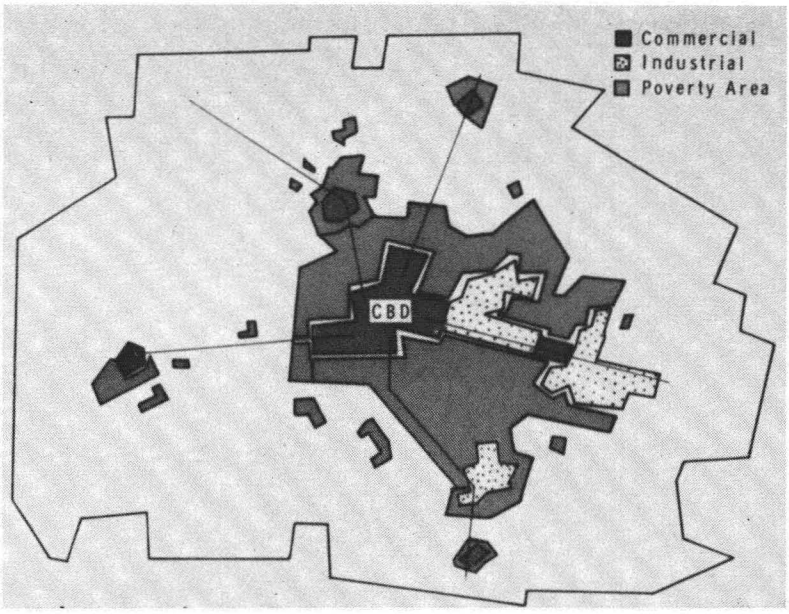

FRONTISPIECE. Urban ecological structure. (See text page 602.)

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Urban Poverty Study

Aerial photographs facilitate the analysis of a variety of socio-economic aspects of a city.

INTRODUCTION

RECENTLY THE INTERPRETATION OF aerial photography has been utilized as a technique for obtaining socio-economic and demographic information about those residential areas of the urban environment in which families and individuals live who are experiencing poverty. This investigation was performed for the Information Center of the Office of Economic Opportunity (OEO) by IBM as one of a series of studies to assist in determining how best to obtain and maintain such information on an up-to-date basis.

The study was performed within the context of the increasing use of aerial photography as a means of obtaining information for use by government and private organizations concerned with the management and administration of a variety of natural and cultural resources.

The results of the investigation indicate that aerial photography can be utilized to:

- Delimit urban residential areas that exhibit poverty characteristics in a more precise manner than urban studies based on census data alone.
- Provide both quantitative and qualitative

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descriptions of these areas either from the photography alone or in conjunction with sample ground surveys.
- Identify physical changes to areas of the city to initiate the deletion or collection of information pertaining to that area.

ABSTRACT: *Aerial photography and its interpretation comprise a technique for obtaining socio-economic and demographic information relative to urban environment. This study, performed for the Office of Economic Opportunity by International Business Machines Corporation, was concerned with finding possible new techniques for maintaining more current information about the disadvantaged segment of our population. Nine cities in the United States and Puerto Rico were interpreted and residential areas that exhibited characteristics associated with poverty were demarcated. Quantitative and qualitative descriptions of these areas were then made in terms of the time the photographs were taken and the changes occuring over time through the use of repetitive photographic coverage.*

- Support the analysis of proposed action programs by portraying the spatial relationships of these residential areas to other functions of the city (e.g., recreation, schools, transportation, industry).

This paper discusses present methods for obtaining this type of information, previous uses of photography in similar studies, the technical approach selected for this investigation and the results obtained.

CURRENT METHOD

Detailed socio-economic and demographic information is obtained in the decennial census by the Bureau of the Census, Department of Commerce. This information is collected on the basis of census tracts and, in over 200 metropolitan areas, is supplemented by detailed housing information at the city block level. Between each major census selected portions of this information is updated based on sample nationwide surveys which indicate changes at the major urban and state level.

For the decennial census each major metropolitan area (designated as a Standard Metropolitan Statistical Area—SMSA) is divided into tracts designed to facilitate data collection and subsequent statistical manipulation. Where possible each tract is designated so as to incorporate similar land use and to have its boundaries selected to facilitate visual identification by the enumerator in addition to be capable of remaining fixed over several decades. Figure 1 illustrates the census tract and city block technique as applied to an SMSA.

USE AND NEED FOR A BETTER METHOD

The anti-poverty programs being administered by the OEO required socio-economic data to the level of the decennial census but at more frequent intervals. Typical information needs included: Population, income, educational achievement, number of persons per household, un-employment, occupation, mobility, rent or house value and housing condition.

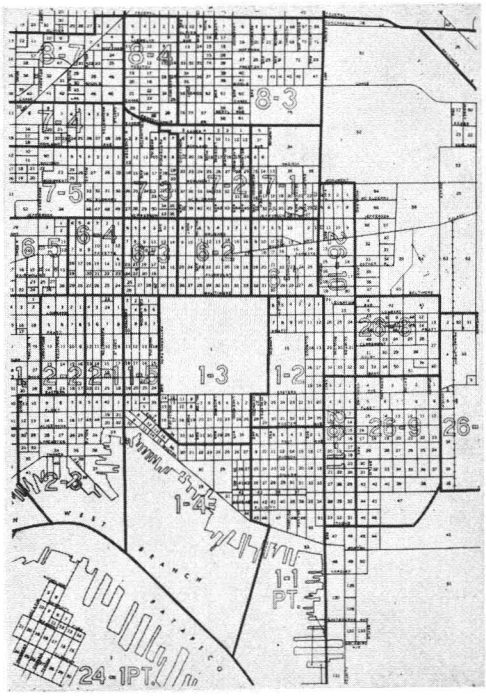

FIG. 1. Standard Metropolitan Statistical Area (SMSA) census tract and city block.

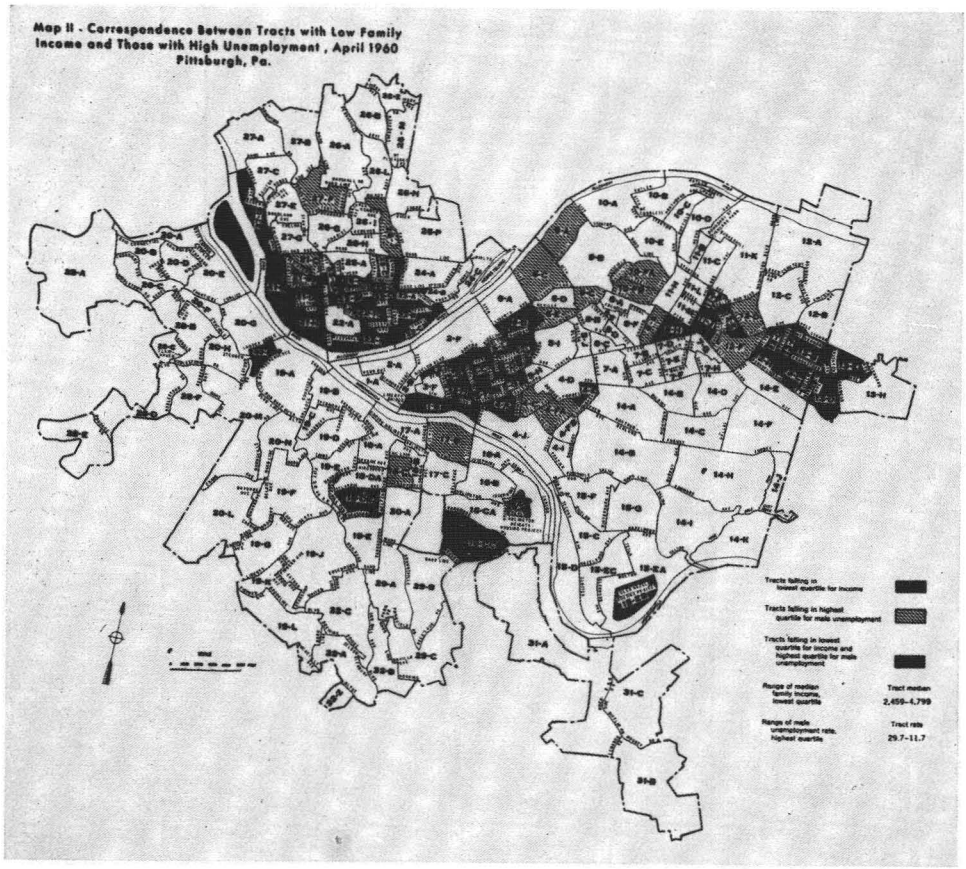

FIG. 2. Example census correlation.

One method of analyzing the metropolitan area used by many agencies and researchers has been to rank the census tracts of the area by selected characteristics and then supplement this data with a graphic portrayal such as 'lowest quartile for income'. Since the census data is in computer format, these calculations and correlations can be quickly performed. Figure 2 is an example of such a correlation performed by the Department of Labor correlating low income and unemployment in Pittsburgh as it existed in 1960.

A series of such computer correlations were made at OEO in 1965 to support their programs. However three questions arose:

- ★ How could this information be made more current both quickly and economically?
- ★ Could a more precise portrayal of the *poverty* areas be made without having to resort to an arbitrary census tract ranking?
- ★ Could the *poverty* areas be portrayed within the context of the other elements of the city structure?

URBAN STRUCTURE AND USE OF PHOTOGRAPHY

Geographers, sociologists and others concerned with the urban environment have over the past several decades noted and studied the growing tendency of cities to fractionate into homogenous areas with similiar social and economic characteristics. These areas differ in composition by factors such as social class, income, occupation and ethnic groups. Also noted has been the tendency of the lower income and disadvantaged urban population to concentrate in older and less desirable residential neighborhoods of the city. As the number of such studies grew researchers began to correlate other aspects of the city such as location of the central business districts (CBD), industrial and commercial areas, major transportation arteries, transitional land use areas and distance of the residential area from the CBD. The Frontispiece diagrams this ecological structure with emphasis

TABLE 1. URBAN AREAS ANALYZED FOR PROJECT

City	State	Photography			Population	% in Poverty
		Source	Date	Scale		
Huntington	West Virginia	Agric.	59	1:20	22,000	23.8
Gadsden	Alabama	Agric.	63	1:20	58,000	28.3
Wilkes-Barre	Pennsylvania	Agric.	59	1:20	95,600	23.8
Reading	Pennsylvania	Agric.	64	1:20	98,000	17.9
Jacksonville	Florida	Agric.	60	1:20	201,000	30.8
		USCGS	62	1:10		
		NRTSC	65	1:10		
Columbus	Ohio	Agric.	64	1:20	473,000	16.0
		NRTSC	64	various		
Buffalo	New York	Agric.	59	1:20	532,000	17.3
San Juan	Puerto Rico	USCGS	64	1:10–30	588,000	59.0
Baltimore	Maryland	NRTSC	48	1:10		18.6
		Agric.	57	1:20		
		NRTSC	59	1:18	939,000	
		Agric.	64	1:20		

on the residences of the disadvantaged population.

References to the use of aerial photography in the study of urban areas go back to 1923, however significant application of aerial photography in this field did not occur until after World War II. Although this photography found many uses by city engineers, it did not appear to be used by geographers and sociologists for much more than an up-to-date detailed map to facilitate data collection for various studies.

In 1955, however, a pioneering study was made by Norman E. Green in which he used aerial photography as a prime source of information in the analysis of the social and economic structure of Birmingham, Alabama. Later, with Robert B. Monier, these studies were extended to include seven additional cities to verify the original work. Their work, in addition to delineating residential areas (based on single and multi-family dwellings) and computing estimates of population and housing density, also noted the relationship of *primarily industrial* land use to the degree of social disorganization, crowding in dwelling units and lower skilled occupations.

APPROACH SELECTED

Based on the above study and a scattering of others reported in the literature it was decided to investigate, on a pilot project basis, the use of photography to obtain socio-economic information on poverty in urban areas. The following criteria were used as a basis for the selection of photography.

- Provide a representative cross-section of urban areas based on population size, regions and presence or absence of other OEO projects.
- Determine best photo coverage and source by using a range of scales, panchromatic and color film and a variety of sources.
- Allow for the analysis of the photography to examine ability to extract data from the photography alone; to correlate with census data and to facilitate update of census information.

Photography was obtained from the Department of Agriculture, U. S. Coast and Geodetic Survey, and U. S. Navy in both color and panchromatic with a scale range of 1:8,000 to 1:30,000. Eighteen cities were selected from the area east of the Mississippi. After preliminary interpretation of the photography was performed, nine cities were analyzed to varying degrees of detail to accomplish project objectives. Table 1 lists these cities. To facilitate the population, density and dwelling unit computations made for the poverty areas a dot matrix method was utilized. This method uses a sampling technique based on the super-imposition of a grid matrix containing precisely spaced dots over the photographic area being measured. A hit occurs when 50 percent or more of a dot impinges on a structure (in this case residential).

ANALYSIS AND RESULTS OBTAINED

The approach used and results obtained are discussed here relative to four of the cities.

¶ Jacksonville, Florida—Using 1:10,000 photography taken in 1965 a detailed land use analysis of the city was made. Residential

FIG. 3. Poverty Area B in Jacksonville, Florida.

areas in close proximity to the CBD, industry, major transportation arteries, and areas in transition were then re-interpreted for physical clues to ascertain dwellings and city blocks that housed the disadvantaged people. In this city these areas were characterized by mostly single-story, moderately-dense housing. Dirt streets, lack of grass and litter on the ground was also used as clue. Lack of automobile parking spaces at apartments correlated with public housing projects (as it did in other cities). Figure 3 is an annotated picture of one portion of the poverty area whereas Figure 4 depicts many of the poverty areas of the city irrespective of census tract boundaries. Table 2 illustrates the close correlation achieved, based on population, to correctly select those city blocks in any given census tract which contained disadvantaged persons.

¶ Reading, Pennsylvania—Using 1:20,000 photography taken in 1964, a detailed analysis of the 'poverty' section of the city was made. In this case, the CBD, industrial and commercial and transportation arteries were delineated and used as pointer type clues to the interpretation of adjacent housing. High density, multi-storied housing was noted in these areas as containing disadvantaged population. Census data was geographically plotted and the areas compared. It is to be noted that some *poverty* areas of the city were missed as a combined result of small scale and the existence of island areas of residences with disadvantaged persons.

¶ San, Juan, Puerto Rico—This city provided both the opportunity to determine the effect of scale and of color photography on interpre-

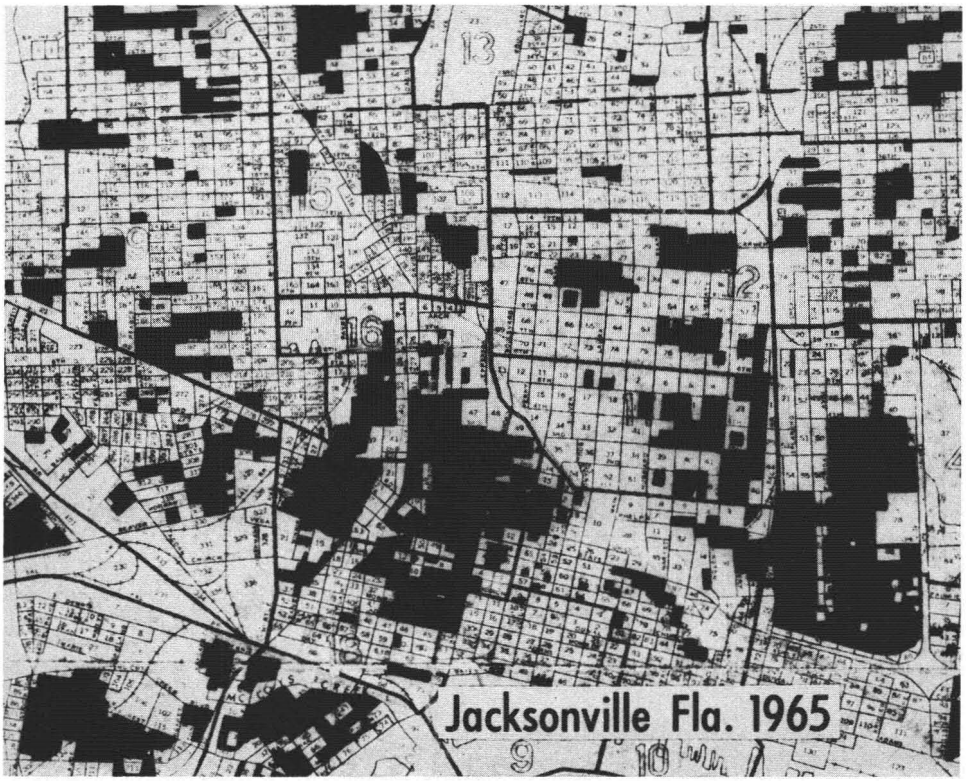

FIG. 4. Contiguous poverty areas in Jacksonville, Florida.

TABLE 2. CORRELATION OF PHOTO DERIVED DATA WITH CENSUS DATA ON POVERTY AREAS OF JACKSONVILLE, FLORIDA

Poverty in Area A (Census Tract 27)

	Census Data Tract	*Census Data Block*	*Photo Derived Data*
Population	2,588	2,561	2,467
Families	599	600	577
% Families	24.1	24.1	23.2

Note: Total population was 10,629 and families was 2,848.

Poverty in Area B

Census Tract	*Population*
9	342
10	439
16	1,084
17	2,407
18	1,736
	6,008

Photo Derived Poverty Population Total 5,500

Result = Photo Technique Underestimate of 8.4%

tation. Scale range was 1:15 to 1:30,000 in panchromatic while color was used at 1:15,000 and 1:10,000. Three detailed interpretations were then compared. As expected the larger scale panchromatic gave better results. The color photography was found to definitely enhance the precision in delineating the poverty areas of San Juan. Figure 5 depicts the poverty areas based on census data subjected to computer analysis and then plotted. Figure 6 depicts the results of the analysis of the color photography. Note in the case of census tract 43 that the photography is much more helpful in eliminating swampland from consideration and alters the visual impression of poverty in San Juan.

¶ Baltimore, Maryland—For this city, interpretation was directed toward the detection of change and ability to update information. Photography at 1:10,000 and 1:20,000 taken in 1948, 1957, 1959 and 1964 was utilized. Figures 7 and 8 and Table 3 picture and tabulate the results of several urban renewal projects in Baltimore by measuring the disadvantaged persons displaced by these projects. In actual practice, of course, the appearance of new residential structures would cause a sample survey to be conducted to obtain additional socio-economic information.

A general discussion of the results obtained from the standpoint of the photo interpreter can be summarized. The positive value of small scale photography is the ease and rapidity in identifying and delineating major urban categories such as major transportation arteries and facilities, the urban core, administrative-institutional, recreation, and major industrial and commercial areas. In general, areas indicative of a poverty environment were identifiable. However, on small-scale photography, the external structural and environmental evidences of poverty are difficult to extract from the photography. Multiple family dwelling units and dwelling

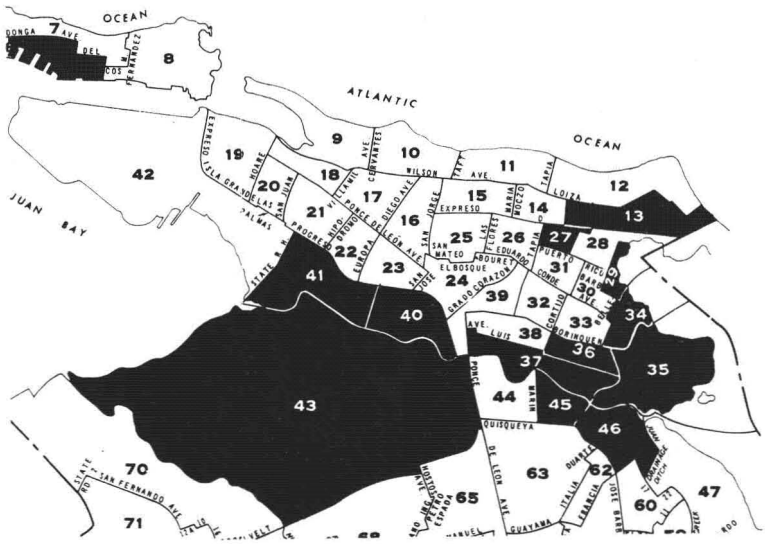

FIG. 5. Poverty in San Juan. P. R., based on census tract data.

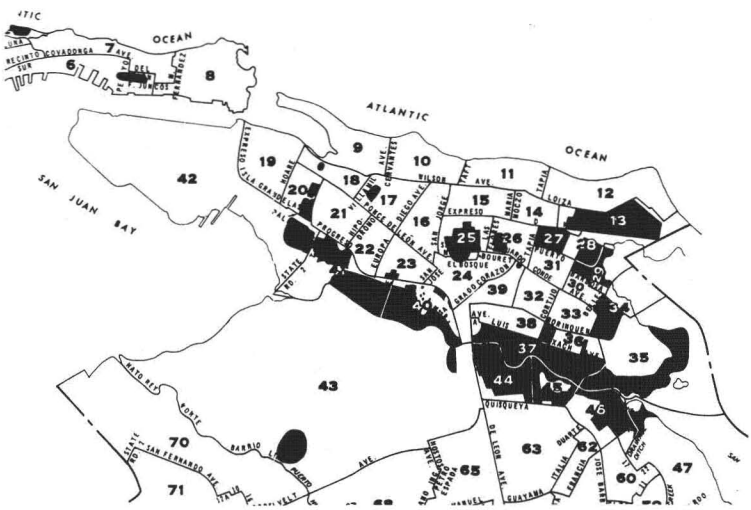

FIG. 6. Poverty in San Juan, P. R., based on photo analysis.

units in the upper part of a commercial building are difficult to assess as to the number of units and families and whether or not they are in poverty.

With large scale photography, housing units and their environment exhibit many indicators of poverty. These indicators include conditions and items such as structural deterioration, debris, clutter, and sometimes the lack of vegetation (shrubbery, trees, lawns, etc), walks, curves, and paved streets. In these areas, items such as junk yards, warehouses, and small businesses can be found interspersed in the housing areas.

Large-scale photography eliminated many of the problems that were found with small-scale photography. Poverty areas were more easily identified and delineated, and this was done with a higher degree of confidence. At this scale it was possible to evaluate each individual housing structure in a city block. Environmental and structural differences from house to house were apparent to the extent that one dwelling unit could be nominated as housing a family in poverty and the structures adjacent to it not be nominated. Structures containing both commercial enterprises on the first floor and dwelling units above were more amenable to interpretation. However, in the urban core area and along linear, street fronting commercial establishments, it was difficult in some instances to

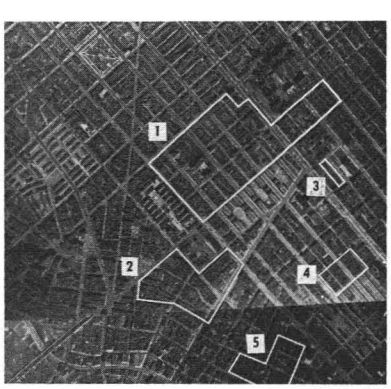

FIG. 7. Five poverty areas in Baltimore, Maryland, as of 1948.

FIG. 8. Five identical poverty areas in Baltimore, Maryland as of 1957. (See Figure 7.)

TABLE 3. DEMOGRAPHIC CHANGE IN FIVE POVERTY AREAS OF BALTIMORE, MARYLAND, 1948–1960.

Photo-Derived Data-1948			*Photo-Derived Description*		*Census—1960**	
Area	*No. of Units*	*Population*	*1957*	*1959*	*No. Units*	*Population*
1	1143	4000	1—high rise apartment 10—apartments (2 story) 1—apartment under construction	same as 57 2 more apartments under construction	120	942
2	500	1750	6—high rise apartments 13—apartments (2 story)	same as 57	769	3711
3	23	not established	9 units, balanced cleared	cleared	None	
4	285	1000	Being cleared	cleared	None	
5	357	1250	3—high rise apartments 16—apartments (2 story)	same as 57	479	1962

* 1960 population still has predominately poverty characteristics based on Census data.

determine if dwelling units were present.

In general, poverty areas identified on both large-scale and small-scale photography exhibited the following characteristics.

- The poverty population was mainly located in large contiguous residential areas that cover a large part of the central city on photography, these areas provide many indicators of related poverty conditions—small, closely spaced structures, debris, deteriorating or lack of facilities such as roads, walks, yards, etc.
- Poverty areas are often in close proximity to the urban core (CBD). In this effort it was interpreted as the concentrated downtown shopping-commercial office building-hotel area. Outward from this core, there is a short outer transitional zone which then gives way to large poverty areas. These poverty areas do not necessarily ring the entire zone, but they do border a large section of the urban area and are separated from each other by linear commercial zones, linear non-poverty areas, and in some places large non-poverty areas.
- Poverty areas are often located adjacent to major industrial, commercial, and transportation activities. These non-housing areas tend to be located near the urban core. Consequently, poverty areas bordering the urban core on one side are often bounded by these activities on its other sides, thereby creating a virtual island of poverty housing.
- Poverty areas are subject to razing and consequently realignment. New highways, expressways, and freeways in urban areas tend to be built through poverty areas. This activity reduces the number of structures, but the displaced families move to other poverty areas or expand the poverty area fringe in which they live. Similarly, new construction in urban areas for commercial and industrial enterprises tend to raze structures on the fringe of poverty areas, creating a change and realignment in poverty areas.
- In outer fringes of urban areas, poverty areas are not as large or in close proximity to each other as they are near the urban core. In these areas, housing density decreases and there is no encroachment of large industry and commerce on the living areas.

SUMMARY

This investigation examined the ability of using aerial photography alone and in combination with other information to (1) depict quickly and economically the physical structure of the urban environment which contains disadvantaged persons, and (2) extract reliable demographic data on a specific segment of the population. The results indicate that photography, because it contains a wealth of detailed distributional data, can provide a unique source of certain data and can facilitate the analysis of a variety of socio-economic aspects of the city. This study also confirms other investigations that have used photography to direct the collection and utilization of sample survey data based on homogenous areas.

Strong correlation between urban poverty and residential areas in proximity to the Central Business District, industry and major transportation arteries were confirmed. By extension from other studies these areas are also correlated with low income, unemployment, low education achievement, family crowding, crime, public financial dependency, low health status and lack of community facilities.

Additional physical attributes or clues are found to be imaged in the photography, and facilitated the more precise delimiting of *poverty areas* in the cities. Repetitive photographic coverage enables the interpreter to

detect changes to the environment which affect the relative accuracy of the socio-economic information previously obtained and provides a basis for shifting the boundaries of homogenous areas. Finally through the unbiased recording of information, aerial photography facilitates the continuing examination of changes in our urban environment.

ACKNOWLEDGMENT

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Photointerpretation Methods and Equipment Clearing House

Have any photointerpretation methods or equipment problems? Created any unique solutions to problems? Contact Sub-Committee III, Photointerpretation Committee. Address letters to Society Headquarters.

ANNOUNCEMENT

Sub-Committee III, Photointerpretation Committee, has organized a Methods and Equipment Clearing House for the benefit of the membership. The aims of the clearing house are to function as a referral service to help members who have problems contact individuals who have experience in the same or related areas. Methods problems will be referred to other members; equipment problems to appropriate sustaining members. Sub-Committee III is under the chairmanship of Carl Strandberg. Mr. Bruce Herrington heads up the Methods Section of the Clearing House. Mr. John J. Evans heads up the Equipment Section.

The P. I. Clearing House hopes to act as a Committee of the Whole—and will appreciate the assistance of the entire membership in helping other members find solutions to vexing problems which impede the progress of photointerpretation.

If you have a P.I. problem, you may address Carl Strandberg, P.I. Clearing House, ASP Headquarters, 105 N. Virginia Ave., Falls Church, Va. 22046. Replies will be carried in this column, as well as directly.