

# VISUAL EVIDENCE FOR URBAN POTENTIAL FIELDS

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**ABSTRACT** *A satellite picture of adjacent cities clearly illustrates the analytical dynamics of urban growth.*

**RÉSUMÉ** *Une image satellite de deux villes voisines met clairement en évidence la dynamique «analytique» de la croissance urbaine.*

**RESUMEN** *Una imagen por satélite de dos ciudades vecinas evidencia claramente la dinámica «analítica» del crecimiento urbano.*

• DALLAS • DYNAMICS • FORT WORTH • SATELLITE PICTURE • URBAN GROWTH

• CROISSANCE URBAINE • DALLAS • DYNAMIQUE • FORT WORTH • PHOTO SATELLITE

• CRECIMIENTO URBANO • DALLAS • DINÁMICA • FORT WORTH • FOTOGRAFÍA SATELITARIA

For over a hundred years attempts have been made to apply to the social sciences concepts expropriated from physics. The danger inherent in reasoning from analogy has always caused these efforts to be regarded with some suspicion. The gravity model of human interaction, however, is one model which seems to have gained widespread acceptance, mainly because it describes aggregate human behavior quite well (1).

Most of the evidence used to calibrate the social gravity model has come from census enumerations, the time and space scales of human interactions being such that direct sensory observations are difficult. The satellite photograph (fig. 1), showing two terrestrial cities, it is suggested, provides direct pictorial confirmation of the existence of potential functions in the field of human geography.

In terms of potential theory, if a source of strength  $k_1$  is located at  $z = a$  of the complex plane, and another strength of  $k_2$  is located at  $z = -a$ , then the complex potential is:

$$\Omega(z) = k_1 \ln(z + a) + k_2 \ln(z - a)$$

and this is readily separated into the equipotential and stream func-

tions (2). The general configuration shown in the satellite photograph appears to conform to these equations. In particular, the developing suburbanization between the two cities appears to outline the stream function ( $a = 25$  km,  $k_1 = 679,684$ , the Dallas population in 1960;  $k_2 = 356,268$ , the Fort Worth population in 1960). The second figure shows this somewhat more schematically, with the city areas approximated by circles of appropriate size (3).

There remains the possibility that the example is spurious or fortuitous; time sequences or examples from twin cities in other parts of the world should illuminate this possibility. In particular, it is suggested that further high resolution photographic exploration of this unusual planet may reveal other phenomena of equally great interest, including further instances similar to that reported here.

(1) Cf. J. Stewart and W. Warntz, *Journal of regional Science*, vol. 1, 1968, pp. 99-123; Gunnar Olsson, *Distance and Human Interaction*, Philadelphia, Regional Science Research Institute, 1965; and Robert E. Nunley, *Living Maps of the field Plotter: Analog Simulation of Selected Geographic Phenomena*, Washington, D.C.: Association of American Geographers, Commission on College Geography, Technical Paper n° 4, 1971.

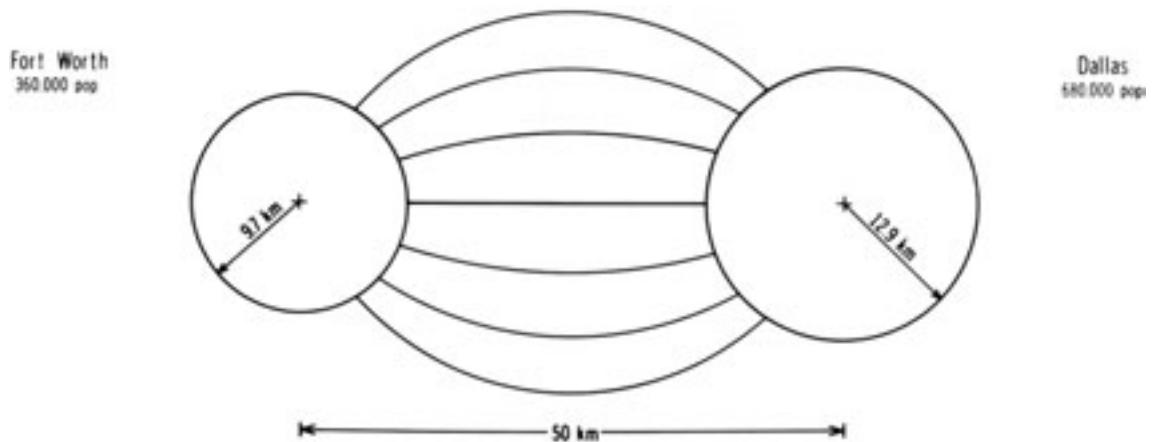
(2) Cf. M. Spiegel, *Theory and Problems of Complex Variables*, Schaum, 1968, p. 248.

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### 1. Apollo VI photograph

Photograph AS6-2-1462, showing the built up areas of Fort Worth (32° 45' N, 97° 20' W) and Dallas (32° 47' N, 96° 48' W), Texas, U.S.A.



### 2. Schematic diagram

Schematic diagram of a portion of the expected stream function, if Fort Worth and Dallas induce a potential field, for comparison with the satellite photograph (fig. 1).