Fairey Surveys

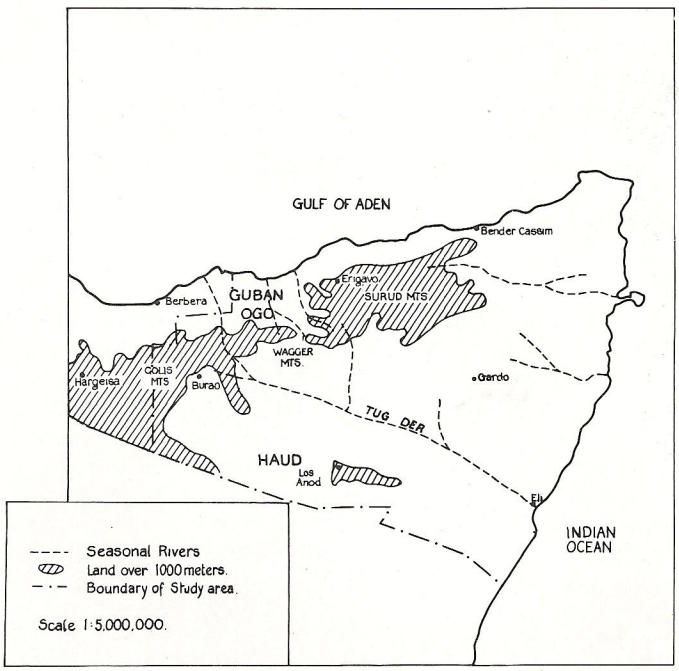
Newsletter 21

News of developments in the world of surveying and mapping JUNE 1979

Northern Somalia Rangeland Project

The Environment and Resources Consultancy department which includes among its specialities, natural resource studies and rural development projects in semi-arid and arid areas, has recently completed a project in Northern Somalia to evaluate potential stock watering sites, flood irrigation and the harvesting of water for fodder production.

The scope of the work required the ERC staff to prepare a series of thematic maps from satellite imagery, taken at different seasons, over the whole area, approximately 180,000 sq. kms., for use in the search to locate more profitable areas for the development of surface and ground water. The requirement was multi-disciplinary and the team dealt with the following tasks:



Location map of the study area of Northern Somalia.

(i) an extensive review of all existing information on the study area relevant to the project was prepared.

(ii) an analysis of all available Landsat data over the study area was carried out from which sequential multi-spectral black and white images and colour composites were selected.

(iii) a set of Landsat photomosaics at a scale of 1:500,000 were produced from the selected imagery to serve as an up-to-date base for the thematic maps.

(iv) detailed surface drainage maps, depicting drainage networks, watersheds, areas of internal drainage, depressions, moisture zones, and other significant features, were prepared by experienced photo-geomorphologists.

(v) the hydrologists in the team prepared geological and ground water potential maps, in order to determine possible sites where ground water resources could be utilised for irrigation and live-stock watering purposes.

(vi) a set of maps showing the eco-climatic zonation of the main vegetation types was prepared by ecologists. These provide a basis for more detailed studies of the vegetation ecology and a useful aid in the analysis of land capability of the area. A series of maps showing vegetation physiognomy and density were also prepared.

(vii) land capability maps were produced utilising the ground water potential and vegetation maps.

On completion of the production of this series of photo mosaics and thematic maps, a detailed report was written outlining the survey techniques together with the results of the study. This included detailed recommendations for the subsequent phases to follow in order to improve the animal carrying capacity of each part of the range in Northern Somalia.

The project was undertaken on behalf of Sir William Halcrow & Partners who are compiling a major survey of the area. From the instruction to proceed to the final report, time taken to complete the project was only 12 weeks.

Aerial Photography of Wadi Sirhan Basin

Beechcraft Queenair used for the Wadi Sirhan Basin project.

One major contract for which flying and photography was completed in 1978 was that commissioned by Riofinex Limited, covering an area of 91,000 square kilometres in the north-west of the Kingdom of Saudi Arabia.

The purpose to which the photography will be put, is a photo-geological interpretation of phosphate potential, being undertaken by the resident Riofinex geological mission, by agreement with the Ministry of Petroleum and Mineral Resources.

The first phase of the photography was undertaken from late April until mid-June during a period when considerable haze was encountered and production was restricted. The second phase was undertaken between 1st October and mid-December when the weather was generally good. The photography was flown with a Wild RC10 camera at a contact scale of 1:40,000 with a lateral overlap of 30%. Full stereoscopic cover was required with a nominal 60% overlap, which involved flying 55 runs in an East-West direction. The area abuts the international borders with Jordan and Iraq and sorties parallel to these territorial boundaries were flown so that turns could be completed without trespass. In all 44 films were exposed and processed for a total of 4780 frames.

The logistics involved entry via Jeddah international airport followed, after formalities were cleared, by an internal mobilisation to the airport at Turayf. This was the only base used for the area and the Riofinex geological teams at Turayf made the aircrew very welcome, plus making arrangements for 100 octane fuel to be available and 125 gallons a day of suitable water for processing.

Dark room processing and printing was accomplished on site at Turayf with certainly no more than the difficulties one expects to encounter on a remote desert station. Phase I was flown using Beechcraft B80 Oscar Hotel and Phase II with Britten-Norman Islander, Kilo Charlie. The landing strip proved somewhat abrasive which meant frequent tyre changes were necessary. The logistic support available by means of a special-flights Skyvan saved the day on more than one occasion, thanks to daily radio contact between Turayf and Jeddah.

The materials being produced after completion of the flying have two purposes. Firstly, sets of contract prints are required for the photo-geologists to undertake the interpretation of phosphate potential; these products must optimise ground detail and landform patterns. Secondly, in order to collate all photo-geological data into a coherent and manageable form, a semi-controlled photo-index mosaic at a scale of 1:100,000 is being compiled. For this use was made of the ground control stations established in the centre of the area by the geological mission.

The technical objective in the second case will be to produce imagery as consistent in appearance as the terrain patterns will allow. The relatively small number of mosaic sheets will also be invaluable as navigational map-substitutes for the field geologists to use during the ground assessment phase.

HELIOGRAPH

A new instrument from our Research & Instruments Group

To meet the continuing requirement for a daylight survey target now that the old Mk.V military Helios are no longer available, we have introduced a replacement with improved design and easier sighting.

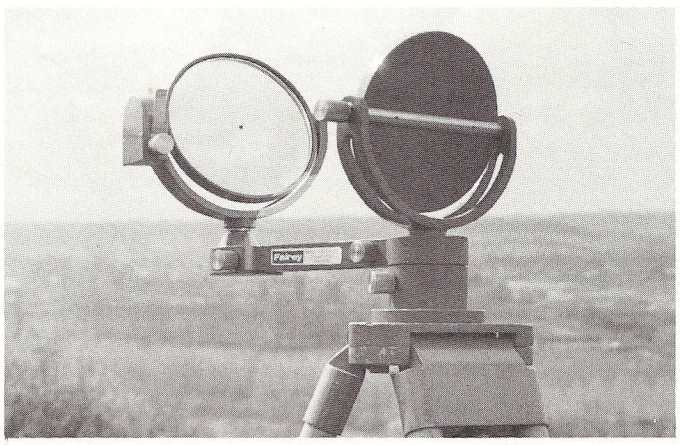
The main feature of the new instrument is that the observer always sees the target in line with the plumb point whether it is in simplex or duplex mode. Formerly, the tracking mirror was positioned over the plumb point so that in duplex mode the target was always offset by a distance up to the length of the support beam. On our instrument the target mirror is over the plumb point in duplex mode, and in simplex the tracking mirror (which then acts as the target as well) is always in a direct line with the plumb point and the observer. Thus errors due to offset, which can be as much as 5 seconds over 10 Km., are avoided.

A clear view hole in the centre of the tracking mirror enables direct target acquisition from behind the instrument in addition to the reflected image technique which some surveyors prefer.

Slow motion drives are incorporated on both axes of the tracking mirror to enable sun declination and azimuth to be followed precisely and a trigger is provided for signalling.

It fits directly to both Wild and Zeiss tripods and we can supply adaptors for other tripods on request.

The instrument is easily dismantled for transportation and is supplied in a lightweight flexible bag with shoulder carrying strap.



Fairey Heliograph designed and produced by the Research and Instruments Division.

Part of the film library at Maidenhead. Over 50 miles of aerial film is in the safe keeping of the library staff.

County Cover Photography for the 1981 Census

Our recent circular letter to County Councils and other Local Authorities has generated a healthy response and request for further details.

In our experience the most widely accepted and generally useful scale of photography is 1/10,000, from this scale it is possible to produce 1/2500 scale revision mapping with 1 metre or 2 metre contours, or photographic enlargements to 1/2500 or 1/1250 scale. For special purposes such as identification of allotment boundaries or positioning of street furniture and road lines we have also produced enlargements at 1/500 scale. With the modern aerial survey camera and good photographic conditions the resolution from 1/10,000 scale is quite adequate for these purposes.

Naturally a larger contact scale such as 1/5000 increases the detail resolution and would enable photogrammetric plotting at larger scales such as 1/1000 or 1/1250 or even for small areas 1/500 scale, with a corresponding reduction in the contour interval to 0.5 metre—1 metre. However for any extensive 1/500 scale mapping with 0.5 metre contour to the normally accepted DOE specification 1/3000 scale photography will be necessary. The penalty for these larger scales of photography, being the greatly increased cost due to the additional number of runs and frames required, the cost of 1/5000 photography for example being at least double the cost of 1/10,000.

A sensible compromise is to have 1/5000 cover of the larger urban areas where the greater resolution can be used to effect on the increased amount of ground detail and to have 1/10,000 cover over the rural areas.

A further consideration is the use of colour photography or infra red false colour.

The last sentence in Item 2.8 of the standard DOE specification states 'the use of colour in the photography and processing will be permitted'. Where the intention is to extract information on the different types and conditions of vegetation or, environmental impact assessment is required before development takes place then colour or infra red false colour will be justified.

United Nations Fellowship Guyana — Maidenhead

Mr. Hansraj Makardajh, employed by the Department of Lands and Survey in Georgetown, Guyana, was in 1978, awarded a United Nations Fellowship for six months advanced training.

In his application, Mr. Makardajh expressed his wish to study further the subject of, 'Topographical Drafting', he nominated England as the country in which he wished to study and Fairey Surveys as the organisation preferred to plan and control his training programme.

This request received United Nations approval and the visit was arranged through the British Council.

The weather was already rather cold and inhospitable when Mr. Makardajh arrived in England at the beginning of October. Coming from sunny Guyana this was a cold welcome indeed. After an immediate purchase of warm clothing Mak (as we came to know him) settled in with Fairey Surveys, impressing his instructors with his ability and eagerness to learn and at the same time falling easily into a good working relationship with his fellow draughtsmen and cartographers.

During his six month stay Mak worked mostly in the Drawing Office on mapping projects of various scales and types using a wide range of materials and equipment some of which were familiar and some a new experience. The training also included an introduction to photogrammetry, working with project leaders in the Project Control Department, editorial and design work, the preparation and production of photo-mosaics and basic instruction in the equipment, materials and processes used by the reprographic section.

Before leaving us to return home at the end of March, Mr. Makardajh produced as an exercise a beautiful four colour map of Guyana at a scale of 1:1,000,000 with a wealth of detail, a copy of which we are proud to have hanging in our offices.

HANSRAJ MAKARDAJH–Department of Lands and Surveys, Guyana.

The Change and the Challenge

In March this year the 45th Annual Meeting of the American Society of Photogrammetry was held as a joint session with the 39th Meeting of the American Congress on Surveying and Mapping, in Washington DC.

This event with its attendant exhibition of over 200 stands attracted some 3,000 delegates from all over the world including our representative, Mr. W. M. Henry.

The theme chosen for this occasion was 'The Change and The Challenge'—the exhibition provided a wide display of digital and automated equipment and the technical papers reflected a similar trend towards automation in mapping and remote sensing techniques.

It is well known that both ASP and ACSM are anxious to encourage greater participation by private enterprise in providing speakers for meetings and articles for technical journals. We support this view and have already responded by sending Dr. David F. Williams to read a joint paper to the 13th International Symposium on Remote Sensing of Environment, in April, at Ann Arber, Michigan.

We will also be represented at ASP/ACSM Autumn Technical Convention at Sioux Falls, in September this year when the theme will be 'Observing and Measuring the Planet Earth'—a task, with which we at Fairey Surveys have been involved since 1923.

NEWS IN BRIEF

New Teaching Materials

In line with new technology in our work we have recently extended our range of teaching materials for higher and advanced educational establishments, to include all types of remote sensing imagery. The sets illustrate the uses of true and false colour photography, multi-spectral and thermal imagery and satellite data in addition to the more conventional black and white photography. Among the applications covered are examples of land use mapping, vegetation and agricultural crops, environmental stress conditions, off-shore discharges and heat loss from buildings. Further details are available on request.

* * *

The following paper has recently been published and copies are available upon request:- 'Monitoring Environmental Pollution by Remote Sensing' by P. A. Vass and J. L. van Genderen.

Remote Sensing Seminar

Fairey Surveys recently sponsored a one-day seminar on Environmental Monitoring by Remote Sensing. The meeting organised by the Remote Sensing Society aimed at providing an insight into the impact of remote sensing techniques in planning and policy formulation.

The six invited papers discussed, to what extent Remote Sensing Techniques could satisfy data requirements; their operational application, costs and consequences and the selection of particular systems for specific purposes.

The reponse to invitations to attend this seminar illustrates the growing awareness of the need to utilise modern techniques for planning decisions.

FAIREY LEISURE MAPS

Announcing two new titles for 1979

MADEIRA and EGYPT

Existing titles currently available include:-

MAJORCA — CRETE — RHODES
MALTA — CORFU — S.W. IRELAND

Title in the Fairey/Falcon Business Map range:- **ABU DHABI — DUBAI — BAHRAIN QATAR**

Nostalgia–De Havilland Dove G-AWFM

Some of our regular readers will remember that between 1968 and 1975 Fairey Surveys owned two De-Havilland Dove aircraft, one of which G-AWFM, was extensively used by our airborne Geophysics department. After leaving Faireys', this aircraft was taken to Biggin Hill where it was left unused and quickly deteriorated to a sorry state. We have heard recently that this aircraft was in fact the very first 'Dove' owned by South African Airways and has now been rescued by S.A.A. and transported in pieces back to South Africa where it is being restored to its original condition as ZS-BCC at the training school in Johannesburg.

BRITISH AIR SURVEY ASSOCIATION

ANNOUNCEMENT

B.A.S.A. has issued its updated and revised specification for vertical aerial photography.

For anyone not already acquainted with B.A.S.A., we would like to explain that the association was set up in 1971, by the premier air survey companies in the United Kingdom, of which Fairey Surveys Limited was one.

The aims and objects of the British Air Survey Association, are to offer client security in the fields of aerial surveying and mapping by setting a technical standard against which others may be measured.

Membership of the B.A.S.A. automatically means recognition of the fact that the company possesses the knowledge, experience, staff, equipment and financial resources to complete major survey contracts.

Acknowledged experts within their own disciplines, officials of the association are also available for consultancy work.

Fairey Surveys have copies of the new specification which can be supplied on request.

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Fairey Surveys
Newsletter 21 Supplement

Remote Sensing in Engineering Surveys

The recent establishment of an Engineering Section within our Environment and Resources Consultancy has prompted this brief explanation of the uses and advantages of a variety of remote sensing techniques in all aspects of engineering surveys.

Developments in the collection and analysis of data recorded by remote sensing systems have resulted in a new era in the application of surveillance techniques which may now be used to gather useful information for the planning, design, construction and maintenance of highways. The interpretation of black and white aerial photographs has for many years played a significant role in highway engineering surveys overseas. This may now be supplemented or in certain instances replaced by new forms of image data derived from satellites, airborne radar and scanner systems, and from infra-red, colour and multispectral aerial photography.

Developing Countries

In many developing countries topographical mapping is limited and geological information, is often too general to be of much assistance to highway engineers. This places considerable emphasis on the planning activities which precede the final design study. To meet the need for improved practice in the early planning stages of route location and to compensate for the absence of relevant highway engineering information, use can be made of the large regional views provided by satellite coverage and new remote sensing systems now available. In applying these survey techniques much can be done to ensure that the costly effort put into the site investigation of the final road alignment is not misplaced.

Aerial Photography

Airphoto interpretation for highway engineering surveys is enhanced by the use of colour emulsions and multispectral techniques. Colour film has proved to be very useful for materials surveys and the discrimination of soils, geology and other ground features. Frequently the added expense of colour is offset by the more reliable information obtained and the shorter period of time required for interpretation.

Panchromatic and colour infra-red emulsions are particularly useful in tropical environments as these films have the capacity to penetrate haze. Also since water totally absorbs infra-red radiation and differences in reflectivity between plant species are most pronounced in the infra-red part of the spectrum, colour infra-red photography is particularly useful for studying drainage and vegetation. Colour infra-red photography is also used to assist in the detection of unstable ground where water-saturated zones, which are most likely to fail, can easily be distinguished by photo-interpretation.

True colour and colour infra-red films provide the best single sources of information within the photographic spectrum but are most effective when they are combined in a multispectral system in which different emulsions and film-filter combinations are utilised.

Photography obtained using a multispectral camera system (see illustration) has greater flexibility and is ideally suited for a wide range of interpretative techniques which are now being effectively used for engineering soils mapping, materials location, determining the depth of bedrock and mapping drainage features in highway corridor surveys.

Scanning Systems

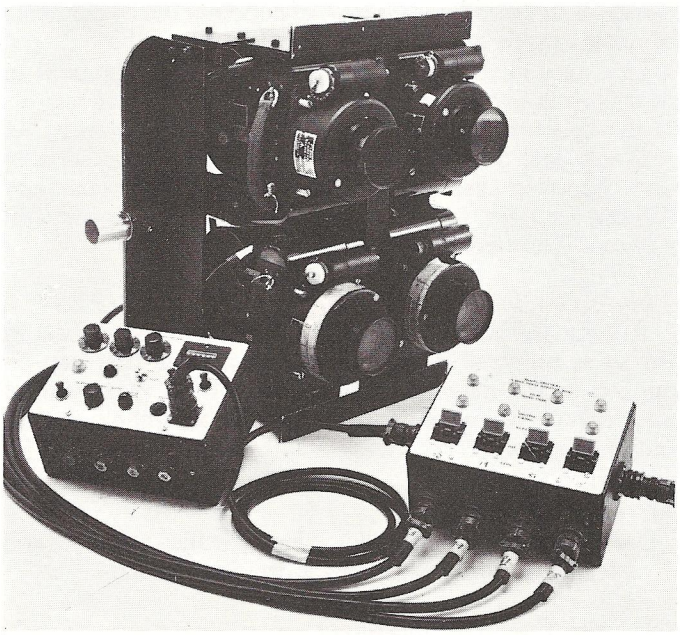
One of the main advantages of using a multispectral scanning system is that spectral bands outside the photographic range can be included in a survey.

Scanners which are able to sample the thermal infra-red part of the spectrum have a particular interest for the highway engineer. These systems can operate both in the day and at night. After processing, an image is obtained which may be black and white or colour coded, in both cases the range of tones portrays thermal contrasts at the ground surface and in effect forms a kind of thermal map.

Hidden subsurface conditions and geological features that influence highway planning and design can be detected by these means. The location of water-saturated slopes and failing ground, soft organic soils, underground cavities and subsurface voids, volcanic and hydro-thermal activity, buried utilities and conduits, subsurface drainage systems, and variations of soil moisture may all be realised by sensing subtle surface temperature differences.

Radar

Radar systems produce pictures much like those formed by scanners but in spectral bands well beyond the thermal



The four small format cameras of the Fairey multispectral system with control equipment.

range. The all-weather day and night capability of radar makes it an excellent survey tool for tropical areas which are rarely cloud-free.

Radar imagery may be used to advantage for regional terrain and engineering soils studies and for preliminary highway planning in remote and poorly mapped areas. Landforms and geological structures are generally well displayed in radar imagery due to the low angle of radar illumination. Interpretation may also be assisted by obtaining stereoscopic coverage. The technique has been successfully used in engineering surveys for the preliminary selection of routes, the location of construction material sources, differentiation of rock types, detection of subsurface voids, differentiation of surface textures and areas of abnormal soil moisture. Radar systems have also been found to be effective for specific hydrological, agricultural, vegetation and land use studies.

Satellite Imagery

The multispectral scanner imagery most accessible to the highway engineer is that currently obtained from orbiting satellites. Since their inception in 1972, the Landsat series have acquired some 250,000 images of the earth's surface, so that at the present time good cloud-free imagery of over 90% of land areas is readily available. Data acquired by the satellite sensors is recorded in four spectral bands.

In general terms two bands namely 5 (red) and 7 (near infra-red) provide the most useful information for highway engineering. Band 5 emphasising soil differences and man-made features, while Band 7 is most suitable for studies of vegetation, geology, drainage and landforms.

Landsat data may be interpreted for the preparation of regional engineering soil maps; regional inventories of construction materials, terrain classifications, route selection and highway corridor studies, and the regional analysis of particular engineering problems such as erosion and slope stability.

Repetitive coverage of land surface areas by satellite imagery also provides a capability to monitor time-dependent changes in surface features. Studies have been undertaken, for example, to obtain information on the seasonal or periodic incidence of flooding, the movements of desert sands and the progress of erosion.

Increases in resolution capabilities and development of new sensors in the thermal infra-red and microwave regions of the spectrum are continuing and appear promising. As technological developments continue to improve sensors and observing systems, it is likely that the importance of satellite imagery in providing the highway engineer with relevant information will undoubtedly increase.

Enhancement and Interpretative Techniques

Another advantage of using multispectral imagery lies in the wide range of interpretative procedures that can be applied to the data in order to extract the maximum of information. Some of these interpretation techniques are outlined below:

(i) Density Analysis:
Measuring or subdividing film densities to detect and delineate subtle variations in the image tone

(ii) False Colour Composites:
Using filters to assign a different colour to each spectral band and super-imposing them.
Colour additive viewers allow several images to be simultaneously projected on a viewing screen, and the resulting false colour composite image adjusted to suit a particular need. In highway engineering studies this may involve enhancing the distribution of a particular soil type or construction material, areas of poor drainage, landslides and unstable ground or any other aspect of the terrain which is visible on the combined multispectral images and which is likely to affect a proposed road construction.

(iii) Computer Image Processing:
Extracting maximum information from the imagery. Digital data can be taken directly from magnetic tapes or indirectly from aerial photograph transparencies and film products by scanning densitometry. The computer also provides the capability for automatic discrimination, classification and mapping of features that are recorded on multispectral imagery.

(iv) Image Rationing:
Dividing the reflectance values of each individual picture element by a value in some other wavelength band. Several different black and white pictures can then be projected through colour filters to give band ratio colour composites. These are extremely sensitive to small differences in such geological expressions as surface colour, brightness and texture. Subtle variations between rock features are consequently made much more emphatic by ratioing.

Although at present computer image processing techniques can be costly, as the technology advances it seems likely that the use of these techniques will become more prominent, especially for major construction works where the image processing costs will be relatively small in relation to the return of information and total overall costs of the project.

Conclusions

In outlining the different types of remotely sensed data and new interpretation techniques now available to the highway engineer an idea has been given of some advantages which may be gained by their use in road construction surveys. It will be clear, however that no single technique, or combination of techniques, is applicable to all the various stages of highway engineering, for where large regional areas are to be evaluated, satellite, radar and other sensors providing broad coverage are applicable, whereas aerial photography and other sensing systems operated from aircraft are more suitable for detailed studies. As both regional and detailed information are needed at different stages of a major highway engineering project, it is apparent that a combination of these two types of coverage will be desirable in many situations.

The technology for acquiring remotely-sensed data and the interpretation techniques required for converting the data into usable information are continuously being developed. The potential application and cost-effective benefits of these new techniques are being fully evaluated by the engineering section as a means of strengthening geotechnical appraisals of terrain for highway projects.

Copies of the full written text by T. E. Beaumont and published in the Highway Engineering Journal can be obtained from Fairey Surveys on request.