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PHOTOGRAMMETRIC COURSE CURRICULA IN DEVELOPED COUNTRIES

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ABSTRACT :

The structure of photogrammetric education, comprising four levels, is treated in detail.

Evaluation of the undergraduate studies in Geodetic and Surveying Engineering leads to the recommendation that the scope of photogrammetric education has to be broadened, in order to fulfill the requirements of modern mapping and engineering techniques.

The substance of graduate studies is analysed with due consideration to the openings and vacancies in professional positions within government, industry, universities and private enterprises.

The equipment for the use of colleges and polytechnic schools is scrutinized.

With an overview of the present status of photogrammetric education and considering the trend of future development, a model photogrammetric curriculum is proposed.

ZUSAMMENFASSUNG :

Die Struktur der photogrammetrischen Erziehung in vier Stufen wird in Einzelheiten behandelt.

Auswertung des Studiums für den ersten Universitätsgrad zum Geodäsie und Vermessungswesen leitet zu dem Vorschlag dass der Umfang der photogrammetrischen Unterweisung erweitert werde, um die Bedürfnisse der modernen Karten- und Bau-Techniken zu erfüllen.

Das Wesen der Studien zum zweiten Grad wird mit Hinsicht auf freie Berufe in Regierung, Industrie, Universität und privaten Unternehmen behandelt.

Die Ausrüstung von Hochschulen und Polytechnischen Institutionen wird untersucht.

Mit Überblick auf den derzeitigen Stand der photogrammetrischen Erziehung und in Hinsicht auf die zu erwartende Entwicklung wird ein Modell eines photogrammetrischen Studienplans entworfen.

INTRODUCTION

Photogrammetric education is structured in four levels :

1. Undergraduate courses at University level, given within the framework of the faculties of Engineering, Geography, Agriculture, Forestry, Environmental and Mathematical Sciences.
2. Graduate Studies, leading to the University degrees of M.S., D.S., Ph.D. and Dipl. Ing. (in Europe).
3. Courses in applied photogrammetry, held in colleges and polytechnic schools, aiming at the education and training of technologists and higher level technicians.
4. On the job training of technical personnel at different levels.

The present status of photogrammetric education in developed countries is the result of the historical development of survey education in Europe. In the thirties the mathematical principles of stereo-restitution were well-known and accurate analog instruments were built, mostly for terrestrial photogrammetry.

During the last three decades the need for small and large scale mapping grew enormously which lead to the application of advanced aerial photogrammetric methods and instrumentation. Consequently Photogrammetric Institutes and Divisions were set up at the Universities, within the framework of the Surveying and Geodetic Departments. These Institutes are responsible today for the curricula of undergraduate and graduate studies.

UNDERGRADUATE EDUCATION - A SURVEY

The faculty of Surveying Engineering is divided in most cases into three major disciplines, namely Geodetic & Land Surveying, Photogrammetry and Cartography. At the undergraduate level the courses given are not aimed to educate specialists in the above mentioned disciplines.

It can be stated that no undergraduate studies exist today which are devoted to the qualification of Photogrammetric Engineers possessing a university degree.

72 percent of all photogrammetry courses are taught in the U.S.A. by departments of Civil Engineering, as stated by Nealey (8). Nevertheless, Photogrammetry as a separate subject has a much higher standing in Surveying Engineering than in Civil Engineering departments.

Remote Sensing/ Photogrammetry courses, of which 75 percent are given in Geography departments, deal mostly with Photo-Interpretation and related application-oriented subjects. These courses are important, but do not add up to a major discipline.

From this survey it can be concluded that in photogrammetry a stand-alone program does not exist at present at the undergraduate level. On the other hand, 14 universities in the U.S.A. are offering Cartography programs of 4 years duration, leading to the B.S. degree - ref. Brandenberger(2). The question arises whether a similarly specialized course in Photogrammetry is really necessary. The answer seems to be negative, as given by Harley (4) and Ackermann (1).

Harley states in general terms : " The distinction between disciplines or professions is a static idea which could become meaningless in a rapidly changing society."

Ackermann forecasts that the development will be more and more interdisciplinary. He expects photogrammetry to converge towards and merge with surveying and cartography.

Pursuing the same school of thought and following a critical evaluation of the subjects taught and the number of hours spent in undergraduate studies, the conclusion is reached that although a specialized course in Photogram-

metry is not required, the scope of education has to be broadened. In general the following subjects appear today in the undergraduate curricula (B.S.) :

- Photogrammetry I -- Aerial Photography.
Optical and Geometrical Principles.
- Photogrammetry II -- Stereophotogrammetry, using analog instruments.
- Photogrammetry III - Basic Analytical Photogrammetry.
- Special Applications - mostly in the domain of Civil Engineering.

The number of lecture hours, during the whole study period, vary from 60 to 150 hours and the practical exercises from 100 to 250 hours.

The subjects of Aerial Triangulation, Orthophotography, Remote Sensing, Non-conventional Photogrammetry, are optional subjects, treated in Graduate Studies only.

GRADUATE STUDIES

Graduate studies are aimed to provide the highest level of professional status. The future tasks of the graduates comprise the following :
Technical Planning, Policy and Decision Making, Management, Teaching and Scientific Research.

Being the highest level of professionals, the graduates have direct technical, ethical and financial responsibility towards the public (or clients) in undertaking their projects. Holden's definitions (5) stated above, were set up for cartographers but they are valid for photogrammetrists, too.

European university studies, granting the degree of Dipl. Ing., are of four years duration and their curricula include the optional subjects of advanced photogrammetry which are listed above. For these reasons they are considered as graduate studies.

Harley (4) expresses his view that the European approach over-emphasises theory in relation to the practical side of the profession. Similar criticism is set forth by Hothmer (6 and 7), who divides the graduates into active and passive photogrammetrists, according to their ability to carry out the work themselves, or have the know-how only to contract it.

Hothmer proposes to set up a stipend fund for German university graduates, in order to sponsor their post-graduate practical training at the ITC.

According to Hothmer's figures a student can spend individually maximum 20 hours per year on the instruments at the University, whilst at the ITC the instruments are available to the students for more than a 1000 hours.

Another aspect which also has to be considered, is the problem of the universities' budgetary difficulties, due to which most of their photogrammetric instruments are obsolete. Students are not enthusiastic using old instruments and therefore exercises are neglected.

In anticipation of new technological developments in the eighties, the author suggests to extend the curricula of graduate studies to the following subjects :

Information Systems -- generated from data acquired by photogrammetric and remote sensing means.

Automation, including Digital Image Processing and "Sensogrammetry".

Digital Mapping and DTM.

Graphic Representation of Data.

Specialization in these additional subjects will certainly create new opportunities for photogrammetrists. New fields will be entered and mastered in which, up till now, photogrammetrists were dependent on physicists, mathematicians, geographers and others.

EXPECTED REVISION OF UNDERGRADUATE CURRICULA

In order to be able to keep up with the anticipated rapid technological development of the eighties, undergraduate curricula will have to be revised. In all the private communications (refer to Acknowledgement) received from a number of well-known University Professors, is clearly stated that preparations for a new study system are under way already.

As a logical sequence of the previously suggested changes in the graduate studies, the following undergraduate curriculum is being proposed :

1. Photogrammetry I -- Aerial Photography.
Optical and Geometrical Principles, the latter analytically formulated.
2. Photogrammetry II -- Stereophotogrammetry. Analog and Analytical Instrumentation.
3. Aerial Triangulation- Computations, Strip- and Block Adjustment.
4. Introduction to Remote Sensing and Digital Image Processing.
5. Digital Mapping, DTM, Automated Graphical Processing of Data.
-an elective subject.
6. Special Applications of Photogrammetry - an elective subject.

The courses will be given during four semesters, 4 hour lectures and 3 hour exercises per week.

To transform the students, after their graduation, into "active" photogrammetrists, about half a year of additional practical training is needed which could only be provided by the employer. Statistics show that about 15 % of the undergraduates of Surveying Engineering specialize in Photogrammetry. From this number less than half become "active", the problem of training therefore should not be overestimated.

TECHNOLOGISTS AND TECHNICIANS - THE THIRD TIER

To complete this survey some thought should be spent on the technological education.

According to Brandenberger (2), there are 47 Educational Institutions in the U.S.A., operating programs of 1-4 years duration for surveying technicians. In Germany the Fachhochschulen - ref. Hothmer (7), concentrate on the practitioners' education. It should be remarked here that the practical exercises carried out in these Institutes are far from being adequate.

In Australia 5 Institutes of Technology have departments for training technicians. In France two such Institutes exist. In Greece a Center of Higher Technological and Professional Education is functioning. In Japan 11 Professional Colleges educate Survey technologists.

In Europe two outstanding Educational Institutes train practitioners; the ITC in the Netherlands and the SSPO in Switzerland. In general their students come from developing countries.

The information received about the different institutions is scarce and it is very difficult to evaluate the level of education available for technologists and technicians. Notwithstanding, in many of the institutes mentioned the instrumentation available is not adequate, neither in quality nor in quantity.

The solution of the problem of instrumentation lies in the introduction of a new type of instrument, similar to the "stereotrainer" designed at the ITC. Such an instrument should cost a fraction of the price of a conventional analog plotter and is well suited for the most important exercise, namely the plotting of topographic maps.

Another instrument which would be highly recommended is a relatively inexpensive mono-comparator of fairly high accuracy.

ON THE JOB TRAINING

On the job training is practiced everywhere. A good example is given by the United Kingdom, as described by reference (9).

Five Governmental Institutions and 12 Private Firms offer training for their employees. They differentiate between two levels of candidates :

1. University graduates who also followed a post-graduate course in Photogrammetry.
2. Technicians, having TEC or higher certificate in surveying, photogrammetry, cartography, or other equivalent qualification.

The duration of the training varies from three to 12 months.

CONCLUSION

In the future photogrammetric education will mean specialization in the framework of a broad professional concept.

The ever increasing efforts made in science and technology should rely on high level professionals, educated and trained in the Universities by means of the best known methods and the best available tools.

The International Society of Photogrammetry, ref. Sitek (10), got the mandate to lead the way - it is up to all of us teachers to contribute to this effort.

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