stereometric camera.

SURVEY AND DEVELOPMENT SERVICES has carried out terrestrial photogrammetric surveys at St Enoch's Hotel in Glasgow to provide record drawings of this building, which was of architectural interest, prior to demolition. A similar terrestrial survey was carried out at St Andrew's Cathedral in Glasgow to provide elevations of the building. Photography was taken with a Zeiss (Jena) UMK 10/1318 camera, and the plans were plotted using a Zeiss (Jena) Topocart B.

The TRANSPORT AND ROAD RESEARCH LABORATORY used photogrammetry in 1978 to measure building movements as a result of tunnelling. Equipment included a Zeiss (Jena) UMK camera and a Zeiss (Jena) Stecometer.

The Photogrammetric Unit of the Institute of Advanced Architectural Studies at the UNIVERSITY OF YORK is primarily engaged in the recording of historic buildings in the care of the Department of the Environment's Directorate of Ancient Monuments and Historic Buildings. The Unit carried out some teaching on courses on building conservation run by the Institute. Equipment includes two Thompson-Watts Mark II photogrammetric plotters, and a pair of Officine Galileo Veroplast cameras.

SECTION 3 : RESEARCH AND DEVELOPMENT

The Image Analysis Group at the ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL has carried out contracts for the Department of the Environment to study the use of Landsat satellite data for monitoring urban development in the United Kingdom.

CARTOGRAPHIC ENGINEERING LIMITED continues to produce the SB series of photointerpretation instruments which are improved versions of original designs by Hilger and Watts. These are the Radial Line Plotter, the Stereosketch, and modular mirror stereoscopes. In addition the firm produces the CP1 Cartographic Plotter, the only stereoplotter manufactured in Britain.

In conjunction with their parent company, Cartographical Services (Southampton) Limited, Cartographic Engineering have evaluated and modified the CP1 with the aim of maximising its performance without recourse to major design changes. Modifications have included an improved reduction hand-control system, and improved gimbal bearings incorporated into the variable enlarger system in conjunction with a strengthened enlarger rod which couples to the polar pantograph system via a magnetic cup. In addition the instruction manual has been completely rewritten and includes an improved setting-up procedure.

The CP1 is also available with modifications to accept three rotary encoders which enable digital recording equipment to be coupled to the instrument for the production of digital map data.

The Air Photographs Unit of the Scottish Development Department operating the CENTRAL REGISTER OF AIR PHOTOGRAPHY OF SCOTLAND has carried out research into the use of colour and false colour photography for environmental monitoring.

The Photogrammetric Unit of the Department of Civil Engineering at the CITY UNIVERSITY has carried out research into the application of stereoscopic video systems to photogrammetry, the development of a dual-observation system for the Zeiss (Jena) Topocart stereoplotter, and the visual factors involved in photogrammetry and their affect on the accuracy of performance.

The Department of Forestry and Natural Resources at the UNIVERSITY OF EDINBURGH has carried out statistical analysis and computer data processing in connection with its aerial photographic analysis of changes in wildlife habitats.

FAIREY SURVEYS LTD has established a new division, the Environment and Resources Consultancy, specialising in the acquisition and interpretation of all forms of remote sensing data. The consultancy now has 12 remote sensing specialists, and in-house facilities include a Daedalus multi-spectral scanner, a multiband camera, a NAC AC-90B multispectral additive colour viewer, a NAC 4200E Interactive Image Analysis System, as well as a variety of visual interpretation equipment such as the Bausch and Lomb Zoom 240 stereoscope. Projects have included radar analysis of parts of the United Kingdom, environmental monitoring in

Scotland using colour and colour infrared aerial photography, thermal infrared studies of coastal discharges from 18 power stations in England, Wales, and the Republic of Ireland, as well as various remote sensing consultancy assignments in China, Colombia, Syria, Indonesia, Nigeria, Philippines, and Malaysia.

The UNIVERSITY OF GLASGOW, Topographic Science, Department of Geography has continued work on digitised parallax measurements, software-controlled digitising for cartographic purposes, and mapping from satellites. The photogrammetric analysis of the metric aspects of reconnaissance frame photography and the accompanying tests have been completed but have not, as yet, been published. A program suite to allow the perspective plotting of the built-up areas of large towns direct from stereophotogrammetric measurements of aerial photography has also been completed. In aerial triangulation, research has continued into the detection and elimination of systematic errors using the existing block adjustment program for independent models. Work has begun on topographic mapping from remote sensing imagery including tests for accuracy and methods of digital plotting from Seasat SAR imagery.

At HUNTING SURVEYS LIMITED development of the Hunting digital mapping system and applications of digital mapping has been the main task in the last four years. Aerial triangulation procedures have also been extended, and practical procedures for small scale mapping from Landsat and radar imagery developed.

The Ministry of Defence HYDROGRAPHIC DEPARTMENT undertakes on-line co-ordinate transformations using a dedicated HP9825A desktop computer interfaced to the EK22 data acquisition system. A suite of programs is being developed (partly by adaptation of existing main frame programs) including relative and absolute orientation, photogrammetric heighting and depth measurement, and some independent model strip formation computations.

ILFORD LIMITED has discontinued its range of glass plates and withdrawn its aerial film products. The company's remaining interest in photogrammetry is through its range of polyethylene laminated base enlarging papers. These were introduced as part of the Ilfospeed system which now also includes a variable contrast paper, Ilfospeed Multigrade.

KODAK LIMITED continues to market a range of photographic films, papers, chemicals and processing apparatus for use in the survey and photogrammetric fields.

Photogrammetric research in the School of Geography at the UNIVERSITY OF LEEDS has focussed on the development of software for cartographic mapping and terrain analysis, using the School's Kern PG2L plotter which is fitted with encoders. Model co-ordinates can be measured and fed directly into either a Wang 600 or a Wang 2200-T4 computer. The latter can be used interactively for setting up models and a variety of simple computational procedures. Digital data may be transferred on magnetic tape to one of the mainframe computers in the University.

Within the UNIVERSITY OF LONDON, the Department of Anatomy and Embryology at UNIVERSITY COLLEGE LONDON uses photogrammetry in scanning electron microscopy of surfaces of microscopic biological objects. The Department is co-operating with Mr H F Ross in the production of a new stereocomparator designed for measuring resorption lacunae in bone.

The Department of Photogrammetry and Surveying at UNIVERSITY COLLEGE LONDON has continued its interest in instrument development with the modification of the Cartographic Engineering CP1 plotter to record densities from photographs which are used for off-line correlation of images and the computation of heights. The mechanical and optical work has been completed, and a successful PhD project was concerned with developing programs for correlation. At present tests are being carried out and programs are being developed for deriving and processing digital terrain models.

Studies of the deformation of a model box girder bridge have been completed, but work is continuing on the calibration of cameras for close range photogrammetry. Work is also in progress investigating the multistation approach to close range photogrammetry and associated problems related to marine structures.

Research into the history of photogrammetry in the United Kingdom continues in the Department with papers published on personalities and methods. A special effort has been put into the life and work of F Vivian Thompson who was born one hundred years ago in 1880.

Other areas of research include the use of kites, balloons, and model aircraft for low level photography, the application of photogrammetry to aspects of Turkish mediaeval architecture, and the development of an instrument for the direct contouring of small objects.

The Department of Civil Engineering at the IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY has investigated the accuracy with which deformations of models of civil engineering structures could be determined from Hasselbald MK70 photography taken with a 60mm lens and using stereopairs of an array of targets at a distance of 1.2m. The photographs were measured monocularly in a Zeiss (Jena) Stecometer.

The Department of Geology at the College is engaged in photogeological research, principally in engineering and mineral exploration, with some activity in petroleum and water studies.

LONGDIN AND BROWNING (SURVEYS) LIMITED are investigating the use of non-metric cameras for underwater photogrammetry.

The Department of Civil and Structural Engineering at the UNIVERSITY OF MANCHESTER INSTITUTE OF SCIENCE AND TECHNOLOGY is investigating the accuracy of photogrammetric measurements using multistation techniques. A stereometric stand for close range photogrammetry has been constructed. The stand allows the Department's two Zeiss (Jena) UMK 10/1318 cameras to be assembled at a base ranging from 0.6m to 2m, and convergent photography to be taken if required. A level or theodolite can be mounted in the centre of the frame. Elevation of the frame can be adjusted using an hydraulic jack.

In the field of photo-interpretation, the NATIONAL COLLEGE OF AGRICULTURAL ENGINEERING has developed a simple microdensitometer for student use to measure variations of grey tone. The College has also carried out a study of the effectiveness of the parallax bar.

The Department of Surveying at the UNIVERSITY OF NEWCASTLE UPON TYNE is investigating the application of non-metric cameras in medical photogrammetry. An analytical system based on a Zeiss (Jena) stereo-comparator interfaced to a Wang PCS 2200 minicomputer has been investigated for use in close range photogrammetry.

The Department of Civil Engineering at PAISLEY COLLEGE OF TECHNOLOGY has investigated the use of Multiplex for measuring small deformations in models, and the use of an aerial camera for quantities measurements in quarries.

PHOTOARC SURVEYS LIMITED is engaged in developing the application of terrestrial photogrammetry in underwater situations.

The Department of Geography at PORTSMOUTH POLYTECHNIC has carried out research in photo-interpretation and photogrammetric mapping of the inter-tidal zone of Chichester and Langstone Harbours from infrared false colour photography.

Funds have been provided by the Nature Conservancy Council and the Southern Water Authority. For educational and research use, the Department has developed the use of a digitised Kern PG2 interfaced to a Wang 2200B computer with digitiser and drum plotter.

The Department of the Environment PROPERTY SERVICES AGENCY has commissioned a development task comparing orthophotography and traditional photogrammetric methods of producing elevations of particular types of structures.

The Department of Civil Engineering at the ROYAL MILITARY COLLEGE OF SCIENCE is developing research projects concerned with digital modelling methods.

K A RYLANCE AND ASSOCIATES are developing the use of a Hasselblad camera mounted on a Zeiss (Jena) BRT 006 Telemeter for the production of low cost photoelevations of 'plane' building elevations.

The TRANSPORT AND ROAD RESEARCH LABORATORY is developing methods of using photogrammetry to measure road surfaces as an aid to identifying factors causing road deterioration.

Within the UNIVERSITY OF WALES, an investigation by the Department of Geography at the UNIVERSITY COLLEGE OF SWANSEA into the application of photogrammetric methods to the evaluation of forests using large scale aerial photography continues.

In the early part of the period of the Report, the Department of Geography at the UNIVERSITY COLLEGE OF WALES, ABERYSTWYTH concluded a study of the effectiveness of the various forms of photomap and line map for the management of small nature reserves undertaken with the

Nature Conservancy. Considerable effort has been involved recently in the application and development of digital terrain models for the definition of floodplain microtopography, particularly with a view to the prediction of washland inundation on flooding rivers, for planning purposes.

The Photogrammetric Unit of the Institute of Advanced Architectural Studies at the UNIVERSITY OF YORK is continuing research into the refinement of the techniques of architectural photogrammetry.

SECTION 4 : EDUCATION

This section is divided into entries for the main organisations offering or concerned with photogrammetric education, and a list of universities and colleges which include photogrammetry as a subsidiary subject in their courses.

The DIRECTORATE OF OVERSEAS SURVEYS gives basic photogrammetric training to all newly recruited technicians during their first nine months of employment. An additional four months training is given to those who have been selected to work in the photogrammetric production sections. Thereafter machine operators are given short training courses on particular instruments as required within the production framework.

During their basic training period, technicians are given the option of part time release to take the Technician Education Council (TEC) Certificate in Cartography, and a limited number are released to take the Higher Certificate after a period of production experience. (These Certificates have replaced the former Ordinary and Higher National Certificates).

Courses in basic air survey and photogrammetry are provided at the Directorate for technician staff from overseas survey and other departments. The trainees may be holders of United Kingdom technical co-operation awards, United Nations fellowships, or scholarships awarded by their own governments.

FAIREY SURVEYS LIMITED runs three formal courses internally to cover basic, intermediate, and advanced training for their photogrammetric staff as the need arises. Day release facilities are also given to suitably qualified employees to study for TEC Certificates in Photogrammetry or Cartography at an approved polytechnic. From time to time on the job training in photogrammetry and other mapping processes is given for technical employees of some of the company's overseas clients. These practical courses are usually of one to three months duration.

The UNIVERSITY OF GLASGOW, Topographic Science, Department of Geography continues to offer a postgraduate Diploma in Photogrammetry. In addition a number of graduate students opt to major in photogrammetry within the M App Sc degree programme in topographic science. Photogrammetry continues to be taught in detail to undergraduate students following BSc degrees in topographic science which include a special course on mapping from remote sensing imagery. A short introductory course in photogrammetry is given to BSc degree students in civil engineering.

At KINGSTON COLLEGE OF FURTHER EDUCATION the Department of General Studies offers the TEC Certificate in Surveying and Cartography, of which photogrammetry related to topographic and thematic mapping forms a part. At TEC Higher Certificate level, photogrammetry can be taken as a main course or as part of a cartographically oriented course. The main course contains a greater emphasis on practical skills. Additional short courses are offered on request for photogrammetric

technicians employed in local mapping organisations and to students from other disciplines such as traffic engineering, geography and geology.

Within the UNIVERSITY OF LONDON, the Department of Photogrammetry and Surveying at UNIVERSITY COLLEGE LONDON has an extensive research programme with 10 students currently registered for M Phil and PhD degrees. Members of staff have connections with several overseas universities and colleges with whom collaboration and teaching takes place. The MSc and Diploma courses in photogrammetry and surveying continue to attract students from the United Kingdom and elsewhere. The number of undergraduates taught by the Department is increasing, and the staff now teach two courses for first year earth scientists, and two second and third year courses for geographers and civil engineers. Most of these courses are taught on an intercollegiate basis within the University of London.

Since 1977 the Department of Surveying at the UNIVERSITY OF NEWCASTLE UPON TYNE has offered a BSc honours degree in Surveying Science. The BSc Joint Honours Degree in association with computing science, geography, geophysics, mathematics, physics, or statistics also continues. Both courses involve a considerable element of photogrammetry. Facilities exist for research in photogrammetry, and students may be accepted for MSc and PhD degrees.

The Department of Land Surveying at NORTH EAST LONDON POLYTECHNIC offers a wide network of courses in land and sea surveying topics. The BSc honours degree course includes mapping and photogrammetric studies in all three years. In the third year, specialist studies in analytical photogrammetry and photogrammetric instrumentation are offered.

The courses designed for students taking the final examinations in the Land Survey Division of the Royal Institution of Chartered Surveyors include one for students preparing for the option paper in photogrammetry. The courses associated with TEC Higher Certificate and Higher Diploma in land surveying include the photogrammetric option. Short courses in both practical and theoretical photogrammetry are also run from time to time in response to specific demands.

At ORDNANCE SURVEY staff recruited into the Air Survey Branch are selected from within the Department and attend a two month course for stereoplotting instrument operators before they begin production work. This training was formerly in-house, but since 1978 it has been undertaken at the School of Military Survey at Newbury.

The PHOTOGRAMMETRIC SOCIETY has recently formed a Special Projects Committee which, among other activities, has been responsible for publishing a careers leaflet giving details of photogrammetric education and employment opportunities in the United Kingdom. The Committee has also organised the first of a series of seminars, which the Society is sponsoring, for people in other disciplines who may benefit from the various applications of photogrammetry.

The Department of Geography at PORTSMOUTH POLYTECHNIC offers BSc geographical science and BA geography degree courses which include a third year option in aerial survey and remote sensing. A first year general course in topographical science is run for students for the BSc science degree. It is proposed that a second year full time topographic science course will be run from October 1980.

The Department of Civil Engineering at the ROYAL MILITARY COLLEGE OF SCIENCE offers a BSc (Engineering) course in the field of civil engineering. The first year has a compulsory full course in surveying with an introduction to air survey methods and equipment. The second year has a compulsory short course in surveying with an introduction to instrument plotting followed by a three week practical survey course including air survey control exercises, and a further three week practical photogrammetry course held at the School of Military Survey. The third year has an optional half course in surveying with a photogrammetric content biassed towards engineering applications.

Undergraduate courses for civil engineering students in topographic mapping make use of Multiplex, Zeiss (Oberkochen) DP1 and Cartographic Engineering CP1 plotters, and a variety of small equipment including stereoscopes and parallax bars. A Wild A7 and an EK5 digital output with access to a computer are to be introduced for students in terrestrial and close range photogrammetry.

The SCHOOL OF MILITARY SURVEY provides professional survey training, including photogrammetry, for selected military officers of the British Army, civilian officers of other British Government organisations, and officers and probationers of British Commonwealth and foreign military and civil survey organisations on the Army Survey Course which assembles twice a year and lasts 14 months. Within the School, the Air Survey Department also trains military and civilian air survey technicians and government survey officers as operators and as technical supervisors requiring a high standard of knowledge in a comparatively narrow field.

The B Eng course in Civil and Structural Engineering at the UNIVERSITY OF SHEFFIELD includes 17 hours of practicals and lectures in air survey (mainly the use and acquisition of air cover), and a full final year option in engineering photogrammetry, together with optional major projects. The Department of Civil and Structural Engineering gives introductory courses to landscape architect and traffic engineering post-graduate students.

Photogrammetry forms a substantial part of the postgraduate Diploma in Cartography offered by the Department of Geography at the UNIVERSITY COLLEGE OF SWANSEA. It also forms a large part of optional courses offered to geography undergraduates.

The following universities and colleges include photogrammetry as a subsidiary subject in their courses:

University of Aston in Birmingham, Department of Civil Engineering
Queen's University of Belfast, Department of Geography
University of Bristol, Department of Civil Engineering
Polytechnic of Central London, Civil Engineering Unit
City University, Department of Civil Engineering

University of Durham, Department of Geography
University of Edinburgh, Department of Forestry and Natural Resources
Hatfield Polytechnic, School of Engineering
Kingston Polytechnic, School of Civil Engineering
Lanchester Polytechnic, Department of Civil Engineering and Building
University of Leeds, School of Geography
University of London, University College London, Department of Anatomy and Embryology
University of London, Imperial College of Science and Technology, Department of Civil Engineering
University of London, Imperial College of Science and Technology, Department of Geology
University of London, Imperial College of Science and Technology, Department of Mineral Resources Engineering
University of Manchester Institute of Science and Technology, Department of Civil and Structural Engineering
National College of Agricultural Engineering
University of Nottingham, Department of Civil Engineering
University of Oxford, Department of Surveying and Geodesy
Paisley College of Technology, Department of Civil Engineering
Portsmouth Polytechnic, Department of Civil Engineering
University of Salford, Department of Civil Engineering
University of Surrey, Department of Civil Engineering
University College of Wales, Aberystwyth, Department of Geography

SECTION 5 : REMOTE SENSING

There has been a rapid growth of interest in remote sensing in Britain during the period of the report, resulting from easier acquisition of data from orbital sensors and an increasing need to inventory and monitor earth resources.

The Department of Industry directory 'REMOTE SENSING OF EARTH RESOURCES' gives an outline of remote sensing and photogrammetric activities of organisations and individuals within the United Kingdom. The 4th edition for 1978 was published in 1979. For each organisation information is given on activities, access to facilities and equipment, future plans, publications, and holdings of space imagery. Organisations are divided into five groups, and in 1978 these were:

Group	No of Organisations
Industry and Commerce	81
Universities, Polytechnics, and College Departments	76
Government Departments, Ministries, and Research Councils	33
National Institutes, Research Associations, and Laboratories	26
Miscellaneous : learned societies, libraries, and consultants	14

The applications of remote sensing and photogrammetry were divided between the following headings:

Heading	No of Organisations Involved
Interpretation techniques - data processing	26
Land Use and Mapping	20
Meteorology	17
Geology and Mineral Resources	16
Multidisciplinary Resource Surveys	15
Sensor Technology	13
Terrain Resources	12
Marine Resources and Oceanography	11
Environment and Pollution	10
Water Resources	9
Soil Survey	5
Agriculture	5
Land Form Surveys	5
Forestry	2

EDUCATION in remote sensing techniques has gained a new importance, and more universities and polytechnics have included remote sensing in their courses and offered facilities for research. Training and refresher courses have been organised by industry and government.

The REMOTE SENSING SOCIETY which was formed in 1974, was established to bring together all those professionally engaged or directly interested in the many aspects of remote sensing, and to provide a means for the dissemination of new knowledge and information through meetings, conferences, publications and courses.

During the period of the report, the Society published papers on land use studies, monitoring environmental change, and remote sensing applications in developing countries. The last three years have seen the membership of the Society double, with members from over 50 countries.

A new quarterly journal entitled "International Journal of Remote Sensing" will begin publication in 1980 and will be an official journal of the Society. All aspects of remote sensing and its applications will be covered. The journal has an international board of editors.

The Silver Jubilee exhibition called 'EXPLORATION' was opened by the Science Museum in London in November 1977. The exhibition, which will remain open for three years, includes a section on remote sensing. The section has a thermal scanner with which visitors can see themselves and familiar household objects in the form of heat/temperature pictures.

The United Kingdom NATIONAL POINT OF CONTACT with Earthnet has been in operation at the Remote Sensing Unit of the Royal Aircraft Establishment's Space Department at Farnborough since December 1978. Its main functions are:

To acquire satellite products, particularly computer compatible tapes (CCT's), from Earthnet, and make them available to users in the United Kingdom (UK).

To derive photographic products from the CCT's.

To establish and maintain an archive of the best available imagery of the UK, and a set of imagery of overseas territories representative of different types of terrain.

To maintain and disseminate catalogues and browse files of available imagery of the UK.

To promote the use of remote sensing data by training and other means.

To organise colloquia and meetings for the exchange of information between users.

To make remote sensing satellite data processing and related services available to users.

Among SATELLITE RESEARCH PROJECTS, two UK proposals were accepted by NASA for Landsat 2 research. These were at Bedford College, University of London, on the use of ERTS imagery in relation to airborne remote sensing for terrain analysis in Australia, and the University of Bristol on mesoscale assessments of cloud and rainfall over south-west England.

One European and two UK projects are presently being studied using data from the Atmosphere Explorer Satellite, a part of the Heat Capacity Mapping Mission. Lancaster University is investigating the feasibility of monitoring marine pollutants, particularly oil, around Britain. Bedford College, University of London, is working on rock discrimination for mineral exploration and detection of geothermal heat sources and moisture content assessment for rangeland management in Australia. Supported by the Natural Environmental Research Council, the Institute of Hydrology and the Departments of Geography in the Universities of Leeds and Reading are involved in the European Joint Research Centre TELLUS project to determine soil moisture and evaluate heat budgets in selected European zones of agricultural and environmental interest.

During the short life of SEASAT, Oakhanger receiving station collected 53 synthetic aperture radar, 659 radar altimeter, and 757 wind field scatterometer passes. This data is being processed by the UK National Point of Contact.

The NIMBUS 7 satellite carries three instruments relating the earth's surface to its atmosphere. These are the coastal zone colour scanner (CZCS), the scanning multichannel microwave radiometer (SMMR) and the limb infrared monitor of the stratosphere (LIMS).

The UK is involved in CZCS experiments in the European Association of Scientists in Environmental Pollution (EURASEP) project, put forward by the European Joint Research Centre. In the UK the programme is co-ordinated by the Research Requirements Division of the Department of the Environement, and the co-investigators are Dundee University, the Electrical Engineering Department of Bristol University, the Institute of Oceanographic Sciences, and the Marine Sciences Laboratories of the University College of North Wales. Tests sites are the North Sea, the south-west coast and the Bristol Channel, and the Irish Sea.

British Aerospace are investigating data reduction methods as part of the SMMR experiment in order to extract sea condition parameters such as temperature, roughness, surface wind speed, and ice boundaries.

The National Physical Laboratory is using information from the LIMS experiment.

To assist organisations with energy conservation measures, some 250 sites in the UK have been covered by airborne thermal infrared surveys undertaken by Fairey Surveys Limited.

OPERATIONAL REMOTE SENSING PROJECTS have included the interpretation of sidelooking airborne radar surveys of vegetation and land use systems in Nigeria by Hunting Technical Services. This firm together with Fairey Surveys Limited and Nigel Press Associates have undertaken remote sensing reconnaissance surveys in a number of developing countries.

SECTION 6 : BIBLIOGRAPHY

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Directorate of Military Survey	Elmwood Avenue Feltham Middlesex TW13 7AF	01-890-3622	J E Farrow	2
Directorate of Overseas Surveys	Kingston Road Tolworth Surbiton Surrey KT5 9NS	01-337-8661	Asst Director (Mapping)	2-3, 21
Fairey Surveys Ltd	Reform Road Maidenhead Berks SL6 8BU	0628-21371	O W Cheffins	3-4, 11,16-17
Fairey Surveys Scotland Ltd	10 Napier Square Houstoun Industrial Estate, Livingston W Lothian EH5 45DG	0589-33528	W A S Clark	4,11, 21
Grassland Research Institute	Hurley Maidenhead Berks SL6 5LR	062-882-3631	J R Tallowin	11
Guy's Hospital Dept of Paediatrics	St Thomas Street London SE1 9RT	01-407-7600 Ext 2702	Dr M Joseph	11-12
H M Dockyard Photogrammetry Unit	HM Naval Base Portsmouth PO1 3NH	0705-22351 Ext 22811	General Manager	12
Hunting Surveys Ltd	Elstree Way Boreham Wood Herts WD6 1SB	01-953-6161	J D Leather-dale	4-5, 12,17
Hydrographer of the Navy	Hydrographic Dept Ministry of Defence, Taunton, Somerset TA1 2DN	0823-87900 Ext 323/242/467	I D Kember	5,12, 17
Ilford Ltd	Basildon Essex SS14 3ET	0268-27744	R R Parsons	17
Institute of Hydrology	Staylittle Llanbrynmair Powys SY19 7DB	05516-652	J A Hudson	12

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Kodak Ltd	Kodak House Station Road Hemel Hempstead Herts HP1 1JU	0442-61122 Ext 54	B J Turpin	17
Longdin & Browning (Surveys) Ltd	Old Castle Llanelli Dyfed SA15 2SR	05542-57401	W S Longdin	13,18
Meat Research Institute	Langford Bristol BS18 7DY	0934-852661	C A Miles	14
Meridian Airmaps Ltd	Marlborough Road Lancing Sussex BN15 8TT	09063- 2992/5	Dr M W Grist	5,14
Nature Conservancy Council	Roughmoor Bishop's Hull Taunton TA1 5AA	0823-83211	R A Fenton	5
Ordnance Survey	Romsey Road Maybush Southampton SO9 4DH	0703-775555 Ext 520	Manager Air Survey	6-7, 22
Ordnance Survey of Northern Ireland	83 Ladas Drive Belfast BT6 9FJ	0232-58225	M J D Brand	7-8
Photarc Surveys Ltd	12a North Street Wetherby W Yorks LS22 4NN	0937-64936	C R Boyd	8,14, 19
Photogrammetric Society	C/o Fairey Surveys Reform Road Maidenhead Berks SL6 8BU	0628-21371	Hon Secretary O W Cheffins	22
Potato Marketing Board	50 Hans Crescent Knightsbridge London SW1X ONB	01-589-4874	R J Dadson	8
Property Services Agency, Directorate of Civil Engineering Services	Lunar House 40 Wellesley Road Croydon CR9 2EL	01-686-3499	A G Hurrell	8,15, 19
Remote Sensing Society	C/o Dept of Geography, Univ of Reading, No 2 Earley Gate, Reading RG6 2AU	0734-85123 Ext 6387	Hon Gen Sec	

Name	Address	Telephone	Correspondent	Page
Royal Institution of Chartered Surveyors	12 Great George St Parliament Square London SW1P 3AD	01-222-7000	Land Surveyors Division	
Royal Commission on Historical Monuments (England), National Monuments Record, Air Photographs Unit	Fortress House 23 Savile Row London W1X 1AB	01-734-6010	J N Hampton	8
K A Rylance & Associates	Winston House 62 Hermitage Rd St John's Woking GU21 1TQ	06862-67888	K A Rylance	15,19
Survey & Development Services	1 Atholl Place Edinburgh EH3 8HP	031-228-1446	J E McCreadie	9,15
Transport and Road Research Laboratory	Crowthorne Berks RG11 6AU	03446-3131 Ext 2177	W Heath	9,15, 19
Wiltshire County Council	County Hall Trowbridge Wilts BA14 8JE	02214-3641 Ext 2887	County Planning Officer	9

Universities and Colleges

University of Aston in Birmingham, Dept of Civil Engineering	Gosta Green Birmingham B4 7ET	021-359-3611	Dr W G Collins	1,23
Queen's University Belfast	David Keir Bldg Stranmillis Road Belfast BT7 1NN	0232-45133	Dr R W Tomlinson	1,23
University of Bristol Dept of Civil Engineering	Queen's Building University Walk Bristol BS8 1TR	0272-24161 Ext 134	Prof R T Severn	10,23
University of Cambridge, Committee for Aerial Photography	Mond Building Free School Lane Cambridge CB2 3RF	0223-358381 Ext 354	Professor J K St Joseph	1
Polytechnic of Central London Civil Engineering Unit	35 Marylebone Rd London NW1 5LS	01-486 5811	M G Burry	23
City University Dept of Civil Engineering	Northampton Sq London EC1V 4PB	01-253-4399 Ext 229	C H Bedwell	16,23

Name	Address	Telephone	Correspondent	Page
University of Durham Dept of Geography	Science Laboratories South Road Durham DH1 3LE	0385-64971	Dr R Harris	24
University of Edinburgh, Dept of Forestry & Natural Resources	King's Buildings Mayfield Road Edinburgh EH9 3JU	031-667-1081 Ext 2723	I Langdale-Brown	10,16, 24
University of Glasgow Dept of Geography	Glasgow G12 8QQ	041-339-8855 Ext 7403	Prof G Petrie	4,17, 21
Hatfield Polytechnic School of Engineering	PO Box 109 College Lane Hatfield AL10 9AB	07072-68100 Ext 362	C M G Francis	24
Kingston College of Further Education Department of General Studies	Kingston Hall Road Kingston on Thames Surrey KT1 2AQ	01-546-2151	L S Kelly	21-22
Kingston Polytechnic School of Civil Engineering	Canbury Park Road Kingston on Thames Surrey KT2 6LQ	01-549-0151	W Schofield	24
Lanchester Polytechnic Department of Civil Engineering and Building	Priory Street Coventry CV1 5FB	0203-24166	P A Greengrass	24
University of Leeds School of Geography	Leeds LS2 9JT	0532-31751	Dr J Hogg	5,17, 24
University of London:				
Imperial College of Science and Technology, Dept of Civil Engineering	Imperial College Road London SW7 2BU	01-589-5111	B Chiat	12-13, 18,24
Department of Geology	Royal School of Mines, Prince Consort Road London SW7 2BP	01-589-5111	Dr J W Norman	24
Department of Mineral Resources Engineering	Royal School of Mines, Prince Consort Road London SW7 2BP	01-589-5111	Dr T L Thomas	24

Name	Address	Telephone	Correspondent	Page
University College London: Dept of Anatomy & Embryology	Gower Street London WC1E 6BT	01-387-7050	A Boyde	18,24
Dept of Photo-grammetry and Surveying	Gower Street London WC1E 6BT	01-387-7050	I J Dowman	13,18, 22
University of Manchester, Institute of Science and Technology, Dept of Civil & Structural Engineering	PO Box 88 Manchester M60 1QD	061-236-3311	Dr A H El-Beik	13,18, 24
National College of Agricultural Engineering	Silsoe Bedford MK45 4DT	0525-60428	M A Keech	5,14, 19,24
University of Newcastle upon Tyne Dept of Surveying	Newcastle upon Tyne NE1 7RU	0632-28511 Ext 2446	I Newton	5-6,14, 19,22
North East London Polytechnic, Dept of Land Surveying	Forest Road London E17 4JB	01-527-2272	C D Burnside	22
University of Nottingham, Dept of Civil Engineering	University Park Nottingham NG7 2RD	0602-56101 Ext 2663	R Wood	24
University of Oxford Dept of Surveying and Geodesy	62 Banbury Road Oxford OX2 6PN	0865-57816	J G Olliver	24
Paisley College of Technology, Dept of Civil Engineering	High Street Paisley Renfrewshire PA1 2BE	041-887-1241	J G Paul	8,14, 19,24
Portsmouth Polytechnic:				
Dept of Civil Engineering	Burnaby Road Portsmouth PO1 3QL	0705-27681 Ext 358	P F Gardner	24
Dept of Geography	Lion Terrace Portsmouth PO1 3HE	0705-27681 Ext 348	M G Coulson	19,23
Royal Military College of Science, Dept of Civil Engineering	Shrivenham Swindon SN6 8LA	0793-782551 Ext 265	W M Barnes	19,23

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University of Salford Dept of Civil Engineering	Salford M5 4WT	061-736-5843	A Bannister	24
School of Military Survey	Hermitage Newbury Berks RG16 9TP	0635-200371	Commandant	23
University of Sheffield:				
Dept of Chemical Engineering & Fuel Technology	The University Mappin Street Sheffield S1 3JD	0742-78555	Dr D J Brown	15
Dept of Civil & Structural Engineering	The University Mappin Street Sheffield S1 3JD	0742-78555	W K Kilford	15,23
Dept of Dental Health	School of Clinical Dentistry Sheffield S10 2SZ	0742-7855 Ext 6026	Prof P H Burke	15
University of Surrey Dept of Civil Engineering	Guildford Surrey GU2 5XH	0483-71281	-	24
University of Wales:				
University College of Swansea, Dept of Geography	Singleton Park Swansea Glamorgan SA2 8PP	0792-25678	D H Maling	9,19-20,23
University College of Wales, Aberystwyth Dept of Geography	Llandinam Building Penglais Aberystwyth Dyfed SY23 3DB	0970-3111	R L Collin	19,24
Welsh National School of Medicine, Dental School, Dept of Orthodontics	Heath Cardiff CF4 4XY	0222-755944 Ext 2447	Prof N R E Robertson	
University of York Institute of Advanced Architectural Studies Photogrammetric Unit	The King's Manor Exhibition Square York YO1 2EP	0904-52606	R W A Dallas	15,20