CARTOGRAPHY, MAP-MAKING, AND GIS

Jan Kelly

I was at a dinner the other week where I became involved in what could be termed a robust exchange on the nature of what I do. The assumption being made by those present, who might be considered to be the consumers of published maps, was that anybody could produce a map given the right tools (or software): that any map was a good map so long as it was readable: that in fact the quality of the production was not significant; and that, in insisting that it was, I was being overly precious about my trade.

My argument in return was that the "quality" argument - they interpreted that I think as the "prettiness" of a map - was not the point. A map is a language, I wanted to say, and if that language is poorly expressed then the result is equivalent to a written text filled with spelling errors, grammatical blunders, mis-applied words, and omitted or glossed over facts. One may derive from the text an impression of its general sense; but the potential for misinformation is very high.

Used in a map this kind of abased language is, in effect, pidgin cartography. More and more maps are being produed, by the uninitiated, in pidgin cartography. This is because class after class of GIS students, and apprentice after apprentice to commercial computing operations, are learning to use that most powerful information tool without being taught, in conjunction with it, the basic principles that would clarify (via the maps they produce as an end product), the results of the analysis.

Some do get it right, through an instinctive understanding of the principles of graphic information. Others do not: and they are, moreover, left unaware of the extent of their failing. They think, in effect, that an imaginative and "pretty" map (of their own design) is a also good map. They also think that a badly designed and poorly presented map of their own creation is a good map.

Cartography used to be the preserve of a very small number of specialists and when you said to people that you were a cartographer most often they said, "What is that", and then, "How interesting, I have never actually met a cartographer before". With the advent of computer software, cartography is out into the public domain. Now anyone can do it. Buy some software, find employment as a computer person, join a GIS class, read the manuals, and there you are, you are making your own maps.

Some of the work being produced as a result is, in cartographic terms, very poor indeed.

There may be a number of reasons for this. One is the "calling" if you like of the GIS field compared to the "calling" of the cartographic field. People have traditionally gone into cartography because it is a career that interests them, they have, quote, "always loved maps, and were good at drawing at school." People go into GIS for quite different reasons, the least of which may be being "good at art at school".

GIS, the manipulation of geographically located data, is (amongst other things) a very promising career path, and the fascination with it seems to be the manipulation aspect, the imaginative use of a very clever information tool. The person doing it will have a high facility with computing, or the capability to learn such, and was most probably "good at **maths** at school". Having "always loved maps" is not a necessary part of the equation, although the user may well have a geographical bias. The problem is, that what comes out of the GIS program as the main product, is maps.

A cartographer will look at the computer as a drawing tool. The project is to produce a map; the computer technique is a little different from wielding a pen, the possibilities are perhaps greater, perhaps lesser, but the purpose is, still, to produce a cartographic product, and that product, visualised and growing in the mind, is the governing structure behind the project.

The GIS operator also (possibly) intends to produce a map. But the governing structure is to correctly access and set up, one on another, the layers of real-world, spatially based, geographic information. It is expected in some ways that, even if one is not a "natural" artist or trained designer, when one comes to the final map product, the software will somehow know what to do.

Put in other terms, the software has available within it a set of "drawing tools", there are line-weights and colours provided, and boxes and headings and keys and fonts, and scale bars: and the user will obediently assemble a selection of these, as given, into a "map".

The cartographer becomes immensely frustrated with the limitations of the computer-based mapping tools. The computer is the only "mapping" tool that the GIS user knows.

These would seem to be small differences, shifts in emphasis perhaps: but the evidence coming in is that the differences are significant. Many bad maps are being produced and published, in such quantity that the art form itself is being degraded. In terms of physical quality the "good enough" result is edging out the commitment to the "best" result that used to be a hallmark of the trade: and in terms of information, the maps produced are quite simply uninformative.

Two questions may be asked. Is the computer software/hardware adequate to the task: and, is the map-maker adequate to the task?

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There is also a third question to be asked, and that is, is the computer a tool suitable to cartography? The answer to that is in process; it is becoming so, and emphatically it should.

Is the computer software/hardware adequate to the task?

This argument ranges over several layers of sophistication of computer-based output, not all software has all of the problems.

Materials. At one time the search for a stable drawing material (with the capacity to neither distort during drawing nor to degrade with time) was of high priority. Paper is made of fibre. It has a visibly uneven surface, and it stretches and shrinks differentially according to daily changes in humidity. It also stores badly, and discolours in light. The waxed linens which replaced paper also distorted, but less obviously. The plastic foils, "Astrafoil" and "Stabiphane" and "Permatrace" and their ilk, became the materials of choice, one paid whatever it took to acquire them. Their hard, fine-grained surfaces allowed for clean black lines of consistent width, and sheets of these materials could be fixed one on the other with great confidence, to draw the eight, ten layers of a "full colour" map. "Scribing" with a sapphire-tipped tool on coated foils became the ultimate in consistency of line width.

Now, once again, we work onto paper: standard copy papers, special copy papers, the thin, easily distorted plastic materials that are tolerated by the heat process of a laser printer, the large soft sheets of plotter paper.

Now, on more sophisticated productions, the layers are created in the computer and go to the printer as files to be extracted onto printing plates. The map maker is dependent not on the accuracy of the eye and hand, nor on the certainty that the drawing foil, and the big camera, will not distort: but on the software designers necessary understanding of the process, the resolution of the software's in-built co-ordinate base, and the capability of the system that interfaces with the printing process. None of these are mechanical processes and none are under the control of the map maker.

Line-work. Using a pen and ink on a plastic surface, or scribing onto a coated foil, all lines at all angles could be drawn at the same width and with the same clean edge. In the computer, line shape is governed by pixels and resolution, "jaggies" are, (shrug) there for keeps: diagonal lines have a different profile to vertical or horizontal lines, and appear to be thinner, circles are not circles. The printed line from the laserjet is rough edged according to the texture of the paper used, there are dips and hollows in the surface and these do not fill with toner. The plotter is largely limited to a 0.3mm line width, a thick result that sometimes "fills" or "thins" at the ends and is of a remarkably uneven density, its colours are poor, its results do not "publish".

Digitised lines are angular, awkward representations of curved outlines; it is impossible to digitise the same line twice and achieve the same result, and so a "best-fit" editing of two disparate lines has to be achieved.

Screened areas print with uneven "banding", large areas of solid colour acquire striped areas of toner failure, colour printout almost never matches the colours chosen on the screen. Dot-matrix productions are published in journals.

Text. The design of text is an art form in its own right, the style and size and weight of text used on a map is part of its "information package" and the choice of good text is a remarkably sophisticated tool. In cartography, beyond the days of hand lettering, a list of words was printed out in a selected font by a commercial printer, on thin Bromide paper or on a transparent medium, and the individual words were waxed or otherwise adhered into position: the resultant map sheet was an unwieldy structure fit only for the publishers cameras, but it was, at least, as professionally perfect as could be achieved. Lesser productions were hand-constructed using dry-transfer lettering.

In the CAD packages, and in ArcInfo, the fonts have been re-designed from scratch, they are, of necessity, formed from a series of straight lines, and are as a result coarse and amateur constructions (that, invariably, contain "fancy fonts" for the "enthusiast": "Olde English Script", straight out of the fantasy games (or, at least, a simulation of the same) an "italic" script with lots of curly bits and flourishes). While the CAD fonts are clean and neat if printed well, their design pays little attention to the exacting art of alphabet design.

Laser printers have access to small selections of "Postscipt" fonts which are more professional in appearance; and other graphics software can, in effect, access much of the "Letraset" catalogue of styles. Until recently, however, these particular typefaces were re-named and subtly altered in shape, letter by letter, to get around copyright problems. Thus each typeface is a distortion of its original form, and in terms of its artistic balance, spacing, and shape, vaguely "wrong".

Line styles. Most software packages advertise a "good" selection of line styles, which indicates seven or eight fixed varieties and weights. In hand cartography, when one produced a dashed line to fill a space of specific length, one divided the space in subtle stages so that the dashes did not fall awkwardly short of the end point, or cluster at a junction, did not "lose" the peaks and hollows in the gaps. This facility to see the problem and "invisibly" adjust the result is not available in most software packages. The dashes are standard, regardless of the inconvenience of their placing, and, moreover, they are in many cases proportional: thus, in "CorelDraw!" for example, a fine-line / long-dash combination is impossible to achieve from the default options. Long dashes can be accessed only in conjunction with heavy lines; as the line thins, so does the spacing of the dashes reduce. Below 0.1mm line-width, all non-solid line styles look alike, they are a barely discernable speckle.

Dashed and dot lines of varying weight and spacing can be custom made in the Custom directory under CORELDRW.DOT. 40 different line styles can be defined.
Editor's note from NZ Cartography and GIS

These mechanical and artistic limitations are all immensely frustrating, and much ingenuity is expended in achieving a result in spite of the tools provided rather than because of them.

The points that may be derived from the above are, that the cartographer is not as firmly in control of the tools as was the case in the past, because the tools are designed with an evident lack of understanding of their intended use: that the map-maker is frequently not a cartographer anyway, and thus is unaware of the difference: and that the "good enough" standard of quality is steadily and invidiously replacing the "best" quality.

Are the above points important? Is wishing that things were better merely an attempt to hang onto the past: is this all about the old style map-maker adapting successfully, or not, to a new tool, as one has always had to do, and the new-style map-maker achieving a different but equally valid product? I believe not, and will quote from a formidable source of support for this belief. Dennis Wood, in "The Power of Maps" writes,

> *"We all know how a map works, right? Good. Then lets get down to business. It is like a cookbook: what does it matter what a cake* ***is****? Follow these instructions and you will be able to* ***make*** *one. Compile and scribe, proof and print, and thats a map. If you can hold it in your hands is there any need to discuss it?"* (p.22).

One definitely needs to know what the cake is.

Is the map-maker adequate to the task?

This question requires a complex answer.

What is a map? A map is a spatially based graphic representation, in symbolised form, of (portions of) the real world. Selected elements are given relative significance and spatial location, this is what a map does.

The art of cartography is in representing the real world in such a way, expressing it so clearly and simply, that the finished map can be accurately *read back* into coherent real-world terms. The technique used for this process is cartographic language.

The language of cartography is in the selection of material shown, and in the way that that information is symbolised. There is always a selection. The real world is made up of the myriad things, the real world as shown on a map fits into the very small descriptive space of the box that surrounds the key or legend.

There is no "reality" as such on the map, even though there might seem to be, everything on the map, from its pictorial representations to its border, colour washes, grid structure, locational text, is a symbol. Size, placing, style, colour, arrangement, design all communicate the symbolisation.

A stream, for example, is customarily indicated on topographic sheets by a blue line of consistent width. Water is not blue, it is transparent. It reflects the sky (often blue, but also whatever colour the sky may presently be), and the surrounding vegetation, land surface, structures; or is discoloured by mud or clay or other suspended materials. Flow levels vary with the season, rivers flood, or meander variably, or dry up altogether. Unless it flows in a ditch, a stream is rarely of consistent width.

The symbol "blue line" thus does not represent the actual presence or actual description of the physical element water, it stands for the **word** "water".

Similarly with other symbols. A road is shown as an exaggerated-in-width, brightly coloured, consistent line. There are no scarlet lines or orange lines traversing the landscape, sometimes alternating brown-white-brown-white-brown-white: the symbol denotes the words, "road present here: road surface of this type".

If the streams are presented as bright green lines, and the vegetation is shown as a flat blue wash, then confusion is created in the mind of the reader: while water is only nominally blue, there are, also, colour arrangements on maps that "make sense".

There is always a case for variability of expression, not even cartographic rules are fixed in concrete. But the rule that is significant is that the resulting map should be a clear and readable representation, well designed, well labelled: an accurate depiction of some aspect of the real world: and that, above all, it can be "read back", accurately, into real-world terms. There are cartographic and graphic "rules" that achieve this, and they can be learned.

The naive map-maker recognises in the options mae available by a software package an apparent freedom to create. But embedded in this **apparent** freedom is the principle that "just because you can, is no reason why you should." If the key, title, box outlines, credits, scale, north arrow, use up more than half of the space, cramming the map into 25% of the page and the north arrow is 15 cm tall and purple: if the scale bar is divided into inexplicable units: if the legend is written in Olde English Script: if the "place" symbols obscure everything in a 5 km radius: if none of the lines meet: if the rivers extend beyond the coastline, poking out into the ocean, then the principle of a communicable language has not been understood. These are student productions. But even in the glossy ArcInfo Yearbook one comes across crashing errors of expression: and the advertising literature for a host of graphics software demonstrates acute unfamiliarity with even the basic tenets of graphic information.

The whole point about a language, whatever form it takes, is that it is embedded so deeply in the culture it comes out of, that most of the time its recognition is unconscious. When someone speaks to us in our own language we do not go off hunting for a dictionary to see what the words mean, most of the time we know. A good map language is that instinctive.

Is the map-maker adequate to the task? The answer must be, that if that person has been taught, and understands, the above principles, and the principles of map-making techniques and tools, then yes he or she will be adequate to the task. More often, it seems, the basics are not being taught, the expectation is that they will somehow arrive in the mind as a natural process. With some people they will, with many others they do not.

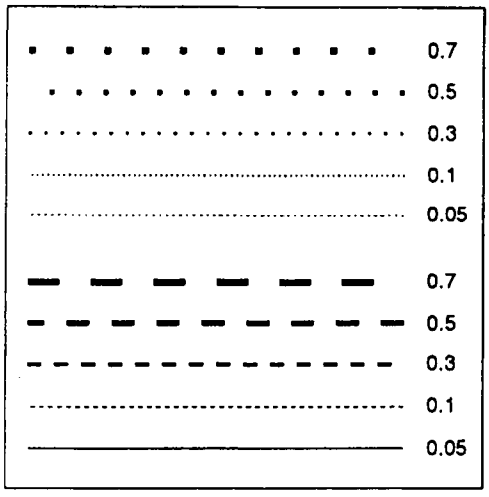

Fig. 1 "CorelDraw!": two line-styles, at five line-widths. Lines are proportionally spaced. All are the same length, and are printed here actual size.

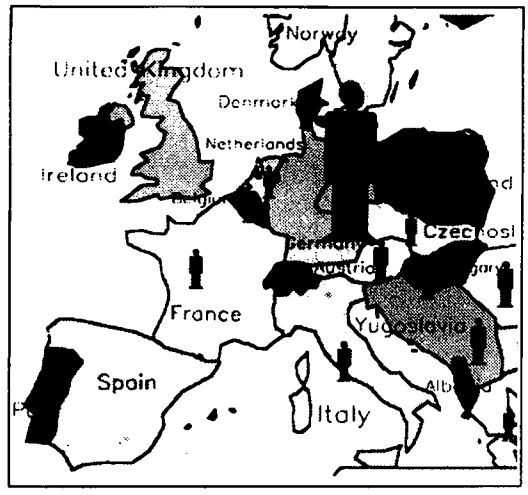

Fig. 2 A portion of the advertising for Golden Software's "MapViewer" software. Data from a worksheet: symbol imported from Micrographix "Designer".

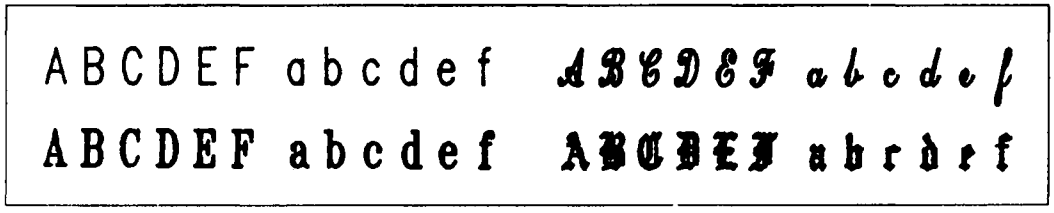

Fig. 3 Fonts from "ArcInfo", via a pen plotter. Reproduced at plotted size.

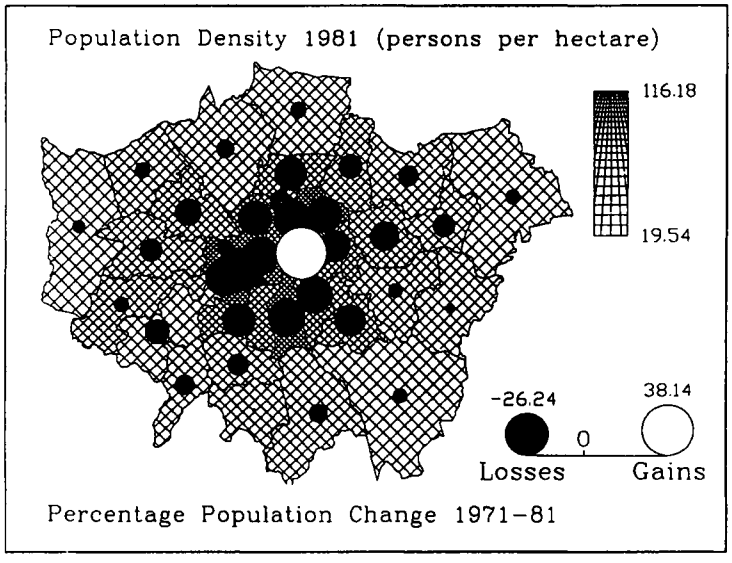

Fig. 4 Choropleth map demonstrates AutoCAD's capability to read data from a file and to produce an automated result.

The text is not a title, it refers in each case to the legend.

Note the machine-set range of each scale.

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The computer is a powerful transformation of technique for the cartographer, and in its possibilities as a tool it is fascinating, frustrating, time consuming, and undeniably useful. For the map-maker (whoever that may be) map-making is **not** a skill that can be automatically acquired with the purchase of some software. This paper is a plea to reinstate in the map-makers the professionalism of the art of cartography, the communicability of mapped information will be the better for it.

References

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