

**TRANSFER OF RESPONSIBILITIES TO THE IHB
AND DEVELOPMENT AND PUBLICATION OF THE 3RD AND 4TH EDITIONS
By Adam J. Kerr**

Summary

This paper describes the development of the Third and Fourth Editions of GEBCO, from the point at which the work was passed from the Cabinet Scientifique of HSH Prince Albert I to the International Hydrographic Bureau. It was a period of significant turmoil and difficulty, with major changes in hydrographic technology, major political upheavals and a shortage of resources. There was also an ongoing debate on the scientific merit of the programme and whether the maps satisfied the needs of the scientific community. Although the Third Edition took a very long time to complete and the Fourth Edition was never completed, the author notes that to keep the data base going at all was a significant achievement of those involved in its management.

Introduction.

The period to be discussed extends from 1928 to 1973, although the end has no sharp point but an overlapping transition into the events surrounding the 5th. Edition, of which you will hear more later. As a hydrographer and particularly one who has been much involved in the IHB, the writer can say that this was a period of which the International Hydrographic Organisation should perhaps be less than proud. Nevertheless there were several mitigating circumstances that may help to excuse those who had an executing capacity during the period. Those who have criticised the developments of the time may not have always fully considered some of the difficulties that had to be faced.

Technically, there were some tremendous changes in hydrography during the period . Politically there was the World War II and above all, there was a continuous shortage of resources to permit the work to be done in a timely manner. Concerning technology, the echo sounder had just been developed and during the period echo sounders were refined to provide a continuous- or at least quasi-continuous record of the depth profile beneath a moving ship. Digital recording and multi-beam systems were yet to have their impact but the amount of data to be compiled on the GEBCO sheets rose exponentially, as noted by BENCKER (BENCKER,1953). He states that the first edition showed 18,400 soundings, the second edition about 30,000 soundings and for the third edition there were 358,700 soundings plotted by the Bureau. This gave rise to the design of completely new organisational procedures, such as the introduction of the 1: 1 million collector sheets and eventually to an inability to show every sounding available and the need to be selective. It is noted that out of the soundings available for the Third Edition 54,518 were selected and shown on the published sheets. The method of the selection was subsequently the cause of considerable criticism.(MONAHAN, 1977).

Position finding also underwent very major changes. At the start of the period and indeed up to the Second World War, offshore position finding was primarily by astronomical observations and dead reckoning. The latter was the cause of very significant positional errors in some of the earlier GEBCO data. Although survey ships may have improved their dead reckoning positioning by methods such as the taut wire run to improve distance measurements, much of the data prior to the Second World War was undoubtedly extremely crude by today's criteria. The war saw the introduction of electronic positioning systems in the form of LORAN, DECCA, SHORAN and others. Apart from a general improvement in the

positioning accuracy, the major step forward was caused by the fact that these electronic systems could operate in all weathers and throughout day and night. This must certainly have led to great improvements in the positional quality of the data in the temperate and high latitude zones, where overcast skies and poor weather are always to be expected. The problem faced by the GEBCO compilers was to integrate the poorly positioned earlier data with that more recently collected.

Money and resources were a constant difficulty and while it is reported that seven draughtsmen were employed on the 1st.Edition, it is noted that initially the Bureau was only able to employ one draughtsman on the 3^d.Edition. BENCKER (BENCKER,1953) also states that at no time between 1933 and 1952 did the Bureau employ more than two draughtsmen. Following a major drive to obtain additional funding from several interested organisations an additional draughtsman was engaged in 1936.

Following the war, when work was at a low ebb, efforts were made by the President of the Directing Committee, Vice Admiral Nares, to obtain more funds. In 1953, in a presentation to the International Joint Commission on Oceanography(IJCO) (NARES, 1953), he outlined the financial situation, noting that the present budget only allowed a 20 year cycle per edition, which was quite unacceptable for the sheets to be of any real scientific worth. This eventually led to a subsidy of \$ 2000 per annum being provided by the ICSU, an amount that was later increased to \$ 4000. Funding from various other sources, including the US Academy of Sciences, the Challenger Society and the Office de la Recherche Scientifique d'Outre-Mer, is also noted. Nevertheless this still seems to have been inadequate and it seems that the shortage of funds and the consequent slow progress of production led to the Third Edition being out of date long before 1955, when it was declared completed.

The production of the Fourth Edition, although undoubtedly still strapped badly for resources, seems to have been the cause of numerous committees being established. The most tangible measures directed towards the production of the Fourth Edition took place during the VIIth I H Conference in 1962, where *inter alia* it was resolved "that the necessary financial provisions to cover the cost of compilation and printing shall be met with IHB funds with such assistance as may be received from interested scientific organisations." It was further resolved " that for this purpose, the sum of 50,000 gold francs per year or 250,000 gold francs over five years shall be set aside by the IHB in developing the GEBCO programme as quickly as possible."(VIIIth I.H. Conference, 1962). Although this may seem to have set the programme on a firm financial footing, the implementation of the programme appears not to have moved very smoothly with production difficulties and contention as to its actual scientific merit. By 1970 the Intergovernmental Oceanographic Commission (IOC) decided to set up, through the Scientific Committee on Ocean Research (SCOR), a study of the scientific requirements, a matter which you will hear about in later papers. Essentially this spelt the knell of the Fourth Edition, which after having had only six sheets published, was never completed.

Initial transfer to the IHB

The initiation of the Third Edition and the associated transfer of the responsibility for GEBCO from the Cabinet Scientifique of HSH Prince Albert I resulted from a letter, dated 6 January 1928, by Dr.J.Richards, (Richards, 1928) previously Director of that body. He invited the IHB to undertake to keep the General Bathymetric Chart of the Oceans up to date with the progress of science. The President of the Directing Committee, Rear Admiral A.P.Niblack, decided to put this offer to the Member States at the next International Hydrographic Conference (First Supplementary IH Conference,1929). The requirement for a Third Edition was expounded in an article in the I H Bulletin in March 1928,(I H Bulletin,1928) Admiral Niblack correctly prophesied that it would entail fairly considerable expenditure and the necessity to increase the present staff of the Bureau. However, he believed that the

expenditure could be met without raising contributions. The requirement to produce a Third Edition does not appear to have been explicitly agreed at the conference. Instead, some more general measures were resolved. Amongst the actions agreed was that there was no need for an English version. In 1930 Ingenieur hydrographe general P.de Vanssay de Blavous, the then President of the IHB presented a report to the International Union of Geodesy and Geophysics (IUGG) (de Vanssay de Blavous, 1930), which set out some of the organisational plans, including the idea of using 1:1 million collector sheets, the method of collecting soundings, the use of the Mercator projection and the need to form a consultative committee. It is also clear that he was very sensitive to the particular requirements of scientists and raised very specific questions on their needs. He received a number of letters from scientists giving their opinions on such matters as format and contents. Having listened to this advice, the Bureau, in a Circular Letter to its Members States on 5 December 1932 instructed them on the requirements for submitting data. These requirements were designed to ensure that sufficient parameters, such as the velocity of sound, were provided from which the accuracy of the data could be assessed. Plotting sheets were made available by the Imperial Japanese Navy. A final note on organisation was the agreement that each GEBCO sheet published should be accompanied by a pamphlet that provided references to all sources of data used. (Bencker, 1953) Work could now begin on the Third Edition.

The Production of the Third Edition.

The difficulties faced in producing the Third Edition were introduced in the Introduction to this paper. Not only was the technology changing but it was a period during which many scientific cruises took place, all contributing to a great inflow of sounding data. The introduction of the 1:1 million plotting sheets, has been noted earlier and this organisational change was essential for recording the large amount of data received. In order to compare these data with data already recorded it was necessary to scale up the earlier soundings, revealing some considerable errors in the earlier data and also introducing errors through the scaling process. With meagre resources the first sheet A1, covering the southern part of the North Atlantic was published in 1935. From then on the chequered development of the series can be seen in the table. Six sheets were published before the start of the war and one published during the war. The compilation was accomplished by the limited staff made available at the IHB and the printing was by the Institut cartographique de Paris and by Gaillac Monrocq et Cie, Paris.

GEBCO Third Edition		
Sheet	Date	Printers
AI	April 1935	Institut cartographique de Paris
AII	1 May 1949	Institut géographique national
AIII	1 February 1940	GAILLAC MONROCQ et Cie, Paris
AIV	1 February 1938	GAILLAC MONROCQ et Cie, Paris
A'I	January 1936	Institut géographique national
A'II	1 January 1951	Institut géographique national
A'III	May 1942	GAILLAC MONROCQ et Cie., Paris
A'TV	1 July 1938	GAILLAC MONROCQ et Cie., Paris
BI	1 June 1937	Institut cartographique de Paris
BII	1 February 1953	MICHARD, Paris
BIII	1 February 1953	MICHARD, Paris
BIV	1 February 1939	GAILLAC MONROCQ et Cie., Paris
B'I	1 October 1952	Anc. Ets. Dufrenoy, Paris
B'II	1 March 1955	Anc. Ets. Dufrenoy, Paris
B'III	1 March 1954	MICHARD, Paris
B'IV	1 March 1954	MICHARD, Paris
CI	1 October 1968	Institut géographique national
CII	1 October 1968	Institut géographique national
CIII	Not published	
CIV	Not published	
C'I	1 June 1969	Institut géographique national
C'II	1 March 1955	Institut géographique national
C'III	1 March 1955	Institut géographique national
C'IV	Not published	

Table compiled by Antoine Ferrero-Regis (IHB)

Figure 1. Table of Publication of the Third Edition

The scheme chosen for the Third Edition was to have sixteen sheets at a scale of 1:10 million on the Mercator Projection between the parallels of 70 degrees North and South and eight sheets on the Polar Stereographic Projection covering the Polar Regions. As also noted earlier, an additional feature of the Third Edition was to have a pamphlet accompanying each sheet, which outlined the particulars of the data used. All soundings greater than 1000 metres were corrected for sound velocity. (Bencker, 1953)

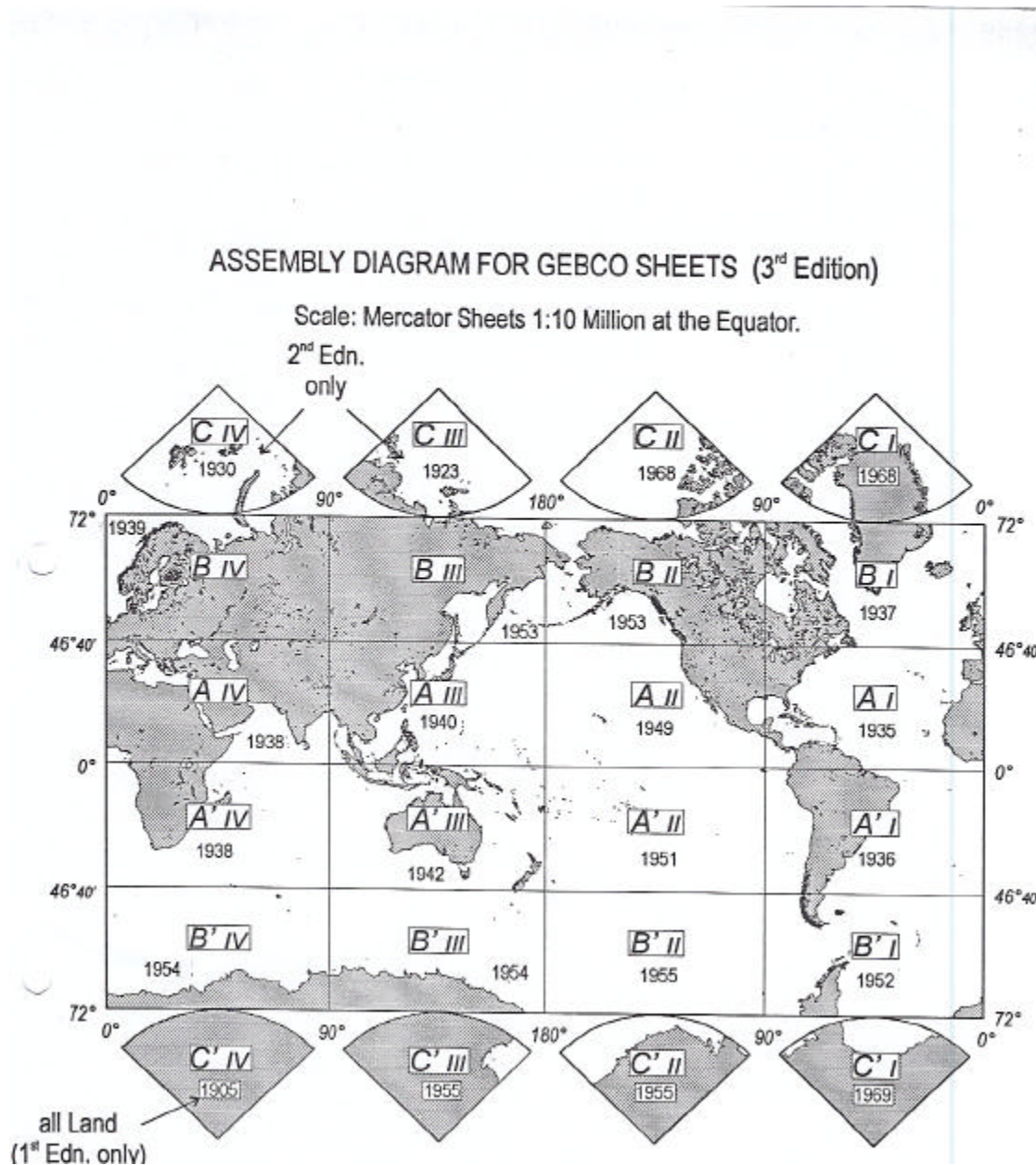


Figure 2. Assembly Diagram for the Sheets of the Third Edition

Following the war the IHB continued its work and initially printing was done by other commercial firms in Paris. However in 1949 the French Institut Geographique International (IGN) in Paris, offered to print sheet AII, stated to be "on terms very favourable to the Bureau". During the last years of this edition all sheets were being printed by the IGN.. Although the Third Edition was claimed to have been finished in 1955, three of the Polar

Sheets were not in fact published until 1968-69. This brought to 21, the number of sheets published out of the total scheme of 24,.

The Production of the Fourth Edition.

It is clear that the Third Edition was not only slow in its production but it was not what the scientific community really wanted. Although the Directing Committee was sensitive to the needs of that community it appears not to have been able to remove itself from the practices of the nautical cartographer with their emphasis on the needs of navigators rather than scientists. The actual organisational procedures for the Member States to acquire the data on the 1:1 million collector sheets was a good step forward but the cartographic procedures were not at all innovative. There was very limited use of bathymetric contours and numerous spot depths. This followed navigational chart practices rather than scientific mapping practices. The process of scaling up older soundings from the earlier 1:10 million sheets, so that they could be compared with the data on the 1: 1 million collector sheets, introduced very major errors, that are stated to amount to as great as 10 miles in their position. Concern that the IHB was not meeting the requirement of the scientists can be read in Admiral Nares's paper to the International Joint Commission on Oceanography (IJCO) in 1953 (Nares, 1953), when he comments on how difficult it was for the IHB to present bathymetry in a form that will fully satisfy the various scientists who they hoped would use the charts. He stated that different types of scientist had different ideas on how the depth contours should be drawn. He suggested that the ICJO could possibly name a scientific expert who should review each sheet objectively.

It has already been noted that the Fourth Edition was the cause of much debate by committees. On the one hand there were committees formed by the scientific institutions and on the other hand, those formed by the IHO. In 1958 a small round table meeting took place at the Bureau attended by representatives of the International Council of Scientific Unions (ICSU) and the Directing Committee (IHB, 1958). This seems to have been the first attempt to bring together the interests of the scientific and hydrographic communities. The result was Resolution P 73 at the VIIth I H Conference. This included references to funding and the responsibilities of the two communities. The IHO committee responsible for implementing some of the recommendations seems to have met infrequently. However at the VIIIth. IH Conference there was a decision to add paragraph VI to Technical Resolution K 29. This set the tone for the production of the Fourth Edition. Amongst other matters it recommended that Member States be asked to accept the work of preparing the 1:1 million collector sheets but the work of the compilation of the GEBCO sheets (the 1: 10 million sheets) be performed under the auspices of the IHB with the assistance of the Member States and other international organisations which have primary interest in oceanic soundings. This appears to formalise an arrangement in which the scientific organisations would have a say in what appeared on the GEBCO sheets.

In 1962 the Head Department of Navigation and Oceanography of the USSR, as a result of discussions at the IOC, stated that it was prepared to carry out the task of compiling and publishing the GEBCO (Tehekourev, 1962)). This was discussed by the IHO Member States and voted upon with 25 of the 41 Member States supporting the proposal (IHB, 1964,CL 4). However in August 1964 the Bureau received an offer by the IGN in Paris to compile and publish the new edition of GEBCO, in cooperation with the French Service hydrographique de la Marine (SHM). By this time the IGN had already published sheets AI and A'I, although this work seems to have been repeated later. Nevertheless, it was given as one of the reasons why the Directing Committee, after due discussion with Member States, came down in favour of the French proposal in 1965. Whether, in fact, manoeuvres associated with the Cold War were behind this decision being made, can only be speculated. The Chairman of the GEBCO Committee stated that the French offer of publication by the two organisations was "the one which was more likely to result in a chart with a truly international character, not restricted to any particular school of thought" (IHB, 1964, CL 22) Having established that the IGN associated with the SHM would now take the lead, the

Directing Committee firmly announced that the GEBCO programme was to consist of three primary steps:

Part 1: Compilation of the 1:1 million plotting sheets by the Volunteering HOs.

Part 2: Final processing of the 1:1 million sheets by the IGN, with technical cooperation of the SHM.

Part 3: Assembling the final overlays and printing of the 1:10 million sheets by the IGN.

The programme of the Fourth Edition was thus formally put in motion. Working arrangements were put in place between the participating organisations, the IGN, SHM and the IHB. But a meeting of the GEBCO Committee, under the chairmanship of Ingenieur Hydrographe general A. Gougenheim, meeting in 1967 at Zurich, found that all was not well (GEBCO Committee, 1967). The committee, it may be noted, now included some distinguished oceanographers, including Dr. A. S. Laughton, of whom we shall hear more later. Nomenclature and Editorial Sub-committees had been formed and their work was discussed. Although the Editorial Committee paid tribute to the work of the Volunteering HOs, it was not happy with the quality of the work by some of the seventeen volunteering HOs, finding a high error rate in the soundings shown. It felt that information from seismic, geologic and sedimentary sources might lead to more accurate knowledge of the bathymetry. There was debate on how depth curves were drawn and stress on the use of geologic and geophysical data being used in their interpretation. Finally there was concern about the slowness of the process. Given that the IGN and SHM had been given the task of actually compiling and presenting the data one must wonder if some of the problem resided there, as well as in the Volunteering HOs.

In 1967 at the IXth I.H. Conference, a proposal by Canada for an English version failed to be adopted primarily due to the cost of producing both French and English versions. (IXth. I.H. Conference, 1967). Later in that year the Bureau announced that it would no longer be responsible for the distribution and sale of the GEBCO (IHB, 1967). The programme dragged on from 1967 to 1970, in the face of continuing criticism of its scientific merit. Regulations for the work of the Volunteering HOs were approved, aimed at improving the quality of their inputs but the end of the Fourth Edition was at hand. In the overall period from 1958 to 1970 only six sheets were published, all by the IGN.

GEBCO Fourth Edition		
Sheet	Date	Printers
AI	1 January 1958	Institut géographique national
A'I	July 1961	Institut géographique national
BI	1 December 1966	Institut géographique national
BIV	1 December 1966	Institut géographique national
B'I	1 October 1970	Institut géographique national
B'IV	1 February 1967	Institut géographique national

Information compiled by Antoine Ferrero-Regis (IHB).

Figure 3. Table of Production of Fourth Edition.

In 1970 the IOC set up a group of experts on Long Term Scientific Policy and Planning. This group recommended that the Commission participate in the production of a world bathymetric map, bearing in mind that the IHB was the most scientific body in this field. This eventually led to the formation of the Scientific Committee on Ocean Research (SCOR) Working Group 41 being formed, of which you will hear more in later papers at this conference.

Conclusions

This period of the GEBCO programme, stretching from 1928 to 1973, has been much criticised, but as noted in the beginning, there were extenuating circumstances why it was

not successful, at least as far as the production of the Third Edition. The Fourth Edition was over burdened with committees attempting to resolve not only the financial dilemma but particularly trying to reconcile the different views of traditional hydrography with those put forward by scientists seeking a greater input of scientific methods and minds. Although it is clear that those in an executive capacity, particularly some of the Presidents of the IHB, were well aware of the need to introduce more scientific data and thought, this does not seem to have been accepted by those hydrographers and nautical cartographers involved in the interpretation, compilation and drafting of the data. They were unable to get away from the methods used for the production of navigational charts, with their emphasis on navigational safety, the tradition of using point depths in favour of bathymetric contours and general emphasis on shallow water rather than deep water features..

Against the criticism we must acknowledge the establishment of administrative systems that were set up to handle the huge increase of soundings that became available once continuous profile echo sounding came into being. The introduction of the 1:1 million collector sheets and the spreading of the load through soliciting the help of volunteering HOs, were clearly steps in the right direction. It must be appreciated that computers were only just beginning to enter the field and digital echo sounders had not then been widely accepted. The fact that the IHB had the tenacity to keep this important data base of ocean bathymetry going throughout all the criticism has much to commend the various Directing Committees and the Member States involved. It could have quite easily decided that scientific mapping was not its business, its business was providing navigational services. Fortunately it did not and as we shall hear, the IHB, to become the IHO, was later to form a strategic alliance with the oceanographic community that has been able to develop and maintain the remarkable global bathymetric data base that we have today. It is important that these ideals are followed today in the Strategic Planning Process that is underway at present and that the IHO continue to be involved in satisfying both navigational needs and the much broader needs for information on the global environment.

References

J.Richards (1928) Letter to President of the Directing Committee, dated 6 January 1928. Cited in I H Bulletin, March 1928 p.63.

IHB (1928) I H Bulletin No.3 March 1928. pp.63-64.

First Supplementary Hydrographic Conference. (1929) Resolution 23. Reports of the Charts Committee p.303.

M.P. de Vanssay de Blavous (1930) Communication to General Assembly of IUGG, Stockholm, August 1930. Cited IH Bulletin July 1931. p.168.

IHB (1932) Circular Letter No. 7-H. 5 December 1932.

Bencker H. (1953) Report concerning the preparation of the Third Edition of the General Bathymetric Chart of the Oceans. I H Review XXX(I) May 1953 pp.73-87.

Nares J.D. (1953) Future Plans for the preparation of the General Bathymetric Chart of the Ocean. I H Review XXX(2) November 1953. pp.137-142.

IHB (1956). Circular Letter No. 6-H. 28 February 1956.

IHB (1958) IH Bulletin. General Bathymetric Chart of the Oceans. P 180.

Tehekourov (1962) Letter to Dr.Wooster, Intergovernmental Oceanographic Commission. 27 November 1962.

VIIIth IH Conference (1962) Decision 15. General Bathymetric Chart of the Oceans. Increase in expenditure.

IHB (1964) Circular Letter No.4. USSR Proposal: Publication of GEBCO. 27 November 1962.

IHB (1964) Circular Letter No.22. Directing Committee Decision on the publication of the 1/10 000 000 GEBCO sheets. 9 December 1964.

GEBCO Committee (1967) Report of the Proceedings of the GEBCO Committee meeting held at Zurich, 3 October 1967.

IXth. IH Conference.(1967).Proposal P 83. General Bathymetric Chart of the Oceans..

Monahan D. (1977) The General Bathymetric Chart of the Oceans. Seventy Three Years of Co-Operation on small scale thematic mapping. IH Review LIV(2) 1977. pp.9-17.

Biography

Adam J. Kerr was a member of the Directing Committee of the International Hydrographic Bureau from 1987-1997. Previous to that he spent nearly thirty years with the Canadian Hydrographic Service. His first involvement with the GEBCO programme was when he was the Chairman of the Working Group on Marine Cartography of the International Cartographic Association. In that capacity he participated in the discussions of SCOR WG 41 in developing plans for the Fifth Edition of GEBCO.

Appreciation

The contributions of **Mlle. Benedicte Ezvan** of ENSIETA, France , who did much of the early research for this paper, are very much appreciated.