SOME NEW HORIZONS FOR OEEPE

Major General C N Thompson
Director of Military Survey, Ministry of Defence
Elmwood Avenue, Feltham, Middlesex, England

ABSTRACT

Since celebrating its 25th Anniversary in 1978 OEEPE has been going through a period of change in its organisation and arrangement of scientific and other investigations. A major force behind this has been the introduction of new technologies and particularly those in the remote sensing and digital technology fields. Greater emphasis has also been placed on directing scientific investigations towards applications which are identified as problem areas by the wide range of users represented in OEEPE. Application fields include topographic mapping, cadastral, the environment and geographic information systems.

New Applications Commissions have been set up to identify problem areas in those fields. Also to simplify and expedite the conduct of investigations, Action Groups are established to control projects which may cover the activities of a number of OEEPE Commissions.

OEEPE Commission D which is responsible for cartography and photogrammetry is one Scientific Commission which has been considerably affected by these changes. Up until about 1980 the two investigations performed by Commission D were Test Stuttgart and Test Fribourg. These investigations were thorough but took a number of years for the results to become generally available. In the present era of emerging digital mapping and database technology, the technology itself is evolving too fast to allow for such detailed and academic analysis. Between 1982 and 1984 Commission D undertook the project Test of Digitising Methods which essentially evaluated alternative methods of digitising maps at 1:2,500 and 1:10,000 scale, and confirmed the generality of the methods available at that time. Under the auspices of the newly formed Action Group Digital Mapping and Database Technology. Commission D is now initiating a more specific project to investigate automatic digitising and other digital mapping and data base projects are under consideration. These will be reported in a general presentation on the present activities of OEEPE Commission D and Action Group Digital Mapping and Database Technology.
INTRODUCTION

1. L'Organisation Européenne d'Etudes Photogrammétriques Expérimentales (OEEPE), or European Organisation for Experimental Photogrammetric Research was founded in 1953. In the Paper "25 Years of OEEPE"(1), presented to the ISP Congress in Hamburg 1980 (and also published by OEEPE,) the functions and achievements of Commission D were given as:

"This Commission was formed in 1964. Its activities are devoted to investigations on both the quality and the economy of mapping procedures as a whole, including cartographic aspects. With a growing arsenal of technological modules (on-line or off-line, manual or automated alternatives), there is a growing need for practical experiments in order to determine their efficiency and economy. The Commission has started its activities with experiments on topographic mapping to the scale 1:10,000 (of direct interest to certain countries) and on revision of topographic 1:25,000 mapping (of immediate interest for many countries)."

The results of these experiments known respectively as Test Stuttgart(2) and Test Fribourg(3) have been published in OEEPE Publications numbers 9 and 12 respectively.

2. Since achieving its first 25 years, OEEPE as a whole has been giving increasing attention to the "growing arsenal of technological modules" and these in their turn have impacted on the activities of Commission D. As the Test Fribourg was drawing to a conclusion in about 1980, and in line with an overall review of OEEPE activities research proposals being considered for Commission D at that time included:

- Digital techniques and photogrammetric-cartographic map production.
- Methods for the production of orthophoto maps.
- Preparation and revision of small scale topographic maps with Space lab photography.
- Use of stereo-orthophotos for map revision and in mapping mountainous areas.

3. In response to these research proposals, and to gain experience in undertaking digital mapping investigations, in 1982 Commission D initiated a new project 'Test of Digitising Methods' to investigate digitising methods being increasingly adopted in cartographic work. The project was intended primarily to test methods in use in production agencies; and for Commission D to gain experience of this type of production procedure many aspects of which are also of importance to photogrammetric procedures. The state of the art in digital photogrammetry and cartography is advancing rapidly, and it was therefore important that the project, and the report of the project, be completed as expeditiously as possible. The project and report were completed in 1984 and has subsequently been published as an official OEEPE publication(4). A summary and project overview of the Test of Digitising Methods is given at Annex A.
4. At this time it was also recognised by OEEPE that the rate of change of technology was accelerating to an extent that the old style project involving a number of participating centres carrying out rigorous tests and subsequent analysis did not encourage the speedy publication of results. Hence the value of much valuable research was being lost, certainly outside the participants in these experiments. Consequently there was strong motivation for some reorganisation of OEEPE and by 1985 major changes had been effected. Whether or not these changes will prove entirely satisfactory has yet to be proved, but it is certain that a new dynamism has been created whereby a whole range of research topics have been identified and some of the more interesting are now being addressed with some vigour.

5. In this Paper I describe the effect of these changes on Commission D in particular, and the wider horizons that are offered in the research or investigative work which relate to the activities of Commission D.

PRESENT ORGANISATION AND PROCEDURES OF OEEPE

6. The business of OEEPE continues to be directed by the Steering Committee which meets twice a year. The tasks and responsibilities of the Steering Committee are:

- Establishment of the general research policy.
- Decisions on priorities and execution of projects.
- Allocation of resources to projects.
- General control on progress of project execution.
- Appointment of Commission Presidents, and Chairman of Action Groups and Working Groups.

7. The Executive Bureau continues to have a staff-function to the President of the Steering Committee, and is responsible for administrative and financial affairs, for assistance in the dissemination of information and communication, and exercises some coordination of the research programme.

8. A new category of Commission has been formed known as Application Commissions with responsibilities for identification of possible areas for improvement in production processes or existing problems, and the subsequent formulation of needs for research and development investigation. The following Application Commissions have been installed:

- I Topographic Mapping
- II Cadastral mapping
- III Engineering surveys
- IV Environmental and climatic surveys
- V Land information systems
As a rule each country will nominate one member representing the specific production process or area of interest of a particular Application Commission.

9. Scientific Commissions have responsibility for: identification of technological and scientific developments with a potential for improvement of production processes in their field of interest; preparation of research and development project proposals as a consequence of the foregoing and related to the needs for research and development projects which may have been identified by Application Commissions; and assistance in the design of scientifically sound research methods. At present the following Scientific Commissions have been installed:

- A. Aerial triangulation.
- B. Digital elevation models.
- C. (Large Scale) restitution.
- D. Photogrammetry and cartography.
- E. Topographic interpretation.
- F. Fundamental problems of photogrammetry.

The membership of Scientific Commissions may be relatively small and are not necessarily selected according to nationality but according to expertise and known interest.

10. Action Groups are installed by the Steering Committee on an ad hoc basis, in order to supervise "on behalf of the Steering Committee" the design and execution of a project, or group of projects, relating to a particular topic. Action Groups may be responsible for the execution of a specific R & D project, or a number of related R & D projects which themselves are executed by Working Groups which are tasked and entrusted with the execution of a specific project on an ad hoc basis. The inter-relationships between Applications and Scientific Commissions, the Action Groups, and Working Groups may appear confused, as membership of Action Groups and Working Groups may be drawn from a number of Commissions or come from outside the formal OEPEE structure. Action Groups that are at present in being and connected with the field of interest of Commission D, and particularly the research projects indicated in paragraph 2 above, are:

- Action Group on Use of Satellite Data.
- Action Group for Map Revision.
- Action Group Digital Mapping and Database Technology.
- Working Group - G (Orthophotos).
THE APPLICATION COMMISSION I/COMMISSION D RELATIONSHIP

11. The creation of Application Commission I has to some extent confused the functions of Commission D. In the previous work carried out by Commission D (Test Stuttgart, Test Fribourg and Test of Digitising Methods) Commission D had very much been addressing the problems of, in the main, large production organisations. The investigations were carried out as they were perceived to be of importance to production areas where optimisation of methods was clearly in the interests of all concerned. It has therefore been necessary to re-define the responsibilities of Commission D as follows:

"The cartographic presentation of terrain and topographic information (principally from photogrammetric and cartographic sources) in conventional mapping or digital forms. Matters to be investigated will include:

- Methods of information or data capture using photogrammetric, cartographic or digital methods.
- Methods of conventional cartographic presentation in mapping or other forms, such as: compilation, revision, edit, generalisation etc.
- Cartographic map standards and specifications.
- Methods of photogrammetric and cartographic digital data manipulation and processing such as: edit, plotting, vectorisation, data storage, update, data compaction etc.
- Cartographic data standards and specifications, such as: data formats, data exchange, data structure, database design, data security, and archiving".

12. Application Commission I for their part have undertaken a thorough review of all processes involved in topographic mapping where problems may exist or improvements are deemed necessary. Some eleven separate topics have been identified including map revision, the application of generalisation in computer-assisted cartography and the application of digitising aerial photographs in photogrammetry. These topics have subsequently been considered and discussed by Commission D and the following projects identified as being of particular importance:

- Map Revision;

  (1) Collect information on the use of "cheap" photogrammetric revision instruments and production methods.

  (2) Collect information on new high technology photogrammetric equipment and its use for revision of mapping and digital data.

  (3) A comparison of revision methods involving tests of graphical and digital procedures for both mapping and digital products.
Automatic digitising of existing maps.

The use of analytical (digital) photogrammetry.

The application of generalisation in computer assisted cartography.

The application of very small scale photography for map revision.

The application of digitising aerial photographs and photogrammetry.

The first two of these topics have now been taken up respectively by the Action Group Map Revision and Action Group Digital Mapping and Database Technology.

ACTION GROUP ACTIVITIES

13. There is not space in this Paper to describe in detail the activities of the Action Groups, and a short summary will have to suffice. The first to be established was the OEEPE Working Group Ortho-photo which was set up in 1982 and has been looking at various aspects of ortho and stereo-orthophotos. Phase II of a series of tests has been completed. This phase consisted of the ortho and stereo-orthophoto rectification of pictures at 3 scales, using DTM derived from these 3 scales and printing out these products by different methods. In all a total of 85 products were produced. These products will be used in Phase III which is the assessment phase involving the measurement of check points in DTM's, orthophots and stereo-orthophots.

14. The OEEPE Action Group on use of satellite data was formed in late 1983, and has investigated the following projects:

- Test on image content of metric camera data. The investigation, which was carried out by Commission E concluded that the Metric Camera imagery was not suited for the extraction of information content for 1:100,000 scale mapping in developed countries.

- Test on image accuracy of Metric Camera data. Results have been received from 11 participants. Initial study of the results shows high accuracy has been obtained, and more detailed analysis of the results have shown some unexpected systematic trends. A report is expected in 1986.

- Test of map compilation and map revision in developing areas. A test using Large Format Camera data in Sudan is being prepared by Ordnance Survey (UK). Discussions have also been going on with SPOT-Image about using SPOT data for a similar test.

15. OEEPE Action Group Map Revision was formed in 1984 following the review of processes involved in topographic mapping carried out by Application Commission I (see para 11). The Action Group has launched one project so far and a Working Group on map revision using
stereo-orthophoto has been formed. In this investigation each participant will select two areas from maps at 1:50,000 of his own country that are due for revision, and for which new photography at a scale of about 1:30,000 is available. The maps will be revised with the use of stereo-ortho photo instruments, and also a comparison made with the conventional method of revision used by the participants. An assessment or comparison with the Test Fribourg of Commission D has also to be made.

16. The most recent Action Group to be set up is that for "Digital Mapping and Database Technology". On behalf of the Steering Committee the Action Group is responsible for supervising the design and execution of:

- Investigation of database and digital mapping requirements.
- Investigation of methods of digital data acquisition.
- Investigation of methods of data editing and quality control.
- Investigation of forms of data analysis and presentation.
- Investigation of data specifications and standards, including standard format for the exchange of data.
- Investigation of database management systems.

To date a Working Group to investigate automatic digitising has been set up. This Working Group will primarily be interested in raster digitising and will be investigating things such as the effect of data structure on the efficiency of data processing, the effect of resolution of scanning on the quality of output, comparison of the effectiveness of techniques for vectorisation and other post-processing for coded vector graphic output and data base creation.

CONCLUSION

17. The re-organisation of OEEPE with the establishment of Applications Commission, Action Groups and Working Groups has occurred at a time when the rate of change of technology was accelerating to an extent that made the old style project inappropriate. Certainly during this time of reorganisation many new and interesting projects have been taken up. In the main the objectives of these projects are in line with the needs of those involved in production processes, and are also realistic in terms of achievement within a relatively short timeframe. It has to be accepted that the reorganisation still leaves some uncertainties as to who should be responsible for running projects, and this is perhaps particularly felt within the Scientific Commission. However the impetus that has been gathered through the activities particularly of Action Groups and Working Groups bode well for the future. However to be successful it is necessary to find people who are prepared to give the time to leadership of projects, and at a time when all organisations are experiencing increasing financial pressures this is tending to make it more difficult to initiate and undertake projects. Volunteers are needed'
REFERENCES


(2) W Beck The Production of Topographical Maps 1:10,000 by Photogrammetry - OEEPE Official Publication No 9.

(3) E Speiss Revision of 1:25,000 Topographic Maps by Photogrammetric Methods - OEEPE Official Publication No 12.

1. PROJECT OVERVIEW

1.1 Background

1.1.1 In 1981 Commission D, OEEPE started discussions on a project to evaluate alternative methods of digitising existing maps. A simple project to gain experience in digital technology was deemed an essential first step before embarking on more sophisticated photogrammetric applications. The project agreed was to consist of two phases with the following objectives:

- **Phase One** - assessment of digitising methods, and the graphic plots produced from the digital data.

- **Phase Two** - assessment of the digital data, including an evaluation of data structures and formats adopted by participating centres.

1.1.2 This report marks the completion of Phase One of the project. At the Commission D meeting in November 1983 it was agreed that Phase Two was more appropriate to specialist investigation, perhaps as a university research project. The data is available from the Ordnance Survey, Southampton, England.

1.2 Scope of Project

1.2.1 The Phase One of the project was designed to provide an evaluation of the currently available (1982) equipment and methods for cartographic digital data capture using the following four broad bands of technology:

- Blind digitising
- Interactive digitising
- Line-following digitising
- Scanning (raster) digitising and vectorising

A general description of the type of equipment used is given in Annexure C.

1.2.2 The map extracts used for the project were Ordnance Survey maps, and three options for digitising were offered as follows:

- 1:2500 planimetry
- 1:10 000 planimetry
- 1:10 000 contours (same map extract as 1:10 000 planimetry

1.2.3 Eleven agencies participated in the trial including six national mapping agencies, one private survey and mapping company, one university and three manufacturers. No agency participated in all options, but for most options there was more than one participant. Three agencies participated in each Blind digitising option and the scanning and vectorising options for 1:10 000 planimetry and contours.
1.2.4 Digitising of map extracts was undertaken between August and December 1982, with assessment of results and draft report completed by June 1983. Commission D considered the draft report at their meeting in November 1983. A further draft was circulated in February 1984 with a view to producing a final draft in April 1984.

1.3 Results

This report is a collation of the material provided by the participants. Some effort has been made to assess accuracy, cartographic quality and comparative times but it was recognised at the outset that there were a number of limiting factors that would make comprehensive comparisons difficult. These include:

1.3.1 Only the Ordnance Survey was familiar with the specification of the map extracts.

1.3.2 Participants' experience of equipment and methods varied considerably.

1.3.3 The grade, expertise and experience of operators varied considerably.

1.3.4 Procedures for recording times of the operations involved varied.

1.4 Summary of Conclusions

This project provides a valuable comparison of cartographic digitising technology and methods available in 1982. It is clear that manual digitising was well established and proven, whilst automated digitising systems were relatively new and suffered some limitations which reflected the state of the art at the time of the project. Many have since been improved. The main conclusions are summarised below.

1.4.1 The project has confirmed that the equipment and software used by all the participants is capable of capturing map information in digital form and of subsequently plotting an acceptable cartographic output. (9.1.2)

1.4.2 A comparison of the times taken by participants to carry out individual operations provides some indication of the relative merits of the equipment and methods used. (9.1.3)

1.4.3 There is a significant difference in the proportion of time spent on preparation/digitising and processing/edit between the different types of digitising. (9.1.4)

1.4.4 There was a significant level of consistency in the accuracy achieved by all participants throughout the trial, and an acceptable standard of accuracy was achieved in all cases in the production of cartographic plots. (9.2.1)

1.4.5 A variety of set up procedures and transformation algorithms were used by participants for manual and semi-automatic digitising, but have had little apparent effect on the accuracy achieved. (9.2.3)
1.4.6 The cross hair cursor is in general considered preferable for manual digitising from a positive base and all participants expressed a preference for backlighting for digitising tables. (9.2.4)

1.4.7 For manual digitising the use of an enlarged base document had no significant effect on the accuracy of the final plots produced. (9.2.4)

1.4.8 The scanning systems achieved a marginally better overall accuracy than the line following system, but the scan resolution in both cases is a critical factor. (9.2.5)

1.4.9 Most participants produced an acceptable cartographic plot. For edit purposes features can be plotted by feature numbers, colour code or as layered plots. (9.5.3)

1.4.10 The squaring and alignment of buildings caused some difficulties for participants using manual digitising methods, particularly at 1:2500 scale. (9.3.2)

1.4.11 In general all participants achieved a satisfactory result with curvilinear detail. (9.3.3)

1.4.12 To produce an acceptable cartographic product from the automated digitising system required extensive interactive editing. (9.3.2)

1.4.13 For manual digitising satisfactory results were achieved with both point and stream digitising, but considerable experience is required to maintain key in the stream mode. One participant used a groove following technique which offers considerable potential for digitising contours. (9.3.4)

1.4.14 If digitising is to be undertaken at a variety of scales there is little to be gained using interactive rather than blind digitising methods. (9.4.2)

1.4.15 With one possible exception, automated digitising methods have proved to be at least twice as quick as manual methods of digitising for planimetry, and for contours of the order of 7 times faster. (9.4.3)

1.4.16 There is further evidence that these systems are better suited to digitising maps with simple line work and coding and less suited to digitising dense urban large scale plans, though this may change as the technology develops. (9.4.3)

1.4.17 It is clear that automated scanning and vectorising systems use significant amounts of CPU time for processing - between 0.2 and 4 hours for these trials. (9.4.5)

1.4.18 The price of equipment varies very considerably with a manual workstation costing less than 25% that of an automated or semi-automated systems. (9.6.1)
1.4.19 It was agreed by all participants that prospective purchasers should ask manufacturers to carry out 'Benchmark' trials. (9.6.2)

1.4.20 Purchasers should be prepared to pay for such trials and should insist on overseeing the trials when they are carried out. (9.6.3)