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### COMPREHENSIVE WALL MAPS\*

A considerable progress has been noted in the design of maps and atlases in many countries of the world over the past years. A new generation of geographical reference maps has been brought out, in which land cover replaced the earlier hypsometric tints. Atlases have been redesigned so as to bring them nearer intellectual requirements of the contemporary map user, to stir his imagination and to widen the sphere of his interests. In teaching an increasingly great stress is being laid on diapositives, diamaps and films to enable the learner to watch ties existing between environmental elements and their dynamics. On the other hand, one can hardly notice any advance in the design of thematic wall maps, extremely important in our opinion. There is more than only one reason for this. Production of wall maps is expensive while the programme of geography in Polish schools requires, for instance, that some eighty of such maps are used, most of them being thematic maps (seventy to eighty per cent). The using of more than only one map during lesson hours, and this will be quite normal in some classes according to the subject discussed, may encounter some serious difficulties unless special class-room is used for the purpose. Certain thematic wall maps are being replaced not without success by the new general geographical maps; others by atlases, diamaps, diapositives and films.

It seems, however, that none of these substitute forms can drive thematic wall maps out of their normal use, from schools in particular. What characterizes a wall map, among other things, is the impression it leaves behind in the subconsciousness of an individual; it will often suffice to have only a glance at hanging-down map to impress information contained therein in one's mind, particularly when the onlooker

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\* The article has been based on the experiences of the Chair of Cartography of the University of Warsaw. The maps (Fig. 1—9, see the cover pocket) were prepared by the Division of Cartographic Reproduction of the Chair of Cartography of the Faculty.

is someone with the visual memory. This feature of wall maps cannot be compensated by any other means of geographical information. Hence, instead of eliminating thematic wall maps we ought to ponder on how to modernize them, similarly as other cartographic instruments. To modernize means to reduce maps in their number while retaining, at the same time, amount of information they had before. This is by no means an easy problem to solve, as the amount of information continues to remain a function of the scale and legibility of a map. New methods must be sought therefore in framing the contents of maps, new principles of choice and new ways of graphic expression. It seems as if one of the ways leading to a new type of wall maps would be a more comprehensive approach to the coding of their content.

The notion of a "comprehensive map" has been in use in cartography for more than fifty years now. Different constructions and definitions have been, however, put on it. According to the *Multilingual Dictionary of Technical Terms in Cartography*, the comprehensive maps is defined as "representing two or more classes of phenomena and their inter-relationships". In L. Ratajski's opinion (1973) comprehensive maps "include a number of phenomena inter-related to each other through functional ties, or such a choice of essential elements as help to explain, by the presence of one phenomenon, the existence of another one . . .". A Robinson (1978) thinks that a comprehensive map is a map that "is concentrating on the spatial variations of a phenomenon, or on the relationship between phenomena". According to H. Bobek and G. Jensch (1970), comprehensive maps point to certain essential features of the objects and to relations existing between them. K. A. Salistchev (1957) thinks that "comprehensive approach consists in pointing out the whole of all physical as well as social and economic phenomena as they occur within a specified geographical space". Rodoman (1959) has defined comprehensive maps as "maps combining several thematic maps under one cartographic presentation. All these maps are therefore multiple-subject maps in which each subject can be viewed separately owing to a variety of methods applied in the presentation and copiousness of the graphical means". According to the approach to the presentation of components, Rodoman draws the following lines of division between comprehensive maps:

- 1) Polyelementary maps which combine in themselves contents of several (i.e. analytical) elementary maps;
- 2) Polysynthetic maps which combine in themselves contents of several synthetic maps;
- 3) Elementary-and-synthetic maps.

From these few quotations and opinions one can easily find how serious the differences in understanding the term "comprehensive map" are, and that these differences apply both to the very heart of the notion as well as to its scope. It would be, in fact, hard to say whether the "superposing" elements of the content are designed to bring mutual relations among components to the fore, or to help disclose such relations. Highly controversial is the scope of the notion itself. Is the comprehensive map to be understood as a map in which "the entirety of phenomena of the particular geographical space" or "only diverse aspects of one and the same phenomenon" have been presented.

It might seem rather useless to try to formulate a definition for maps whose methodology is right under a process of evolution. Nevertheless, it would be wise to attempt to say with some more precision what sort of construction is to be put under the notion of a comprehensive map. At the Chair of Cartography, Faculty of Geography and Regional Studies of Warsaw University, a comprehensive map is understood as "a map designed to inform, in detail, about phenomena and effects of their presence in a manner offering possibly full characteristics of the theme". In other words, comprehensive map is a map of the kind in which the fullest possible answer is given also to the last member of the set of questions: "what, where, how much, and why?". But even this definition lacks clarity. As a matter of fact, it does not allow us to say whether a particular map ought to be classified under comprehensive maps or not. This is however a direct result of the peculiar gist of cartographic presentation, a consequence of the map being more complex in its character, where a number of items and phenomena—usually such as they remain in mutual relation towards each other—are presented. But from such a notion there result certain requirements likely to be met by a comprehensive map; notably, it will be necessary that such a map should expose inter-relationships existing between objects or phenomena presented therein. The choice of essential elements, i.e. their "completeness" or complexity, will chiefly depend on the map scale. The choice of indicators/indices and the way of approach to the presentation of contents, on the other hand, will depend on the particular map application.

With that in mind, a number of comprehensive maps have been designed under the direction of the scientific workers in the Chair of Cartography, as students' diploma papers, over the past decade, and these maps can roughly be divided into two groups. The first group includes maps of the following regions:

1. *Mapa kompleksowa Australii* (A comprehensive map of Australia), scale 1 : 4 000 000, by G. Piotrowska-Baranowska, 1973;
  2. *Bliski Wschód* (Near East. A comprehensive map), scale 1 : 3 500 000, by J. Książak, 1973;
  3. *Francja* (France, A comprehensive map, scale 1 : 1 000 000, by E. Wójtowicz, 1978;
  4. *Obszar Śródziemnomorski* (The Mediterranean Region), scale 1 : 1 500 000, by M. Podgórski, 1978;
  5. *Republika Południowej Afryki* (The Republic of South Africa). A comprehensive map, scale 1 : 1 500 000, by K. Sibińska, 1979;
- Another Group includes economic maps:
6. *Hutnictwo żelaza na świecie* (Ferrous Metallurgy in the World), scale 1 : 20 000 000, by P. Kowalski, 1976;
  7. *Ropa naftowa i gaz ziemny* (Crude Oil and Natural Gas), scale 1 : 20 000 000, by J. Berdek, 1977;
  8. *Mapa przemysłu Wielkiej Brytanii* (Industrial Map of Great Britain), scale 1 : 1 000 000, by T. Petlak, 1977;
  9. *Energetyka Polski* (Poland's Power Industry). A comprehensive wall map, scale 1 : 700 000, by E. Bolesławska, 1981.

In the Map of Australia an attempt was made to combine in it the main features of the reference and economic maps, traditional in their character. Since the number of features was such that it would be hard to accommodate them all in one map, should the latter remain legible enough, some of them had to be approached synthetically. The climatic, vegetable and agricultural zones shown by chorochromatic ditions, may serve as an example of such a synthesis. Orography was technique, i.e. colours imitating the actual landscape and natural conomitted in this case, as it failed to secure clear-cut boundaries for colonization and transport, well perceivable from the map. The Australian Alps do however constitute a climatic and vegetable barrier, as shown by the zones marked on the map. Industry and transport have been shown in an analytical form, by using adequate signs and diagrams to identify centres of the mining and processing industries. It is, on the other hand, animal husbandry which is rather poorly legible from the map. This applies, in particular, to the breeding of sheep, which performs an important function in the Australian economy.

Another example of a comprehensive regional map is represented by the Map of the Near East, showing natural and anthropogenic elements of geographical environment in an analytical form. The peculiar character of this region made it that elements of content, other

than those in the Map of Australia, had to be exposed. Two facts are known to have dominated the natural and anthropogenic landscape of the Near East, namely the shortage of water and the abundance of crude oil, and this has been brought out in the Map by means of the well-balanced graphics. The first of these moments by exposing orography which forms natural barriers to the displaced air masses, influences directions of their flow, has its effect on the spatial position of deserts and semi-deserts produced as a result of climate, orography and geology, sets regimes of rivers, and causes the man to „improve” the nature itself by watering the land. The other moment, i.e. crude oil resources, is emphasized by relevant graphical means, too. More attention has been devoted also to agriculture and to some useful minerals. Little has been told, on the other hand, of the processing and manufacturing industries which — apart from petroleum refineries and other smaller processing centres of Israel, Egypt and Syria—have never reached any distinguishable levels.

Because of a rather skilful selection of the elements of content, users of this map may by way of associations and deductions draw a number of conclusions, provided of course they are conversant with the rudiments of geographical science, viz:

— Conclusions concerning established climatic zones, drawn from the characteristic flora of the region, peculiar position of deserts, and from the course of flowing rivers;

— Conclusions concerning the movement of humid air masses, drawn from land relief and from the characteristic position of arid areas;

— Conclusions concerning the farming world, drawn from the layout of areas watered and from the species of crops cultivated;

— Conclusions concerning natural resources and, in association with the former, also conclusions concerning reasons for the specific scattering of population and types of economy existing in particular countries of this part of the world;

— Better comprehension of the popular term “Fecund Crescent”.

Also environmental and anthropogenic features have been presented, in an analytical form, in the Mediterranean Map. Colours and patterns as well as shadowed contour lines (land relief) and linear signatures (river-flow regimes), have been used in this case to show natural complexes of the habitat. Following general principles of semiotics, colours have been selected so as to fit well features they represent. A dozen or so distinguishing marks have been introduced to underline anthropogenic components of the environment, such as the level of advancement in farming and in some chosen branches of industry,

attractiveness of the region from the tourist point of view because of its landscape and natural qualities as well as remnants of the material culture inherited after ancient civilizations, quite numerous in this part of the world. The region, as this can be seen from the map, proves highly diversified from the environmental point of view, diversified being also the ways in which natural resources of this region are exploited. That is why so many characteristics must have been introduced in the map, somewhat diminishing its overall clarity worsened yet by the very low generalization of contents. Nevertheless, a keen observer will be in a position to reveal a lot of interesting pieces of information about the region itself, and deduce a number of conclusions about elements of the local climate, about reasons for the specific pattern in the occurrence of deserts and semi-deserts, about the character of economies in various countries, natural and historical backgrounds of colonization in this part of the world, etc.

In the Republic of South Africa map we find characteristic features of this region, provided in an analytical and synthetic form. The potential natural vegetation, forming colourful background of the map, is just the synthesis referred to above. Presentation of the potential natural flora seems extremely purposeful, for much of the Republic has undergone relatively small anthropogenic changes. The use of shadowed contour lines in representing land relief helps draw conclusions about weather conditions and trends observed in agriculture. As the extracting and processing industries play an important part in the South African economy, next to farming (animal husbandry), special emphasis has been laid on the existing mining areas and on the processing-industry centres, marked with symbolic signatures and colour diagrams to show the number of the so-called theoretical employees in particular branches of industry (the indicator of theoretical employees was devised by L. Ratajski, 1966, and represents a product of the actual number of employees times average productivity index).

Quite different editorial premises have been assumed when preparing the Map of France. The habitat of France is known to have undergone a process of deep changes as a result of economic activity of man, so that all basic sectors of the national economy are there well and more or less uniformly advanced. Some extra problems in working out the concept of the map came from the highly advanced diversification of the environmental conditions, hypsometric conditions in particular, and from the non-uniformly located anthropogenic structures. Under these circumstances, it became necessary to analyse, rather

accurately, particular components of the environment to find out what their mutual relations were. As a result of these considerations, the most essential areas of the crop land were found to occur throughout the country five hundred metres above sea level at the highest, and so the grey-scale pattern was adopted to present the hypsometry of the land according to the principle "the higher you go the darker will it be". Heights up to five hundred metres were thus left white to render it possible to colour the crops according to their intensity, applying the chorochromatic method. Towns were presented by using graduated or continuous circle diagrams according to their overwhelming functions. The remaining elements of economy, such as centres of the mining industry, transport, power industry and petroleum refineries, took the form of quantitative presentations related to dots and lines. Information about environmental conditions (nature), apart from hypsometry already mentioned, can be deduced from the map and by the analysis of the characteristics of the anthropogenic elements, such as e.g. information about the extent of Mediterranean climate from olives grown in the region.

The Map Ferrous Metallurgy in the World seems to be the first attempt to provide a complex cartographic presentation of the subject by a wall map. The intention of map makers was to show the phenomena in their actual relationship as resulting from functional associations and from such a selection of the elements of content as to help explain the occurrence of one phenomenon by the existence of others. The three basic elements of the map content, i.e. steel production, iron ore and coal output (hard coal) have been calculated by the method of the relevantly graduated diagram. To make the map complete, qualitative signatures have been introduced to show the centres of cast steel metals extraction and production of steel per capita according to individual states, or economic regions of the world, using the choropleth method. The issue of trade in the iron ore and ferrous products (exports and imports by paired countries) has been presented in the form of flow diagrams. Projection of the Map was identical with that in the *Atlas Świata* (Atlas of the World) published by PWN (State Scientific Publishers) and Topographic Section of the Polish Army, (Warsaw 1962), ensuring greater graphic capacity in the moderate latitudes. In areas with a particular concentration of the phenomenon (Central and Western Europe; United States, N. E., Japan) inset maps, scaled 1 : 7 500 000, have been added. The map in question presents ferrous metallurgy in the form of six quantitative characteristics, complementary versus each other, supplying a rather comprehensive and complete

image of the metallurgy and its position in the world so as to help the reader in understanding the gist of information being conveyed much better.

Similarly novel in its character proves to be the comprehensive wall map Crude Oil and Natural Gas. It exhibits a worldwide approach to the theme, using four quantitative and three qualitative characteristics. The oil-bearing and gas-bearing sedimentation basins, those already in existence and the prospective ones, and the principal oil and gas extraction areas, form the very content of the map. Against such a background, graduated diagrams have been plotted to identify areas in which oil and gas are mined. While following the principle of the isomorphism of form, diagrams took the shape of trapezoids symbolizing boring towers. Graduated-circle diagrams were introduced to show oil refineries in operation, and their capacities. The main directions of oil transport (trade) may be studied from the flow diagrams. The map includes descriptions of all the areas in which oil is being produced or processed. Inset maps have been added for areas of an intense concentration of the phenomena, such as e.g. the United States in their eastern part; Central and Western Europe, Near East, or Japan. An identical projection as that used in the former map helped to extend the moderate-latitude areas and to reduce graphical loading in those regions where the intensity of the phenomenon was the greatest. Extremely suggestive is the manner in which particular elements of the map contents are being brought to the fore. Thanks to colours varying in their intensity, and contours changing proportionally to the size of signs, the map makes the impression as if having the third dimension. The more important themes seem to come much nearer as if they were going out of the map. This is really an unprecedented cartographic work, comparable only with a few other publications in the world. (The nearest in form is perhaps the German Publication *Bergbau und Industriegebiete der Erde*, 1:15 000 000, VEB Hermann Hack, Gotha, Leipzig, 1961).

The Map of Great Britain's Industry is another example of an attempt made to solve cartographically the problem of an economic wall map, very narrow in its thematic scope. It tackles the problem of British Industry in the fullest possible, complex manner. The main idea of the venture was to present the whole cycle of economic processes which usually accompany each industrial activity. These processes form a logical chain of events: the supply of processing centres with the power-generating raw materials; transformation of raw materials by manpower; delivery of the end product and its distribution. It



is the transport that links relevant components of this process. Industrial production is the most important element of the map. While taking into account requirements posed by the visual method, it has been classified into seven categories according to existing similarities, associations, levels and trends likely to follow. As regards production levels, they have been shown by means of the so-called "theoretical-labour indicator" in respect of the nine, generally approved, economic regions of Great Britain. Each of these regions is represented by a fragment of the diagram, annular in shape, showing an industrial pattern of the particular regions. All those parts taken together form a large ring depicting the level of British industrial output. Mining industry, approached identically as the other eight categories, has additionally been enriched by an illustration added to show the distribution of mineral resources. To show connections existing between manufacturing industries and the power industry, the latter being classified under the sphere of services in Great Britain, the authors of the map instead of taking the electric power production as a basis for diagrams referred to the consumption of power by the processing industries, in terms of hard coal having been utilized. To underline disproportions in the industrialization of the country, the main industrial areas have additionally been marked on the map. Thus the less important industrial centres could be left out in places where concentration of the industry was the highest. The picture of the country has been made more complete through diagrams added to show the actual employment figures for the most important industrial centres and manpower of the dominating branch of industry. Information has also been furnished about the share various industries have in the industrial output of the region and the country taken as a whole. An attempt was made to furnish overall characteristics of the centres themselves and to provide illustration of industrial activation of the regions and concentration of industrial workers within the territory of Great Britain, and indirectly also production pattern. The image has been made more complete through elements of transport added to the map in the form of the network of major roads and the most important railway lines, main ports and pipelines. A supplement to the map includes foreign trade balance sheet and data concerning imports of raw materials, fuels and basic materials, as well as exports of industrial goods according to regions. Signs used in the map are of traditional design. Somewhat less typical, though simple, appear diagrams illustrating how big particular economic regions are and what the consumption of energy is. Concentric position of ring

segments shows their mutual relations. All segments taken together make two full rings, each of them representing hundred per cent of a feature under consideration in all-nation terms.

Another attempt to this effect, though much narrower in its thematic approach, was made in the Map called Poland's Power Industry, Comprehensive Wall Map. This is an all-round presentation of power industry in Poland, including problems of power generation, transmission of electric power and its applications. A hydrographic network, more important towns and administrative boundaries of the country form a characteristic background of the Map. The method of extents, using signatures and a continuous diagram, informs us about actual raw-material resources, their occurrence and output. Production figures have been referred to relevant basins. Installed capacity of the power plants, fuel consumption, energy production, and the cost per one kilowatt of the produced energy illustrate the level of output. All this has been expressed by means of two three-dimensional diagrams, 30 individual diagrams altogether, in which both the size and the colours are meaningful. The extraadded rectangular prism and cube, when put together, provide a signature in the form of a factory building, quantitative in its character. This adds to the pictorial character of the presentation. Where power stations come up in greater numbers, they have been shown by giving also the number of plants in operation. A choropleth map has been introduced to explain how and where the energy is consumed (energy consumption per capita by provinces). Details concerning transmission lines, boundaries of the administrative power-regions, as well as the balance of trade for energy supplied to, and received from, other countries, supplement the map information. Inset maps added show in detail the image of the Main Industrial Region (GOP) scale 1 : 250 000; scale 1 : 3 500 000 was used to underline one of the most serious environmental aspects, notably harm having been done by power industry to the habitat in Poland, as a supplement showing concentration of sulphur dioxide in the atmosphere in various parts of the country.

Maps of the world and particular world countries are an expression of the overall tendency to render the presentation more complete through the addition of some new, usually neglected or ignored, thematic aspects which prove in themselves to be extremely important for the comprehension of the subject-matter. The specific position of wall maps comes here well to the fore.

The size of the cartographic sign on the maps where only the non-scale symbols may be used will depend on the manner in which the

particular map is expected to be utilized, and not upon its scale. This is why signatures in the pocket and atlas maps are, as a rule, one to two millimetres high and those in the wall maps are more than five millimetres. To make them larger than this, or not, will only depend on the significance of the particular reference items, on the author's intention, etc., but not on this whether we have to do in the given case with a map of the state, region or world. In the case of thematic wall maps scales are much greater than those in the small-scale thematic maps for desk uses (pocket maps and atlases). In practice, it will be very seldom that wall maps will be smaller in size than one square metre and a half.

To give an example, the scales as used in the thematic maps forming part of the *Atlas Geograficzny Polski* (Geographic Atlas of Poland), published by the PPWK-Warsaw in 1978, are usually 1:4 000 000. A signature 2 mm × 2 mm, i.e. 4 sq. mm in size, would occupy in them a twenty and fifth of their unit area (one square centimetre of the map). In a 1:700 000 wall map, on the other hand, a minimum signature of 5 mm × 5 mm, i.e. 25 sq mm in size would take only 1/130 of the area corresponding to the unit area assumed. Scales applied to atlas maps of the world tend to range between 1:100 000 000 and 1:200 000 000. In a 1:20 000 000 wall map, a minimum signature of 25 sq.mm could occupy 1/100 and 1/400 of the area, referred to as the conventional unit area of the map, respectively. This would increase considerably "thematic depth" of the map, and combined with the skilfully handled „reading plans" likely to be used to their full extent precisely in the wall maps, could offer quite unique potentialities seldom exploited in cartography so far. With this in mind, we can afford to present the theme on a corresponding level of synthesis so as to combine characteristic graphic expression of wall mapping technique with the pictorial side of the work so very important for the efficacy of a medium of information.

Each of the above-mentioned wall maps in which their subject matter has been presented in a wider or narrower, but nevertheless well comprehensive, manner exhibits no doubt some didactic qualities. As a matter of fact, they are intended for map readers on a university level, specially prepared and educated for this purpose. They can, or rather they should, be used by economic, geographic, technical and commercial departments. Versions somewhat simplified in their context and having less details could, at the same time, successfully serve the secondary school boys and girls, in their programmes of learning. Unlike the so-called chorographic or economic reference maps, the former

ones concentrate on the specific and most characteristic properties of the region, which have been brought out by cartographer on the map (the so-called comprehensive reference maps), or on a selected well-presented and documented problem, furnishing details of its actual state and geographical layout in the context of essential complementary features (the selected-theme comprehensive maps). In our opinion, this creates extremely advantageous conditions for visual memorization of map contents in both cases.

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