by Olivier Y. Dottin

The Commission for the Geological Map of the World at cartographic crossroads

The past, present, and future of an IUGS affiliate responsible for mapping the world

Organized in 1881 to create a geological map of Europe, the Commission for the Geological Map of the World (CGMW) later expanded its purview to include all the continents and ocean basins. CGMW is well known for its elegant, small-scale geologic and related thematic wall maps, most of which were produced using conventional cartographic techniques. Because the traditional cartographic process has been modified by the use of satellite imagery and computers, detailed large-scale maps and general small-scale maps will serve very different needs in the future. New maps published by the CGMW will respond to the need for regularly updated information, and they will continue to fill a vital role in the production of maps of the continents and ocean basins. (Ed.)

What is the Commission for the Geological Map of the World? Precisely what is its purpose? Except for familiar IUGS members, its Bureau members, and its direct collaborators who are well informed on the subject, the Commission is known especially in the worldwide geoscientific community for its small-scale maps and its biennial General Assemblies—a form of grand "rite" of earth science cartography. However, this is the visible, more spectacular part of the iceberg, the true nature of which I will try to unveil here.

The past

How a daughter can be older than her father and still hold an honorable position in the family

We all know that the International Geological Congress (IGC) is the oldest and most important worldwide meeting on the earth sciences. The Commission for the Geological Map of the World (CGMW) is almost as old, as it was at the 1881 IGC in Bologna that a group of geologists decided to create a scientific organization initially in charge of creating the Geological Map of Europe. From this small organization, the CGMW developed in 1911 into the form we know today. At the beginning, the Commission was in charge of preparing a legend that would be valid for the geological map of the entire world, as well as in charge of drafting of the corresponding model or maquette.

Because no adequate world geographic base was available at the time, the CGMW concentrated its efforts toward the preparation and publication of maps covering smaller areas. Seven Continental Subcommissions were created, one each for Africa, North and Central America, South America, Australia-Oceania, the USSR, South and East Asia, and the Middle East. Simultaneously, the original organization for the Geological Map of Europe pursued its coordination work for that continent. Later, collaboration with the Scientific Committee on Antarctic Research (SCAR) directed the creation of a Subcommission for Antarctica.

As the international geological community realized the need for thematic mapping at a small scale, the CGMW expanded quickly beyond the original continental theme for its mapping projects. Thus, over the years, the Subcommissions for Tectonic, Metallogenic, Metamorphic, Environmental, Sea Floor, and, more recently, Hydrogeological Maps were created within the framework of the Commission. Little by little the present structure has come into being, as shown here in figure 1, which has continental entries on one side and thematic entries on the other.

The International Union of Geological Sciences (IUGS) was created in 1961 in response to the need for an organization to coordinate international research programs in the field of the earth sciences. Quite logically, the older Commission for the Geological Map of the World became an Affiliated Organization at that time. However, of the 20 or so organizations affiliated with the IUGS, CGMW holds a position apart. No doubt this is because of its prior existence and history, but perhaps this is due also to the strong personality of some of its officers. Whatever the case, within the large IUGS family, CGMW has acted with a certain independence, probably thanks to partial financial autonomy. And the young spiritual father, IUGS, has not been too strict with his adoptive daughter in regard to this independence. Family spirit has remained strong over the years and is reinforced periodically during the International Geological Congresses and the CGMW General Assemblies.

The present

How a venerable institution should take stock of its activities and decide to dust off its techniques...and mentality

Officially, the purpose of the CGMW is to promote the development of geological mapping in general and, more particularly, to ensure international coordination for the preparation and publication of various earth-science maps of continents or the world at a small scale. In order to attain this goal, it has developed a rather rigorous structure that is summed up in figure 1. To recapitulate briefly, let me simply say that the CGMW has a President, a Secretary General (assisted by a Deputy Secretary General when finances allow), nine

SEPTEMBER 1989

Special CGMW Cartographic Projects:
- —Geological World Atlas (G. Choubert, A. Faure-Muret)
- —Tectonic Map of the World (V. Khaine, Yu. Leonov)
- —World Plate Tectonic Map (F.W. Dunning)
- —World Mineral Atlas (P.W. Guild, A. Emberger)
- —Geological World Wall Map (O.Y. Dottin)
- —Circum-Atlantic Project (IUGS/CGMW)
- —Map of Metallogenic Zoning of the World (D.V. Rundqvist/CGMW)

BUREAU
President: J. Aubouin (FRANCE)
Secretary General: O.Y. Dottin (FRANCE)
Deputy Secretary General: Ph. Bouysse (FRANCE)
Continental Vice Presidents
Presidents of Thematic Subcommissions
Secretaries General of Thematic Subcommissions

Statutory Members: National organizations responsible for solid earth science mapping of all the countries or territories of the world that adhere to CGMW aims; 152 Member Countries

Associate Members: Public or private organizations interested in and supportive of the CGMW's work; 21 Associate Members

CONTINENTAL SUBCOMMISSIONS	THEMATIC SUBCOMMISSIONS						
	GEOLOGICAL Continental Vice Presidents	TECTONIC Pres.: V.E. Khaine (USSR) Sec. Gen.: Yu. Leonov (USSR)	METALLOGENIC Pres.: K.M. Dawson (CANADA) Secs. Gen.: A. Emberger (FRANCE) M.P. Foose (USA)	METAMORPHIC Pres.: G. Desmons (FRANCE)	ENVIRONMENTAL Pres.: G. Lüttig (FRG) Sec. Gen.: F. Wolff (NORWAY)	SEA FLOOR Pres.: G.A. Chesher (UK) Sec. Gen.: J. Segoufin (FRANCE)	HYDROGEOLOGICAL Pres.: W. Struckmeier (FRG)
AFRICA Vice Pres.: G.O. Kesse (GHANA) Sec. Gen.: J. Sougy (FRANCE)	Coordinators: C. Choubert (FRANCE) A. Faure-Muret (FRANCE)	Coordinators: R.M. Shackleton (UK) J. Sougy (FRANCE)	Coordinators: A. Emberger (FRANCE) P.A. Traore (BURKINA FASO)	Coordinator: E.P. Saggerson (UK and THE NETHERLANDS)		Sea floor parts: J. Segoufin (FRANCE) A. Faure-Muret (FRANCE)	(OACT-Algiers, M. Safar-Zitoun)
NORTH AND CENTRAL AMERICA Vice Pres.: J.M. Aaron (USA)	(DNAG Project)	(DNAG Project)	Coordinator: P.W. Guild (USA)				
SOUTH AMERICA Vice Pres.: J.R. de Andrade Ramos (BRAZIL)	Coordinator: A. Bellizzia (VENEZUELA)	Coordinator: F.F.M. de Almeida (BRAZIL)	Coordinator: C. Martin F. (VENEZUELA)	Coordinator: F. Herve (CHILE)		Sea floor parts: C. Schobbenhaus (BRAZIL) and others	Coordinator: Nelson da Franca (BRAZIL–Unesco)
ANTARCTICA Vice Pres.: C. Craddock (USA)	Coordinator: Inst. Antarctic Studies (Leningrad)	Coordinator: Inst. Antarctic Studies (Leningrad)		Coordinator: Inst. Antarctic Studies (Leningrad)			
EUROPE Vice Pres.: G. Gabert (FRG)	Coordinator: G. Gabert (FRG)	Coordinators: V. Khaine (USSR) Yu. Leonov (USSR)	Coordinator: A. Emberger (FRANCE)	Coordinator: H.J. Zwart (THE NETHERLANDS)			Coordinator: W. Struckmeier (FRG)
MIDDLE EAST Vice Pres.: A. Haghipour (IRAN)	Coordinator: A. Aghanabati (IRAN)	Coordinator: (Seismotectonic map) A. Haghipour (IRAN)				Sea floor parts: A. Haghipour (IRAN)	
SOUTH AND EAST ASIA Vice Pres.: D.P. Dhoundial (INDIA)	Coordinator: A. Ghose (INDIA)	Coordinator: D.K. Ray (INDIA)	Coordinator: K. Kanehira (JAPAN)	Coordinator: Sang Man Lee (SOUTH KOREA)		Sea floor parts: A. Ghose (INDIA) J. Bannerjee (INDIA)	Coordinator: Dr. Pathak (INDIA)
USSR Vice Pres.: A.I. Zhamoida (USSR)	Coordinator: A.I. Zhamoida (USSR)	Coordinators: V. Khaine (USSR) Yu. Leonov (USSR)	Coordinator: V. Rundqvist (USSR)				
AUSTRALIA–OCEANIA Vice Pres.: K.A. Plumb (AUSTRALIA)	(BMR, Canberra)	(BMR, Canberra)	(BMR, Canberra)	Coordinator: W. Doutch (AUSTRALIA)			

EXPLANATION

Latest edition published — New edition partly published — New edition in preparation

Figure 1.—Organization and projects of the Commission for the Geological Map of the World.

Continental Vice Presidents, and six Presidents of Thematic Subcommissions, who together form the Bureau of the Commission.

According to the statutes, the CGMW headquarters is located in the country of residence of its Secretary General, which is now Paris (fig. 2). The Secretary General is, in fact, the center of an immense spiderweb network that covers the entire world, including both the continents and the ocean basins. A Secretary, appointed by the CGMW, works there fulltime with the Secretary General. Relations and liaison with the Continental Vice Presidents, Subcommission Presidents, Project Coordinators, and the geological surveys of the world are assured continuous service by correspondence, telephone, telex, and missions over six continents.

The Statutory Members of the CGMW include all the countries or territories of the world that have an organization in charge of geological mapping of their lands (national geological surveys or similar institutions). To date, these members number about 150. There are also about 20 Associate Members (petroleum or mining industries, government-run or private).

The CGMW meets every two years for its General Assembly; every other meeting coincides with a session of the International Geological Congress, which meets every four years. The Continental and Thematic Subcommissions meet whenever required by the progress on mapping projects, as do the Editorial Committees and Working Groups.

The existence of the CGMW is linked closely to the annual subscriptions of its Statutory Members and Associate Members, as well as to the proceeds from sales of its publications and the financial contribution of Unesco toward the preparation and publication of many maps. Unesco also partly finances the coordination meetings held regularly around the world. The French government, through the Bureau de Recherches Géologiques et Minières (BRGM), gives exceptional support by providing both an annual subsidy and, for many years, a geologist to fill the position of Secretary General. Thus, since its origin, the Commission has been able to survive and complete the preparation and publication of many mapping projects, which I will enumerate below.

A proliferation of new projects over the last four or five years has been confronted by an unfavorable economic state. The combined effects of the drop in the value of the U.S. dollar as compared to the French franc, the inability of some member countries to pay

Figure 2.—CGMW staff O. Dottin (second from left) and M. Adams (second from right) confer with BRGM geologists at CGMW's Paris headquarters.

their subscriptions, and the increase in map printing costs all have served to bring CGMW finances down to a critical threshold. A policy of relative austerity has been instigated, and this, so far, has not had too many adverse effects on the preparation and production of planned maps.

CGMW cartographic products are its main *raison d'être*, the best proof of its dynamism, and its best publicity around the world as well. After humble beginnings, the products have multiplied over the last two decades, during which the CGMW published more than 25 maps or series of maps. To date, the brightest feather in the CGMW cap is the Geological World Atlas in 22 sheets (fig. 3), which covers the continents and ocean basins and has bilingual explanatory texts. Production was completed in 1984.

In addition, tectonic, metallogenic, metamorphic, hydrogeological, and other maps have been produced for almost all of the continents. Obviously, a geological map is never truly completed, and the emergence of new techniques, new theories, or new vogues that promise to be durable, as well as recent geological syntheses in many countries, requires preparing a new edition of a map as soon as the preceding one comes off the press. The "life span" of a small-scale earth science map has been calculated to be about 12 to 15 years. This life span is determined by taking into account new data as enumerated above, as well as simply the depletion of stocks.

Thus, the CGMW presented at its 1989 General Assembly parts of the third edition of the Geological Map of Africa at 1:5,000,000 planned for 6 sheets. Apart from its regular "continental" programs, the CGMW has undertaken a few projects on a worldwide scale, some of which have been produced already or are about to be produced. Besides the Geological World Atlas mentioned above, I will mention the Geological World Wall Map, the World Mineral Atlas, the Map of Metallogenic Zoning of the World, and the Circum-Atlantic Project, this last project being cosponsored by IUGS and CGMW and planned along the lines of the partly completed Circum-Pacific Project. Table 1 also lists the maps recently published under the sponsorship of the CGMW. On reading it, one may note that all the continents already have been covered by maps including most of the CGMW themes. The maps in preparation have been omitted, notably the Geological World Wall Map (1:25,000,000, 2 sheets); the Geological Map of South and East Asia, third edition (1:5,000,000, 6 sheets); and the Geological Map of Africa, third edition (1:5,000,000, sheets 4 and 6).

Table 1.—Maps published under CGMW sponsorship

World	
Geological World Atlas	22 sheets (continents at 1:10,000,000; oceans at varying scales), general legend, introduction, and explanatory notes in French and English; index map; sturdy attractive red binder (ideal for classroom use); 1984, CGMW/Unesco.
Tectonic Map of the World	12 sheets at 1:15,000,000, explanatory notes, 1984, CGMW Subcommission for Tectonic Maps. 1 sheet at 1:45,000,000, 1984, CGMW Subcommission for Tectonic Maps.
Africa	
Geological Map of Africa	1:5,000,000, 3d edition, CGMW Subcommission for Africa/Unesco. Sheets 3 (1985), 5 (1986), and 2 (1987) available.
Mineral Map of Africa	1 sheet at 1:10,000,000, explanatory notes, 1969, ASGA/Unesco.
Metamorphic Map of Africa	1 sheet at 1:10,000,000, explanatory notes 1979, CGMW Subcommission for Metamorphic Maps.
Tectonic Map of Africa	9 sheets at 1:5,000,000, explanatory notes, 1968, ASGA/Unesco.
North America	
Geological Map of North America	2 sheets at 1:5,000,000, 1965, USGS/GSA.
Metallogenic Map of North America (Preliminary Map)	4 sheets at 1:5,000,000 and 2 circulars, 1981, CGMW/USGS.
Tectonic Map of North America	2 sheets at 1:5,000,000, 1969, USGS.
South America	
Metallogenic Map of South America	2 sheets at 1:5,000,000, explanatory notes in English, Spanish, and Portuguese, 1983, CGMW Subcommission for Metallogenic Maps.
Tectonic Map of South America	2 sheets at 1:5,000,000, explanatory notes, 1978, CGMW/DNPM.
Antarctica	
Metamorphic Facies of Antarctica	4 sheets at 1:5,000,000, explanatory notes, 1980, Research Institute of the Geology of the Arctic, Leningrad.
Tectonic Map of Antarctica	1 sheet at 1:10,000,000, explanatory notes, 1978, Research Institute of the Geology of the Arctic, Leningrad.
Asia	
Geological Map of Asia and the Far East	2d edition, 4 sheets, explanatory notes, 1971, UN-ECAFE/Unesco.
Geological Map of the Middle East	1 sheet at 1:5,000,000, 1986, CGMW Subcommission for the Middle East.
Metallogenic Map of South and East Asia	4 sheets at 1:5,000,000, legend, 1985–86, CGMW Subcommission for Metamorphic Maps.
Metamorphic Map of South and East Asia	1 sheet at 1:10,000,000, notes, 1984, CGMW Subcommission for Metamorphic Maps.
Seismotectonic Map of Iran-Afghanistan-Pakistan	1 sheet at 1:5,000,000, notes, 1984, CGMW Subcommission for the Middle East.
Tectonic Map of South and East Asia	4 sheets at 1:5,000,000 and 2 sheets at 1:10,000,000, legend, explanatory notes, 1982, CGMW/Geological Survey of India.

Australia-Oceania	
Metamorphic Map of Australia	1 sheet at 1:5,000,000, 1984, BMR Canberra.
Europe	
Geological Map of Europe	49 sheets at 1:1,500,000, ongoing production, BGR Hannover/ Unesco.
Geological Map of Europe and the Mediterranean Region	2 sheets at 1:5,000,000, 1971, BGR Hannover/Unesco.
Hydrogeological Map of Europe	30 sheets at 1:1,500,000, explanatory notes, ongoing production, BGR Hannover/Unesco.
Principal Mineral Deposits Map of Europe and Neighbouring Countries	1:18,750,000 (36 x 29 cm), 1986, AMS/BRGM/CGMW/Unesco.
Metallogenic Map of Europe	9 sheets at 1:2,500,000 and deposits list for each sheet, 1968–82, BRGM/Unesco; explanatory memoir, 1984.
Metamorphic Map of Europe	17 sheets at 1:2,500,000, explanatory notes, CGMW/Unesco.
Metamorphic Map of the Alps	1 sheet at 1:10,000,000, explanatory notes, 1978, CGMW/Unesco.
Tectonic Map of Europe	1 sheet at 1:10,000,000, 1979, USSR Academy of Sciences, Moscow.
International Tectonic Map of Europe and Neighbouring Countries	20 sheets at 1:2,500,000, 1980–81, CGMW Subcommission for Tectonic Maps/Unesco/USSR Academy of Sciences, Moscow.

The author apologizes for this long and boring enumeration of products, but it is important that the CGMW justify its existence by products other than international meetings and scientific articles. Publication of these cartographic products constitutes the best justification for the use of funds obtained from the sources mentioned above.

Years have passed, however, since the first CGMW cartographic products were published, when the well-oiled mechanism of the system was established from the initiative, conception, choice of scale, choice of legend, contribution of the working group, elaboration of the maquette, and its acceptance to the printing and distribution. This familiar progression has led gradually to a routine that is dangerous because it has a tendency to encompass the work in a closed system without sufficiently taking into account the evolution of new principles and techniques. In the end, competition outside the CGMW system has forced a change, and it is time to react!

The future

How an aging lady gets an overall lifting and opens her eyes to techniques of the future, all the while wondering if she will have the means to carry them out

Until now, the CGMW has prepared and published its cartographic products according to classic and time-tested methods, which geological cartographers familiarly call "Daddy's cartography." In this method, the maquette was drafted from syntheses already prepared for each country of the continent in question. Necessary readjustments were made in order to standardize the whole and to erase, as much as possible, the disparities in geological knowledge from one country to another. A specialized drafting office then took over the maquette, considered "definitive," and hand-carved the various elements on separate plates, such as black lines, type, and colors, in order to prepare for printing.

Now, the use of satellite imagery can give maquette refinement a boost forward. Remote sensing provides the chance for the "small-scale" cartographers that we are to observe our continents with the distance required to understand better the overall structural arrangement of a region or a continent, shown previously on the maps as dotted lines by each of the countries collaborating on the work. However, no doubt thanks to her great age and thus her long experience, the old CGMW lady held back from the wild enthusiasm that won over some of her colleagues, who tended to consider the use of satellite imagery as a universal panacea. One saw here and there the production of superb cartographic spider webs that represented structural maps seen by satellite but that were devoid of reasoned interpretation. More wisely, at CGMW we prefer to consider satellite imagery as an instrument, never as an end in itself, and to use it for verification, as a complement, or sometimes as an explanation of structural data previously established by fieldwork. Thus, our future tectonic maps will use Landsat, SPOT, and, we hope, Cosmos photos (the first of the program being Africa, second edition) to combine completely known ground data and new satellite-imagery data, unidentified on the ground but still credible. The viewing distance given by the scale of our maps (1:5,000,000) certainly allows a dose of extrapolation and artistic blur, but not to the extent of accepting as gospel the supposed lineaments that could well be artifacts or even construction work, such as the alignment of a highway.

The production of modern maps bears witness to the end of an era as a result of techniques linked to computerization. This phenomenon was named "The quiet revolution in mapping" in a remarkable article appearing in the "U.S. Geological Survey Yearbook, Fiscal Year 1979." The two most recent CGMW cartographic productions, the Geological World Wall Map at 1:25,000,000 scale and the Geological Map of South and East Asia at 1:5,000,000 scale, benefit from this quiet revolution. Graphic elements were digitized and an electronic scanner delineated colors. Graphic digitization will allow both greater speed in the preparation of plates for printing and for the later production, at low cost, of various elements of the map at any scale and in any projection system. This also will allow for progressive updating of the map with a view to preparing a new edition later. Electronic scanning of the colors will allow low cost editions of various thematic maps after initial publication, for example a map of the Upper Cretaceous of such-and-such a region, a map of recent volcanism, or a map of the Precambrian of this or that continent.

Contrary to what we had hoped, use of these new techniques at the editorial stage of mapping has turned out to be at least as costly as the classic techniques—we still do not dare say former. Only at the stage of later applications, which we have just described, can computerization of data be considered as a good investment. This assumes that the market for thematic maps derived from the general map is as wide as that of the general map itself, a condition that remains to be proved.

The "quiet revolution" also has the secondary effect of transforming what has been considered a sort of work of art into a very prosaic work tool. We will no longer speak of a "beautiful geologic map," as the choice of tints, balance of colors, layout of the legend, or curve of certain tectonic lines will not be the major concern of "map makers" today—and even less so tomorrow. One will be more appreciative of the precision of data and, even more, the fact that the data are very up to date. This is not to be regretted. At most, CGMW will try in the coming decades to maintain a certain equilibrium between producing works of art and producing working docu-

ments. The new Geological Map of Africa at 1:5,000,000 scale, now in preparation, seems to us to be a model of this kind, but one difficult to maintain. We will try to keep the best of both methods in the great cartographic projects in the works at CGMW, such as the World Mineral Atlas and the Circum-Atlantic Project of IUGS co-sponsored by CGMW. The geologists for whom intensive use of computerization will not have killed all artistic sense will tell us if we have succeeded.

Conclusion

Is there a future for "classic" earth-science maps?

We have tried to demonstrate that the CGMW, placed at a cartographic crossroads, has chosen resolutely the direction toward the "quiet revolution." However, it is there that the quietness of our

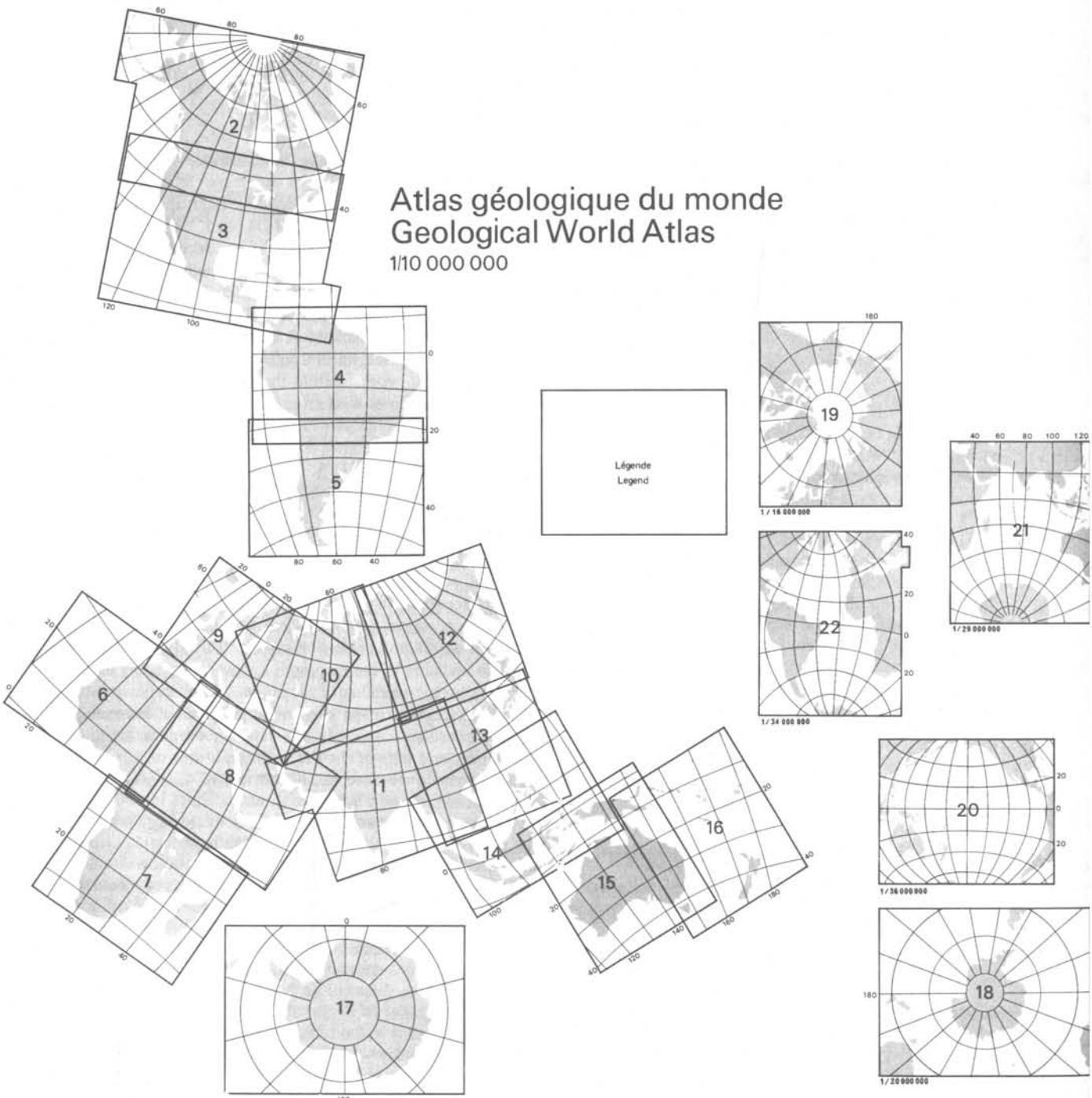

Figure 3.—Atlas géologique du monde/Geological World Atlas at a scale of 1:10,000,000 and other scales as shown.

Commission risks being greatly tried. Indeed, the future evolution of earth-science cartography must be examined in light of two aspects, detailed maps and general maps.

Detailed or large-scale maps always will be primarily working tools, just as they are now. For this reason, they are destined to evolve very quickly and even to be replaced by computerized products. Independent from national programs for regular mapping projects, these computerized products will no longer be concerned mainly with the two-dimensional representation of data on a sheet of paper or even on a screen. Instead, these two-dimensional forms will have a tendency to be replaced gradually by data banks at every level—in the field, in the laboratory, and in partial or general geographic syntheses. Many geological or mining surveys around the world have understood the problem well and are computerizing their field and laboratory data. This problem obviously does not concern our Commission directly.

General or small-scale maps are the concern of the CGMW. Their use is unlike that of detailed maps. One can say that detailed maps fit on a table top (or on the hood of a jeep!), whereas general maps are for posting on a wall. For this reason, CGMW maps are distributed flat, never folded. Because of their vocation as a synthesis and the great areas that they represent on a small surface, general maps will escape, we feel, both short term and long term, from the destiny that awaits detailed maps. Comprehension of significant and large structural and geological phenomena can be done only with difficulty without a visualization of their component data. To accomplish the visualization of component data, the collection of data must be totally linked to the geographic distribution of the same data.

Therefore, we are resolutely optimistic about the destiny of small-scale earth-science maps, even in the distant future. The instructor, the multinational or international planner, the geoscientific philosopher—at least everywhere a geologist will be allowed to think—will always need to display a CGMW map on his classroom wall or lecture hall wall.

We think that the CGMW lady, over a century old, still has many good years ahead of her. We think that if she diversifies her cartographic themes gradually (a lot has been said lately at the Commission about sea-floor geology and natural hazards) and if she accepts, along with printed color maps ("fossilized" for years), "evolutive" maps (regularly updated and printed out on request), she will remain the only international organization to cover at small scales all the continents and ocean basins on documents both credible and precise.

All geologists and other friends of the earth sciences may contact CGMW (77 rue Claude-Bernard, 75005 Paris, France) to receive information about our work. □

Dr. Olivier Y. Dottin *has been Secretary General of the Commission for the Geological Map of the World (CGMW) since 1984. Educated in French universities (Toulouse, Clermont) and Geological Engineer at the BRGM, French Geological Survey, since 1961, he has devoted most of his career to the geological cartography of Madagascar, Brazil, Burundi, Cambodia, Zaire, Saudi Arabia, Syria, Nigeria, and France from 1958 to 1980. He has produced about 40 geological maps, alone or in collaboration, and the corresponding geological syntheses.*

FREE Sample Copies Available On Request

JOURNAL OF AFRICAN EARTH SCIENCES (and the Middle East)

Editor-in-Chief: **CORNELIUS A KOGBE**, *Rock View International, Tour Onyx, 10 rue Vandrezanne, F-75644 Paris Cedex 13, France*
Editorial Board: **Z R EL NAGGAR**, *University of Petroleum & Minerals, Department of Earth Sciences, PO Box 144, Dhahran 31261, Saudi Arabia,*
RICHARD REYMENT, *University of Uppsala, Paleontologiska Inst., Postadress Box 558, S-751 22 Uppsala, Sweden* and **JOHN J W ROGERS**, *Department of Geology, University of North Carolina at Chapel Hill, NC 27514, USA*

Aims and Scope

The *Journal of African Earth Sciences (and the Middle East)* is an international interdisciplinary journal devoted to all aspects of research related to the African continent and neighbouring regions. Papers incorporating the results of research on regional geology of the African cratons and mobile belts, economic geology, geophysics, structure, Quaternary geology and analysis of sedimentary basins are featured.

Submission of papers for publication is welcomed. Contributors should send three copies of completed manuscripts to the Editor-in-Chief or to any of the Editorial Board. In addition the journal includes book reviews, short notes and selected papers from the proceedings of conferences, symposia and workshops on any aspect of African geology and related subjects.

A Selection of Papers

C NYAMWERU (Kenya), Activity of Ol Doinyo Lengai volcano, Tanzania, 1983-1987.
C O DUBLIN-GREEN (Nigeria), Foraminiferal biostratigraphy and palaeoecology of Lower Cretaceous sediments of the South Atlas Basin, Western Morocco.
D S G THOMAS & P A SHAW, (UK), Late Cainozoic drainage evolution in the Zambesi basin: geomorphological evidence from the Kalahari rim.
G CIVITELLI (Italy), The Meso-Cenozoic sedimentary sequence of the Cabo Delgado Province, Mozambique.
E J L DIETVORST (Botswana), Early Precambrian basement uplift and block faulting along the western margin of the Bushveld complex, Southeastern Botswana.
O I OGUNSOLA & P C WILLIAMS (Nigeria), Particle size effects on compositional analyses of Nigerian tarsands.
S GUERRAK (France), Ordovician ironstone sedimentation in Ougarta ranges: North Western Sahara (Algeria).

Subscription Information

1989: Volumes 9 & 10 (8 issues)
Annual subscription (1989) **DM 650.00**
Two-year rate (1989/90) **DM 1235.00**
ISSN: 0731-7247

Advertising rate card available on request. Back issues and current subscriptions are also available in microform.
The German Mark (DM) prices shown include postage and insurance, and apply in Europe, Africa, Asia/Australasia (with the exception of Japan). For the rest of the world including Japan apply to the nearest Pergamon office. Prices and proposed publication dates are subject to change without prior notice.

Pergamon Press plc
Headington Hill Hall
Oxford OX3 0BW UK

Pergamon Press Inc
Fairview Park, Elmsford
New York, 10523 USA

8B/44/4/87