Heinz Gruner*
Bausch & Lomb
Rochester, N. Y. 14602

Down to Earth

Should we not divert some of our talents to the creation of apparatus which may lack joysticks and Mixie tubes but which the practitioner can afford?

Members of the American Society of Photogrammetry (ASP) have witnessed in oral presentations or have read in articles in Photogrammetric Engineering a number of statements concerning the present and future tasks of photogrammetry as a tool of surveying and mapping. In one of these publications (e.g., March 1935) an authoritative attempt was made to convey a picture of what future photogrammetric tools will consist of, which must meet requirements of increased production at high speeds and greater economy. The authors envisioned the creation of highly complex, highly costly, and highly efficient data systems capable of presenting results rapidly in a variety of forms and providing a wide range of services.

To the interested bystander these statements were quite exciting. They offered a forecast into the near future in which many building stones of our present map producing techniques will be completely changed. Entirely new generating methods and new types of maps will be the revolutionary results. they will require new organizations, large capital investments and a great diversification of trained personnel. But to the man of the surveying profession who uses photogrammetry as an integrated tool for his mapping business and who has to bear the responsibility to his customers and his employees to keep his organization solvent, these prospects may have a frightening perspective. Many privately operated mapping companies have made a high financial investment in proven photogrammetric equipment and are committed to meet the standards of accuracy and completeness of the map product that they deliver to their customers. What will their future base of operation and their chances for survival be when the time arrives in which, quoting from one of the authors, "our new society, the computer and his handmaiden—automation—will perform the drudgery and ultimately only those operations will be left over that require human judgment"?

Space age concepts of this sort are primarily supported by the activities of our great government users of Photogrammetry, our civilian and military agencies. If we visit their installations we have the impressive feeling that the space age has already become ubiquitous. We find that some of them are intensely concerned with mapping the moon using conventional as well as highly unconventional procedures.

The endless number of professional and fiction magazines and reports of the Jules Verne type by technical experts in the newspapers add to the imaginative powers of the

Heinz Gruner

* Presented at the Semi-Annual Convention of the American Society of Photogrammetry, Los Angeles, Calif., September 1966. Mr Gruner currently serves as President of the Society.

human mind. We are convincingly taught that there exists a compelling need to leave this planet and exploit the vastness of the universe, just as though this may be the only way out of our earthly dilemmas. Subsequently, within several decades, we shall have manned space stations, communications with the planets, have cities of 10,000 inhabitants on the moon, and speak the language of the Martians by the logic of computers. We may acquire the feeling that living in a vacuum and under permanent weightlessness may be desirable conditions under which life will be really exciting.

life support and recreational purposes. All these claims can quite certainly be verified by a technological bulldozer operation of which we are probably capable, but the average globe trotter may raise the timid question if there was not a simpler and more direct way to solve such problems more economically.

OUR EXHIBITS AT annual and semi-annual meetings brilliantly demonstrate the results of provocative research and design which result in hardware of increasing complexity, vulnerability, and price. The self-sufficient type of photogrammetric apparatus that could be fully understood and controlled by the owner and its operator seems to become forcefully set aside by equipment that depends more and more on a servicing industry quite foreign to the heritage of photogrammetric practice. Some of the sophisticated and least understood new systems may already be the forerunners of the predicted new p' otogrammetric society.

We seem to be faced here with a development similar to that of the automobile. Only 20 years ago the technically inclined driver stranded along the road could analyze the trouble and correct it. The complexity of today's cars requires optimistic drivers who can only hope in the emergency that some expert samaritan may come by and put new life in the dead body. In a continued trend of development of modern photogrammetric equipment it may become inevitable that the serviceman be accepted by the photogrammetrist as a permanent adjunct to the mapping crew.

We may ask these questions:

Will the new systems of the future make the present instrumentation of the private mapping industry obsolete?

ABSTRACT: *In concurrence with the technical theme "Time of Appraisal" chosen for the 1966 Semi-Annual Meeting in Los Angeles, a second look is taken at instrumental and methodical accomplishments of Photogrammetry in the field of map making. In the light of advanced technologies and the invasion of electronic components into the instrumentation, many questions are raised as to the validity of claims of new equipment and its impact on the mapping business, as to the benefits the photogrammetric practitioner derives from space age advances, and as to his role in the solution of real down-to-earth problems arising from ever increasing needs for better maps all around the globe.*

IT IS NOT THE purpose or intent of this panel to belittle the enormous achievements that science has accomplished and that some of our industries have put into hardware. We acknowledge the astounding progress in the sector of information acquisition, in data extraction and analytical treatment of these data. However, for many professionals in the field of photogrammetry, some of the claims attached to the new methods and instrumentation are hard to reconcile. Traditionally the surveying professional observes an honored code of ethics and sound practice inimical to exaggerations and speculations.

It is therefore not surprising that many a respected photogrammetrist has turned into a doubting Thomas on reading reports concerning the photographic and photogrammetric equipment developed and intended for use on orbital missions. Of such equipment it is claimed that the resolution of panoramic photography from an orbiting vehicle 200 km above the ea[illegible]urface contributes (among other far-fet[illegible] but realizable goals) to the identification or discrimination of crop types, to the determination of species compositions of forests, to the identification of diseased areas in crops and forests, to the charting of small rivers and lakes for irrigation, wild

Will new and enormously higher investments be necessary to keep this industry alive?

Will the higher investment be profitably compensated by a commensurate increase of production?

Will also the new face of the future map, which attempts to replace the presentation of the third dimension by some other mode of symbolism than contours, meet the specifications for accuracy and legibility, will their appearance and interpretability be acceptable to the public, to the engineering profession, to the legal authorities and to the map using public at large?

Before going into a few details, let me quote an internationally known authority for a collective answer to these questions. Professor W. Schermerhorn writes in his report of Commission II to the Lisbon Congress:

> The problem is, how far these two lines of developments (namely, (1) the replacement of the analog plotter by digital instruments, and (2) the replacement of the operator by electronic means) can and will replace the function of the classical analog plotter in the practical production of maps. Looking at what has been discussed at Commission IV: 'Mapping of the earth's surface', one gets the impression that so far normal civil map production limits itself to the use of the classical instruments. This impression is confirmed by the fact that in a few cases the delivery for new instruments goes up to almost three years which is an indication for the heavy demand of the classical types. Nevertheless this report will pay more attention to the developments in automation than is proportionate to their use in practical map production today. In other words, it is looking more along the highways where designers and hunters for the absolutely new are going than it is serving the practical Photogrammetrist responsible for either a Government or a private organization which wants to find out the most economic and efficient type of instrument to solve his daily problems.
>
> These people will find that there has been little change since the London Congress (1960). The instrument purchased after the Stockholm Congress (1956) can fortunately still be considered a justifiable choice even after the Lisbon Congress (1964). Also, as photogrammetrists have probably learned in Lisbon, that they need not be nervous about changes over the coming years which will not be so radical as to seriously affect the choice they must make today.

It should certainly be emphasized that the fabulous development of electronic devices has widened the field of photogrammetric applications and expedited its solutions by supplying auxiliary equipment and accessories. This essentially applies to the computational phases of the mapping procedure and particularly to the analytical treatment of control extension and aerotriangulation. The progress in this sector and the continuous efforts of a large contingent of mathematicians entitles us to the hope that some day in the future the many approaches to strip, block and other variations of triangulation by analytical means will be reduced to a reliable and readily accessible form for general consumption by the practitioners.

The much-acclaimed successes of automation of the mapping process (i.e., electronic image correlation as a means of automatically drawing contours) are of high significance to military operations under circumstances where peacetime standards of map accuracy and economical considerations are not applicable. The replacement of the human operator in the process of industrial map production still seems a wishful speculation nourished by somewhat unrealistic experiments. Unfortunately, that small portion of our globe which we call land is not as barren everywhere as the moon or the surface of the preferred test areas of Texas and Arizona. Also the defoliation measures over war torn jungles do not seem advisable over cultivated land to help the cause of automation. Nor is the atmosphere over the continents as absent, crystal clear and well becoming to spectral reflectance as here in smogfree California.

The concept of automatic contouring by electronic means deserves some special attention. One of the strongest arguments for stereoscopic perception of terrain features as a result of human eye and brain functions is the point by point fidelity in recording planimetry and altimetry, a process which is relatively little impaired by vegetation, ground slope and scantiness of surface detail.

Moreover, the design of a good map is not limited to graphical fixation of a mathematical model of the earth but it demands intelligent and receptive annotations by the expert topographer of the morphological features so essential to the interpretability of the finished product. In an overall appraisal of human visual capability versus electronic image correlation, which is by its nature an area sampling process based on conjugate imagery of two different perspective aspects and differing photographic properties, it appears obvious that the latter has serious limitations hard to overcome by future technical refinements.

We do have, however, some important developments in this field which promise economics in professional map production, i.e., the automatic transformation of the central perspective of an aerial photograph to an orthographic projection. This may and in some instances does eliminate the step of plotting planimetry in the accepted mapping process. As this transformation requires the knowledge of the topographic forms of the terrain imaged on the aerial photograph, several solutions suggest themselves which hopefully some day may take the shape of relatively simple accessories to existing plotting equipment.

Having mentioned previously the serviceman in the sense of an undesirable repair function in the mapping process, we should acknowledge, however, the significance of a type of service that stands ready to furnish to the mapping industry control data of diversified descriptions by electronic programming and utilizing the rapid and dependable performance of the electronic computer. Once certified computing centers exist in sufficient number and geographical distribution, they are inevitably destined to become of economic significance in the operation of the private mapping industry.

LET US TURN NOW to an important function of our own organization, ASP, which is responsible for the dissemination to its members of information of all phases of photogrammetric developments and applications and covering all fields where metrical photography contributes to the advancements of science, technology, and the human society at large. In so doing, our photogrammetric engineering journal has given more and more room lately to articles and materials related to the space age, and to very specialized fields remote from immediate earthly usefulness and remote from the needs of the majority of our members, who are practitioners with day-to-day and very much down-to-earth problems. Our Publications Committee and our Editor are very much concerned about criticism and opposition to glamorous articles which may satisfy scientific minds in their search for excitement and revelation, but do not encourage the minds of sober-thinking business men.

As a matter of fact, the strong influx from scientific disciplines not at all related to the basic sciences of geodesy, astronomy, perspective, and geometry, which are photogrammetry's heritage, is chopping at the roots of the laws of rigorous photogrammetry and gives cause to serious questions. Are we on the way to lose sight of our fundamentals, does the new technology permit us to replace the geometrical strength of solutions accepted in practice by approximations? (The ardent promotion of panoramic photography for metric purposes is a typical example of this trend.) Have the claims of higher resolution, greater speed of operation, without human guidance, higher accuracy, and reliability of new and revolutionary systems been substantiated by exhaustive tests similar to those that have been conducted on an international basis for world-wide accepted instrumentation? Does the practicing photogrammetrist receive some benefits from the tremendous amount of government-sponsored research essentially aimed at the nation's space efforts and essentially conducted by nonphotogrammetrists as far as metrical photography and evaluation is concerned? Based on this latter fact, should we conclude that our professional integrity has received only a low rating in space projects of national ambition and prestige?

If we turn for a statement to this effect to one of our recognized and internationally known authorities in our field we get the assurance that true expertness will indeed find a better solution than one inspired by imagination. We quote Professor Thompson in his review of the third Edition of the Photogrammetric Manual. Commenting on Chapter XXII, which deals with photogrammetry in the space age, he writes:

> We are at the moment studying the Ranger series of photographs with a view of obtaining metrical information. It struck me, as it has indeed struck other photogrammetrists, how very much more information we could obtain from these pictures if photogrammetric advice had been taken. . . . I hope it will with the remainder of the book persuade the spacecraft designers that we are people worth consulting.

A still stronger statement by Professor Thompson follows with an illustrative sample photograph from one of the Gemini flights which reads as follows:

> While I am thoroughly convinced of the value of space photography in lunar and planetary mapping, I find it difficult to understand how it can help us in the topographical mapping of the earth. On page 1086 there is a remarkable photograph of the Nile Delta, taken by astronaut McDevitt, that would have brought joy to *Ptolemy* some 2,000 years ago. What information does this give us that is not obtainable from any school atlas?

For the defense of Mr. McDevitt, we should admit that this picture is not intended for metric use. It belongs to the category of reconnaissance photography. But even as such it appears quite difficult and daring to use it for the detection, let us say of an unpolluted bathing beach along the coast line of the Bay of Abukir.

A GENERAL SURVEY of occurrences of this and similar cases provokes a number of further questions, answers to which may be given by some of the papers in support of this panel, as for instance: Should not an adequate amount of US defense and Space age dollars advantageously be spent to improve techniques and equipments for the general practitioner which would put him in a position to cope with the enormous tasks that the future has in store for him with higher speed and higher economy of his operations?

It is commonly known, that 80 per cent of the land area on the globe is still unsurveyed, that it will still take 10 years to complete the U. S. national mapping plan at the scale of one mile and one half mile to the inch, that only a small portion of the U. S. territory is covered by adequate larger scale maps, and that revisions of map sheet in many areas is overdue. Then there are the vast underwater areas along our shores, the continental shelves which are essentially bare of systematic topographic charting with exception of very small and scattered areas of high importance to navigation and to national de fense. We have come to the realization that the relatively shallow maritime areas are of instant importance strategically and soon will become the sources of supply for food and materials that will tangibly affect the economical structure of the country. These developments will perpetuate and steadily augment the demand for up to date maps of larger scales and information content.

After our advanced research has proven, that man can live in outer space and at the bottom of the sea, let us realize that it is getting tougher and tougher to make a living in peace and comfort in the area in between. Should not our domestic industries be encouraged and effectively aided to divert a part of their engineering talents and production capabilities to the creation of unsophisticated apparatus lacking the joysticks and Nixie tubes, but incorporating those features of merit that reliably enhance the economy of map production and that the practitioner can afford to buy?

SURELY THE PROBLEMS of our space age are extremly challenging. Their solutions exhibit ingenuity and mastery of the laws of nature. However, very many down-to-earth problems remain with us haunting us, and are of equal if not higher importance to the progress of mankind facing a steady expansion of the world's population and a pressing need for the development of our natural resources, all of which inevitably call for more and better maps. This requires a thorough knowledge of the world in which we live as earthbound individuals. The medium that conveys this knowledge is a good map. Its intelligent preparation entails a great many problems of similar importance as those of the space age.

Some of these problems have stayed with us through decades, have outsmarted our ingenuity, and are as corny and persistent as pigeons roosting on Los Angeles' Beethoven Statue in Pershing Square and the persistent starlings in the trees of Washington's Pennsylvania Avenue.