Chairman McNair: I expect it is time that some of you folks began giving more thought and taking appropriate action, for photogrammetric education. We already have a little start in that some professors are really concerned over what they teach and why they do not teach this or that.

You know that it is all too easy at an educational institution to get a series of completely unrelated courses. It is not at all difficult to set up a course in photogrammetry, in surveying, in structures, in anything you want to name. It is very easy for an instructor to fall into the pit of being so tied up in his own field that he does not see the forest for the trees. Hence, the title, as you will notice, is "Integration of Photogrammetry into Higher Education." *This instruction in photogrammetry has to be integrated into the entire curricula.* That is very important. We do not need a detailed discussion on educational methods.

I am willing to admit—I do not know about my colleagues—that higher education is probably the slowest in adopting progressive methods of instruction and methods of integrating that instruction so as to give a better unified whole.

Without any more comments, I think we should try to answer some of the questions that you in the audience may have.

DISCUSSION

N. A. Christensen (Director of Civil Engineering, Cornell University): This morning you saw Professor McNair's chart showing the supply of engineers that we anticipate during the next four years provided the Army does not take any of them. What the defense operation will require is rather doubtful. Instead of having 51,000 graduates the number may drop in the next four years to perhaps 12,000, possibly even lower. That means that there must be very careful use made of the engineering supply. I desire to direct one question to the three men who represent employers of engineers.

If you were to analyze your own operations and then decide what positions in your own organizations require men with four years of engineering education, how many in your organizations would you have to have of that level of training? Could we have any estimate of the total in the United States of such men needed each year?

This may be a hard question to answer, but it is very important. If we are going to make the best use of personnel, we must know the job ahead of us during the next ten or fifteen years.

Mr. Moravetz: I can only answer in a general way as I do not have the facts and figures with me. I believe that in the USGS alone, however, there are about 900 people in the Survey now who are professional people. As far as the static condition is concerned, if there were no turnover and all those 900 worked for forty years, that would not mean very many additions per year. I mention that because Professor Perez asked me earlier, "How many engineers per year do you need?" My quick answer to him was, "From zero to five hundred." It depends a great deal upon the condition of the economy of our country and the emphasis placed on mapping and like matters. The impetus given to mapping, from that standpoint, is quite important, and the impetus that counts, of course, is that given by the House and Senate Appropriations Committees.

I cannot answer Mr. Christensen's question specifically. It is difficult to answer because of the varying conditions from time to time. An average figure for the Geological Survey itself, as a single agency, perhaps would be around 120 or 130 or so added engineers per year. I know we have representatives here from Coast and Geodetic Survey. I wonder whether Mr. Jones can estimate how many engineers are needed per year in the Coast and Geodetic Survey?

Bennett G. Jones (Coast and Geodetic Survey): I think at the moment it would be perhaps 50 or 60. Of course, it will increase if many are taken out by military service; we expect to lose some.

There is another phase of that question from the floor that was not answered and it is interesting to me.

What percentage of engineers are needed in a mapping organization? I should like to hear from Mr. Coltharp and others. I will hazard a guess that in photogrammetry we should have a minimum of at least 25 per cent, both in field surveys and compilation. If others think that percentage should be much larger, I should like to get their estimates.

We have to get along with what we can get. We found very few graduate engineers in the last few years who were available for employment. We have not obtained as many as we want by any means.

Duane Lyon (Aeronautical Chart Service): I am not a graduate engineer, and in the Chart Service, we have very few in responsible positions who are graduate engineers. They may have B.S. degrees in mathematics or something like that. To make your question really clear, what do you mean by an "engineer"?

Mr. Jones: I mean men out of college, beginning work with a degree mostly in civil engineering, but with a few who have perhaps electrical and mechanical engineering degrees. Of course we are speaking about degrees in photogrammetry and we prefer some with degrees in photogrammetry. But we have not been able to be that choosey.

Mr. Coltharp: To answer the first question about the total number of engineers that would be required, I think that the number for the commercial endeavor is even more vague than for the Government agencies, particularly with the war coming on. We do not know anything about the kind and amount of work, we are going to get. If there is a big engineering map program, that would be one thing. If it slows down, that will be something else. I know that the number would vary from zero to fifty very easily in some organizations; it might be zero to maybe several hundred as far as the industry as a whole is concerned.

As to the percentage that would be required in any organization, that is a somewhat nebulous figure. I would say that maybe 25 per cent would be a top figure of the really qualified engineers and that probably 10 per cent might be even a better figure. But if you got down to the 10 per cent, then you definitely must have a much bigger percentage of people with engineering training—at least in the process of becoming engineers—to do a lot of the routine work. For doing the planning and the direction of the various phases, one engineer ought to be able to direct seven to ten people without any trouble; so ten per cent would not be a bad figure for that phase.

If you are trying, however, to get a percentage for those with an over-all engineering background, then I would say 25 per cent is too low.

Chairman McNair: I should like to point out that everyone here is going to be responsible for the job of selling education and training in photogrammetry.

As you could see from the chart this morning, the supply of engineering graduates is going down sharply. The demand is going up. Remember that during the past fifteen to twenty years there has been a stigma attached to surveying. The student graduating from college has been the same as told that if after graduation his first job is surveying, he should think of that only as a first step and get out of it as soon as possible. "Don't stay in surveying. You are typed for life." That means that in order to put qualified men into your organizations you must do a job of selling to get full realization that surveying is something more than a routine job, that it has possibilities and that the new developments in photogrammetry, instrumentation, various methods and techniques, have put a great deal of punch, and romance even, into the field of the surveyor. Without that selling, you will have a hard time attracting men from engineering colleges into your surveying-mapping programs.

Possibly Mr. Spelman would like to add a word or two about the program of the Public Roads.

Mr. Spelman: I am not sure that I understood the kind of information the gentlemen wanted. For a number of years past, Public Roads has given employment to from fifteen to twenty-five graduates from the colleges who have taken engineer training courses.

The Public Roads organization has been recruited partly in that way and partly from skilled men who are drawn in from the highway field after some years' experience with other organizations. Essentially, of course, Public Roads is an engineering organization. However, we have a number of engineering aides in minor surveying positions who are not graduates of colleges. And of course we must have a large number of accountants and clerks and people of that kind, because of the tremendous amount of paper work that the various Acts of Congress impose upon all Government agencies. I suppose that in the eighteen or twenty years I have been around Washington, the amount of clerical personnel has easily doubled for the amount or volume of work we have.

In the general field of highways there was a report made for the American Association of State Highway Officials about two years ago. I think the chairman was General Anderson, the State Highway Commissioner of Virginia, and formerly dean at V. M. I. He listed the requirements of the State Highway Departments for engineering graduates. However, at this time, it seems to be almost impossible to project into the future the requirements of the engineering organizations, particularly in the public works field, because no one can tell just how much of public works is going to be undertaken during the next two or three years. We feel that transportation is sort of the crux of the problem and that we should not make the mistake of treating our highways as expendable in the war effort. If handled as expendable, the war effort will bog down. Probably other people will feel the same about other features of public works, but—and this is purely a personal opinion—all that is largely in the future. How much of this construction is going to be continued? In what fields will it be spread? I think it will be very difficult at this time, because of the impact of war or the preparation of war, to make an intelligent estimate of the requirements for engineering graduates in the immediate future.

Mr. Hallert (Stockholm): It has been a great pleasure to hear this discussion. I have been in the United States for about four months and have studied this question of education in photogrammetry. Certainly the matter of higher education is of great interest. I was very glad to hear what was said by Mr. Moravetz on his topic. Also I discussed education with Professor Harding in Columbus, Ohio. I can give you some comments based on our experience in Europe.

We have in Europe a certain special education for what you here would perhaps call topography—we call it land surveying—and this is rather similar to the program we are discussing today. We educated twenty a year of the ground type but three years ago we had to increase the number of our students to forty. This seems large for a population of only several million, so I am sure that in this country you probably will need at least fifty. We have a much more complicated condition, especially in cadastral mapping, than you have. We use photogrammetry not only for mapping but for forestry, highway engineering, and in many, many other ways. So I suppose we will have to educate about forty people for the next five years. We have civil engineers and photographers, too. I think the program for civil engineering in photogrammetry is rather the same as in the United States. We give the land surveyors a rather good background in photogrammetry, and in the theory of errors. Every year we have people who want to continue in it, so they may get some aid from the Government to continue their education in photogrammetry, because every one knows very well that specialized technical training is a thing that takes a very long time. We hope, in the future, to get a rather good supply of educated photogrammetrists.

During the war and after the war, all photogrammetrists have been very busy and have not had time to do very much research. We hope during the next few years that the number will be increased, and that we may get some valuable service from them.

Walter G. Stoneman (Inter-American Geodetic Survey): I should like to add to the requirements aspect.

We have a requirement for fifty to seventy-five graduate engineers per year. I suggest that several of the defense agencies, which may or may not be represented here, have some very sizable requirements.

I should like to ask two questions. The first regards getting together the customer with the source of supply. We have had considerable—I should say a great deal of—difficulty in recruiting personnel for our operations in Latin America. We are under the Department of Defense and we are operating an international program. The Defense Recruiting agencies broke down completely in trying to satisfy our requirements. We have had an informal recruiting program of our own which Mr. Larsen has been conducting for some time. We have had a great deal of difficulty in knowing where to go and in finding the best source of supply.

Can the American Society of Photogrammetry or the American Society of Engineering Education contribute something to that field by publishing a list of the schools which are outstanding and which would be good sources of supply for our needs? That is one question. I have another one later.

Chairman McNair: It is always difficult to get administrators to realize that there is a real need for a particular specialty. Professor Brinker may have a word to say in behalf of the American Society of Engineering Education, but first, I want to call on Mr. Davidson of the U. S. Geological Survey.

John I. Davidson: I should like to speak, not as a representative of the Geological Survey, but as the chairman of the Employment Opportunities Committee of the American Society of Photogrammetry. The Board of Directors, last spring, decided after some urging by a few members, that we should set up an employment service. As I was one of the people urging this service, they made me chairman. With the help of some others in the Federal service here, we set up a procedure. We sent letters to all the commercial firms that we knew were engaged in photogrammetry. We also wrote to the major government departments that use photogrammetrists in any capacity—either subprofessional or professional. We decided to publish quarterly bulletins listing job opportunities, together with salary, duties required, training required, et cetera. Three of those bulletins have been sent out so far. A great many of you have probably seen them. They were sent to all Members of the American Society of Photogrammetry in the United States. With each letter of inquiry requesting the listing of vacancies, we also asked that if possible the agency contacted furnish us with the results of previous bulletins. The whole program was set up on a trial basis—it is rather expensive—and at the end of next month when we publish the fourth bulletin, the committee is to make a report to the Board to see whether this activity has any value. To date I have failed to learn of the service placing a single person. That may indicate that we are mailing the bulletins to the wrong people, or that there is a tremendous shortage of trained people.

The last bulletins listed over 200 vacancies, mostly for those who could qualify, as engineers.

N. A. Christensen: I believe that my first question was not completely understood because it seems to me the answers have been on the basis of what they would like to have. It would not be possible to get as many people as indicated because of competition with other fields of civil engineering which also must be supplied. It is important that you get the men you simply must have, but it is equally important that you use no more than that number because other groups in engineering activities must also have their supply of men that they need.

There needs to be quite a change in objective of the men who are responsible for employment. They must determine their minimum need for fully trained engineers and the salaries must be made high enough so they can keep them once they get them, because there will be competition for the men even after they report for work. The four-year men coming out of the colleges are not specialists; they are more or less broadly trained and can work in several fields. So it is not a matter of what you would like to have, but what you must have, and then giving a salary sufficient to keep them once you get them. That, it seems to me, is the real problem ahead.

Professor Harding (Mapping and Chart Research Laboratory, Ohio State University): I have listened with a great deal of interest to part of the program. I am sorry I did not hear all. One thing might possibly be brought out. I have heard the term "engineering" used quite a lot today and I am wondering if it is applied from the standpoint of training, as a sort of philosophy of education, or has something to do with the rigor of training or something of that sort, rather than as the term "engineering" might be understood elsewhere.

I believe that the problem breaks down into two parts. For twenty-one years I have been trying to do something about this type of education within various universities. We have had varying successes; none of the efforts have been too successful, although some of the effort has materially contributed to the advance. What we must realize is that the term "Civil Engineering as used today really is a misnomer; the work is really construction engineering.

My remarks are not directed at any individual institution, and your own institution may be an exception, but, if you will look through the scheduled courses, the curricula of, say, one hundred different institutions in the United States, and list them, you will without any preconceived notion of what to call it, agree that the work is construction engineering.

In that connection, there have been a great many courses which civil engineering of necessity has had to add as time goes on for its immediate purposes. For instance, probably no modern civil engineering department today would consider giving a man a degree unless he had had a course in soil mechanics; and twenty-five years ago, probably no one had heard of a course in soil mechanics.

There are many things that are being added to the requirements to get a civil engineering degree. At the same time we have had the development of this budding new profession of which this society is the representative. It has been sort of straining at the sleeves and arms and wanting professional recognition, which is surely natural, but trying to accomplish this within the confines of something else which has other obligations. I am wondering if the answer may not be an entirely different attack. I believe, that every civil engineer who graduates should certainly know something about photogrammetry, something about geodesy, something about cartography. The amount that he can get within the time that is available in the curricula, may vary, depending upon the institution. I believe, however, that there should be available within these United States a place where a man can get an education and then specialize in the field in which he plans his career.

I think that that can only be done as a separate entity and not as a part of engineering.

Many of the courses which are absolutely essential to engineering have, outside of their mental training, no direct relationship to mapping and charting. In other words, all of the fine courses which are very essential, say, for structural steel design, timber design, and so forth, are very good from the standpoint of the construction engineer. They are not essential from the standpoint of a photogrammetrist.

It seems to me that when planning on giving a man training we must eventually come to the realization that in four years or five years, as the case may be, there is only just that much time available. If we really need to turn out a few top men who will be thoroughly grounded in all of the essentials that have been mentioned today as being necessary to successful photogrammetry, mapping and charting, full consideration must be given to the time requirement as well as the study courses.

As I have said, I have been trying for twenty-one years to find the best solution of the problem. It may interest you to know that an experiment is to be made beginning in the fall of next year.

The Board of Trustees of Ohio State University has approved the establishment of a separate educational setup within the university which will cut across all college lines. An undergraduate curriculum has been prepared; it will present both the regular curriculum and an opportunity for the degree of master in photogrammetry. In conducting this experiment, we will need a lot of help, encouragement and suggestions from others who realize that this is similar to a pilot plant, and there will probably be a great many adjustments in the setup as time goes on. However, we believe that this method will be one partial solution. There is probably no great need for a great many efforts along the same line. I think it would be wrong for, say, three hundred engineering schools on this continent to try to start tomorrow turning out photogrammetric engineers or whatever you want to call them. We prefer to call them photogrammetrists, cartographers, and geodesists; we believe this is just as good and there is just as much prestige implied as in adding "engineer." In some of our schools "engineer" has come to cover a very wide field. In some cases, there are fourteen departments in engineering.

You probably recall some of the arguments that have waged in the A. S. E. E. when they were discussing the new types of engineers that were advertised, such as tonsorial engineers. We do not believe that the term "engineer" is necessary to professional status. The geologist occupies a very honored position, and many other people of like education and like background have honored positions without being called an engineer.

I hope I understood you rightly that you spoke of engineering education in terms of philosophy of education, that is, rigorous training covering all of the essentials and also probably weeding out some of the things which have no direct bearing.

Chairman McNair: It is encouraging to know that at least one institution is greatly concerned about the situation and making great effort for correction. I wonder, however,

in most schools, especially with the current reduction in students, whether or not the boards of directors will be very receptive to adding a new degree. I also wonder about the requirements in the proposed study courses. I know that everyone will watch the experiment with much interest.

I think that most of those here feel that we would not like to turn out a cartographer, surveyor, photogrammetrist, or whatever his title may be, who does not have some appreciation of the problems involved in mechanics, structures, soil mechanics, or in hydraulics, because all of those subjects have a relationship to mapping per se, to cartography, to photo-interpretation, and all of the related fields.

You all know that there have been many subjects added to the curricula at all schools. You are also aware that whereas fifty years ago we required possibly thirty credit hours of surveying and mapping work, the number now as Professor Brinker just reported, is an average of eleven. That means a cut to one-third. What we need is to add more to our surveying, mapping, photogrammetry, instrumentation, whatever the courses will be, and regain some of that which we had earlier. Obviously, that is impossible in a four-year curricula. Possibly we will have to add two years similar to the action of the professions of medicine and law. I am not yet ready to say seven years as a total.

At Cornell University, we have a five year course; there are several other schools in the country doing the same thing. They are being watched carefully, of course, to find out whether they can stand the economic strain of a five-year curriculum. That is something that always has to be dealt with and if we survive, I feel that the profession will rather completely go to a five-year curriculum. I, however, did not intend to interject that into the discussion this afternoon. I am sure there must be some other questions from the audience.

Mr. Robert W. Richman (U. S. Forest Service, Mapping Division, Alexandria, Virginia): I rather hoped that you would introduce your word "integration" again and emphasize it.

I hoped that because I think it has been stressed a bit wrongly. I believe there should be a greater defense made for perhaps a majority of the people in photogrammetry and some in other fields of engineering who do not have an engineering degree. It occurs to me that there are a number of colleges which permit what they call an associate in science after two years. That is a group of people who are potentially a source of workers for the various agencies. They are not trained, of course, to the extent the graduate engineers are.

Many agencies have been wanting graduate engineers and have been stressing that side. As Professor Harding pointed out, they may be slightly wrong in their approach. Also Professor Christensen urged that we try to think of as many men as we can who are partially trained but will be able to do the required work.

It seems that we are talking about two different things and we ought to integrate them. There are a group of people trained generally who are engineers and then there are specialists in various fields who probably will want to go on to advanced degrees. They would go to schools such as Ohio State and other colleges offering various degrees. The general engineer and the people who will do the spade work, the little fellow of which there must be many more than the upper fellow, those people will go to these schools which give general degrees—even schools which are not engineering schools but may be liberal art schools which give degrees in science or mathematics.

I think that is a group of people we are overlooking.

I was also interested in the discussion of the materials required for courses in photogrammetry. In the basic course there were just a few tools to be used and it was suggested that in the advanced course there would be required some specialized tools such as the K.E.K. Plotter, the Kelsh Plotter, or the Multiplex. I am interested in knowing what some of the people in the various agencies feel would be the most important of those tools for advanced workers.

Chairman McNair: Mr. Richman. I am very much interested in your remarks concerning integration.

You perhaps know, that at Cornell University there is being given master's and doctor's degrees for work in photogrammetry or topographic engineering. Very recently

we had a little discussion with the committee of the graduate school and they brought up the matter you discussed.

There is a feeling that we should have more integration of our work. They said, "Why do you have to specialize in photogrammetric engineering," and so forth. "Why don't you call it surveying, and let that field be broad enough to take care of the personnel you need and then let them specialize in that field?" I think that, perhaps, is a move in the opposite direction to what we have had before.

There is, however, a plea for integration from people outside of our own engineering field.

Professor Brinker: I have several points that may help. First, with regard to integration, we can carry that too far. I know the dean of one school who is setting up his curriculum in this manner: transportation is one subject. Whether water moves through a pipe, or electricity goes through a wire, or a truck runs on a highway, that is all transportation; one man is going to teach all that. If we get to that, I have no idea where we will finish. That same dean said that any time spent in laboratories, whether it be surveying or strength of materials, is time that can be saved. So the boys have no laboratory periods.

One question has come up about the selection of graduates when employing additional men. Where you have to compete for graduates, the thing to do is look for the number of credits in surveying which are given. Minnesota, for example, found that prior to the war about 50 per cent of the graduates had gone into surveying and mapping and drafting work; so on that basis it gave a much heavier surveying program than most schools. And some of the boys were interested and several now hold positions in the various Federal Mapping services. On the other hand, the West Coast has not felt the need for much surveying; so any one looking for a man to take a surveying job is wasting his time going out to the West Coast. The students do not get much surveying in school, and therefore are not interested in it afterwards.

From some employment in the Navy two years ago, I found in checking various parts of the country that 80 per cent of the students want to be structural engineers. If 80 per cent of the students want that, that is what the schools are going to give. The schools having cut down the surveying requirements give the boys less, and therefore the boys are less interested. When they get out they are not so likely to go into that kind of work.

The feeling at Minnesota has been that if the boys get a good strong program in college, then when they get out, instead of taking a road man's job, they will have had enough experience in many types of work to go ahead as an instrument man; and that is what has happened. So the answer is a selling job, both on the part of the industries and the organizations that need surveyors, to sell that need to the schools.

You may know the results of a recent questionnaire in which the students were asked what they took in school that they wished they had not taken. The thing that stood at the top of the list was geodesy. That being the case, we are not going to get many students interested in geodesy. They have to be shown that the work outside is available and that what they take in school will be helpful.

It is up to you to tell these schools that you have enough jobs available and the schools will then be willing to train the people for them.

Mr. Stoneman: I will amplify my first suggestion which Professor Brinker primarily answered. The regular personnel agencies of the Department of Defense fell down in supplying our needs. We got our men when we went directly to the universities with our own recruiting program.

I am wondering if there isn't a gap between the source of supply and the personnel agencies that needs to be filled, perhaps by some agency or some organization such as this one. I believe it is a reflection both on the governmental agencies and the universities that that gap has existed.

Another thing I had in mind was that at these meetings we talk to a bunch of specialists and we appreciate the problems that we are talking about. The people we need to reach are our bosses, especially the bosses in the universities—the board of trustees—so I should like to suggest that a committee consider trying to coordinate and muster support from the governmental agencies towards putting pressure on the uni-

versities to offer courses in mapping. I am especially interested in the geodetic field which appeared rather low on the recent questionnaire. I believe that if approached in the manner that Professor Brinker has shown with his questionnaire, we could get some results.

Lieutenant Colonel Angel G. de Mendoza (Military Attache, Spanish Embassy): I wish to suggest, Mr. Chairman, a system for the training of photogrammetrists, especially beginners, that I happened to learn twenty years ago in Spain. It consisted of printing one belt of photographs, not on photographic paper, but on other paper, one green and one red and one yellow. Then you take the photograph glasses and with paper on which the bond has been prepared up and down, you can fix the permanent altitude.

By this system, many pupils can work together and you can compare the work of one with another. The experience is very interesting because, for a beginning, it is a very good system.

Chairman McNair: I am sure that this device is very interesting and novel in this country and is useful in teaching stereoscopic measurement.

Mr. Moravetz: Mr. Chairman, I want to try to answer a little better a couple of the questions which seem to me were not completely answered.

One was the question of Dr. Christensen regarding our capability to adapt an organization so as to get useful engineers to fill the demand of the number of engineers on a percentage-wise basis. That certainly has been recognized as a must by several of the agencies in the government work. That "must" is just as real as the must of using a tape when you chain a line in a traverse, because we all realize that a lot of these people are not available. I think also in answering that question we must also answer at the same time the question which Mr. Jones asked a little bit ago, and Mr. Davidson dwelled a little bit on, as well as Mr. Lyon. That is regarding the percentage of personnel in the surveying and mapping field who should be engineers.

I believe that we should consider that first on a static peacetime basis and, second, on an emergency basis in which the original conclusion is changed by the course of the circumstances. To begin with, during a peacetime static condition, various kinds of these steps in mapping can be organized differently so as to use different proportions of engineers versus the total. That can be observed through inspecting the manner in which various government organizations who turn out a similar product organize their activities.

For instance, in stereo plotting, some agencies feel that it is proper to train subprofessional people to do the actual plotting and to supervise that plotting with much supervision as one person might be able to give a few people, such as five to eight. In this case, the professional person in charge is required to carry out the professional judgment required of all of those seven or eight people. In plotting, for instance, to continue that same analysis, if a subprofessional person who has had only the experience of how to run a particular photogrammetric machine runs on to a control problem, he calls his supervisor to find out how to solve that problem. Some agencies operate that way in peacetime as well as wartime. The percentage of engineering in that case might be one in eight.

Other agencies prefer and feel that the product which they turn out is of much higher grade if each individual operator in the field is able to solve his own problems.

It so happens that as we approach wartime, we decide that by necessity the earlier course will have to be taken in the case of several organizations. We can not find and can not get enough engineers to use the latter course. So we may revert back to the earlier course depending upon the number of engineers available.

We have found that girls, for instance, can be trained to do a photogrammetric operation or several other types of office operation even though they have not seen a civil engineering institution. We have found, however, that girls who have some scientific background, have gone to school and have taken some science course are better equipped in general; on a percentage-wise basis they turn out better than the others just because of the training that their science courses have given them.

I think that the answer has to be flexible. Some of the agencies use as high as 45 per cent of their total personnel in the professional field; that is, 45 per cent of the total

personnel of some agencies have been on the static basis of professional engineers. In other cases, there are as few as ten or fifteen per cent. What the optimum is, of course, would take a Solomon to tell.

I have one other comment that I think may be helpful. Mr. Harding raised a good question which I touched on a little in my paper and want to amplify. Some of us felt that the words "professional activity" or "professional training" are a little more sure of hitting the mark and what we are talking about. Some are raising the question which Mr. Harding raised. It is awfully hard to answer. We have to go back and say: What is a professional activity? What is a professional person? Who is a professional person?

We first think that a professional person is one who has been to college. But that in reality is not a good definition. We feel that the Civil Service Commission's definition of professional activity or professional personnel holds water much better. The definition which they use is this: that an activity is a professional activity whenever the operator in that activity is required to apply and be familiar with the basic theories which underly that particular field of activity. That is what we feel is a professional position. A man may get to that position without having gone to college. Ordinarily we mean the man who knows his mathematics, his physics, his mechanics, and so forth. Talking about physics and mechanics, I certainly did not want to imply in my original comment, Mr. Chairman, that I would recommend taking out the fundamentals of all these things. I had reference particularly to such things as the economy of highway work and to decide whether or not it was worthwhile to have a 4 per cent grade or a 6 per cent grade on a highway, as a requirement for a mapping engineer.

So I feel that the answer is that this whole thing is a professional activity and that there are a lot of things taught in schools now which we like to see a mapping engineer have, but he has to jump around to get them. What we really want is to see an integration accomplished so that various subjects which might be useful to a mapping engineer would be all concentrated. We would like you to turn out some really high-powered mapping engineers who would be qualified in any of these fields.

Chairman McNair: I have two or three subjects in mind which we have not touched upon. For instance, we have had no mention concerning textbooks for our courses.

Many of you know that the MANUAL OF PHOTOGRAMMETRY, which has been considered somewhat as a bible for photogrammetry, is out of print. The new edition is still not on the press. The matter of textbooks has not been touched upon. It is a field which could be discussed.

There are several other subjects which could have been mentioned. Some of these were discussed at the meeting held last summer under the joint auspices of the American Society of Photogrammetry and the American Society for Engineering Education. If you are interested in a report, it can be obtained from the University of Denver, upon receipt of one dollar. Write directly to the Civil Engineering Department.

One other word. I know many of the mapping agencies and commercial mapping organizations are discontinuing the use of some of the simpler equipment such as stereocomparagraphs, K.E.K. plotters, and so forth. Many of the schools are having difficulty obtaining equipment. This is particularly so because of the decrease in enrollment. You do not realize how greatly professors and schools have been caught in a spiral of increasing costs, together with decreasing enrollments. There is very little opportunity for them to add to their equipment now. Any equipment which organizations have which would be useful for instructional purposes, although it may not be useful for you as a production mapping unit, would be welcomed by any one of one hundred forty-five engineering schools throughout the United States and Canada. I should like you to keep that in mind as you dispose of such equipment.

This panel discussion has been very instructive. I thank all of you for your cooperation and for the good thoughts you have brought to the panel discussion. I particularly thank the six members of the panel discussion group for their participation and the good points which they brought out in helping to coordinate this entire program.