

II. Results

Results appear on Table A. Headings were inserted manually before listing for the purpose of clarification.

TABLE A
AERIAL SURVEY SAMPLE
STRIP 64

FLTG PT	A	B	C	D	E	F
TRAN 1	2466823251	2097503150-	2225910055	5687800054		
TRAN 2	4024698948	3422142247-	9153262053-	1527430353-		
TRAN 3	3053645041-	1924217247	5323737341-	1154699343-	1325147751-	
TRAN 4	1640740841	8212895141-	7728129146	2628994151-		
TRAN 5	1699996541-	6991376041	3061298541	8639890746-	3698850946	2785798050-

PT ID	X	Y	Z	DEL X	DEL Y	DEL Z
145	64744.041	584914.340	8649.698	.030-	.094-	.302
146	64730.410	584906.173	8646.824	.036-	.021-	
175	66843.404	585170.466	8096.052	.165	.168	.452-
214	68399.389	584717.792	8001.614	.048-	.154	.514-
234	69723.463	585121.447	7811.350	.086-	.220-	.650
241	70374.333	584138.892	7968.536			
251	70950.647	584053.699	7826.359			
253	71069.774	585404.220	7775.603			
261	71532.925	583959.613	7671.790			
277	72257.159	584558.951	7670.237	.012	.187-	1.063
284	72810.818	584719.890	7638.626	.019	.201	.926-
286	72318.090	584271.920	7368.021			.121-

Sociogrammetry

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THE PROBLEM

SOME time ago 172 Kenya Africans were killed when tribesmen from across the border made three successive raids; two battalions of King's African Rifles were rushed to the scene. A series of enquiries into the causes of this, the largest of frontier disturbances, was instituted. Following a long period of calm, both of the two old tribal enemies had moved into the neutral zone which had been planned to be a separation area. This movement no doubt was due to urgent need for grazing land and by growing numbers. Control had become lax. The fighting not only caused a heavy loss of life, but it created new enmities with cries for vengeance, and with fears that in this already disturbed continent, new problems are to be added.

The raids came as a surprise. The Kenya

Police is large and mobile and has an air wing. It also has made several studies using air photography. What appears to have escaped the observation of the local authorities is that these air photographs could be used in tribal administration. This is perhaps less curious than it at first appears, because information is deficient in the general area of cooperation between the photo interpreter and the administrator, or of even greater significance, between air surveyors and social surveyors.

It is the purpose of this paper to examine what the social scientist might be able to contribute to the kind of aerial survey that so often is commissioned by governments in the hungry parts of the world; where human needs are crying out for more man-power research, census work, urbanization studies, information on migration patterns, that is in

areas where problems are broadly similar to those found in Kenya. It is suggested (1) to governments, that aerial photography would raise their standards of sociological investigation; (2) to social research workers that the air survey would expedite and reduce the cost of furnishing their government with data; and (3) to air survey teams, that the social (ground) surveyor has an important but still novel role to play in any team studying a region's resources. The aerial survey when used for socio-economic studies raises a number of statistical problems which in this form are somewhat new to photogrammetry—or as the combined air-social survey might be called—to sociogrammetry.

WHAT ARE SOCIAL SURVEYS TO THE UNDERDEVELOPED COUNTRIES

Social surveys are commissioned all over the world by governments and local authorities for use in their planning. They are also obtained by private industry—for operation perhaps of a company oil, mining or steel town—as well as by community development organizations and universities.¹ The traditional gap existing between the physical and the social sciences is the explanation of these bodies not having thought of a combination of sample ground surveys on a small basis and extrapolations of numerical information to be derived from air photographs. The one social science that is making appropriate use of aerial photographs is archeology.²

But social surveys like aerial surveys are undertaken because the community wants accurate information on the facts needed by it for carrying out its plan and for legislation. Social surveys bring forth the size and composition of sampled households; types of housing; income and occupational distribution; way and standard of living; trends and changes in public opinion and behavior; distress and other potential dangers to public peace.³ Such action-oriented enquiries might be called "action surveys" with distinction made between two types.

- (a) the *survey-before-plan type of survey* which locates the problems in space and size; in other words, for mapping and measuring the extent of evils, and reducing the intervention to a minimum—to a matter of conservative surgery, operating where it can be most beneficial;
- (b) the *measurement of change type of enquiry* which answers such questions as

"has poverty been diminished," "to what extent has a shanty town been cleared up," "have educational campaigns aiming at soil conservation been effective."

The first type of social survey is often spoken of as *appraisal*; the second as *evaluation*. In each the surveys are descriptively-statistical reports based on total or sample enquiries which are made by a group of trained field workers, interviewing, under controlled conditions, a predetermined number of resident informants.

Sometimes questionnaires can be substituted by schedules sent to householders and filled in by them, or the man on the street is interviewed, or some body of informed persons, such as school attendance officers or community leaders; sometimes the interview is replaced by direct observation—facts are noted by the field worker without questioning, such as the condition of the house and yard, the race of the respondent, the furnishings in the living room.

Sampling is frequently of the random type or a sequential scheme is employed. Point sampling is used where a single unit (say a dwelling) is the sampling unit; block or cluster sampling is where a whole housing block, or perhaps a square mile of rural land, is taken out of a total statistical "universe." The term "census" is used where total enumeration is found necessary.

THE USE OF AERIAL PHOTOGRAPHY IN SOCIAL SURVEYS

To return to the Kenya example, no census has ever been taken in the Northern Province of Kenya, nor in the whole of Ethiopia. An anthropological survey of the Turkana has been published, and the existing information on the Southern tribes of Ethiopia has been put into book form, but no quantitative data have been made available. The well known Dixie plan for water bores, and its successors, provide for a series of water pans, intended to keep the nomadic population on the move and thus to protect the soil and vegetation. For its proper implementation are required some figures of tribal groups and their stock; these are difficult to obtain because of the suspiciousness of the people whenever figures are collected. Grazing control is dependent on a clever tactical use of police forces, the logistics of water pans, demographic and stock counts. It is based on a complex but definable spatial and kinship relationship. In short a statistical social survey.

Range and vegetation studies such as made for the governments of the Sudan, Iraq, Jordan, Pakistan—to mention only a few undertaken by the same firm—can be used as guides, provided the social information contained in the photographs, but hitherto left unmapped and uncalculated, is forthwith reported. A successful frontier delineation by means of aerial photographs and, in addition, a range policy in Northern Kenya, could be an example for use in other frontier difficulties experienced in this entire area—between the Yemen and Aden, the Sudan and Egypt, Saudi Arabia and her neighbors—a model of the technical solutions founded on a social analysis and geographical features. The political will to make peace may still be wanting, but it is advisable to push the technical conditions for peace and make them as overwhelmingly persuasive as possible.

Kenya is using air surveys for topographical purposes and for other reasons; they now should also be utilized for social surveying. Attached to the usual team studying natural resources could be a sociologist who, familiar with the general features of the nomadic cultures of Kenya, would study the photographs to find a statistically controlled sample of different peoples. He would make a purposive sample of different geographical and clan types or, once decided on his strata, he might take within each stratum a random or sequential sample, the aerial photographs acting as his "frame." *Four steps* are then necessary:

- (a) The *F or field stage*, when his field workers go to the people and collect the information;
- (b) the *A or air survey stage*, in which obliques are produced to give close-ups of typical human congregations and landscapes, and their uses;
- (c) the *C or control stage*, wherein the findings for the sample having been multiplied by the number of similar units found in the air photographs, are verified in a control sample;
- (d) the *T or trend part* of the enquiry in which the same selected areas are examined a period later in time, and changes are noted.

The gain for social studies is that smaller ground samples, more purposively collected, can be chosen, with more attention given to each unit in the sample by a smaller and more highly trained and supervised field staff. Once he is convinced that his samples of various strata are typical, or of the homogeneous

groups into which the field is readily divided, the social surveyor can multiply his data by the number of similar units found in the air photographs; he can reproduce the results with the greater speed which is essential in times of sudden crises and rapid turn-overs of governments. The gain for the aerial surveyor is that more information is extracted from the photographs; the survey is useful to more departments of government and industry; with its uses broadened, the survey will be in greater demand.

SOCIOGRAMMETRIC ANALYSIS

The social surveyor finds employment for photogrammetry in no less than four different auxiliary capacities:

- (1) His knowledge of social structures and house types, of ploughing and herding techniques, as well as other social and economic activities, sharpens the definitions employed in land use, settlement studies, and crop analyses. Vagueness in classification is much resented by users of aerial surveys; some of these, as the administrators of Northern Kenya, have spent a lifetime in the territory.
- (2) By his descriptive statistical information of the area, he gives important correlations between physical and social distributions, which can be ranked for significance of association. The fairly recent development of ecological statistics differ from individual statistics in that they give summarizing values of mass phenomena, such as obsolescent buildings, sizes of camel herds, climate over a period, water resources, homicide for a region or in a season.

The relationship of ecological and individual statistics has been argued by social statisticians.⁴ A number of geometrical and algebraic representations has been given to such concepts as dispersion, spacing, population potentials, community size.⁵ Thus the dispersal of a population is calculated as in a Lorentz curve—first developed to measure the inequalities of wealth—by its "concentration ratio."

Another approach derived from plant ecology, would be to measure the statistical significance of aggregations differing from the null-hypothesis of random distribution. The median center for the population of an area "would

allow the area to balance if it were a rigid plane without weight, and the population distributed thereon with each individual assumed to have equal weight and to exert an influence on the central point proportional to his distance from that point."⁶ The area can be intersected by additional points i.e. quartilides, decilides, and centrilides. Growth potentials in the aggregates can be given, as well as subdivisions of communities and neighborhoods within urban entities, according to objective indices compounded in a community "profile."

- (3) His growth measures take us into a posteriori evaluation.⁷ It is here that causal relationships become important and sampling must be done in a controlled fashion. It is well known that the least controlled part of aerial surveying is ground control, which often follows impressionistic sampling techniques, the unreliability of which can easily be demonstrated.⁸ A repeat aerial photograph shows changes, say in forest cover, but only by a proper social and ground analysis would it be possible to determine why the cover is not what it was in the first instance. Answering the question "how has the change been brought about?", sociogrammetrists are able to suggest how further desirable changes can be introduced by a new policy. It is not sufficient to propose the ideal, needed also is an explanation for the population falling short of the ideal and with what expenditure of effort it can be assisted towards a more rational use of its resources. Another purpose of analysis is to prevent "overplanning"—a too ambitious program compared with the means at the authorities' disposal.
- (4) After analysis comes planning: the spacing and location of social and utility services (schools, water holes, slaughter houses, etc.); a series of mobility projects known as "queuing problems" and other "operational research"⁹ and in the case of disturbed areas segregation plans and on the other hand, places where the hostile tribes can gradually get to know one another, perhaps intermarry, and eventually conceive of units much greater than at present familiar to the clans—the Kenya aim of policy.

FIRST BEGINNINGS IN SOCIOGRAMMETRY

The Kenya example has been chosen because it is so simple—nomadic areas lend themselves to wide-scale surveys. There cover is usually slight and weather conditions are favorable to air photography. The administration is sufficiently sure of itself to welcome research. The second reason is that a study in conflict, so important in these days of sensational press reports and cold-war propaganda, is often the tacit reason why surveys are applied for. The nervousness which physical surveyors display towards social studies can be shown to be unfounded once the procedural problems have been practically stated. Thirdly, the example puts the question of raising the standard of living—in this case by working within the original social context. It will be noticed further that the solutions were sought within the territorial sovereignty of Kenya, rather than in a regional framework which however would be brought nearer general acceptance in Africa by the national surveys.

It is indeed interesting that the rare instances in which sociogrammetric ideas have been tested under field conditions have been located in urban areas, where their usefulness is obscured by the complex, heterogeneous society studied, and the many vital things that cannot be seen. The relationship of visible to non-material cultural phenomena is an old subject of the Chicago School of Ecology and indeed of behavioristic and physicalist approaches to society, generally.¹⁰

To Green and Monier, probably there is owed the pioneer studies of air-ground surveying. Birmingham (Alabama) and in contrast, Rochester (New York) were analyzed for a number of variables; it was shown that the ratings given to various neighborhoods on the basis of air photographs differed but little from the ranking deduced from census tracts.¹¹ Other students have pointed out that not only physical features go into the creation of a progressive environment¹² but that the pioneers would be the last to quibble or protest. A graver fault is the lack of a refined statistical and theoretical orientation—the limits of urban sociogrammetry have not been indicated in this work.

The study of Paris undertaken by de Lauwe and his collaborators is more theoretical in its orientation, grappling as it does with "social space" and its "structure of values."¹³ It diverts attention upon such institutions as churches and it is historical in its approach, showing how and why land use has

gradually been changed in the Paris region. It is also configurational in the manner of social ecology, asking how and why the zones relate to the center of the city. Some quarters of Paris are more profoundly studied, bringing together with such social data as voting behavior of the different constituencies, the distribution of banks, notaries, and homes of high officials. A series of overlays would have suggested hypotheses which a statistical analysis might have easily verified; but after the valiant beginning the authors leave their aerial photography behind, and concentrate on mapping statistical data, culled from other sources which in no way are connected with the aerial survey photographs. More self searching than the American work, it lags technically far behind the initiative of Green and Monier, even less an ideal sociogrammetric study than theirs.

To those who may demur at the use of the word "sociogrammetry" either because "sociograms" are tools pre-empted by Moreno and his school—now well represented in the U.S.A.F.—or because it is contended that no new term is needed, two defences are made. The sociograms which show by means of circles and lines how often one child wrote to another, are not really so different from the analysis here outlined¹⁴ In them future distinction could be made between micro-sociogrammetry—small groups which can be easily seen on a ground picture or film—and macro-sociogrammetry which loses much in formation of the micro-sociogrammetrist because taken from the air—either from a plane moving through space or a helicopter filming the moving scene beneath as is many times done in traffic studies.

With newer devices, sociogrammetry will be able to make further strides and become firmly embedded in aerial surveying. Infra-red photography and recordings on magnetic tape, the use of color photography and new scanning instruments open up possibilities which the Nation or the company first in the field, will soon rapidly develop. The gaps that still exist between social surveys and aerial surveys will soon be closed.

NOTES

1. International African Institute (under the auspices of UNESCO): *Social Implications of*

Technical Changes 1955 contains a good summary of the best social surveys in Africa. For a more methodological discussion cf. L. Silberman: "The Colonial Social Survey," in *Zaire* (1954). For detailed treatment of one social survey cf. L. Silberman: "The Social Survey of Port Louis (Mauritius)" in *Review of the International Statistical Institute*. 1954, pp. 85-94.

2. The authoritative book, is by J. Bradford: *Ancient Landscape*, 1957. Father A. Peidebard: *La Trace de Rome dans le Désert de Syrie*, 1934, comes closest to the kind of study discussed in our Kenya example.
3. L. Silberman: *Analysis of Society*. 1951. Ch. VI and IX.
4. L. A. Goodman: "Ecological Regression and Behavior of Individuals." *American Sociological Review*. 1953, pp. 6-63; W. S. Robinson: "Ecological Correlations and Behavior of Individuals." *American Sociological Review*. 1950, pp. 351-357; W. S. Robinson: "The Statistical Measurement of Agreement." *American Sociological Review*. 1957, pp. 17-25.
5. O. T. Duncan: "The Measurement of Population Distribution." *Population Studies*. 1957-58, pp. 27-45.
6. *Ibid.*, p. 34.
7. L. Silberman: Problems of Evaluation Research. *Rural Sociology*. 1955, pp. 229-241.
8. To prove the need of proper statistical controls, F. Yates asked 12 persons to select 20 stones from a collection of 1,200 in such a manner that the samples would represent as nearly as possible the size distribution of the whole collection. The result showed a consistent tendency to over-estimate the average size of the stones and to under-estimate the variance of the distributions. (*Transactions of the Manchester Statistical Society*. 1936-37).
9. Cf. the journal: *Operational Research*.
10. L. White: *The State of the Social Sciences* (cf. P. Hauser's chapter on human ecology). Chicago. 1956.
11. N. E. Green: "Scale Analysis of Urban Structures." *American Sociological Review*. Vol. 21 (1956), pp. 8-13; N. E. Green: "Aerial Photographic Analysis of Residential Neighborhoods." *Social Forces*. Vol. 35 (1956), pp. 142-147; N. E. Green and R. B. Monier: *Reliability and Validity of Aerial Reconnaissance as a Collection Method for Urban Demographic and Sociological Information*. Maxwell Air Force Base, Ala. 1953; M. C. Branch, Jr.: *Aerial Photography in Urban Planning and Research*. Cambridge, Mass. 1948.
12. M. M. Witenstein: Photo-Sociometrics. PHOTOGRAMMETRIC ENGINEERING. Vol. 20 (1954), pp. 419-427.
13. P. H. Chembart de Lauwe, et al.: *Paris et l'Agglomération Parisienne*. Paris. 1952.
14. L. Silberman and B. Space: *Colour and Class in Six Liverpool Schools*. Liverpool 1950 is a social study extensively using sociograms.