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IGCP Progress Reviewed

Paris, February 7-19, 1983

The 1983 annual meetings of the Board and Scientific Committee of the International Geological Correlation Programme took place in Paris recently. In his opening remarks to the Board the Chairman, G.O. Kesse (Ghana), referred to IGCP as a "healthy ten year old which has shown spectacular growth". He anticipated that the program would in the future become more concerned with the effective protection and utilization of the environment and with the more efficient identification and assessment of resources. He also referred to the need for better exchange of information and technology and increased involvement of scientists from developing countries.

The Chairman welcomed new Board members S.A. Alsinawi (Iraq), S. Aramaki (Japan), J. Corvalán (Chile), K.S. Heier (Norway), Ye Zhizheng (China), and V.A. Zharikov (U.S.S.R.). He also acknowledged the great contributions made by the IGCP Scientific Committee and its retiring chairman A.W. Bally (U.S.A.).

The Assistant Director General for Science at Unesco, A.R. Kaddoura, stressed the importance of the second Interim Report on IGCP, now being prepared for the period 1978-1982, in getting the message of the success of the Programme across to the General Conference of Unesco this coming fall. He urged that national and regional organizations be sent copies of the report so they could transmit to their delegates to the conference the relevance of IGCP to Unesco's own development activities. Dr. Kaddoura noted that the lack of funds is a continuing concern to Unesco and IUGS, but he made no optimistic forecasts and recommended that IGCP should seek the assistance of bilateral aid programs for projects which involve developing countries.

The Secretary of the IGCP, E. von Braun, reported that of the 50 ongoing projects in 1982, 15 had reached their final term. There were 17 proposals for new projects before the Board, 4 of them being re-submissions from the previous year. Since the last Board meeting, regional IGCP meetings were held in Buenos Aires, Nairobi and Bangkok, leading to 13 proposals for new projects, of which 7 had previously been submitted.

The IGCP Secretariat in 1983 plans to support regional IGCP meetings in Zambia and in Sri Lanka. Approval was also given to support the fourth regional IGCP meeting for Latin America and the Caribbean on the occasion of the 10th Caribbean Geological Conference to be held in Cartagena, Colombia, in August 1983. It was recommended that a meeting of Arab IGCP national committees should be held in 1984 in order to stimulate the participation of Arab countries in the program.

A.W. Bally reported that the Scientific Committee is particularly concerned with a number of gaps which it felt had developed in the overall structure of the Programme. The first of these involves the gap between continental and oceanic geology: the vast amount of data from the deep sea has been conspicuous by its absence from many IGCP projects

concerned with Mesozoic and Cenozoic geology. The leaders of the projects concerned with Jurassic, Cretaceous, Tertiary and Quaternary geology are encouraged to make full use of the data from marine geology and to integrate this knowledge with that from the continents.

The Scientific Committee also emphasised the importance of increasing the participation by geophysicists and the use of geophysical data and methodology in IGCP projects. IGCP should encourage more interdisciplinary projects, for example, those which utilize deep seismic profiles carried out as part of geotraverse projects. The Board stated that it would welcome projects involving geophysics, as for example in studies of comparative tectonics, stratigraphic relations and the correlation between continental and oceanic geology. In order to emphasize its multidisciplinary and international aspects, the Board proposed changing the name to the "International Geological Cooperation Programme."

The following 11 new projects were admitted to the program:

- No. 165 "Regional Stratigraphic Correlation of the Caribbean" under Project Leader J.I. Yparraguirre Peña (Cuba);
- No. 196 "Calibration of the Phanerozoic Time Scale" - G.S. Odin (France) and N.H. Gale (U.K.);
- No. 198 "Evolution of Northern Margin of Tethys" - M. Rakus (Czechoslovakia);
- No. 199 "Rare Events in Geology" - K.J. Hsu (Switzerland);
- No. 200 "Sea-level Correlations and Applications" - P.A. Pirazzoli (France);
- No. 201 "Quaternary of South America" - H.H. Camacho (Argentina);
- No. 202 "Megafaults of South America" - F. Herve (Chile);
- No. 203 "Permo-Triassic Events of Eastern Tethys and their Intercontinental Correlation" - Yang Zun-yi (China);
- No. 204 "Precambrian Evolution of the Amazonian Region" - W. Teixeira and C.C.G. Tassinari (Brazil);
- No. 206 "Comparison of Active Faults" - R.C. Bucknam, (U.S.A.) Ding Guoyu and Zhang Yuming (China);

IGCP Project 156 participants examine Cambrian phosphorites in Queensland, Australia.

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- No. 210 "Continental Sediments in Africa" - C.A. Kogbe (France);

The IGCP Board concluded that the time is appropriate for Unesco to consider a new major development project with the theme based on the problems of the Quaternary and their crucial importance to mankind. The Board suggests that this should be organized as an inter-regional project on "The Quaternary - Geology for Survival". Among the many facets of surficial geology which are appropriate for study in this project are:

- Climate crisis prediction and water resources;
- Peat exploration and exploitation;
- Hazards and risks in unstable areas (rift valleys, marine invasions along shorelines, earthquakes, volcanic activity, etc.);
- Geothermal resources;
- Useful minerals such as ilmenite, zircon, diamond, gold placers and other sedimentary concentrations;

- Geochemical concentrations in weathered layers and their relation to geochemical prospecting;
- Soil studies for agriculture;
- Engineering geology.

The Board recommended that the organizational structure for such a project should include regional groups within the developing world and that it should also make use of the IGCP Board and Scientific Committee as monitoring bodies.

In view of the significant results obtained from remote sensing and their application to geological correlation over long distances demonstrated by IGCP Project 143, the Board also welcomed the proposed establishment of a joint Unesco-IGUS remote sensing program for geological applications.

*EPISODES Staff from reports by
the IGCP Secretariat and D.J. McLaren, Ottawa*

IUGS Executive Meets

Bangkok, January 26-29, 1983

The 1983 meeting of the Executive Committee of IUGS took place recently at the Asian Institute of Technology outside Bangkok, Thailand. In reviewing the activities of 1982 the Secretary General Dr. C.C. Weber, reported that he had made special efforts to strengthen contacts with French-speaking countries, particularly in west Africa, and applications for membership had been received from Burundi and Upper Volta. These were approved by the Executive Committee, as was an application for affiliation from the European Association of Science Editors (EASE).

The Secretary General had worked closely throughout the year with the Organizing Committee for the 27th International Geological Congress to be held next year in Moscow. Weber reported that he had encouraged the representatives of many countries to defend Unesco science programs such as IGCP. It had appeared that support for these science activities might be reduced in the Unesco Mid-Term Plan for 1984-1989, but as a result of many representations the outlook is now more encouraging.

The activities of the many commissions, committees, boards and affiliates of IUGS were reviewed by the Executive Committee, and summaries of a number of these are included elsewhere in this issue of EPISODES. The extensive activities of IGCP were reviewed by its Secretary, E. von Braun. The Union's other joint program, the International Lithosphere Program, has made good progress, with a total membership in its working groups and coordinating committees of more than 350 scientists. A newsletter and directory have now been issued.

The Chairman of the Commission on Stratigraphy, Prof. A. Martinsson, anticipated that a number of firm recommendations would be made on international stratotypes and boundaries at the 1984 Congress. The Subcommittee on Strati-

graphic Classification, for example, is continuing its work on formalizing the stratigraphic classification and nomenclature of igneous and metamorphic rocks and of unconformity-bounded units. It is also compiling a glossary of stratigraphic terms to be included in the next edition of the International Stratigraphic Guide. The Precambrian Subcommittee is considering a recommendation to separate the Proterozoic and Archean Eons at 2 500 Ma, with the Proterozoic subdivided informally into three Eras and eight Periods. The Cambrian-Ordovician Working Group has made an informal decision to draw the boundary at the base of the Tremadoc Series. The Devonian Subcommittee has selected a stratotype for the lower-middle Devonian boundary and agreed on a level for the middle-upper Devonian (see EPISODES 1982/4, p. 18-21).

IUGS Executive Committee and Observers, AIT, Bangkok

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The Permian Subcommittee has made significant progress selecting potential stratotypes in the U.S.A. and southern China, and another Subcommittee is working on an integrated time scale for the Triassic. The Jurassic-Cretaceous Boundary Working Group has fixed this boundary provisionally at two levels, one for the Tethyan Province and another for the Boreal realm (EPISODES 1982/4, p. 41). A new regional correlation chart has been produced by the Paleogene Commission and much work is being done on the Neogene. The Commission itself has decided to produce a first addition of a wall chart to illustrate a unified geological time scale.

The Executive Committee dissolved its Exploratory Working Group on Geology as Related to Human Problems, and adopted new terms of reference for its Ad Hoc Committee on

Sedimentology. It also approved guidelines for its new publications series; these will be published in a later issue of EPISODES.

Acting on a recommendation from its Advisory Board on Research Development, the Executive Committee decided to hold a seminar on remote sensing before its 1984 meeting in Paris or Orléans next February. This would be orientated toward applications to geological mapping and would involve participants from the CGMW of the World. (Since the Bangkok Meeting and at the urging of the IGCP Board and Scientific Committee, a joint Unesco-IUGS Steering Committee has been set up to develop plans for an on-going program on the geological application of remote sensing.)

EPISODES Staff

Milankovitch and Climate

Palisades, New York, November 30-December 4, 1982

Late last year at the Lamont-Doherty Observatory of Columbia University, André Berger (Belgium) and John Imbrie (U.S.A.) convened a group of 105 scientists from many disciplines and 11 countries to consider "Milankovitch and Climate: Understanding the Response to Orbital Forcing". The meeting constituted both a workshop under the auspices of NATO and a symposium sponsored by the International Commission on Climate (ICCL) of the International Association of Meteorology and Atmospheric Physics (IAMAP), Columbia University, the U.S. National Science Foundation and the Palaeoclimatic Commission of INQUA.

The rhythmical nature of Pleistocene glaciations became apparent in the mid-19th century, and a link to the orbital rhythmicities of the earth was suspected then. Subsequently, Milankovitch spent a lifetime calculating the effects of orbital variations on the patterns of insolation, and attributed the glacial rhythms to them. In recent decades, deep-sea cores and their analysis by geochemical, palaeomagnetic and palaeontological techniques have provided a basis for unravelling the climatic record of the Pleistocene in detail, and for testing the Milankovitch hypothesis. Most of the periodicities displayed by these records indeed center around four of the "Milankovitch periodicities" — 19, 23, 41 and 100 thousand years.

The Pleistocene, as revealed by these records, represents a magnificent series of large-scale natural climatic experiments, now accessible to study by climatologists, oceanographers, geologists, astronomers and other groups. Current opinions on the origin of Pleistocene climatic fluctuations vary. Extreme Milankovitchians see them as direct responses to orbital forcing, while extreme oscillationists view them as internal responses to stochastic perturbations, and attribute matches with orbital cycles to chance. Participants tended to a consensus in which a substantial fraction of the climatic variance observed over the Milankovitch frequency band is attributed to orbital forcing, and the rest to non-orbital causes. Major questions revolve around the problem of the mechanisms by which orbital forcing affected climates. Some are inclined toward entrained self-oscillations, while others search for more conventional feed-back amplifiers.

The Pleistocene record is now being analyzed in many ways. Orbital parameters are being refined, and their effects on insolation are being determined in greater detail. In the

geological record, the timing of events is being pinned down by statistical tuning techniques in which sedimentation rates are allowed to float within limits. From the timing of rhythms in one or two cores, work has moved to the search for geographic patterns with lags and phase-shifts, by means of many cores and through cross-spectral analysis and other statistical tricks. Climatic records obtained from seas such as the Mediterranean and from continental bogs and lakes are also being integrated. Many general climatic models are being tested against the observed data, and particular attention is being paid to variations in monsoonal circulation.

This group also, for the first time, turned to consider the evidence for climatic rhythmicity in the pre-Pleistocene world: in Pliocene deep-sea cores, pre-dating a large boreal ice sheet; in the 100 Ma old sediments of the Cretaceous, when ice accumulations must have been very small at best; in Triassic lake sediments; and in Permian varved sequences, remote in time (250 Ma) and of radically different global geography. The ancient sequences show strong expression of rhythmicities at about 20 000 and 100 000 year timing. This poses riddles to the celestial mechanicians who doubt the unchanged persistence of the Milankovitch parameters over such long time spans. It is even more disturbing to the oscillationists, whose ice-drive oscillators could not have functioned with similar periods in those so radically different worlds.

I found this meeting exceptionally mind-expanding. Rarely does one have the opportunity to interact with such a diverse set of colleagues, to whom the same phenomena pose such different questions. The sessions were well organized and pleasantly varied with opportunities for informal discussion. In a fitting and delightfully informal homage to that great, modest, but infinitely persevering Yugoslav scientist, Milutin Milankovitch, the meeting was graced by the presence of his son, Vasko, who presented moving vignettes from the Milankovitch household and from a bygone age of science. The University of Belgrad and the Yugoslav Academy of Science were represented by Professors Pantic and Stefanovic. Thus the meeting was cast in a fitting historical perspective. The papers of this enormously stimulating conference will be issued by Reidel Publishing Company.

*A.G. Fischer
Princeton, New Jersey*

Earthquake Prediction Reviewed

Geneva, October 12-15, 1982.

Characterized not long ago as "quackery" by recognized experts, earthquake prediction is forcing seismology from its ivory tower. Responsible prediction requires multidisciplinary cooperation and appears to be incompatible with a narrow scientific approach.

To review recent work in the field, Unesco and the UN Disaster Relief Organization held a seminar last year in Geneva. Most of the papers and discussions dealt in a remarkably frank manner with problems raised by prediction procedures within a broad framework involving scientific, economic, social, ecological, political and ethical considerations.

There were reviews of large magnitude earthquakes, such as the disastrous Tangshan one, which emphasized the great number and complexity of various prediction techniques used, some of whose relative value and exact interpretation are difficult to determine. There were also discussions of predictions based essentially on one or two rather simple arguments. Although such simple arguments have sometimes resulted in extraordinarily accurate predictions, they are all the more treacherous because they usually fail and run the risk of raising undue alarm. In this regard the frequent oversimplification of the concept of seismic gaps drew especially strong criticism.

From an economic view point, long-term predictions — and the failure of short-term ones — tend to have notable economic effects. For example, an involved prediction procedure described for the U.S.A. might result in substantial costs even greater than those of the earthquake itself. The special problem of insurance company policy was raised several times and participants noted that false or ambiguous predictions have sometimes given rise to large claims for damages, though these have so far been unsuccessful. A remarkable piece of legislation prepared by Japan relieves the government of all responsibility for any errors in predictions.

Much was made during the seminar of the sociological and psychological aspects. In Japan, for example, a false alarm given out over a loud speaker as a result of technical error prompted an instructive sociological enquiry. Similarly the

way the public received the prediction of earthquakes in California in 1976 was also analyzed. Cases are known where an irrational prediction of an earthquake at a time when the moon was full caused a major exodus of people. On the other hand prompt psychological action can also exorcize such demons. For example, authorities in Mexico and Greece recently organized important folk festivities for the days when the earthquakes were supposed to occur, and the presence of experts among the crowds also helped to calm fears.

Emphasis was also placed on ethical problems raised by predictions and especially the need for a code of behaviour which might even be presented as a condition for believing the predictions. An obvious parallel can be drawn to predictions of volcanic eruptions. Of considerable relevance here is the draft code of scientific conduct recently drawn up by the Seismological Society of America.

Problems faced by decision makers were raised a number of times. However those present were sometimes left in the air regarding the logic of the ultimate decision-making process. Of course authorities tend to demand a definitive "black and white" choice, which is often not possible to make. In any case the emphasis will continue to be on the need for better integration of earthquake prediction into the activities of various agencies directly or indirectly concerned with seismicity. Indeed earthquake prediction could even serve as a catalyst to end rivalries between agencies and to lead toward a more coherent and rational policy especially regards prevention and education.

Some of the discussions at the seminar may well have appeared futile and protracted to those who are accustomed to simple isolated procedures and clear-cut decisions. In actual fact, they demonstrated a desire to conquer a problem that is exceptionally complex and full of aspects unfamiliar to seismologists. They also demonstrated a concern with credibility and an increased sense of economic and social responsibility, whatever economical or political systems are involved.

*J. Vogt
Strasbourg, France*

Sixth International Symposium of IAGOD

Tbilisi, Georgia, U.S.S.R., August 30-September 20, 1982

Mineral resources, ore deposits "... why are they where they are, and how using this information can one find new ones ...". This, to quote a young Australian scientist, Tim Hopwood, should be the motto for any International Association on the Genesis of Ore Deposits symposium. This was indeed the case when some 760 geologists, including almost 300 from 33 countries outside the Soviet Union, gathered recently in the ancient city of Tbilisi for the 6th International Symposium of IAGOD.

The Symposium concentrated on three main themes: ore-forming hydrothermal systems, the relationship between ore formation and granitic magmatism, and mathematical methods of studying ore deposits. More than 120 papers were

presented, covering a broad spectrum of topics within the framework of these three main topics.

On the theme of ore-forming hydrothermal systems, much attention was directed toward the problems of possible source, methods of migration, and the localization of ore fluids. A multidisciplinary approach (involving ore zoning studies, data on isotope composition, geophysical influences on ore transport and sedimentation, etc.) convinced many in the audience of a deep-seated, juvenile source both for low-temperature epithermal deposits (mercury, antimony, arsenic, lead, zinc, silver) and for other types of deposits, such as porphyry coppers, massive sulphides, copper-lead-zinc and quartz-gold-sulphides. This opinion is supported by the fact

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Participants of Excursion A-2 to the Transcaucasus after a visit to Madneuli, a massive copper sulphide deposit, and a hospitable Georgian lunch.

that ore-bearing structures are predominantly connected with basic to alkaline magmas of deep origin. These magmas also play a significant role in determining the composition of ore-bearing fluids, as exemplified by the western part of the Circum-Pacific belt with its sulphide-cassiterite, tungsten, boron and related deposits.

As regards the relationship between ore formation and granitic magmatism, a number of interesting papers discussed granitoids associated with gold, lead-zinc, tungsten, copper-molybdenum, tin, uranium and rare-earth deposits. Topics included contemporary investigations of the isotopic composition of elements, partitioning of rare-earth elements between rocks and minerals, melt and fluid compositions, identification of vertical polymineralic zonation in granitoid bodies and element distribution factors between crystals and

melts. They were applied to the evaluation of specific features of granitic magmatism in the ore provinces in U.S.A., U.S.S.R., Bolivia, China, India and other countries. Not surprisingly, conclusions concerning the relationship of each type of deposit to granitoid magmatism were not unequivocal, and a variety of different models and hypotheses were offered.

In the mathematical section, there were many papers of interest, especially those concerned with new methods of identifying agents which have a bearing on ore formation, and those presenting computer techniques for analyzing and presenting three-dimensionally distributed geological data.

At the end of the symposium, a general discussion emphasized two rather different approaches to the problem of mineral exploration and the discovery of new ore deposits. A number of scientists held that new discoveries are based largely on detailed knowledge of empirical features such as structure, lithology, geochemistry, type and intensity of hydrothermal alteration, and appearance and composition of associated igneous rocks, with little reference, if any, to changing ideas on the genesis of ore deposits. Others argued that genetic concepts are most essential, the more so for discovering deep-seated "blind" deposits.

Field trips were run before and after the meeting to the Great Caucasus, Transcaucasus, Uzbekistan and Kirgizia. During the conference seven IAGOD Commissions and Working Groups met, as did the IUGS Commission on Experimental Petrology at High Temperatures and Pressures.

During the closing ceremony Dr. G. Kautsky (Sweden) on behalf of Scandinavian geologists invited the 7th IAGOD Symposium to convene at Lulea in northern Sweden in 1986.

Ruslan I. Volkov
Moscow, U.S.S.R.

IUGS Reviews the Geosciences in SE Asia

Bangkok, January 24-25, 1983

"Several years ago IUGS decided to combine meetings of its Executive Committee with seminars, and to do it alternately in industrialized and developing countries. Last year we met near Bonn, the year before in Ghana. Now we are happy to meet in this area with its very interesting and complex geology — a geology full of active volcanoes, forgotten and coming earthquakes and tsunamis, sinking plains and rising mountains".

With these comments Prof. E. Seibold, President of IUGS, opened a meeting on Development and Coordination of Regional Geological Programs in Developing Countries held recently at the headquarters of the UN Economic Commission for Asia and the Pacific (ESCAP) in Bangkok, Thailand. This was sponsored by IUGS in cooperation with the Association of Geoscientists for International Development (AGID), the ESCAP Coordinating Committee for Joint Prospecting in Asian Offshore Areas (CCOP), ESCAP and Unesco.

Prof. Seibold went on to say that "IUGS must promote advancement of science, and in this region we have tried to do so together with many other organizations. So far many programs and projects have been very successful. Why? Perhaps one of the reasons is the long cultural tradition of

this region. Perhaps it is the very urgent need to understand better your friendly but often threatening natural environment. Perhaps it is your wealth in mineral resources to be explored and exploited, and our general concern to restrict environmental damage.

"During the next few days we are asking you why these programs have been so successful, what was achieved, and what is left to do. What factors of international cooperation have been especially helpful? Have we been able to raise the interest of the very best scientists in this historical task, to help the development of this fascinating region located between a vast and young ocean and an old continent?"

"My last point concerns the relation between fundamental and applied sciences. It is quite obvious that in many of your countries the needs of today and of tomorrow ask for direct answers, for application. However, it is always application of basic sciences, and basic research remains the basement for all progress. New and better models for oil formation, for example, will help — maybe not today or tomorrow, but perhaps the day after tomorrow. Better stratigraphy will improve basin assessment for oil, gas, coal and phosphate resources. And perhaps sometime in the future someone can

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explain to me why God was so interested in concentrating tin in southeast Asia over hundreds of millions of years without becoming tired."

Dr. John A. Katili, Director General of Mines for Indonesia, set the stage for the meeting with a comprehensive overview of the geological and tectonic framework of the region. He summarized many of the results of the SEATAR Program (Studies of East Asia Tectonics and Resources) which since the early 1970s has studied the offshore and onshore geology and geophysics of many parts of south and east Asia. Dr. Katili stressed the need to continue basic research on the tectonics of the region, to translate ideas and theories into testable working schemes for relating mineral and hydrocarbon deposits to regional tectonics, and to engage in detailed studies in the search for resources. This would require tracing the geology of marine areas onto land, and the identification there of collision zones, accreted terrains and tectonic platelets.

In the review sessions that followed, summaries were presented of many of the international and regional organizations, programs and projects active in geoscience in southeast Asia. These range widely from governmental agencies like ESCAP and Unesco to non-governmental organizations such as the Circum-Pacific Map Project (CPMP) and the Commission for the Geological Map of the World (CGMW). Some function largely as administrative and coordinating bodies (e.g. ESCAP's Mineral Resources Section), while others like RMRDC (ESCAP's Regional Mineral Resources Development Centre — see EPISODES, 1982/2, p. 16-18) and CCOP are actively carrying out field projects. There are those such as CCOP, GEOSEA (the triennial Regional Conference on the Geology and Mineral Resources of SE Asia — see EPISODES, 1982/1, p. 9-12) and IGCP that are well established and widely recognized as successful and those that are younger and less well-known like the SE Asian Tin Research and Development Centre (SEATRAD).

The interconnections between these groups are complex and cooperation, though sometimes close, more often needs improving. The overall impression, however, is of a rich mosaic of group activities now operating in the region. All have at least some focus on training and information, although CCOP and IGCP, for example, are more research-oriented than others such as AGID. The search for mineral resources, hydrocarbons and water is the ultimate objective for many

groups, but there are also a growing number of activities related to the physical environment, urban geology and the Quaternary.

The presentations of the first day of the seminar led to a series of questions related to the research needed, to the required mechanisms for support and management of this research, and to related activities in training, information and communications. Should a SEATAR II be established, concentrating more on land geology and metallogenesis? What is the balance between applied and basic research that should be sought in this region, and between a focus on mineral resources and one on surficial geoscience? What are the key ingredients that led to the success of projects like SEATAR? Local geology? People involved? Management structure? Should current moves to form a regional union of geological societies be supported, and what mechanisms should be established to strengthen national research and training efforts? How should research results be presented in order to make the greatest impact on planners and funders? What should IUGS' role be in the region?

The second day of the meeting began with a brief review of regional programs and activities in Africa and Latin America. Some of the same organizations and programs operating in southeast Asia are also active to a greater or lesser degree in these regions, such as IGCP, CGMW and AGID. In Africa there is a functioning continent-wide geological society, with its joint newsletter and regional conferences, and a new French-based organization (Le Centre International pour la Formation et les Échanges Géologiques) has recently launched a program of training and geological exchanges. A recent Unesco project under the title *Geology for Development* is sponsoring a series of geotraverses across key orogenic belts (see EPISODES, 1982/4, p. 44). There have been, of course, a number of multilateral and bilateral projects on minerals and water, though a preliminary analysis of their economic impact raised many questions.

In Latin America the Consultative Council of Directors of Geological Services provides a means of communication between geological surveys. The on-going Latin American Geological Congress, like GEOSEA, is a much needed forum for discussion and information sharing. CPMP is active in western regions, and regional seismic and energy organizations had proved especially useful.

The participants in the seminar then turned to a consideration of possible new programs and mechanisms. One of these was a proposed Asian Institute of Earth Sciences which would operate as an umbrella organization to coordinate and engage in investigations related to mineral resources and applied geoscience as well as providing a center for training, documentation and publication. The IUGS Advisory Board for Research Development recommended a major focus on basin analysis in SE Asia, studying the evolution of sedimentary basins as a guide not only to hydrocarbon and mineral deposits but also to groundwater and to the management of waste disposal and pollution. A number of general points were raised regarding the basic conditions necessary for specific projects, and various approaches were discussed to the popularization of geology, pre-university education and training at an advanced level. Newsletters were commended as a useful way to promote communications.

The meeting ended with a panel discussion involving Prof. Prinya Nutalaya, Mr. Jiang Minxi, Dr. F. Hehuwat, Mr. J.M. Tater, Dr. J.F. McDivitt, Dr. B.K. Tan and Dr. J. Katili as Chairman. From this came several major conclusions and recommendations to IUGS:

Scientific research programs

- A "SEATAR II" coordinated land-sea research program should be developed along the lines of "SEATAR I", but

Reviewing SE Asian geoscience at ESCAP, Bangkok

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At the IUGS Seminar: (l-r) Liu Dongsheng (China), T.T. Khoo (Malaysia), J. Katili and F. Hehuwat (Indonesia).

with greater emphasis on resources studies and on studies of rotation and accretion of terrains or platelets both on land and at sea. This requires development of plans for the program through a meeting of experts, similar to the meeting held in Bangkok in 1973 to plan "SEATAR I". IUGS should assist CCOP and ESCAP to organize such a meeting in cooperation with other appropriate international and local agencies.

- A coordinated program in geology applied to urban problems is needed for cities such as Bangkok, Hong Kong, Manila, Jakarta, Shanghai and Tokyo. Such a program would involve workshops, research and training, and could include a symposium on urban geoscience being planned for Hong Kong, an AGID seminar scheduled for Kuala Lumpur and a pilot project by the Department of Mineral Resources in Southeast Thailand. IUGS should help to organize a coordinated regional program in consultation with INQUA, IAEG and other interested bodies.

- Development of a basin analysis program should be encouraged for southeast Asia, including a map project to organize, compile and evaluate geological and geophysical data related to the distribution of hydrocarbons and non-energy resources such as phosphates and evaporites. Such a program will involve the coordinated efforts of existing CCOP and ESCAP projects in hydrocarbon assessment, heat-flow studies, Quaternary geology, geophysical data compilation and stratigraphic correlation, as well as the operational framework of the Circum-Pacific Map Project and the work of CGMW. The program would be carried out jointly by CCOP and the Circum-Pacific Project, under the aegis of the IUGS Research Development Program and in consultation with CGMW. It would be an initial component of the Research Development Program's world-wide basin analysis project. Plans are being formulated jointly by IUGS, CCOP, CGMW and the Circum-Pacific Energy and Mineral Resources Council.

- IUGS should develop a regional program of research on tin and tungsten mineralization, examining the relation to crustal evolution, the geological framework of the principal areas of mineralization, and guidelines for exploration. This program would utilize the plan being developed for a new IGCP project on tin-tungsten granites in SE Asia-China. It would also be coordinated with the programs of SEATRAD as well as relevant ongoing regional and national programs. It would supplement the IUGS research program already underway on tin mineralization in the Andes region.

Institutional development and management

- To strengthen and maintain effective institutions and programs such as those in southeast Asia and to develop institutions and programs in regions that are less effectively served, governments and international organizations need to have evidence of practical benefits and timely results. IUGS should offer guidance and assistance as far as practicable in strengthening and orienting programs towards such benefits and results.
- Where programs are developed or assisted by IUGS, efforts should be made to involve local institutions and on-going programs. To the extent that mapping is involved, guidance should be provided by CGMW in the use of the most effective methods and to ensure uniformity.
- Efforts should be made, with IUGS assistance, to strengthen local geological societies, and IUGS should assist in any way it can if a regional geological society is organized in southeast Asia.
- The success of CCOP seems to have been partly a result of the use of special advisors in its Technical Advisory Group. IUGS should call attention to this as a possible model for regional and other international organizations to consider.

Education and communication

- General public awareness of geology needs to be strengthened in order to assist in the protection of natural resources. Increased geological "literacy" will also lead to a better understanding of specific issues among land-use planners and policy-makers. IUGS should recognize the need for and support efforts to organize workshops and training courses in order to impart special skills, to improve professional standards and to make better use of intellectual resources of the region, working towards decreased dependence on foreign assistance.
- The Union should be aware of the serious difficulties encountered in the flow of information between developing and industrialized countries, and the problems which poorer regions face in gaining access to reference materials. It is important that the Union encourage and support, for example through its Commission on the Teaching of Geology, the increased use of local and regional newsletters and technical publications and the international exchange of books and journals.

The broad representation of regions, disciplines and organizations at the Bangkok seminar resulted in an excellent overview of geoscience in the region. The discussions that took place seem likely to lead to a number of specific research projects and related activities which will help to promote local development and regional cooperation.

*EPISODES staff after reports
by J.V. Hepworth, D. Shook-Wiercimok
and J.A. Reinemund*

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