

AIR PHOTOGRAPHS*

*Commonwealth of Pennsylvania, Department of Commerce,
State Planning Board, February, 1944*

EDITOR'S NOTE: It is my opinion that the following material, taken from the Pennsylvania Planning Board's publication of 1944, is of sufficient interest to be worthy of reprinting in our journal. I am also of the opinion that every State Department of Commerce and every County and City Government, that is not already doing so, could make similar use of aerial photographs not only for post-war planning but for every day mapping problems. I would be very pleased to hear from any other State, County or City thus using aerial photography.

THE BIRD'S-EYE VIEW

AIR photography predates the invention of the airplane by many years. Long before the Wright Brothers made their historic hop at Kitty Hawk, cameras had been carried aloft on balloons and by the once famous tetrahedral kites of Alexander Graham Bell.

One of the first and most astonishing discoveries made when the use of air photography became wide-spread was the fact that many important features of our history and of our land use, which had never been detected with any ordinary methods of examination, were made instantly clear through the inspection of air photographs. In the Ohio Valley the sites of ancient Indian mounds and villages were visible from the air long after all traces of them had been obliterated by plowing and by forest growth. On the Carolina coast air photographs detected the record of what may have been a great world catastrophe of early times—the fall of a huge swarm of meteors whose craters are still visible when seen from high in the air.

Applied to more prosaic scenes and problems these photographs have led to other discoveries not so dramatic but of larger economic importance to the communities of Pennsylvania. Areas of land not recorded on any local assessor's books and even, in one important case in the West, a large tract without any recorded owner, have been detected through a comparison of air photographs with existing tax maps.

Some hint as to the immense variety of the physical features of our State may be gained from a series of Pennsylvania air photographs presented in this issue. While the interpretation of many of the characteristics of our landscape, as seen from above, is sometimes a matter which requires an expert eye, it will be evident, even from a casual glance at these pictures, that a new device is now in our hands giving important aid in dealing with the complex problems of our forests and streams, our agriculture, our industries, and our towns and cities.

AIR PHOTOGRAPHY IN WAR AND POST-WAR PLANNING

In 1937 a program for the aerial photography of the entire surface of Pennsylvania was urged by the State Planning Board. In 1939 the program was authorized and funds provided. This project was finally completed in June, 1941.

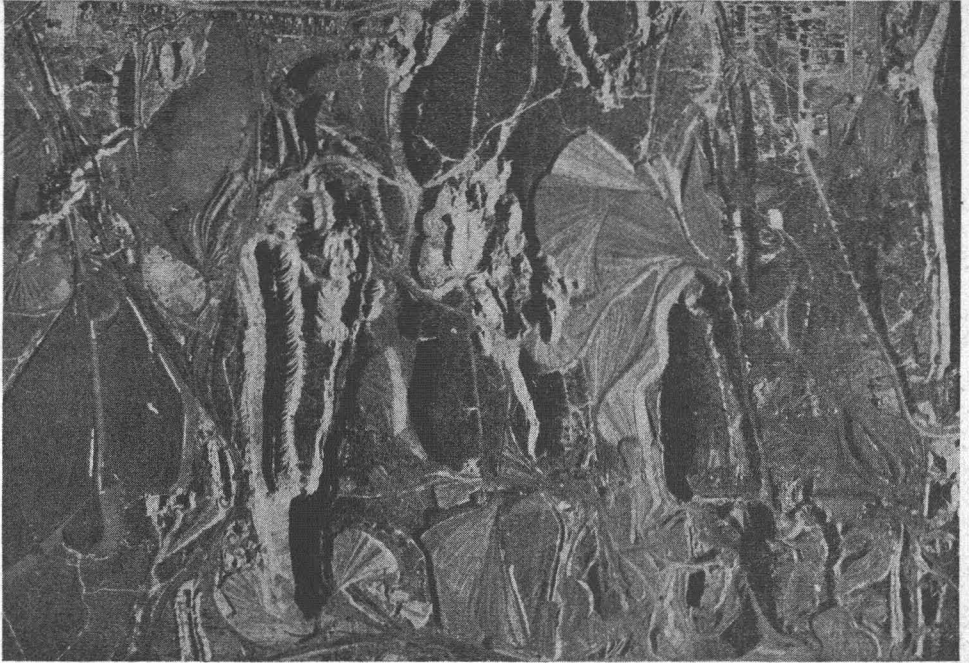
Six months later the United States was at war.

Throughout the past two years the existence of this complete file of air photographs has been an important means of expediting the location of war

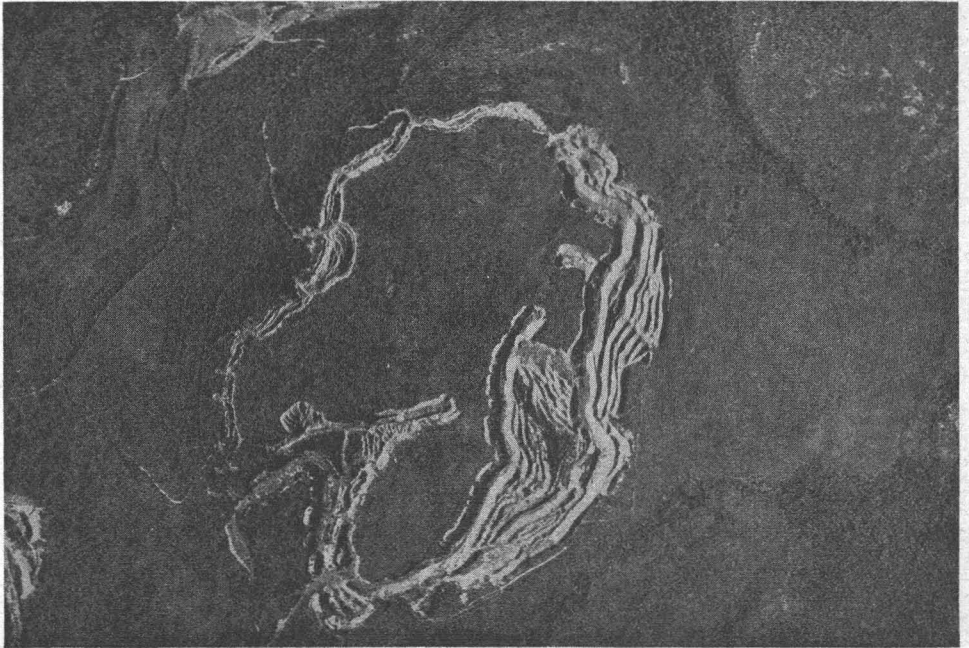
* Reprinted from "Pennsylvania Planning" Vol. 9, No. 3, February, 1944, by permission of the Executive Director, Pennsylvania Planning Board, Department of Commerce.



Gully erosion as seen from the air.



An anthracite coal mine creates this surrealist sculpture.



The earth worm pattern of a strip mine.



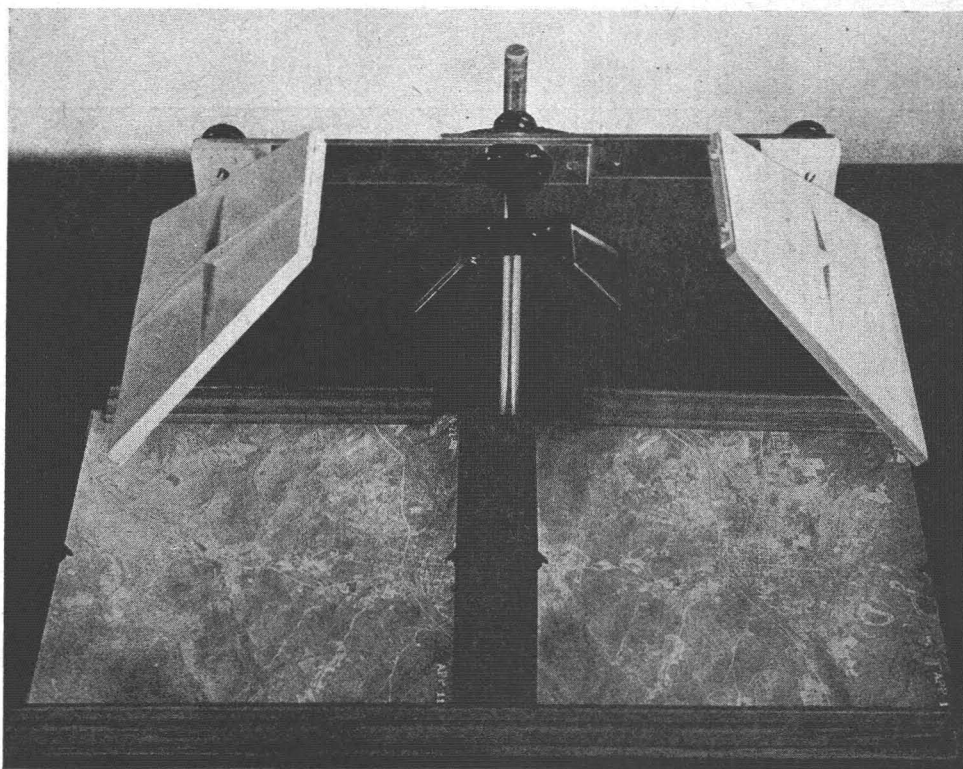
Patterns woven by orchard trees.



Contour plowing draws these strange symbols.



Deep valleys in Pennsylvania's wooded hills.



Mirror stereoscope for viewing air photographs.

plants. It has saved weeks and perhaps months of field work in determining areas best suited for various types of military installation and has enabled the Federal Government and our various local governing bodies, as well as our public utility companies, to lay out routes for highways, pipe lines, telephone and electric power wires, and extensions of railroad rights-of-way. Private industries in search of suitable locations for the manufacture of military supplies have found the air maps of our Commonwealth to be invaluable.

The State Highway Department has made extensive use of these photographs in connection with its highway planning program. Geologists have found them important in conducting preliminary field investigations. Owners of private forests have made use of them in laying out scientific cutting programs. Penal institutions have made use of the State's air maps to direct the search for escaped convicts. The United States Army has found them essential in planning military defenses.

In many of our State's communities directly affected by the growth of defense industry the use of air photographs has been of vital importance in planning needed public facilities and emergency housing, necessary for the war effort. Other towns and cities are finding the photographs in the form of mosaic maps, indispensable in zoning work and in making comprehensive plans. Allegheny County, faced with an immense war boom, has made use of air photographs in connection with vital land-use planning and allocation of public facilities.

Long range plans made in times of peace have thus resulted in our possession of this most valuable weapon of war. The lesson of that fact is plain and unmistakable. During these years of National war effort our preparations for the years of peace are no less urgent. The planning and zoning programs which have been made necessary, in many of our communities, by the problems of war will need to be extended to all our counties, boroughs, cities, and townships if we are to meet properly the challenge of a peace which may arrive just as suddenly and unexpectedly, and with just as serious and immediate problems, as those which confronted our Country and our State the day after December 7, 1941.

THE VALUE OF AIR PHOTOGRAPHS IN SOLVING CIVIC PROBLEMS

Many Pennsylvania communities have already made important use of the State's air photographs in laying the basis for their local post-war planning programs and in revising their tax assessment lists.

In Blair County a comprehensive classification of land use and values was recently completed by the School of Agriculture of Pennsylvania State College in which the County's air photographs were used as the basis for field investigation.

Crawford County has employed photographs in the preparation of a county zoning ordinance and in its county planning program, and has already discovered, through the checking of these photographs with tax maps, considerable areas of land not registered on assessors' lists.

The following letter from the Honorable Wesley G. Reitze, Chairman of the Crawford County Commissioners, explains the various aids and economies developed in that county through the use of air photographs. Because of its general interest to all civic officials the letter is presented in full:

COMMISSIONER'S OFFICE

Crawford County
Meadville, Pennsylvania

November 30, 1942.

Mr. F. A. Pitkin,
Executive Director,
State Planning Board,
Harrisburg, Pa.

Dear Sir:

I take this opportunity to say that the air photographs of Crawford County which were purchased recently through your office are proving to be of inestimable value to the county in many different ways. I have no hesitation in saying that although we have had them less than two months they have already produced enough revenue and saved enough time for the county to more than pay their cost.

We use air photographs in the management and sale of properties acquired by the county at tax sales. We find that they aid greatly in determining values. In many instances more information can be gotten, and better judgments formed, from an hour's study of an air photograph than from a day's inspection on the ground. They show the different kinds of uses—cultivated, pasture, timber, waste, etc., in their true sizes and shapes, and in proper relation to each other and to other properties in the vicinity. We have already been able, on one or two occasions, to secure higher prices for property sold than the original bids which we might have been inclined to accept if we had not had the information obtained from air photographs to enable us to bargain intelligently.

We find the air photographs useful in correcting errors in assessment, particularly in the matter of acreage. There are probably more errors in the descriptions and acreages of county owned land than of other properties, due to carelessness in copying. Air photographs furnish a quick and inexpensive means of discovering and correcting errors, which otherwise might not be detected, or might require a field survey.

In the use of air photographs in connection with the management and sale of county owned lands, we have already discovered several properties which were not assessed. Ordinarily these omissions are not disclosed by the records, but they are brought to light by the air photographs. We see to it that these lost properties will appear in next year's and subsequent assessment rolls.

Our main object in acquiring the air photographs was to use them in making a complete set of tax and assessment maps of the entire county. They have already proven their worth in that use. A large percentage of the properties are described in the deed only by bounds and acreage. The lines and corners of nearly any property can be identified from landmarks which show on the air photographs by a person familiar with the place, and the lines and angles can then be scaled and the acreage computed quickly. More information about property lines can be obtained from air photographs in half a day than can be gotten in a week by a surveying party.

There are deficiencies in many of the property descriptions which are given by courses and distances. The figures that are lacking can be obtained almost instantly, and with certainty, from an air photograph; whereas any other method of supplying deficiencies takes much time and (except in the case of a field survey) has the element of uncertainty.

Air photographs have other advantages in assessment work. Where different uses are assessed at different rates, the acreage of each kind can be obtained accurately and quickly from an air photograph, which is an improvement over the guesswork of past assessments. Another advantage is the fact that with the use of air maps all the acreage can be accounted for. It is a known fact that there is hardly a farm in the county, except those which have been surveyed recently, that does not contain more land, ranging from six to twenty per cent, than the old deeds call for. If for no other reason, the air photographs will justify their use by accounting for this surplus.

However, it is the opinion of the county authorities that the air photographs will not only pay for themselves, but will pay the entire cost of making the tax and assessment maps and setting up the new assessment system, by enabling them to detect and get back onto the assessment rolls the properties that the present time are not being assessed at all. A reasonable estimate, based on the experience inaugurated in the county, and on our experience in the handling of properties acquired at tax sales, and our past two months' experience with the air photographs, is that we will discover at least 2000 properties that are not paying taxes at the present time (as compared with 25,000 which are assessed). It is not necessary to discuss here the reason why they are omitted and have been for years. The exact number, location, nature and extent of these omissions will eventually be disclosed by the air maps.

It is reasonable to assume that when these lost and omitted properties are back on the rolls, the assessed valuation of the county will be increased by a sizable percentage, all of which can be credited to the air maps.

It might not be out of place to state that the only other method of accounting for all the

property in the county known to this writer is by a county-wide property line survey. He has repeatedly stated that such survey could not be done for less than \$100,000, and probably would cost much more. Results, better in many respects, are being secured in Crawford County for less than one-twentieth of that amount by the use of air photographs.

Crawford County is at present concerned with the preparation of a Road Docket Index, in which it is proposed to show the location of every road which has ever been petitioned for, approved, disapproved, located, relocated or abandoned. Anyone who has ever tried to locate old roads from record descriptions, many of which refer to landmarks long since obliterated, realizes the difficulties involved unless some key is found. We have already found a number of instances where roads which have been vacated for many years show up plainly on the air photographs, even when they cannot be seen on the ground.

Crawford County found the air photographs invaluable in the preparation of maps for the County Zoning Ordinance. The skeleton maps were traced directly from the air photographs. In making field surveys for the "existing use" maps and the list of non-conforming uses, the air photographs were taken out into the field, and all the essential information marked on them and then traced on the proper map. This method made it unnecessary to take measurements in the field, or to spend any great amount of time in plotting in the office. The air photographs also made it possible to determine the location, nature and extent of the various classes of zones more scientifically and quicker and cheaper than could be done on the ground. It is hardly necessary to say that all our future planning and zoning will be based on air photographs. Our experience indicates that only by their use can the work be done properly and scientifically and at a feasible cost.

We do not believe that we have exhausted all the possibilities of the air maps. We will undoubtedly find future uses for them in ways that we have not thought of up to the present time.

In conclusion, we take this occasion to suggest that every county in the State should have a set of air photographs. They will prove to be the best investment a county could make.

You may use all or any part of this letter in any way that you see fit. We hope that it may be instrumental in inducing other counties to take advantage of the manifold opportunities afforded by air photographs.

Very truly yours,
CRAWFORD COUNTY COMMISSIONERS,
Wesley G. Reitze, Chairman.

Several municipalities recently adopting zoning ordinances, such as Lancaster and Manheim Townships, have found the use of the State's air photographs invaluable in the preparation of their general development plans and zoning ordinances, while the City of Erie, and also Bradford County are considering the use of these maps for correcting their real estate assessment tax lists.

While purchase of air photographs at this time is dependent upon the consent of the Army Intelligence Office, and the need for such photographs in the prosecution of the war effort must be proved, every Pennsylvania borough, city, township or county might well determine on the purchase of a complete set of air photographs as the first items in its post-war planning program.* In most instances there will be no difficulty in obtaining "Army" consent for release of photographs, at least for local official use.

The cost of air photographs is best illustrated by a concrete example. Crawford County, which has an area of 1016 square miles is covered by 741 photographs. The location of these prints are shown on 17 photo index sheets. The contact prints, which are seven inches by nine inches are at a scale of one inch equals 1667 feet. The prints overlap sufficiently for use with a stereoscope. Contact prints and photo index sheets for an area equal to that of Crawford County would cost approximately \$125. These prints are not recommended for county planning or tax assessment purposes as the scale is comparatively small.

The more intensive the study to be made of an area, the more important it becomes to use enlargements of a scale adequate to show all necessary detail. On page 185 is illustrated a small section of a contact print and an enlargement of

* Information concerning the cost and number of prints required for any area in Pennsylvania can be obtained by writing to the Executive Director of the State Planning Board.

the same area. In such enlargements, individual houses and even smaller structures are readily discernible and comparative street and road widths may be determined with a fair degree of accuracy.

The cost of enlargements of 370 alternate prints, giving full non-stereoscopic coverage, and the necessary photo index sheets for an area approximating that of Crawford County at various scales is as follows:

1 inch equals 1,000 feet	\$179.25
1 inch equals 800 feet	179.25
1 inch equals 600 feet	253.25
1 inch equals 500 feet	475.25
1 inch equals 400 feet	752.75

PRACTICAL USES FOR AIR PHOTOGRAPHS

The cuts on pages 185-188 illustrate certain applications of air photographs to municipal planning and tax assessment.

In cut A, page 185, is shown an enlarged photograph of an area of approximately one-third of a square mile on the outskirts of a small Pennsylvania city. At the lower left-hand corner of page 185 is shown the same area as it appears on the original contact print. From the enlargement, and by the use of information available from the office of the city, borough, or township engineer, there may be traced a street map of any desired locality adequate for planning, zoning, or tax assessment purposes. Such a traced map is illustrated in cut B, page 186.

On such a map may be recorded most of the facts as to dwelling types, and as to business, industrial or institutional use of land necessary for the preparation of a zoning map and ordinance, and much additional information important to the preparation of community development plans or of a local planning program.

As may be seen in illustration A, this particular area presents a difficult traffic problem due to the turns and bottlenecks on its approach along a main highway. Moreover, all east bound traffic is forced to proceed through the congested business section of the town.

How such a condition may be dealt with in a preliminary local plan is illustrated in cut C where a new main highway layout is suggested and there is indicated, in addition, the possible conversion of an unused area along a small stream into a public park and recreation center. In making such preliminary highway plans the air photographs are particularly valuable in revealing obstacles, such as buildings and intensive land uses, and in thus enabling the selection of the most suitable and most economic locations.

In cut D, page 188, is illustrated the possibility of the discovery of land areas not entered on tax assessment books through the plotting on such air photographs of assessed areas from local tax maps or records. In the absence of tax maps, the use of the air photographs can be extended to the economical preparation of such record maps, by identification of property lines directly on the photographs. This method of making tax maps is particularly applicable to rural and relatively low-value areas. It is largely in the process of making such maps that one discovers the "lost" parcels and "lost" acreages.

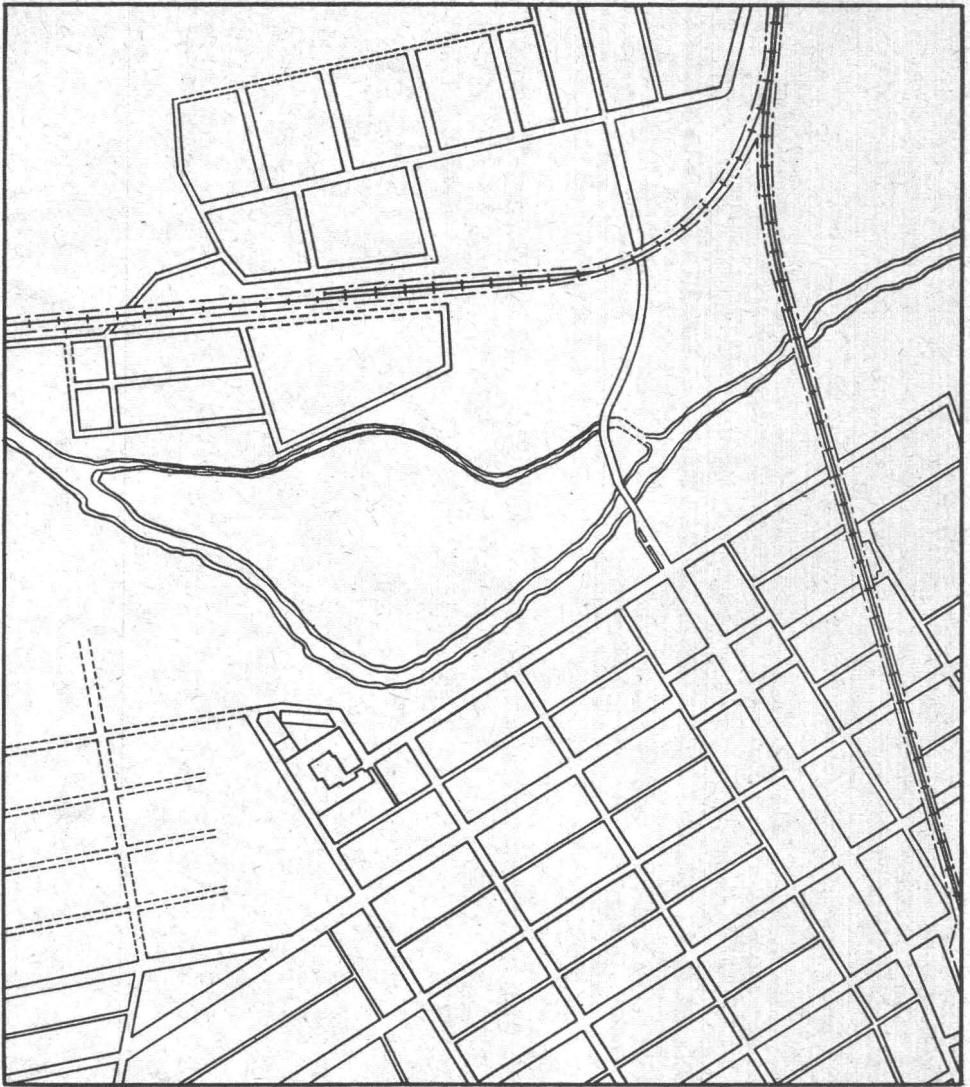
Since air photographs are taken at intervals as the plane flies over a landscape the resulting prints when viewed in a stereoscope show an exaggerated relief which sharply reveals all changes of contour. This fact is of great importance in both urban and rural planning and zoning and in determining suitable industrial locations. A simple stereoscope for such use is shown on page 180.



A



Enlargement above, from section of standard contact air photograph (shown at left), yields detail adequate for mapping and planning.



B

Map (traced from enlargement on preceding page) may be used as a base for planning and zoning programs.

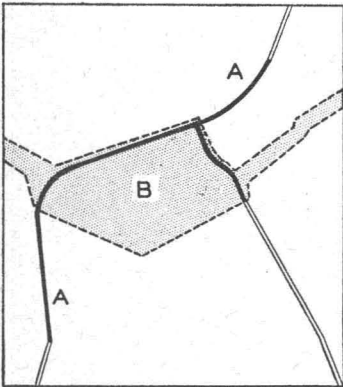
More elaborate stereoscopes have been developed for the tracing of contour lines and the determination of elevations directly from air maps. By their use the preparation of topographic maps has been greatly speeded and simplified.

The development of many precision devices by which photographic distortions are rectified and all photographs reduced to an identical scale now makes possible the preparation of very exact tax and planning maps where property values justify the cost.

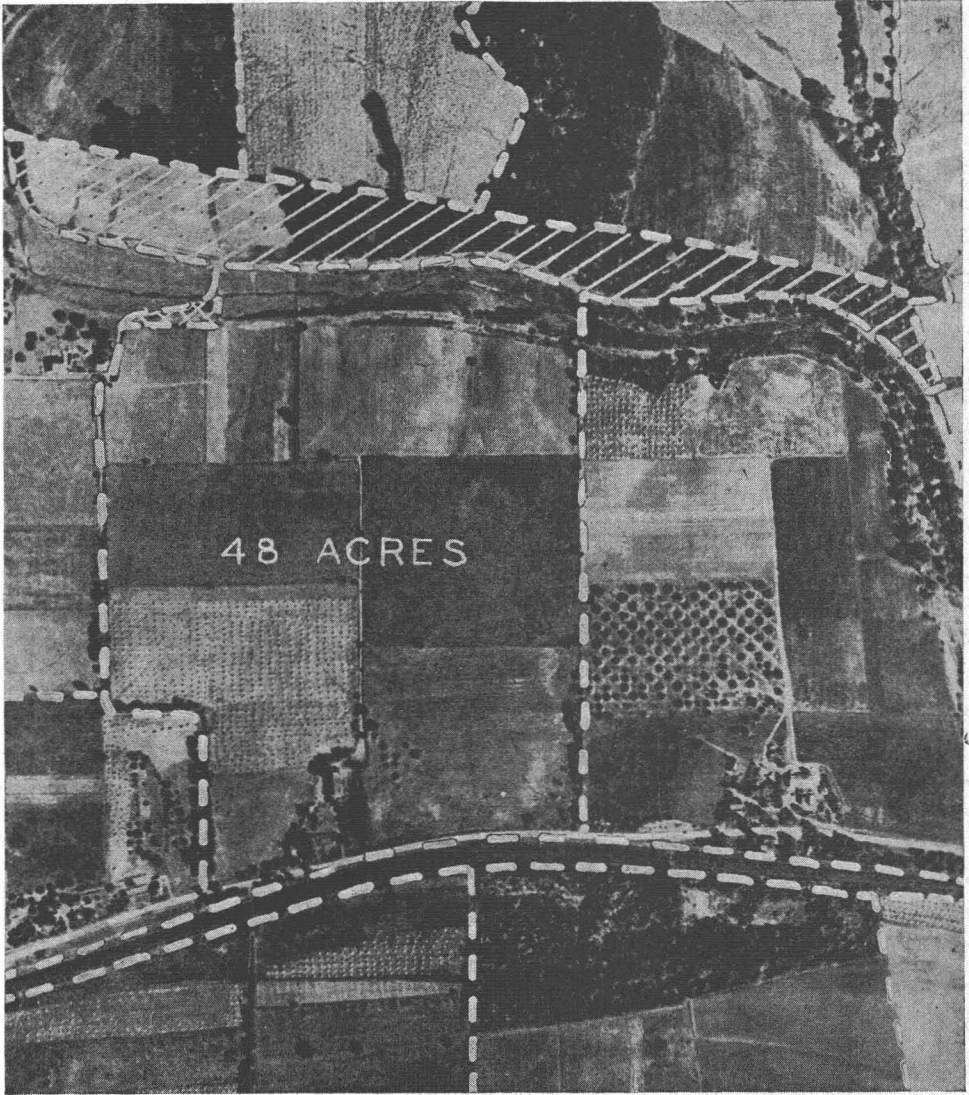
Further information in regard to the application of air photographs to local planning problems will be found in the concluding article in this issue.



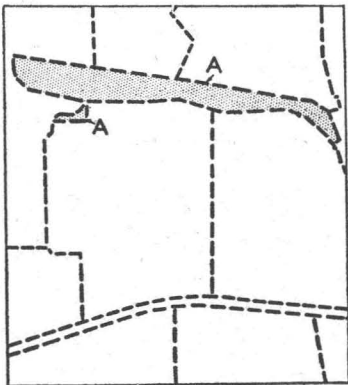
C



- A—Proposed highway realignment to avoid traffic bottleneck is drawn directly on enlargement.
- B—Suggested park and recreation area.



D



A, A—Areas which have escaped taxation are revealed to the assessor through the drawing of property boundaries on this air photograph.

AIR MAPS AND PHOTOGRAPHS IN CITY, COUNTY AND REGIONAL PLANNING

(Written for the Pennsylvania State Planning Board Bulletin on use of Aerial Photographs, by Russell V. N. Black, Consultant.)

Air photographs are among the most valuable of all planning tools. Such photographs are particularly effective when pieced together to form continuous maps or mosaics of the areas under study, but even individual photographs enlarged to an appropriate scale can be used to advantage.

Making a city or county map by field survey is a costly and lengthy process. At scales of from one inch equals 400 feet to one inch equals 1000 feet, it is entirely practicable to prepare maps sufficiently accurate for most general planning purposes, by direct tracings from good mosaics. (Individual photographs can be used for this purpose but only with greater difficulty and with greater likelihood of error.) The mosaic, when expertly made, can be brought to any reasonable degree of accuracy by reference to known dimensions on the ground. The process is fast and relatively inexpensive, especially in districts for which the initial photographic work has been recently done, as is now the case for most parts of the country.

The air photograph, of course, shows only physically existing objects. In making maps from photographs it will be necessary to go to other maps or records for such data as the widths of street and road rights-of-way, property lines, the location of mapped but non-existent streets. Whether for use in making a new map or in supplementing existing maps, it will be found necessary or advantageous to have the mosaic photographs at the same scale as that of the map or maps upon which the planning studies are to be made and presented. For convenience it is sometimes desirable to have two or more such mosaics, or sets of photographs, at different scales, corresponding to the scale of other maps in use.

The utility of air photographs in planning ranges beyond making ordinary base maps as described above. They can also be used as a basis for quick small-scale reconnaissance surveys of large areas, or even for the construction of large-scale topographic maps. The latter are made by use of a special stereoscopic machine coupled with ground surveys, and may be sufficiently accurate and detailed for use in making construction and site plans for individual projects like housing developments and sewerage systems.

MAKING EXISTING-USE SURVEYS AND MAPS

Whether plotting the course of a new highway, determining the boundaries of a new park, or deciding the appropriate nature and extent of a zoning district, a first essential is intimate knowledge of the existing use and character of the land—the location of forests, streams, lakes, and railroads; and the location and distribution of houses, factories, and other buildings. The skilled can read all these and many other useful facts directly from the air photograph. Objects not directly identifiable and the finer definition of land and building types and uses may be covered by systematic checking in the field.

Not the least value of air photographs in planning is in what they show of things in the interiors of blocks and large properties—things not ordinarily shown on maps and not visible from the street or road. Such information, often important to planning decisions, can be obtained otherwise only by tedious and costly mapping or by time-taking trips into the field.

Essential to intelligent zoning is the so-called "existing-use" map, ordinarily made by field survey. Air photographs supply more than nine-tenths of the information needed to make the existing-use map. All that is needed to supple-

ment them is closer identification of special building types and uses like two-family and multiple-family dwellings, the various classes of business and industry, and public and semi-public buildings and lands. Such identifications can be made by taking prints of the photographs or mosaic into the field and making the necessary notations upon them. Finally, the record existing-use map can be made by transferring information from the aerial map to a line map. Or a print of the air map itself may be developed as the existing-use map by use of color and symbols to identify the buildings and uses of special significance in zoning.

USE OF AIR PHOTOGRAPHS IN PLAN MAKING

Following its initial services in base-map making and in portraying the location and use of land and buildings, the air map (or photographs) becomes an important frame of reference in projecting plans and improvements. Along with topographic maps and other maps and records, usually available, it supplies a sufficient body of physical information, in the office, for projection of general layout plans without need for numerous trips into the field. Even minor obstacles like trees and, often-times, property lines can be identified in the aerial picture, facilitating the economical and practicable location of objects like new streets and roads.

The air photograph likewise tells a story of land character, useful in selecting sites for things like parks, schools, large scale housing developments, and airports. For, in the photograph, it is usually possible to distinguish active farm lands from abandoned lands; crop land from pasture; good forest from scrub; and high well-drained lands from low lands and swamp. Such information enables the planner quickly to narrow down the field of possibilities to such an extent that final site selections can be made with little loss of time.

Naturally the larger the area being planned and the greater the lack of other maps and information the more useful becomes the air photograph and its various by-products. But seldom is there a circumstance in land planning where photographs will not enable the planner to do a better, faster, and more economical job. The utility of air photographs in planning is greatly increased when they are available as mosaics, permitting study of whole large areas without the confusions and interruptions involved in having to work through a batch of oddly-matched individual photographs.

USE OF AIR PHOTOGRAPHS IN PLAN PRESENTATION

If plans are to be carried out, they must be understood and accepted by people not well accustomed to reading ordinary maps. The location of many kinds of planned projects can be shown directly on air maps or photographs in relation to objects and land marks that can be identified both on the ground and in the picture. Thus, by way of illustration, it is possible, by plotting the location of a new highway on an air map, to show an interested property owner exactly where the proposed road is to go in relation to some familiar object like a tree or a line fence.

USE OF AIR PHOTOGRAPHS AS PERIODIC RECORD OF CHANGE AND TRENDS

The value of periodic censuses of population and of business and industry in appraising conditions and estimating long-range social and economic trends has long been accepted. It seems likely that the same kind of periodic record of changes in the use and character of land would also be of large cumulative value in long-range planning. Such a record could be made available by periodic air mapping.