from the curve for Super XX corrected to eye sensitivity with a Wratten 13 filter. Image shifts between these two wavelengths were then read from the curves of Figure 2 and plotted to give the comparison curve in Figure 4.

This procedure is only a rough approximation to the theoretically correct one which would require emulsion characteristic curve data for all wave-lengths and complicated integration. However, the agreement between the two curves is sufficient to confirm that the differences found between the two calibration procedures can be attributed chiefly to the chromatic differences of distortion of the lens as seen by two spectrally different receivers.

These results emphasize the necessity of calibrating air survey cameras by a procedure which closely simulates conditions of use. The error investigated here arose primarily from the visual test procedure having the wrong chromatic sensitivity. It is also highly probable that similar errors would arise from other departures from normal conditions of use.

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*The Future of Your Profession Rests With You**

DR. JOHN J. THEOBALD, *President, Queens College and Deputy Mayor, City of New York*

WHEN I ended my formal association with Federal mapping efforts in 1941 or 2, the American Society of Photogrammetry was less than ten years old, and the American Congress on Surveying and Mapping had just been started. We were talking about the photoalidade, Tom Pendleton and the Geological Survey's relatively recent applications of multiplex equipment to precision mapping and the new nine-lens camera of the Coast and Geodetic Survey. At TVA George Whitmore and his colleagues had been demonstrating the effectiveness of aerial methods for property surveys and the big debate centered around the relative merits of glass and copper plate engraving.

This seems a long time ago. When I scanned your present program, I was particularly interested in identifying what new trends it indicated. This is what I found. First there were the usual technical papers—"Pendulous Cantilever Principles Applied to Self-leveling Instrument Design", "Distortion Tolerance Specifications for Mapping—Camera Lenses" and the like. A little more complicated, more varied, but basically marked evidence of the same scientific advances which were being made 15 years ago and which are obviously being continued at a thoroughly healthy rate.

Two other types of papers are amply represented. One group includes those devoted primarily to the service functions of mapping and photogrammetry—"Use of Topographic Maps in Flood Disaster Areas," "Correlations Between Terrain and Human Activity Which May Be Analyzed by Photo Interpretation," "Control Surveys and Photogrammetric Maps for Superhighways and Toll Roads," "Several Uses of Air Photo Interpretation to the Soils Engineer," "What Topographic Maps Mean to California." Papers of this type, if written twenty years ago would probably have consisted largely of attempts by one

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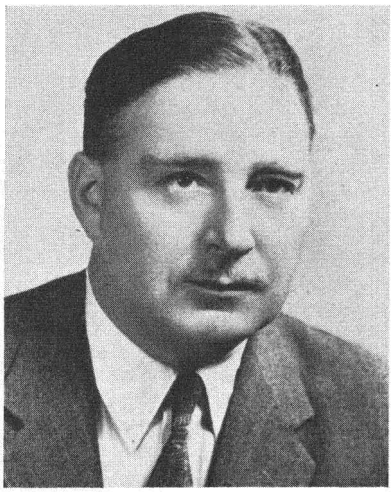
mapping agency to prove that its methods and techniques, developed for its particular and frequently limited purpose, were distinctly the best, and cheapest, for all uses. Strictly among ourselves that this was not valid, but with a limited understanding of the new mapping methods, we would not have admitted this publicly for fear of its effect on Departmental Budgets. Today, judging by both the number and the character of such papers, there is apparently a wholesome, objective, professional interest in applying newly developed tools, most effectively to an ever broadening horizon of activities and uses.



DR. JOHN J. THEOBALD

The third group was probably stifled during the late 30's by a combined awareness of the woeful inadequacy of maps in our own country and our acute consciousness of the pending threat of war. Bob Randall and a small group of co-workers were beginning to develop a Pan American interest in coordinated mapping of the western hemisphere, but projects with a broadly international flavor such as the paper on "World Mapping" were not yet in the public eye.

All of this adds up to just one thing, surveying and mapping, in the strictly professional sense, has come of age. No one would question its high intellectual level or the integrity of its practitioners. Here at these sessions is ample evidence of the sharing of knowledge and scientific advance, evidence of public service through research, and proof of a sense of obligation to society as evidenced by the many efforts to extend the use of the tools of the profession to the increasingly greater service of man. These are the hallmarks of a profession.

Status as a profession, however, brings with it special responsibilities. In the early stages of a profession's growth its practitioners are likely to have had a variety of technical and cultural backgrounds. The new area of knowledge is developed primarily because those engaged in the work have special skills of an unusually high order, great vision, keen intellectual capacity and an undying faith in the pursuit of an idea. The chance circumstances which bring such giants as these together in a new and common interest, happen infrequently. Spontaneously it seems, they develop a new science and uncover heretofore unrecognized principles. But there comes a time when new people must be specifically trained and educated to carry the new profession on or it will die.

This is the stage at which surveying and mapping, or perhaps I should say The Cartographic Sciences, has now arrived. This is the subject about which I will talk with you briefly.

Surveying was at one time the core of civil engineering curricula. Even license-wise the civil engineer and the surveyor were practically one. As our knowledge of strength and mechanics of materials, of stress analysis and of hydraulics was increased, however, the early emphasis on mapping and land measurement gradually gave way to the applications of structures, sanitation, transportation and fluid flow. This trend away from surveying was further augmented by an increasing awareness that engineers, if they were to be of maximum service to society, must also be given a broad cultural and social background. This in a sense was an attempt to return to the traditional liberal

arts concept of pre-professional education and most of our engineering schools are still struggling with makeshift attempts to squeeze both a liberal arts base and adequate professional preparation into four baccalaureate years.

Academically there have been many casualties on the way. One result of this two-way squeeze has been to reduce the credits and course offerings in surveying to little more than a token in most civil engineering programs. This may be lamentable from our standpoint but, in the light of the intense scientific advances and the broad areas which civil engineering now encompasses, even we could hardly expect more from the average typical civil curriculum.

Educationally there are only two practical paths which might be followed. One would be to establish a major or option in "Surveying, Geodesy and Photogrammetry" similar to those which now exist for such as highways, structures and sanitation. The other would be to fashion a new curriculum pointed specifically at the professional needs of this relatively new field. Each approach has been tried to a limited extent and in terms of the immediate present either one would probably do. But looking ahead to new developments, it seems to me that only the latter can possibly be satisfactory in the long run. I will give my reasons.

To begin with, the present options in Civil Engineering stem in general from an expanded knowledge of mathematics, mechanics of materials, fluid mechanics or a combination of these coupled with other sciences, such as chemistry and biology. In contrast, cartography takes off from a basic knowledge of mathematics—particularly plane and spherical trig, geodesy and optics. Clearly both are applied sciences, and as such are technically engineering; both build their technical knowledge upon mathematics and physics as a base; and both need a knowledge of elementary surveying. But there the similarity stops.

We have already reached the stage where the professional in surveying and mapping, in addition to an understanding of the basic use of the level and the transit, will certainly need some specialized preparation in such areas as geodesy, geophysics, photogrammetry, electronics, optics and mathematics. These have become the technical tools of mapping and they would have to be preceded at least by basic physics and mathematics and perhaps by some chemistry.

In addition to all this, improved transportation and communication are rapidly reducing the effective size of the world and in the process, increasing our interest in and concern for more adequate and precise location of far off places. To say the least, this will create a most important international role for the mappers of tomorrow. Just as our surveyors of the 18th and early 19th centuries were in a sense our early ambassadors into the hinterland of the west, so too will our geodesists of tomorrow necessarily be in the forefront of those bringing a better understanding of our American culture to foreign lands and giving us in turn a greater appreciation of our American, European and Asiatic neighbors.

As professional people, therefore, it is particularly important that their education be not limited to the scientific aspects but include a broad foundation in the humanities and social sciences with particular emphasis on an adequate understanding of the world-wide scene.

Such a curriculum would most certainly require at least four full years, and a considerable number of students should probably go on to graduate work in order to do it full justice. Certainly there would be little time and little need for many of the subjects which most engineering faculties would consider a minimum essential to any degree in civil engineering. As a civil engineer I certainly realize that a civil engineer still needs some surveying. But this is not the point. The cartographic sciences and civil engineering just are no longer the same thing,

and any attempt to keep them so only succeeds in providing a diluted version of both.

I recognize that at this stage the numbers of students and numbers of jobs will of course be small. Fortunately however most leading colleges and universities could draw upon existing courses for the non-technical phases of such a program and even for the basic mathematics and science work. Under these conditions it should be possible to develop independent curricula provided colleges are reasonably careful about unnecessary competition among themselves. This it seems to me is certainly something about which your societies should deeply concern themselves.

There is another phase of the problem which we must keep in mind. A good many sub-professional people are needed to keep one professional fully occupied with professional work. College enrollments are rising at a startling rate. They have already reached 2,500,000, and on the basis of children already born will go to 5,000,000 or more in the next ten or fifteen years. This is a distinct shift from college education for the few to college education for the many. If preliminary indications and our experience with the similar shift in high school education during the first quarter of this century mean anything, we shall see the growth during this period of many new curricula of less than four years, tailored specifically to meet the special needs of a much broader cross section of our society.

With our growing recognition of the need for balanced teams of professional men, technicians and skilled craftsmen, many if not most of these will undoubtedly be pointed toward the demand for technical, sub-professional personnel.

As our modern survey and mapping moves into full professional status, we too will have to give considerably more attention to the development of an adequate supply of such technicians, if we are to use our manpower to its fullest measure.

As we look ahead then it seems to me that the time has come to urge the creation of a limited number of special four year programs in what might be broadly termed geodetic science. The present offering at Ohio State University is an excellent example of this.

In addition we might well be fostering a somewhat larger number of two year terminal programs designed to provide the variety of technically trained people needed to round out the picture and provide the balanced team.

Furthermore in the light of the relatively limited employment opportunities which at present exist, these programs must be carefully planned and co-ordinated.

Individual colleges can be asked to prepare and administer curricula, but no single college can be called upon to undertake the co-ordinating function. Rather this is the responsibility of the professional societies.

Over the past 25 years you have fashioned a new profession but history is replete with skills which died with their creators. The future of this profession still rests with you. You must see to it that there are properly qualified young men to carry on what you have started.