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Kuala Lumpur

B.K. Tan
Department of Geology
University of Malaya
Kuala Lumpur

S.C. Toh
Conzinc Riotinto
P.O. Box 291
Kuala Lumpur

F.S. Chong
Geological Survey
P.O. Box 1015
Kuala Lumpur

N.H. Chong
Associated Mines
P.O. Box 2125
Kuala Lumpur

Address of the Society: Geological Society of Malaysia
c/o Department of Geology
University of Malaya
Kuala Lumpur.

G E O L O G I C A L N O T E S

Recent successes and future challenges in geophysics*

G.D. Garland, Dept. of Physics, University of Toronto, Canada

The successes of geophysics in the past few years result partly from improved instrumentation, and partly from theories of explanation of the earth's behaviour. Among the important contributions would have to be included seismology, which, with the world-wide network and also arrays of instruments, has provided the improved definition of the earth in terms of crust, mantle, core and inner core. Recent successes in this field include the confirmation that the inner core is solid, and the definition of the low-velocity zone beneath the lithosphere. Similarly, the advance in mapping of the geomagnetic field led to the understanding of the magnetic character of the ocean floors. This feature (the "stripes"), together with the recognition that the ocean ridges form a continuous series, and the identification of the new class of faults known as transform faults, really provided the basis for the theory of global plate tectonics.

This theory has become so widely accepted that it is easy to overlook the fact that there is as yet no satisfactory explanation of the driving mechanism of the plates. It has been suggested that plates slide off ridges, that they are pulled by sinking slabs in subduction zones, and that they are driven by mantle convection currents. Most geophysicists probably favour the last of these, but the theory of convection in the mantle, where viscosity undoubtedly varies greatly with temperature, remains a difficult problem.

A further complication is the role of "hot-spots" or plumes. These are believed by some to be limited regions of up-welling of hot mantle material, possibly from very great depths. Their relation to any more general system of mantle convection remains a mystery.

*Summary of talk delivered to the Society on 6th March 1974

Turning to the earth's magnetic field, the extension of the mapping of the field and of its time-changes, with modern instrumentation including satellite-borne magnetometers, is certainly one of the successes of geophysics. Advance in the theory of origin of the field has been much less rapid, and the origin remains one of the great challenges. Ten or fifteen years ago, the theory of a dynamo action in the earth's core appeared to be rather well established. Recently, complications have been introduced. For example, it has been suggested that the temperature gradient in the core is too small to provoke the necessary core convection. However, this argument in turn could be overruled if the core, instead of being purely metallic, were an alloy including carbon, sulphur or potassium. Similarly, the behaviour of the field during a reversal of polarity, and the unusual range of periods between reversals, are factors which are not yet explained by any theory.

Finally, the effect of life of reversals of the field remains one of the great puzzles of earth science. It had been proposed that increased cosmic radiation, at times when the field is very small, could affect living organisms. This was rebutted on the grounds that the increase would have a negligible biological effect, but recent evidence suggests that some species have become extinct at the time of a polarity reversal. It is possible that reversals are responsible for a secondary effect, such as climate, which produces the extinction.

Sapphire from Bentong, Pahang*

K.N. Murthy, Jabatan Penyasatan Kajibumi, Malaysia

Recently, Dr Jaafar Ahmad and the writer discovered some sapphire crystals from the discarded heavy minerals of the tin dressing shed of the Eu Joon Seng Tin Mine, Bentong, Pahang. The sapphire crystals are blue, translucent and occur as hexagonal

* Publication authorised by the Asst. Director General, Geological Survey Malaysia.

prisms. They are associated with some colourless topaz.

The sapphire crystals are similar in size and colour to the blue spinels found in Anak Sungai Reman near Kuantan by Fitch (1952) and the writer believes that the blue spinels are probably sapphires.

Reference

Fitch, F.H. (1952). The geology and mineral resources of the neighbourhood of Kuantan, Pahang. Mem. No. 6 (New Series) Geological Survey of Malaysia, 144 pp.

A sillimanite-bearing rock from Pulau Tioman, Pahang

T.T. Khoo, Jabatan Geologi, Universiti Malaya

Pulau Tioman is the largest of a group of Malaysian islands situated off the south-eastern coast of Pahang. Present knowledge of its geology comes mainly from the work of Bean (in manuscript). In his report, he described the presence of sillimanite in thermally metamorphosed rocks occurring in north-west Pulau Tioman. Recently, the author examined a rock from the central part of the island (GR 511400, sheet 111, new series) collected by Dr T.E. Yancey (Universiti Malaya) and it was found to contain about 5 modal percent sillimanite (var. fibrolite). It appears that sillimanite is more widespread in Pulau Tioman than previously thought.

In addition to sillimanite, the rock has a fine grain quartz-feldspathic groundmass, very minor amounts of biotite and muscovite, and some small hematite grains. The groundmass is composed of approximately equal amounts of quartz and feldspar. Most of the sillimanite form parallel bands, about 1mm thick, which extend right across the hand specimen. Elsewhere, the sillimanite occurs

rarely and sparsely. Biotite and muscovite are only present in the sillimanite bands.

The petrography of the rock suggests that it could probably be a metamorphosed acid volcanic rock which occur abundantly in Pulau Tioman (Bean, in manuscript). The origin of the sillimanite bands is uncertain. The bands may be originally kaolinitic sediments or kaolinitized volcanic rock occurring adjacent to sets of planes such as joints or fractures.

Reference

- Bean, J.H. Geology, petrography and mineral resources of Pulau Tioman, Pahang. Map. Bull. 5, Geological Survey of Malaysia (in manuscript).

REPORT OF MEETINGS

International Workshop on Earth Science Aid to Developing countries,
18-19 May, 1974

Seventy earth scientists from 27 countries met at this workshop held at St. John's, Newfoundland to discuss the effectiveness of earth science aid to developing countries which was initiated in August 1972 at the 24th International Geological Congress in Montreal.

In the field of earth science aid to developing countries, many geologists from recipient and also donor countries have for sometime expressed dissatisfaction with the effectiveness of aid programs which were usually finalised or administered by non-earth scientists in Governments or their agencies. It is felt that the effectiveness of the aid programs can be improved significantly if

the people concerned can be convinced to make the necessary changes. With this task in mind, an international association on earth science aid was set up by the participants of the workshop. The organizing committee of this association consists of Dr D. Ajakaiye (Chairman, Nigeria), Dr R. Blais (Canada, Vice-Chairman), Dr A.R. Berger (Canada, Secretary), Dr A.M. Al-Shanti (Saudi Arabia), Dr S. Bonis (Guatemala), Dr G. Constantinou (Cyprus), Dr W. von Engelhardt (Germany), Dr Leo A. Heindl (U.S.A.), Dr J.A. Hepworth (Botswana), Mr C. Hudson (Peru), Dr S. Singh (Guyana) and Dr B.K. Tan (Malaysia).

The new association is composed primarily of concerned individual earth scientists. At the meeting, there was considerable debate on whether or not to include Government agencies and corporations in the association. It was finally decided that these would be able to join as corporate bodies together with educational institutions and geoscience societies.

The important objectives of the association are:

1. to emphasize to both donor and recipient countries the fundamental role of earth sciences in international development;
2. to encourage communication among individuals, societies and agencies interested in international aid in earth sciences and
3. to encourage and promote coordination of the activities of the various agencies relating to international aid in earth sciences.

Other objectives are concerned with problems relating to regional cooperation, guidelines for training, personnel selection, "brain-drain", information centres, evaluation of aid projects and publication of results.

The constitution of this Association would be drawn up shortly and be presented to the next meeting of the Association in Sydney, Australia in 1976 at the 25th International Geological Congress. The first of the Association's quarterly Newsletters is due to be printed in August 1974. Geologists or organizations interested in receiving the Newsletter or in joining the Association are requested to write to the Association's Secretary, Dr A.R. Berger, Department of Geology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada.

B.K. Tan
Leeds, England

Institute of Mining and Metallurgy (Malaysian Section) Meeting,
25 July 1974.

This meeting was held at the Jabatan Geologi, Universiti Malaya at 5.45 p.m. Members of the Geological Society of Malaysia were also invited, however, at rather short notice. At this meeting short talks were presented by Mr B. Knight and Mr P. Forbes.

Mr Knight gave an illustrated account on the construction of the Mica Dam in British Columbia, Canada. The dam was built in a terrain covered by glacial till consisting predominantly of very fine rock flour. Before the dam could be built several other projects such as construction of new highways, a village, river diversion tunnels (50 ft diameter) and coffer dams were executed. He said the water level behind the coffer dams could be as high as 250 ft above the base and the water level was carefully controlled to ensure that the dams would not burst. Systems of tube wells were installed at the base of the coffer dams to collect any seepage which was pumped back into the reservoirs. He also said that to avoid spalling off of rocks at the dam-site, it was necessary to have a 'smooth' slope which could be obtained by first pre-splitting the rocks with small charges and later followed by bigger blasts.

Replying to questions from the audience he said that cement plugs were used to seal the diversion tunnels and that graded materials were used to construct the dam to avoid development of fractures due to uneven settling. In reply to a 'tricky' question on the possibility and consequences of large landslides falling into the reservoir behind the dam, he said that there was a case of landsliding into the reservoir which caused the generation of 50 ft high waves. The dam was later widened to prevent destruction from this source.

Mr Forbes gave a talk on methods of disposal of tailings with examples from Africa. He said that in Malaysia dredges are now excavating deeper than in the past and also are increasingly working on worked materials. As a result inclination of slopes considered to be stable in the past may not be so. He further said that some experimental work on slope stability of dredging ponds are presently being undertaken at the Ayer Hitam tin mine.

(TTK)

NEWS OF THE SOCIETY

Circum-Pacific Plutonism Project

The Council has extended an invitation to the organizers of this Project to hold a Circum-Pacific Plutonism Conference in Kuala Lumpur. It is believed that the meeting can be held at no financial cost to the Society. According to the organizers of the Project grants for the meeting could be obtained from sources such as the funds of the International Geological Correlations Program.

We hope that our invitation will be accepted. If so, we tentatively plan to hold the meeting sometime in late February or early March 1975.

Malaysian Postage Stamps-

The Council has decided to approach the Malaysian postal authorities in the near future regarding the issue of some stamps depicting beautiful geological specimens native to Malaysia and/or depicting various aspects of the mineral industry in Malaysia. In order to make our proposals attractive and acceptable we need to have colour plates of geological specimens, etc. to show to the people concerned. Members possessing beautiful specimens or relevant photographic masterpieces in colour are requested to inform the Secretary of the Society and, if possible, send to him colour plates of their prized possessions. Suggestions are also welcome from members on this matter.

Resignation of a Council member

Mr S.C. Toh (Conzinc Riotinto, Kuala Lumpur) has resigned from the Council owing to pressure of work, particularly overseas. The Council has reluctantly accepted his resignation and thanked him for his services to the Society. A new councillor will be co-opted to fill the vacancy.

Publications

The availability of adequate funds has enabled the Society to issue to members Bulletin 7 free. However, the soaring cost of printing has forced the Society to consider raising the prices of Bulletin 7 and future publications. The price of Bulletin 7 has yet to be decided upon.

In order to stimulate interest in and promote the advancement of earth sciences in Malaysia, the Council has decided to sell Bulletins 1 - 5 of the Society to Group A student members at a token price of \$10 (Malaysian).

The Council has agreed to exchange publications with the following libraries:

1. University of Kansas Library
Lawrence, Kansas 66044
U.S.A.

2. Prof. N.A. Eremenkho Library
 Institute of Petroleum Exploration
 Oil & Natural Gas Commission
 Kaulagarh: Dedra Dun
 India.

Membership

The following applicants were elected to the Society:

Full members

Ashton, P.R.
 BP Petr. Dev.
 1 Pasir Panjang Road
 Singapore 5

Hollenshead, C.T.
 El Paso Natural Gas Co.
 P.O. Box 1492
 El Paso, Texas, U.S.A.

Lee, E.L.
 Guan Ann Sawmill
 3158 Jalan Atas Paloh
 Kota Bharu, Kelantan

Smit O.E.
 Jabatan Kajibumi
 Universiti Kebangsaan Malaysia
 Peti Surat 1124
 Kuala Lumpur

Wonfor, J.S.
 Gulf Oil Co. South Asia
 P.O. Box 641
 Singapore

Culp, B.L.
 Esso Exploration
 P.O. Box 857
 Kuala Lumpur

Lai, K.F.
 P.O. Box 2125
 Kuala Lumpur

Presley, W.C.
 Esso Exploration
 P.O. Box 57
 Tanglin, P.O.
 Singapore 10

Veijyaratnam, M.
 Geophysical Services Int.
 G.P.O. Box 1748
 Singapore

Wood, G.V.
 BP Petr. Dev.
 1 Pasir Panjang Road
 Singapore 5

Zeissink, H.E.
 Perry House, 8th Floor
 131 Elizabeth St.
 Brisbane, Australia

Student Members

Ab. Wahab Suboh
 3/10 Kokaribb Road
 Carnegie, Vic. 3163
 Australia

Kading, J.A.
 5th Residential College
 Universiti Malaya
 Kuala Lumpur

Loy, W.C.
 1046 Jalan 17/42
 Petaling Jaya

Mahzan Bakar
 Jabatan Kajibumi
 Universiti Kebangsaan Malaysia
 Kuala Lumpur

Mau, G.
 1000 Berlin-62
 Sachsendamm 78
 Germany

Mohd. Kassim Kinchu
 5th Residential College
 Universiti Malaya
 Kuala Lumpur

Nik Nasruddin H.W. Mahmood
 4th Residential College
 Universiti Malaya
 Kuala Lumpur.

 G E N E R A L N E W S

Another oil strike in Malaysia

The Straits Times (25 July 1974) reported that the Continental Oil Co. (Conoco) had struck oil again in its contract area of 7,400 sq. miles off Pahang. This is the company's fourth strike since the first oil discovery in May last year. According to the report the recent discovery has a tested flow of between 75 to 1952 barrels of oil a day and the other producing wells are yielding altogether about 10,000 barrels of oil daily.

(TTK)

Mae Sod zinc deposit, Thailand

It is reported in World Mining (June, 1974) that the Thai Zinc Co. is now operating its Doi Pa Baeng mine at the Mae Sod zinc deposit and has shipped about 18,000 tons of ore to the United States for smelting. The report said that the mineralisation consists mainly of hemimorphite (hydrated zinc silicate) and smithsonite (zinc carbonate) in a gangue of limestone or calcareous sandstone.

(TTK)

"Glacial grooves" de-glaciated

In March 1973, a UPI release carried by major newspapers and subsequent articles in Science News, Geotimes and Science magazines, reported numerous grooves on a bedrock outcrop at 1370 m. a.s.l. in Grandfather Mountain, North Carolina, USA. The grooves were cited as the first direct evidence of local Pleistocene alpine glaciation.

However, in a recent abstract (Geol. Soc. Amer. Abs. with Prog. 6, 6, March 1974 pp. 529-530) McKeon et al of Ohio State University maintain that these grooves were made by abrasion by a cable during logging operations and cite the characteristics of the grooves, the discovery of a weathered wire cable near the outcrop, and the fact (established by talking to a retired logger) that the area was extensively logged in the late 1910's, when a winch-driven cable suspended from high spars was used to transport felled trees to the railway terminus.

N.S. Haile
Jabatan Geologi
Universiti Malaya

N O T I C E S

Fourth World Conference on Tin

The conference which is jointly organised by the International Tin Council and the Ministry of Primary Industries, Malaysia, will be held in Kuala Lumpur from 30 October to 5 November 1974. During the Conference excursions to mines and dredges near Kuala Lumpur have been arranged. There will also be post-Conference tours to Ipoh-Penang and Kuantan-Kuala Trengganu-Genting Highlands. The Conference fee is \$100 (Malaysian) or £20 sterling.

The papers to be presented at the Conference are divided into 4 sections. They are (number of papers in brackets):

1. World tin resources (4)
2. Prospecting, mining, and processing (16)
3. Smelting (5)
4. Marketing and consumption (4)

Conference programme, attendance form and further information can be obtained from:

1. The Steering Committee
 Fourth World Conference on Tin
 Ministry of Primary Industries
 Bangunan Baru Pejabat-Pejabat Kerajaan
 Jalan Gurney, Kuala Lumpur 15-01
 Malaysia

OR

2. The Secretary, The International Tin Council
 Haymarket House, 28 Haymarket
 London, SW1Y 4ST
 England

International Geological Congress, 25th Session, Australia

The Congress will be held from 16 to 25 August 1976 at the University of Sydney's campus, Australia. The main themes of the programme are Precambrian geology, petrology, tectonics and structural geology, mineral deposits, fossil fuels, stratigraphy and sedimentology, palaeontology, marine geology, geophysics, geochemistry, hydrogeology, Quaternary geology, engineering geology, mineralogy, planetology, geological information and mathematical geology, and geological education and history.

Further details about the Congress can be obtained from:

The Secretary General
25th International Geological Congress
P.O. Box 1892
Canberra City ACT 2601
Australia

Information on Quaternary sea levels and shorelines of S.E. Asia

Prof. H.D. Tjia (Jabatan Kajibumi, Universiti Kebangsaan Malaysia, Kuala Lumpur) would like to obtain information on:

1. publications and reports of sea levels and shorelines during the Quaternary of S.E. Asia and
2. researches in progress in the same field.

Readers who are able to help in this matter are requested to write to Prof. H.D. Tjia at the address shown above not later than 20 September 1974. The information is required for the annual report of the Pacific and Indian Oceans Subcommittee (a subdivision of the INQUA Quaternary Shorelines Commission).

PAPERS OF INTEREST

Ishii, K. and Murata, M (1974). Khumerspira, a new genus of Bellerophonidae, and some middle Permian gastropods from Cambodia. J. Geosciences, Osaka City Univ., Vol. 17, pp. 73-86.

The authors describe some gastropods found in Member D of the Sisophon Limestone (Ishii, Kato and Nakamura, 1969). At the lower part of the member Khumerspira ishii Murata n-gen. n.sp. and Bellerophon (Bellerophon?) aff. regularis Waagen were found and at the middle part of the member Straparollus (Euomphalus?) sp. Worthenia cf. schirjaevensis Stuckenberg, Palaeostylus (Leptozyga?) sp. and Meekospira sp. were found. The authors mentioned that these fossils belong to the middle Permian. However, they quoted Ishii, Kato and Nakamura (1969) who found that Member D is upper Permian and contains fusulinids such as Lepidolina (or Yabeina) multiseptata multiseptata Deprat, L. multiseptata gigantea Gubler, Verbeekina verbeeki Geinitz, etc.

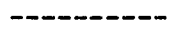
(TTK)

Pan, Y-S (1974) Tin-content frequency distribution of rhyolitic rocks in Mexico. Trans. Am. Geophy. Union Vol. 55, pp. 475-476 (Abstract).

In the Mexican type tin deposits the matrixes of mineralized breccia formations contain disseminated cassiterite and along the steeply dipping flow bandings of tin host rhyolites exist the cassiterite and wood-tin veins. By X-ray fluorescence analysis, several hundred bulk samples of breccia formations and rhyolites from Mexico give common and distinctive geochemical tin content

frequency distribution curves. The following peaks have been found: for barren breccia formations: 0-10 ppm, 25 ppm, 150 ppm tin; for mineralized breccia formations: 250 ppm, 750 ppm, 1500-2500 ppm, 5500 ppm, 1.5-2.5% tin; for barren rhyolites: 0-10 ppm, 45-55 ppm, 150 ppm tin; for mineralized tin host rhyolites: 250 ppm, 450 ppm, 950 ppm tin. The presence of regular frequency distribution of tin contents is more than a coincident. It is noticed that 100 to 150 ppm tin is the limit between mineralized and barren rhyolites. This tin-content boundary can be very useful in geochemical exploration for tin deposits. A very high geochemical background of 50 ppm tin which is about 15 to 20 times that of the crust has also been found. This abnormally high tin-content background can be achieved through anatexis of tin placers or tin-enriched granites during later orogeneses. This process also accounts for the formation of narrow and elongated tin belts on the continents of the world along younger orogenic belts.

(author's abstract)



Zonenshain, L.P., Kuz'min, M.I., Kovalenko, V.I., Saltykovskii, A. Ya, Natapov, L.M., Kudryatsev, G.A., Gatinskii, Yu, G., Vinogradov, I.V., and Mishina, A.V. (1973)

Structural-magmatic zonation and metallogeny of the western part of the Pacific belt. Geotectonika No. 5 pp. 3-21 (in Russian)

Palaeotectonic analysis with short intervals of geological time (40-60 m.y.) reveals structural-magmatic and metallogenic zonation peculiar to each such interval. It reveals the following (from the Pacific ocean to the Asian continent):

1. Eugeosynclinal zone with ophiolites and Cu, Au, Cr, Ni, Pt;

2. Rear terrigenous troughs
3. Zone of surface calc-alkaline volcanism and granodioritic magmatism with subzones
 - (a) granodiorite-granite batholiths with Au, Mo and
 - (b) rare-metal granites with Sn, W, and occasionally Pb-Zn.
4. Zone of alkaline effusive and intrusive magmatism with characteristic rare elements.

The zonation depends on the position of the eugeosynclinal zones and intersections of deep transverse (transform) faults. The zonal patterns are interpreted from the standpoint of plate tectonics, existence of fossil Benioff zones (tectonospheres of Sheinmann) and the moving of eugeosynclines under the continent.

(Authors' abstract translated
by TTK)

Gatinskii, Yu. G., Kudryatsev, G.A., and Mishina, A.V. (1972).
On the 'Mesozoides' of south-east Asia. Bull. Moscow Soc.
for Study of Nature, Vol. 47, No.4 pp. 62-70 (in Russian)

The authors reviewed the formational composition and structural features of Palaeozoic and Mesozoic deposits from various parts of mainland south-east Asia and came to the conclusion that the geosynclinal development of the greater part of this region was completed in the Palaeozoic.

The paper has 2 figures. One of them shows rather informative stratigraphic columns of the Shan Plateau, north-eastern part of North Vietnam, Ch'iong Shon Range, western part of the Malay Penin-

sula, eastern part of the Malay Peninsula, western part of North Vietnam and the Black River basin.

The authors said miserably little about the geology of Thailand in their review.

(TTK)

B O O K R E V I E W

Statistics and Data Analysis in Geology, by John C. Davis, John Wiley & Sons, Inc., 550 p., 1973. US \$18.50

This book discusses the techniques of statistics for data analysis in geology. The author states that his reasons for writing the book are very simple. He teaches the techniques of data analysis to earth scientists, both practitioners and students, and his job would be easier if he had a suitable text book. The reviewer tends to agree with the author's view. Although in the past few years there appeared a number of books dealing with application of statistical methods in geology, none of these books was found to be satisfactory as a basic text for a course in data analysis. On the other hand, it may be mentioned that several good texts written specifically for geophysicists are available, but these books are usually too advance for the comprehension of most geologists who do not have mathematical background beyond elementary calculus.

There are seven chapters in this book together with an appendix listing the sources from which computer programs or systems for the

analysis of geological and geographical data are available.

The first half of the book is made up of four chapters which provide the necessary background materials for the understanding of the techniques presented in the next three chapters. The basic philosophy of data analysis is discussed in Chapter 1. This is followed by the introduction to some basic topics in computer programming, elementary statistics, and matrix algebra. Sufficient information concerning programming using FORTRAN IV language is included in Chapter 2, thus enabling readers to follow the computer programs presented in later parts of the book. The presentation of this chapter is clear and precise. The concepts of probability and statistics are expounded in Chapter 3. Readers who have no previous knowledge of the theory of statistics may encounter some difficulties in understanding the discussions of the techniques of statistical inference appearing in the last few sections of this chapter because no derivation is given for most of the formulas employed. However, collateral reading of an elementary statistical text, such as Mayer (1965) or Wine (1964), may help the readers to overcome their difficulties. An introduction to matrix algebra is given in Chapter 4. A lucid but elementary discussion on the eigenvalues and eigenvectors of symmetric matrices is found at the end of this chapter.

The longest chapter in the book is Chapter 5 which covers some of the standard techniques of time series analysis in 125 pages. The topics dealt with in this chapter are interpolation, runs tests, least-squares methods and regression analysis, filtering, autocorrelation and cross-correlation, Fourier analysis, cross-association, and Markov Chains. This chapter is well written, but the reviewer has a few comments. In the discussion of filtering theory, the author restricts his discussion to filtering in the time (or space) domain by the method of moving averages. No interpretation of the filtering process in the frequency domain is presented. It is a well known fact that frequency domain interpretation can provide a deeper insight into the effect of a filter on a given set of input data. Another point to note is that the theory of Fourier series appears after the discussion of filtering, autocorrelation and cross-correlation. It seems more logical to the reviewer that the theory of Fourier analysis should be presented before these other topics because it provides the basic tools for the study of the processes of filtering, autocorrelation, and cross-correlation.

A brief discussion of power spectrum is given in the section dealing with Fourier series. When the author discusses the smoothing of power spectrum, he uses the term "Hanning filter". This is a misuse of terminology and may lead to erroneous interpretation of the concept of filtering. Strictly speaking, the smoothing of power spectrum is not equivalent to filtering in the original sense of the term. By definition filtering of a time series refers to the convolution of the time series with a certain weighting sequence, which results in the rejection or suppression of certain frequency components of the input data. The smoothing or convolution of the power spectrum with the Hanning weights in the frequency domain corresponds to the operation of multiplication in the time domain between the Fourier transforms of the power spectrum and the Hanning weights respectively. This operation does not lead to rejection of any frequency component in original time series. The fact that there is no loss of any frequency component is clearly evident from a comparison between Fig. 5.29 showing the raw power spectrum and Fig. 5.30 showing the smoothed power spectrum of the same time series (see p. 268-269 of the text). Furthermore, it is important to note that when smoothing is performed on the power spectrum, the original time series from which the power spectrum is derived is not affected by this operation. The reason is obvious because according to the Wiener-Khinchin theorem (Lee, 1960) the power spectrum is the Fourier transform of the autocorrelation function of the time series rather than the time series itself. Smoothing of power spectrum is essential because the raw power spectrum is an inefficient estimate of the true power spectrum of the time series owing to the truncation of the length of the time series in practice (Blackman and Tukey, 1958).

The remaining two chapters of the book give a good coverage of the current techniques used in map analysis and multivariate analysis. The main topics dealt with are trend surface analysis, moving averages and kriging, double Fourier series, multiple regression, discriminant functions, cluster analysis, and factor analysis. The reviewer is pleased to see a clear exposition of the concept of kriging in this book. There is only little of the literature pertinent to this topic published in English. The techniques of fast Fourier transform (FFT) is mentioned briefly in the section dealing with double Fourier series. It is not out of place to mention here that the FFT algorithm provides a very powerful tool for digital processing of data in a wide range of scientific researches.

There are two further points worth mentioning. First, this book contains a good collection of FORTRAN IV programs which, after some modifications, can directly be adopted for the solution of practical problems. Second, at the end of each chapter the author provides an adequate list of references which are extremely useful for those readers who desire a deeper understanding of the techniques described in this book.

On the whole the author is to be congratulated for having achieved his aim in providing a suitable text book for a basic course in data analysis. The book is written in such a style that it is highly readable. Although the price set by the publisher is on the high side by the Malaysian standard, the book still deserved a place in the book shelf of any geologist who is keen in applying modern techniques of data analysis to the solution of his problems.

S.H. Chan
Jabatan Geologi
Universiti Malaya

References

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- Lee, Y.W., 1960. Statistical theory of communication: New York, John Wiley & Sons, Inc.
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- Wine, R.L., 1964. Statistics for scientists and engineers: Englewood Cliffs, Prentice-Hall International Inc.

NEW PUBLICATIONS

1. Bulletin of the Geological Society of Malaysia No. 7, 138 pp., 1973 (price to be fixed)
2. Map Bulletin of the Geological Survey of Malaysia.
 - No. 1 Geology and Mineral resources of the Lake Chini-Sungei Bera-Sungei Jerau area of South-central Pahang by S. MacDonald. 44 pp., 2 coloured maps (1 in. to a mile), 1970, \$10 (Malaysian).
 - No. 2 Geology and mineral resources of Johor Bahru-Kulai area south Johor by C.K. Burton, 72 pp., 1 coloured map (1 in. to a mile), 2 coloured geological sections, 1973, \$10 (Malaysian).
 - No. 3 Geology and mineral resources of the neighbourhood of Kulim, Kedah by D.B. Courtier, 50 pp., 2 coloured maps (1 in. to a mile), 1974, \$10 (Malaysian).
3. Geological Papers of the Geological Survey of Malaysia, Vol. 1, 100 pp., 1972, \$10 (Malaysian).

This book contains papers on palaeontology, stratigraphy, sedimentology, mineralogy, applied mineralogy, engineering properties of rocks, etc. (TTK)
4. Silvester, R. (1974). Coastal engineering, I: generation, propagation and influence of waves. Developments in Geotechnical Engineering 4A, Elsevier, 457 pp., \$29 (US)
5. Levingson, A.A. (1974). Introduction to exploration geochemistry. Applied Publishing Ltd., Calgary, 612 pp. \$25 (US).
6. Tricart, J. (1973). Landforms of the humid tropics, forests and savannas. St. Martin's Press, 306 pp., \$17.95 (US).
7. Geological map of Pulau Tioman published by the Geological Survey of Malaysia. Coloured, 1 in. to a mile, 1973, \$3 (Malaysian)

8. Tectonic map of China and Mongolia published by Geological Society of America. 2 coloured sheets (34" x 42 $\frac{1}{2}$ "), 1:5,000,000, 1973, \$7.50 (US) fold in 9"x12" envelope; \$10.00 (US) rolled in mailing tube. Member prices \$6.00 (US) and \$8.00 (US).

Several entries have been received for the GSM prized geo-crossword No. 1 competition. The winner is Mr G.E. Kelly (Tenneco Thailand Inc.) who will receive the prize of a copy of Bulletin 7. Other members who have sent in all-correct entries are:

G E O - C R O S S W O R D

Many members have expressed interest in the geo-crossword which appeared in the previous Newsletter. So it has been decided to make the geo-crossword a more regular feature in our Newsletters. To make this possible, members, particularly crossword enthusiasts, are invited to send in geo-crossword puzzles together with clues and solutions to the Editor for possible publication in future Newsletters.

Several entries have been received for the GSM prized geo-crossword No. 1 competition. The winner is Mr G.E. Kelly (Tenneco Thailand Inc.) who will receive the prize of a copy of Bulletin 7. Other members who have sent in all-correct entries are:

1. Mr Johnny Ating Kading (Universiti Malaya)
2. Mr Lean Kian Hai (38, Chatwell Drive, Singapore 19) and
3. Mr Chow Yue Cheong (Robertson Research, Singapore).

The answers to GSM geo-crossword No. 1 are given below:

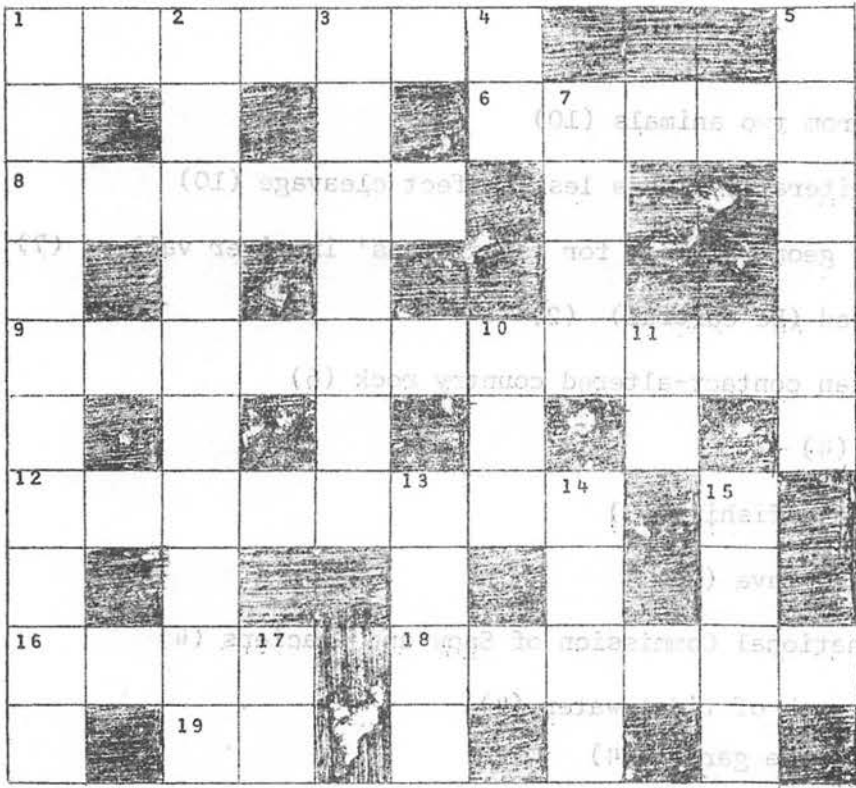
Across

Down

- (2) Opal
- (13) SG
- (15) Garnet
- (22) AGM
- (27) Ed
- (29) Toit
- (34) Mu
- (38) Ar
- (45) Nicol

- (3) Permian
- (7) Ag
- (8) Agate
- (13) Stem
- (16) Ago
- (28) Dull
- (32) Tri

Geo-crossword No. 2 is made by Dr C.S. Hutchison (Universiti Malaya). Members are invited to send their entries to the Editor not later than 20th September 1974. The first all-correct entry to be drawn from a hat will receive a prize consisting of Bulletin 1, 2 and 3. In case there is no all correct entry, the best entry will receive the prize.



(CSH)

CLUESAcross

1. Element of silviculture (4, 3)
6. Gemstone to be kept closed (5)
8. Home town of Geologie en Mijnbouw (6)
9. Pluto's hanging ornament (4, 7)
12. Black garnet (8)
16. Palaeontological trial (4)
18. Industrial action or what oilmen are looking forward to (6)
19. Voltage on an atomic scale (2)

Down

1. Tungsten from two animals (10)
2. Silicate literally with a less perfect cleavage (10)
3. Concept in geomorphology for 'stairsteps' in river valleys (7)
4. Not analysed (Be careful) (2)
5. Scandinavian contact-altered country rock (6)
7. 19.3 pure (4)
10. Stereographic fishing (3)
11. Rough jagged lava (2)
13. The International Commission of Snow and Glaciers (4)
14. A violent rush of tidal water (4)
15. To pitch in the garden (4)
17. Television (2)