

ized professional training rather than broad academic training. I agree with Professor Doyle in advocating the opposite.

I ask this rhetorical question, "Are we educators or are we instructors in trade schools?" I believe we should be educators trying to train and develop men with broad points of view, both in the humanities and in the sciences. I disagree with those who believe we should simply train trade school graduates to work a multiplex projector. Among other things, I venture to predict that in one or two decades, the multiplex operator may be seeing the end of his days.

In conclusion, Mr. Chairman, I hope that the goal of future photogrammetric education will be to train photogrammetrists as scientists rather than as multiplex technicians.

DISCUSSION

MODERATOR: There will now be an opportunity for some discussion.

There has been a certain amount of unanimity of opinion. It has been stated that photogrammetry is definitely a science and should be approached from a scientific standpoint and that we must consider such as optics and mathematics. (Our men have been instructed along that line for some time, but in a limited way.) Also we must start thinking about giving instruction in other lines, such as electronics. Again the student should be quite familiar with statistics.

Information theory, electronics system research, and electronic computing devices in my opinion will undoubtedly play an important role in future photogrammetric education.

Joseph C. Elgin, Dean of Engineering School of Princeton University recently expressed his opinion that engineering is to become more scientific, for example in such lines as geodesy, geophysics, photogrammetry, applied mechanics, soil physics, and soil mechanics. I am sure that instruction in basic sciences will make better scientists out of our engineers. One of the staff in the Aeronautical Engineering Department at Princeton applies himself equally well to problems of the airplane's stability, optics, electronics and to typical mechanical engineering problems.

I think it is quite possible that in the future we will no longer use the names civil engineering, mechanical engineering, chemical engineering. Instead engineering will be one big, broad field in which a man with the fundamental training we have been discussing can turn not only to photogrammetry but to many other fields.

I will now question some of the panelists. Professor Doyle, why should we have a first-order instrument in our engineering schools?

MR. DOYLE: I didn't state that this is necessary. I believe that in a school which sets out to train a geodetic scientist, photogrammetry is only one of the subjects with which he should be familiar. Photogrammetry by itself is not a science, it is just one subject with which a scientist should be familiar. We should train these individuals in all of the subjects which make up the geodetic or earth sciences.

Relative to instruments, I believe significant research in photogrammetry can be done with a first-order instrument not only in aerial photogrammetry or in topographic photogrammetry, but also primarily and essentially in the non-topographic applications of photogrammetry. At Ohio State I have received a request from four different agencies for work in non-topographic fields. I have had to discourage these requests because we lack the proper equipment for extracting all of the information that is available on the photographs.

As a matter of interest these particular requests include first of all, one from

the Biophysics Branch at Wright Field because of interest in determining a great number of dimensions from the human body. These dimensions are correlated and later used in the design of instruments and equipment. At present, all of these measurements are taken with such as calipers, tapes and scales. Some sort of an arrangement is sought whereby an individual could stand in one spot, have two pictures made and then walk out. The photographs then would be used in some type of instrument, and all dimensions now requiring several hours to obtain could be deduced by a photogrammetrist.

The second application is from the State Highway Department of the Engineering Experiment Station. In the design of highways, determining the deflection of the pavement under actual traffic loads becomes of fundamental importance. This is an extremely difficult operation with any normal type of indicating instrument. The possibility to be explored is whether photogrammetry can offer one type of solution for this problem.

The third request for assistance came from the Medical School. In a rather extensive investigation of a particular type of blood cell, it is of fundamental importance to be able to determine the contour and the volume of the cells. Obtaining these dimensions is very difficult where any normal sort of instrumentation is used. We have been asked to determine whether it would be possible to determine the dimensions from stereo-micrographic pictures.

The fourth application came from the Snow, Ice and Permafrost Research Association by way of the Geology Department. The interest is in determining the movement of glaciers so that a study can be made of putting in various kinds of pipe lines and transmission lines and so on. They want to do this photogrammetrically if possible rather than by conventional surveying methods.

All of these problems could be investigated much more readily by using a first-order instrument or perhaps such as a stereo-comparator, although that is not quite as versatile as a first-order plotting machine. Therefore, I think that any organization intending to undertake fundamental research at a high level in the field of photogrammetry should have access to one of these large plotting instruments.

If we intend to uphold the profession of photogrammetry, we should be able to help individuals who come to us with the type of problems I have mentioned. It is unfortunate that these people have been encouraged by attending lectures and reading in magazines and so on, to believe that photogrammetry can be used for all of such problems. They come to a group such as ours where we are presumably specialists and we are forced to tell them "yes, we could help you, but we cannot."

It is true that the basic problem is in one of the other fields. But I again insist we are trying to train scientists, not photogrammetrists; and as scientists we should have a universal interest in various problems of this type.

MODERATOR IRISH: Mr. Meyer, who attends those advance courses at the University of Minnesota?

MR. MEYER: The students are mainly at the graduate level. Occasionally both advanced undergraduates and graduate students are interested in going further, either in doing original research or in extending their knowledge in certain fields. Those coming from the graduate level are students working for their master or Ph.D. degree. They are not specializing in photogrammetry but in some particular phase of it which will help them in their special work.

MODERATOR IRISH: Mr. Moffitt, have you given any thought to refresher courses for men customarily referred to as civil engineers, such as highway engineers primarily but possibly also men in soils work?

MR. MOFFITT: At the extension school at the University of California, L. A. most of those given instruction in photogrammetry are practicing highway engineers. At Berkeley, it is possible occasionally to give an extension course in photogrammetry. This however is frowned on by the Division, I'm sorry to say, as not being a very scientific productive endeavor so far as the individual instructor is concerned. The Division of Highways had Mr. William Pryor in 1950 give a two-weeks' course in photogrammetry as applied to highways.

At every opportunity we offer extension. That is the only way we have to get into contact with the civil engineers in the field.

MODERATOR IRISH: We have a big public relations and publicity job. We have our services to sell. Photogrammetry will go ahead only as fast as we push it.

At Princeton the title of a one-day conference for land surveyors is "New Techniques for the land Surveyor." In two papers we give a little about photogrammetry, hoping thereby to acquaint our men in New Jersey with the possibilities of photogrammetry.

MR. HOWE: Mr. Doyle, you said that the practicing surveyors in Ohio claim they need approximately 100 men trained in surveying and mapping, and then you described some of your courses in photogrammetry and cartography at the undergraduate level. Are those courses the answer to what is asked by the surveyors of Ohio?

MR. DOYLE: No they are not. We definitely do not have the entire answer. Fundamental among what they desire is that the individual have some knowledge of land and property law; at the moment instruction is completely lacking in our curriculum. I think that this particular group is selling short the profession of land surveying and that what it is demanding or asking be turned over to it would more properly be the graduate of a trade school. It wants a man who can run an instrument, who has some judgment for locating property lines and so forth, and who has a little knowledge about law. But that is actually all that is wanted. It wants his education in mathematics to be stopped at trigonometry or around that level. That in my opinion is not a legitimate goal of university education. The man who comes from our undergraduate program could do what is wanted.

The attitude of many practitioners of surveying and mapping in the country is unfortunate. While a very strong group favors professional recognition, a very large number work in the old tradition of the land surveyor who goes into the wilds and roughs it, and the less mathematics he is faced with the better he likes it.

If we intend to gain professional recognition we have a duty to increase the standards of knowledge, education and training for those who are in the field. This, I think, is a legitimate goal of university education, whereas the training of a pure technician or somebody who is capable of doing this job and nothing else is not a legitimate goal.

MR. LEES: I disagree with Doctor Rosenberg's proposition that photogrammetry is a science. Instead, it is a means to an end which combines many sciences with the profession.

MR. ROSENBERG: I think some of our disagreement may be due to different definitions of a scientist. I don't mean to say that photogrammetry is a pure science or a basic science; it is definitely an applied science. But I think you will find most of our applied sciences nowadays are combinations of the basic sciences.

What Professor Doyle and I have been asking for is a more thorough training

in all of the basic sciences, so that the photogrammetrists can firstly understand better what he is doing, and therefore do a better job; secondly, so that the photogrammetrist of the future will be able to handle the necessarily complex equipment and highly complex methods that will be given to him; thirdly, so that we can develop photogrammetrists who can do their own research and development in their own field instead of depending upon the specialists in various contributing fields.

Someone must integrate those basic sciences into a combined science of photogrammetry; the best man to do that is the photogrammetrist himself.

MR. CURTIS: Mr. Doyle, How many of your students at the undergraduate level and graduate level specialized in photogrammetry and geodesy?

MR. DOYLE: We are now in our third year of operation of active teaching in the Institute. Our enrollment has grown steadily though not spectacularly.

In the first year, 1952-1954, we had eight students. I think five were in photogrammetry and three in geodesy. All were at the graduate level.

I am not sure of my figures for this academic year but believe there are twenty-five students. Of these, 15 are in photogrammetry, 8 in geodesy and 2 in cartography. I think 8 are in the undergraduate level and 17 in the graduate.

In the graduate level there are three divisions. Those called special students already have a degree in some other subject and are therefore taking special courses but are not candidates for the degree. Then, we have candidates for the master's degree and candidates for the Ph.D. At the moment, our candidates for the Ph.D. are two—one in photogrammetry and the other in geodesy. The remaining divisions between special students and candidates for the master's degree is about equal.

MODERATOR IRISH: It is now 5 o'clock and time to close this panel discussion. I thank the speakers on the panel for their efforts and participation. I especially thank Doctor Rosenberg for his pinch hitting.

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