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The Projection of the Sphere on the Circumscribed Cube

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with those in the common rectangular polyconic; it is sufficient to give the results for longitude 25° .

Lat.	30°		45°		60°	
Long. 25°	Mer. +14	Par. -84	Mer. +21	Par. -42	Mer. +42	Par. -28

Thus, while the modification here indicated reduces the scale error by nearly one-half, it at the same time has the effect of rendering the representation nearly orthomorphic.

The modified projection is suitable for a meridional rather than a longitudinal configuration, but for areas whose total width does not exceed 40° of longitude it seems to be little, if any, inferior to the best forms of representation where the meridional extent is also considerable. The scale error is very much the same as that of the Transverse Mercator (Gauss Conformal). It would form an excellent projection for a general map of Egypt and the Anglo-Egyptian Sudan, or a country of similar proportions.

The Projection of the Sphere on the Circumscribed Cube

ARTHUR R. HINKS

THE projection of the sphere on a circumscribed cube was, according to D'Avezac, first used by Reichard in a work published at Weimar in 1803. The poles were at the centres of two opposite faces. A small sketch of a projection on the cube touching the sphere at 30° N. and 100° W. was given by G. A. Schott in the Reports of the United States Coast and Geodetic Survey, Washington, 1882, and is reproduced in the writer's book on 'Map Projections' published by the Cambridge University Press, though by a regrettable oversight there is no acknowledgment of the source. In this example the meridian through the above point is drawn parallel to the edge of the face. Similar projections of the celestial sphere have been used by the writer for studying the galactic distributions of star clusters and nebulae (Monthly Notices, R.A.S., vol. 71, p. 693). In all these examples the poles were placed in the median line of a face. It will be convenient to call this class the "inclined" projections on the cube, reserving the term "oblique" for the class in which the pole is not on the median line of a face.

The Washington projection referred to above cuts up the continents very awkwardly, and the same thing happens if one draws an inclined projection with London at the centre of a face. But by giving the cube a suitable obliquity it is possible to get a map of the world in which the principal land-masses are fairly well disposed on the faces of the cube,

Projection of Earth on inclined circumscribed cube.

Preliminary construction of equator and meridians on oblique circumscribed cube.

as in the sketch below, which is, I believe, the first example of the world map gnomonically on an oblique cube.

The projection has some interesting properties. All great circles are

Projection of Earth on oblique circumscribed cube, with circles of equidistance from London at each 1000 miles.

straight lines on the faces of the cube; and a great circle which passes through the centre of one face is parallel to the edge of the adjacent face. Hence it is very simple to draw the great circle from any point of the world to the place which is at the centre of a face. It is also not

hard to draw the circles of equidistance from that place : they are shown dotted on the sketch.

The great circle joining any two points whatever of the sphere can be constructed quite simply, and the great circle distance measured, as is shown in 'Map Projections,' pages 42 and 46.

The accompanying sketch has no claims to accuracy, the meridians and parallels being constructed by a graphical process which is fairly simple to effect, but tedious to describe. The outlines of the land masses are roughly sketched to show that they fall well in relation to the edges of the faces. If the projection is ever redrawn, the north pole should be shifted a little more to the right, when the representation of Central America will be improved.

I do not know that such a projection has any very useful applications. The time has hardly come for laying out great-circle air routes. But it might be useful in showing the ranges of high-power wireless stations ; and anyhow it makes a rather attractive little world map of an unusual kind.

Colonel Sir SIDNEY BURRARD : As I have no technical knowledge of this subject, I find it rather difficult to follow three of the foremost experts and to say anything of use. I can speak only from the purely map-making point of view. Sir Charles Close has put forward a new projection, and he has explained it with that lucidity which has characterized all his writings, but I did not realize until Mr. Hinks spoke of it that it was the beginning of a new class of projection. It will probably in future be known under the name of "Close's Projection." As far as I understand, Mr. McCaw has made a new modification of an old projection. I think he has introduced an arbitrary change, and I understand the justification for that is that he has reduced the errors. It would be very interesting to distant readers who are unable to be present this evening if, in dealing with his errors, he could also give them in terms of the errors we generally employ in mapping. We know we can plot to within one-hundredth of an inch, and draw a pencil line to within one-eightieth part of an inch, but I do not know what magnitudes of error Mr. McCaw was dealing with from the mapping point of view. With reference to his arbitrary change, when I have had to attend conferences on this subject I have met with certain projections which are called "quasi," and I have never quite known what "quasi" meant. One of our projections in India is called the "quasi," and our mathematical adviser told us that the mathematicians apply the word when they have been doing something which is not quite above board. As Mr. McCaw has introduced a modification, I thought I would take the opportunity of asking, "Is it 'quasi'?" Mr. Hinks greatly excited my interest when I saw he was reading a paper on the projection used by the Allies, but he did not tell us what was the solution of the problem—that the Artillery wanted a map covered with squares. Many years ago we were called upon to cover the Punjab with squares. If two lines on the surface of the Earth are parallel they cannot both be straight, and if they are both straight they cannot be parallel. Is the Artillery problem the same?

Colonel E. M. JACK : The only thing I would say is that it was not simply a matter of covering a map with squares, but providing a complete system of co-ordinates all over the area. We started with an arbitrary system of squares