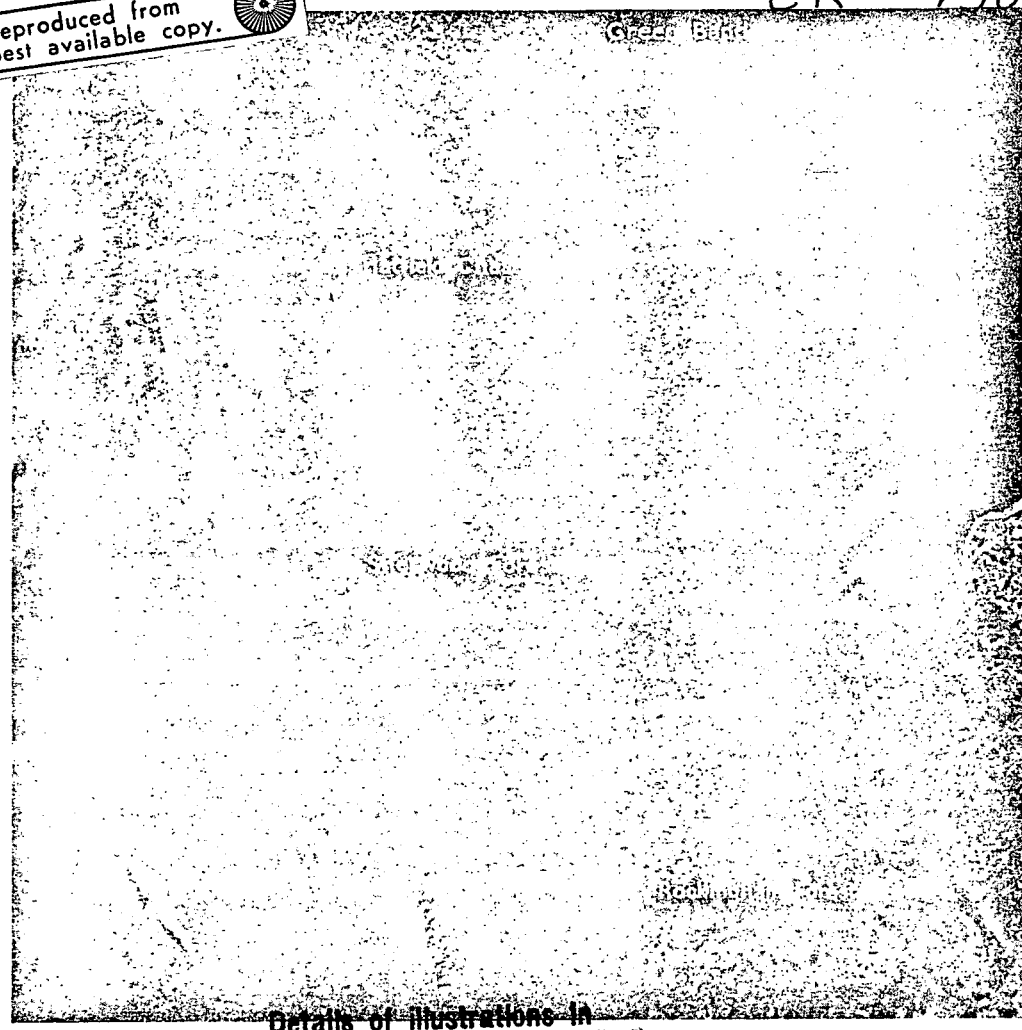

The East Midlands and The Wash are clearly discernible in photographs from the first Earth Resources Technology Satellite (ERTS-1). Photographs which have been produced by image scanning at a very small scale in varying atmospheric conditions are not comparable with conventional aerial photographs. For the purposes of photo-interpretation, results are produced in four separate spectral bands. Green/yellow band (right) is of limited value on its own, but can be combined with others to identify many types of detail

The world surveyed in eighteen days

by Peter G. Mott

THE FIRST Earth Resources Technology Satellite (ERTS-1) was launched by Delta rocket on July 23, 1972. This satellite is now circling the earth fourteen times a day on a polar orbit at an altitude of approximately 900 kilometres. Its multi-spectral scanners produce complete coverage of the world every eighteen days, though much of the earth will be covered in cloud and the photography valueless. The scanning system of the satellite is designed to provide four simultaneous images of the earth's surface, each in a different spectral band – green, orange/red, red and infra-red. This data is then telemetered to stations on earth where it is processed from its digital form into corrected photographic images. The photographs look conventional and have a 'contact' scale of approximately 1 : 3,400,000. A single photographic exposure from the satellite covers an area of 185 square kilometres.

The very small scale of the photography and the fact that it is the result of a scanned image transmitted back to earth to appear similar to that on a television screen, means that the resolution cannot be compared with that of conventional air photography. There will also be small distortions in the transmission which will give rise to small errors in the recorded image. Nevertheless the results of ERTS-1 have so far exceeded all expectations and confirm the belief that the imagery obtained will be of wide-ranging value in the study and mapping of the earth's surface.

Finding the best band-width

The division of the spectrum in a multi-spectral camera into four distinct wave-bands enables the photo-interpreter to find the particular band-width best suited to the reflection or absorption qualities of the ground object which he wishes to examine. If desired, a combination of two or more of the individual exposure bands can be superimposed. By projecting these through coloured filters, and superimposing them, it is possible to simulate a colour or infra-red colour photograph and to vary the intensity of one band sector compared with another. The scanned record on tape can also be processed through a multi-spectral viewer to record small tonal differences in enhanced arbitrary colours on a cathode ray tube (CRT) screen. By such methods the specialist interpreter is enabled to extract the maximum information from the photography and to undertake a wide field of thematic mapping including vegetation and surface water distribution, snow cover, geology and land use.

Image produced on the orange/ red band (left) shows forested areas. Indifferent quality of the photography is largely due to the presence of haze

Red/infra-red band (left) normally shows road pattern. MI motorway and A46 trunk route are just discernible

Major cities of the East Midlands and drainage patterns may be identified on the infra-red photograph (left)

The examples of ERTS-1 photography illustrated here represent the green/yellow, orange/red, red/infra-red and infra-red bands of a single exposure covering the east coast of England from the Humber to the Wash. The drainage pattern and the limits of major cities such as Sheffield and Nottingham show best on the infra-red band. It is just possible to define the route of the M1 motorway and the A46 trunk-road to the north of Leicester on the red/infra-red band. Major woodlands, such as Sherwood Forest are clearly defined on the orange/red band. The green/yellow band on account of atmospheric haze is of limited value when used alone but when combined with one or more of the other bands it assists in the identification of certain types of detail.

Satellite map of UK

Contrary to the generally held belief, there still exist large areas of the world where maps are so unreliable as to be virtually non-existent. For reasons of politics, topography or economics, these areas have remained inaccessible to the surveyor whether approached by land or by air. Only now with the availability of satellite photography does it become feasible to obtain a highly accurate record of all the topographical features and to gain some much needed knowledge of the detailed nature of the terrain.

Since we are only at the beginning of our knowledge in interpreting satellite photographic coverage, the launching of the first satellite designed specifically for gaining an accurate dimensional record of the earth's surface is of tremendous interest and importance to those engaged in practically all of the earth's sciences, not least that of surveying and cartography.

Under the sponsorship of the UK Department of Trade and Industry, Hunting Surveys in association with the two largest map publishing companies in Britain, George Philip & Son and John Bartholomew & Son, have been selected by NASA as one of the three British participants to undertake a unique cartographic research project based on ERTS-1 data.

The area chosen for the experiment is the whole of the UK, for which NASA will supply the coverage as it is acquired. Using only the ERTS photography and no other data except a few Ordnance Survey geodetic points, the Hunting Consortium will compile a detailed map of the UK at a scale of 1 : 1,000,000. This will then be compared, area by area, with the existing Ordnance Survey map at the same scale and an analysis made of the accuracy and completeness of the satellite map. The UK was chosen not merely for the sake of convenience in obtaining 'ground truth' but because of the wide variety of its terrain including mountains, a detailed pattern of agricultural land, forests, tidal estuaries such as the Wash and Bristol Channel, large conurbations and a complex infrastructure.

Manned Skylab next

By this means it is hoped to build up a clear picture of what can and cannot be extracted from satellite coverage in the present state of the art. The knowledge and experience gained from the ERTS-1 data will then be applied in two years' time to a further study based on the much more ambitious Skylab. This spacecraft, due to be launched in 1973 from Cape Kennedy, will be manned by three-man crews serving for periods of one to two months. A command module will act as the relief vehicle linking up with the spacecraft and will bring back to earth, in addition to the personnel, the original photographic film and digital data on magnetic tape. Thus, the microwave transmission of the ERTS-1 system with its inherent limitations of accuracy and distortion will be eliminated.

The improvement in the material recovered from Skylab should mark a leap forward in technical quality and in the corresponding potential of the imagery. Whatever can be achieved from ERTS-1 can only be a forerunner for Skylab-1 and its successors.