How to make a population map

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Ball bearings, one-eighth of an inch (3.2 cm) in diameter, cost approximately $4 per 1,000, or did in 1970 before the present wave of inflation. Before their final polishing, however, they could be purchased for about 40¢ per 1,000, and this difference was a significant feature in producing one of the most unconventional maps of Canada ever published, the isodemographic map.

"Isodemographic" is a word coined by the team which developed the map at the School of Community & Regional Planning, University of British Columbia. It means "equal population", and the basic task of the team was to construct a map on which the 266 census divisions in Canada would be shown in proportion to the population they contained at the 1966 census. The map might well be described as a map of Canadians rather than a map of Canada.

Why should the Government of Canada contract for the production of such a map? The answer is rooted in the most fundamental fact of Canadian geography: the contrast between the vast area of the country and the distribution of the population. All of us are qualitatively aware of the main elements of this contrast; the concentration of the population in the extreme southern part of the country, and the fact that three-quarters of the Canadian population is urbanized. But it is practically impossible to have an accurate quantitative impression of the magnitude of this contrast if we continue to plot population data on the map of Canada's land area. Some of our conventional descriptions of the contrast may indeed be more misleading than helpful. For example, we are aware that the great number of the Canadian population lives within 100 miles (160 km) of the United States border. This statement may seem to suggest that there is a fairly densely populated strip along this southern border, whereas in reality the population is concentrated in a relatively small number of towns and cities lying close to the border. These urban areas are separated by sparsely populated areas which are enormous when compared with the size of the cities themselves.

The most convincing argument that it is almost impossible to develop a precise mental image of the urban-
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Rural distribution of the Canadian population is the isodromographic map itself. It simply does not coincide with our notion of demographic reality, and yet it is a highly accurate representation of that reality. It is our individual notions which are inaccurate.

The need for such a map is not solely the need to give Canadians a more accurate image of urban-rural ratios or of regional distributions. The map can serve as an instrument of public policy development. Every five or ten years there is a national census, and the results of censuses are the basic data on which governments use to design programs and to change existing ones.

Maps are frequently an important element in this planning process, especially where we are dealing with programs that affect different parts of the country in different ways. But if we map data which relate essentially to people (their age, education, health, employment, income and so on) on a map of the land of Canada, then we inevitably produce a map in which the characteristics of the 67,252 people (1966) who live in the Cochrane division of northern Ontario seem to be more important than the characteristics of the 2,238,000 who live in the much smaller area of Greater Toronto. This is a difficulty that all geographers and most map users instinctively recognize; the difficulty is to allow for it in an accurate manner.

Various devices such as proportional spheres can be used to indicate populations of different sizes, but tests have shown that even trained persons find it difficult to compare the areas of different circles accurately, and almost no one can compare the volumes of proportional spheres. The isodromographic map avoids the need for this, though obviously at the cost of some considerable distortion of the land area. The same number of people are represented on the isodromographic map by the same area of paper, whether they live in Yorkville or the Yukon Territory.

The isodromographic map is much easier to describe than to produce. This map of Canada seems to be the first of its kind in the world that is based on census divisions and can therefore be used as a basis for mapping census data. The two principal researchers, John Robertson and Lou Skoza, were asked to produce a map that would satisfy three basic conditions. First, it should be isodromographic: it should show the census divisions of Canada with areas proportional to the population that each division contained at the 1966 census. Second, contiguity should be preserved: if census divisions touch on the ground they should touch on the map, without leavings (likewise, "holes") on the map. Lastly, there should be some general resemblance to the map of Canada, so that the user would not be totally confused by, say, finding Vancouver located south of Alberta.

Instructively in this day and age we assumed that a computer would be the essential tool. On a computer we can bend and twist the shapes very rapidly, so that they can be assembled quickly and the results displayed.

Robertson and Skoza decided, however, that in fact a computer might not be so quick in the long run, especially because it would be very difficult at the outset to specify what an acceptable solution to the third constraint should be. We might have to repeat many time-consuming and expensive calculations on the computer in order to produce a result that was recognizably Canada. Maybe it could have been done. But Skoza and Robertson believed that with the relatively small amount of money available for the work, and the need to produce a result in a clearly defined time-period, it would be safer to build a model of the isodromographic map, almost literally as a jigsaw puzzle.

Hence the ball bearings: instead of rigid pieces of cardboard or wood, the census division "pieces" consisted initially of flexible aluminum strip fences that contained an appropriate number of ball bearings. One ball bearing represented 1,000 persons, so that some 143,000 ball bearings were required for the isodromographic map of Canada. More detailed isodromographic maps were also constructed of the 12 largest cities, based on urban census tracts. These had to come to a "scale" twice as large, one ball bearing for every 70 persons. These models required another 120,000 ball bearings or more.

The main model was built on a special table, 8 x 6 ft. (2.4 x 1.8 m), in the residence of the University of British Columbia. The team began with trial and error in the relatively regular census divisions of southern Saskatchewan. The toughest problems were encountered in the almost uninhabited areas (try maintaining contiguity by stretching the fences and ball bearings that represent 20,000 people [1966] of the North-West Territories so that they touch every province and territory from the Yukon to eastern Manitoba) and in the vicinity of major cities.

Think, for example, of the population distribution in the province of Ontario and in Winnipeg. A densely populated city of half a million people (over half the provincial population) is surrounded by a thinly populated prairie. Stretching these thinly populated rural census divisions around a dense city makes the isodromographic area of Winnipeg was not easy, and the same was true of Montreal, Edmonton and Calgary. For most of the other large cities, however, the difficulty was not so great: Halifax, Toronto, Hamilton and Vancouver, for example, are each bordered by lakes or the sea so that their isodromographic size can be accommodated by expansion in the direction of the water without violating the shape of adjacent rural census divisions.

As the model grew, it was possible for the researchers to modify its shape as a more recognizable image of Canada. When the model was complete, it represented a reasonably accurate solution to the problem. Even with the use of so many ball bearings, the model still fitted into a desk drawer. The ball bearings did not always pack together in the same way, and some census divisions became so narrow that their spines they could not accommodate even a single exaggeration. The printed map is therefore not a direct copy of the model. Instead, the pattern of the model was traced, and then the area of each individual census division was measured by planimeter and adjusted until it accurately represented its 1966 population.

When the map was published, the major metropolitan areas and other large cities were tinted pink in order to emphasize their importance in the overall population distribution. This led one awed journalist, contemplating the map for the first time, to exclaim, "Ye Gods! Canada is a T-bone steak."

That may not be the general reaction, but there is no doubt that practically everyone who studied the isodromographic map is reminded of facts he had forgotten, or learns things he did not know. How easy, for instance, is it for the resident of eastern Canada to forget that Vancouver Island has a substantial population which does not live in Victoria? How many outside Quebec are aware of the size of the Chicoumi–Jonquière urban region? Although the Maritimes have relatively small provincial populations, do we not tend to exaggerate this disparity, forgetting that the Atlantic Region still contains two million people, or 10% of the Canadian total? How many people realize that more people live in the North Peninsula than in any of Canada's cities except the three largest?

Since the map was published in 1971, the first edition has been sold out as copies have been distributed widely in Canada and abroad. It has now been reprinted, and can be purchased for $1 from the federal government's Map Distribution Depot, Department of Mines & Resources, 615 Booth St., Ottawa. Copies of an outline edition (without the pink tint) designed to be used for mapping census data can also be bought, as can the more detailed maps of the 12 largest cities.

For those who are interested in more details of the map's design and construction, Geographical Paper No. 50, Isodromic Map of Canada, by L. Skoza and J.C. Robertson, can be purchased for $3.00. One last word, in case you think that the whole thing sounds too well-planned to be true. The complete model, 8 x 6 ft. (2.4 x 1.8 m), containing over 140,000 ball bearings, was preserved for exhibition. The balls were sealed in place with a plastic transparent film and the whole thing was shipped to Ottawa. If you happen to come across it anywhere, please let us know. It seems that some eager civil servant decided to clean out the storeroom one day, and just threw it away.

During the initial stages of model making, the census division boundaries were built from aluminum strip, a few divisions at a time. Once the ball bearings had been inserted, the aluminum fences could be contracted, expanded and distorted to accommodate the ball bearings and preserve contiguity with adjacent divisions.