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Congress of the United States
Washington, D.C. 20515

A Congressman and Photogrammetry

Work on the Armed Services Committee more meaningful because of study of subject.

FIRST I WANT TO thank you for asking me to be with you today. And I'm going to start off with a confession: I didn't even know what the word *photogrammetry* meant when you asked me to speak to you. The first thing I did—and I'm being very frank with you—was to look it up in the dictionary. The definition, even in the unabridged Webster, was very simple. But I didn't stop there. I started to assemble material and read on the subject whenever I could find the time. I found that the dictionary definition of *photogrammetry* bore about as much relationship to the whole subject as a clump of mesquite to the State of Texas.

I realize that I am standing before a group of highly trained, deeply disciplined, technical people; both a well-considered humility and an abundance of caution dictates that I not permit myself to become involved in a technical discussion, a discussion which would clearly be beyond my comprehension.

However, I want to tell all of you here today that I *do* know something that I'll bet no one else in the room knows—and it relates to photogrammetry. I know that at this moment I am standing and you are sitting at exactly

Latitude: 29 degrees, 25 minutes, 20 seconds;
Longitude: 98 degrees, 29 minutes, 12.4 seconds.

People in political life are often accused of vacillation and not knowing exactly where they stand. I think you will agree that this charge can not be made about this particular politician. I know exactly where I stand.

And if I know my human nature, someone in this room right now is doing some rapid mental calculation to prove that we aren't *exactly* where I say we are.

As I said, when you asked me to speak here I made a real effort to find out just what the subject of photogrammetry was all about. And I think I do have a fair understanding of it now. But I had the unfortunate experience of picking up for my very first piece of reading an article from the journal *Interavia*. And what did I read as almost the first thing? It was a discussion of a Fairchild Camera designated as the F-415F. And concerning this camera it said:

> "This compensation mechanism works with an accuracy of 1° throughout the entire scan range. In the autocycle mode, ½ to 5 cycles per second are possible, and according to the data input, the F-415F will work over a 10:1 V/H range (V=flight speed, H=altitude). The cycling rate necessary to maintain a 60 percent overlap is determined by the V/H ratio. The image motion compensation rate is also proportional to the V/H ratio and varies from 0.9 inches/second to 9 inches/second."

As I finished reading that paragraph I just about decided then and there to confine my speaking engagements in the future to the Texas Sheep and Wool Growers, where I would know what I was talking about.

But I didn't give up and I found very

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shortly that I was reading about a subject that not only is as interesting as any technical subject that I had ever read about, but that its functions and its implications are an integral part of every day life—even my own.

As a member of the Armed Services Committee, I have looked at literally hundreds of maps and photographs, many of them highly classified, but without any realization of what went into their making. In fact a very substantial part of our briefings and hearings deal with matters of which photogrammetry plays an extremely important part. I can recall, for example, that immediately before what became the Cuban crisis a highly secret meeting of the Armed Services Committee was called and Secretary of Defense McNamara appeared before us and provided irrefutable proof of the construction of intermediate range offensive missiles on the island of Cuba. I have noted with great interest that the new book—just published a short while ago by the famous journalist Authur Krock—describes in intimate detail many of the circumstances that led up to the final decision to face down the Soviets with respect to the missile installations in Cuba. He says that Secretary Rusk *and* Secretary McNamara both were for proceeding with very much greater caution than President Kennedy, and that it was the evidence of the clear and detailed photographs taken by our reconnaissance airplanes that made the final action that was taken as the only thing we could do. These were the same photographs that I mentioned as having been presented to the Armed Services Committee at a somewhat later date.

This incident brings to mind also President Kennedy's statement after the Bay of Pigs when he said:

> "All my life I've known better than to depend upon the experts, . . ."

He, of course, was not referring to the experts—people like you here today—who devise the means and the techniques that permitted these amazing photographs to be made—but rather to those who made the judgments that preceded the abortive undertaking that came to be known as the Bay of Pigs.

In reading about photogrammetry one of the first pieces of material that I came across was the brochure prepared by your Society and the very first page of it asks the question, "Have you ever wondered how maps of the moon are made? Or how an artificial satellite could possibly be used to map far away and inaccessible places? Or how one could possibly 'map the eye of a patient' to detect a tumor?" As I have said, these things simply hadn't occurred to me before, nor had I had any idea that the whole concept of photogrammetry goes back almost 250 years to the French scientists Capeller and Lambert—and from them to several other Frenchmen including a French Army Colonel who appears to be the creator of the first surveying camera and the compiler of the first photogrammetric map in 1859. From their start we now have something over half of the United States covered by modern topographic maps, a process that of course will continue until every part of the United States, however remote, can be the subject of detailed study by those charged with responsibility for planning roads, dams, forest conservation or any of the other multitudinous jobs that still remain for completion in the country.

And I have read about some of the forerunners of those who do our modern mapping such as John LaMountain who, while not engaged in mapping, did go up in a balloon during the Civil War at night and counted the tent lights of the Confederate forces in order to estimate their strength. I couldn't help but think that Mr. LaMountain was well named for the activity he was engaged in.

Biographical Sketch: O. Clark Fisher of San Angelo; born on a ranch in Kimble County, Texas; attended Texas and Baylor Universities, LLB from latter; served as County Attorney 1931–1935; State Representative 1935–1937; District Attorney 1937–1943 at San Angelo before election to 78th Congress, 21st District, in 1942; now serving 13th consecutive term. Seniority—he is 4th (1968) in Texas delegation of 23; ranks 25th in the House of Representatives (composed of 435). Committee—serves on House Armed Services Committee (composed of 37 members), ranks 4th from top; is Chairman of a subcommittee dealing with military installations and national defense. Family—married; has 1 daughter and 4 grandchildren. Hobbies—Indian lore and frontier history; is author of 3 books, all dealing with Texas frontier: It Occurred in Kimble," "The Texas Heritage of the Clarks and Fishers," "King Fisher;" and co-authored another, "Great Western Indian Fights."

I WAS INTRIGUED to find that as early as 1915 during the Meuse-Argonne offensive, pilots delivered 56,000 photographs to the U. S. Expeditionary Force within four days. And according to a statement of General Mitchell, both Allied and German reconnaissance efforts were so successful that from 1917 onwards, troop movements could take place only during the night.

In World War II between the Allied landing in northern France and the ultimate cease fire, reconnaissance pilots of the U. S. 9th Air Force produced 13 million photographs.

Needless to say, a lot of this is dangerous work. I don't know whether Mr. LaMountain survived his balloon ascensions but we all know that many pilots engaged in photography and mapping in World War I and in World War II lost their lives while engaged in this work. And there doesn't seem to be any really safe way to engage in some of it when we think of the most dramatic incident of all when the U-2 was shot down at somewhere around 70,000 feet in May, 1960 over central Russia with Gary Powers as the pilot.

Just a few months ago—in June I think—a matter came up before the Armed Services Committee that created quite a bit of controversy, and the controversy continued on to the Floor of the House of Representatives. The subject was the new CHEYENNE helicopter. Without going into detail about the whole matter I'll just say that the controversy centered around the very high cost of this helicopter. But all of the time that the discussion and argument was going on, I had no idea at all that among the functions that this radically different and very much faster helicopter would perform was one involving photogrammetry. This helicopter is heavily armed and can fly at a speed of over 200 knots. But very importantly—and apart from its fire power and its speed—the CHEYENNE incorporates a laser rangefinder, a doppler radar and an on-board computer. Assistant Secretary of the Army O'Neill who has charge of the research and development activities of the Army described on another occasion—that is to say, not before the Armed Services Committee—that the pilot during his orientation to the surrounding area uses a military map. He puts into his computer the coordinates of his target. The doppler radar guides them to the general target area. Here he illuminates the target with his laser rangefinder and obtains from his computer the map coordinates of that particular point. From that point on the pilot can either use his own armament to attack the target or can bring in artillery fire or other airplanes or take a number of actions designed to destroy the target. I mention this only because as Secretary O'Neill said, the "important ingredient to the CHEYENNE's effectiveness is the availability of accurate terrain information." This information, of course, has been obtained prior to the flight and is an absolute requirement for that pilot to do his job in an effective fashion. Indeed the effectiveness of the modern pilot in every kind of combat airplane would be literally *lost* without high-speed computers and visual-display systems. Virtually all of the intelligence that is gathered in Vietnam, for example, has as its most important original source the photography that can be performed in the air and then brought back to, or otherwise transmitted to, intelligence centers on the ground.

We all have read about the dramatic incidents in Vietnam today—and of course similar incidents occurred in World War II and in the Korean conflict—where it becomes necessary for an isolated and beleaguered U. S. force to call into their immediate area artillery fire or machine gun fire, bombs or napalm, from aircraft. Sometimes these weapons have to be brought to bear on points at a distance that is measured in yards—and not very many yards. This kind of action would be impossible if it were not for the precise intelligence that had already been obtained by aerial photomapping which indeed is continued to be done, and the principle used, right up to the time of the actual pressing of the cannon button in the airplane.

IN MY WORK WITH the Armed Services Committee, and indeed as a Member of the Central Intelligence Subcommittee, I am the recipient of a great deal of unusual—even exotic—information and I had thought that I had arrived at a position where it would be difficult to startle me on almost any scientific advance or capability.

But—and again referring to my reading on the subject of photogrammetry—I was truly startled to find that the U. S. Department of Agriculture can interpret the exact number of trays and boxes filled with cut grapes that are laid out on the ground in such way as to make forecasts on a daily basis on the number of grapes being cut, and thereby growers get to know how to adjust their ratios between raisins and wine. That is definitely something I never would have thought of as a function of aerial photogrammetry.

Closer to home I find that gas transmission lines are flown over by airplanes and color photographs are taken, and in this way gas leakages can be found in a matter of an hour or two that would otherwise take days or weeks and cost several times as much.

But perhaps the most startling thing of all that I read is something that is called an infrared thermal sensor which not only can detect something that is happening *now* but can take "pictures", so to speak, of something that has *already happened*. What I am referring to is an aerial photograph that was taken 27 hours after a convoy of tanks and trucks had passed a particular point. These leave their images behind wherever they pass or park. The sensors can detect differences in temperature down to as small as a few thousandths of a degree centigrade and up to more than a whole day later. This is getting into the area of pure magic so far as I am concerned.

I read, too, that the whole state of Vermont was photographed on a scale of one inch to 1,500 feet in ten days flying time with one camera mounted on a single-engine airplane. It took, as I say, only ten days as against several years if conventional ground survey methods had been used, and it would have cost 100 times as much to do the job using old-time methods.

So now as an informed, but still very amateur, *student* of photogrammetry I am aware of how to find gas leaks in transmission lines, how to tell how many grapes have been cut in miles and miles of vineyards, how to count wildlife such as ducks—to say nothing of the almost infinite variety of military functions that are performed—all the way from the discovery of the first German jet airplanes in World War II to the operation over Cuba that we are all still so familar with.

In my reading I ran across a reference somewhere that referred to photomapping as being a $100 million a year business in the United States. The reference must have been to what I will call *commercial* activities.

It would be extremely difficult to determine what the Department of Defense budget contains in it for matters related in one way or another to photogrammetry simply because literally hundreds of functions involve expenditure of funds for this purpose.

Also it is difficult to allocate funds within a given program in such fashion as to indicate that so much goes for photogrammetry, and so much goes for other activities that support the photogrammetry. Notwithstanding this difficulty, I think its importance to our national defense is somewhere revealed by the fact that the Air Force budget alone for this year contains $393 million, an increase of 45 percent over last year's program, to accelerate work on detection and surveillance systems.

Again, although it might be considered at first glance as somewhat remote from photogrammetry, the $600 million in the defense budget this year for the Manned Orbiting Laboratory will be spent for the purpose of developing means whereby we can see, understand and communicate *things* that will further our national defense. I personally do not find these programs remote from the work which you perform.

I realize that I have told you nothing new in this talk except perhaps exactly where you are which you didn't know before.

All in all I can say that I am truly grateful that you invited me to be with you here today because it has caused me to become informed on a subject that I really should have been informed about long ago. I can say in all honesty that my work on the Armed Services Committee will be considerably more meaningful because of the knowledge that I have gained over the past few weeks in my intermittent and amateurish study of the subject of photogrammetry.

And I might say this, too. Because no funds can be appropriated for the Department of Defense in the area of research and development, for example, until these funds have been authorized by the Armed Services Committee, I will pay a great deal more attention to those requests of the Department of Defense that involve this so-important activity of photogrammetry. Needless to say the knowledge that I have acquired has induced a sympathetic attitude toward these programs and therefore you might say that you have performed an important function through the process of developing my understanding of what this business is all about and the part it plays in our national defense effort.

I will close on this note: you all have heard the story of the American traveling in Ireland who found himself in the town of Wicklow. He wanted to get to Blarney Castle. He stopped an Irishman on the street and asked him how he would get to Blarney Castle. The Irishman responded, "Well, that's a good many miles away and you can't get there from here. You've got to start somewhere else." Although the Irishman undoubtedly didn't realize it, he seemed to feel that there was a question of geodesy involved here, that

is, the relationship of where he was at the moment and exactly where Blarney Castle was. I rather doubt that any of you here today will have any difficulty finding your way from here to wherever you are going when you leave here. But on the chance that you do have a problem of geodesy, I tell you again that this very building in which you are at the moment, the corner of Market and South Alamo Streets, is located at:

Latitude: 29 degrees, 25 minutes, 20 seconds;

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Book Review

Optical Fundamentals of Underwater Photography, by Gomer T. McNeil, President, Photogrammetry, Inc., 12230 Wilkins Ave., Rockville, Md. 20852. 9 by 11 inches, 115 typewritten pages, spiral bound, 64 illustrations, $5.00.

The purpose of the book is to serve as a manual of instruction in the optical fundamentals concerned with underwater photography. It also serves as an introduction to the use of underwater cameras and the taking of underwater photographs. The book will serve an important need in the rapidly growing science of underwater photography.

Underwater cameras are substantially different in geometry from aerial or terrestrial cameras. Aerial cameras normally function in an air environment in both the image and object spaces. An underwater camera, however, normally functions in two dissimilar environments, one in an object space of water and one in an image space of air. Thus the water camera requires a different optical and mechanical construction. In addition to this problem there are additional optical problems such as the absorption and scattering of light.

The book discusses, chapter by chapter, the problems of underwater optics, the effects of thin lenses, thick lenses, lenses used exclusively for underwater photography, flat optical windows, thick windows, and the wonderful dome windows that now provide a more simple approach to the design of water lenses in variable refractive fields. The panoramic camera, when combined with concentric spherical optical surfaces, opens an entirely new set of doors which have already produced substantial advances in the science of underwater optics. Calibration procedures and ranges are now required for underwater photography for the same reason that they are required for aerial mapping cameras—to insure a predictable accuracy of the final map.

The mathematics used in the book do not extend beyond algebra and trigonometry as the purpose of the book is to reach an audience that is concerned more with the problems having operational significance rather than those of optical design.

It is noteworthy that, although many different types of lenses have been designed for photographic use under standard atmospheric conditions, only a few lenses have been built exclusively for underwater photography. In some instances those that have been designed for standard use have been found to be applicable to underwater photography without any alteration; these latter lenses, however, have remarkable differences in characteristics from atmospheric photographic lenses. In designing such lenses the differences are examined theoretically and most of the conceivable types of such underwater lenses are systematically classified into groups which are organized among the chapter headings:

1. Introduction
2. Cardinal (nodal) Points
3. Thin Lens in Water
4. Thick Lens in Water
5. Object and Image Distances
6. Depth of Field
7. Flat Window
8. Dome Window
9. Lens Speed
10. Refractive Index of Water
11. Attenuation of Light
12. Panoramic (AquaScan) Camera
13. Camera Calibration
14. Definitions of Terms and Symbols
15. References

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This manual, authored by the 1965 President of the American Society of Photogrammetry, constitutes a valuable contribution to the science of underwater photogrammetry and the design of underwater cameras. It will serve a very useful function in training underwater photography specialists in a field of work in which advances in optical design in cameras have been achieved only with great difficulties. The book combines practical experience together with some of the most advanced ideas in camera design used in underwater exploration. It should serve to advance the skill of all underwater photographers. —*David Landen*