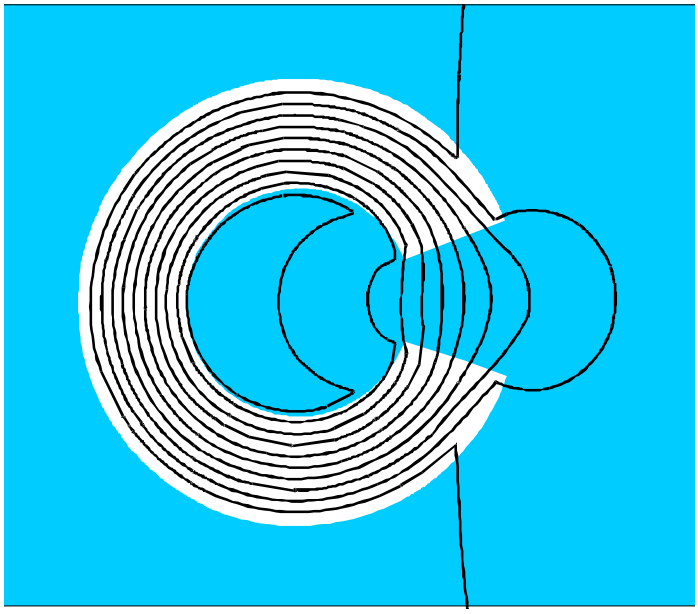
Compumag Conference

The First 25 Years

Part 1 Oxford to Fort Collins

Bill Trowbridge



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International Compumag Society

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1. Introduction

The Compumag Conferences began in 1976. The broad aim of this conference series is to review recent developments in numerical computation of electromagnetic fields that are of interest to physicists and engineers engaged in the design of electromagnetic devices. There have been thirteen conferences held so far, seven in Europe, four in USA and two in Japan. The purpose of this booklet is to place on record facts and memorabilia of the conference to celebrate twenty-five years of professional progress.

The Compumag series of conferences was brought into being on 8 October 1974 at the first meeting of the International Steering committee held at Rutherford Appleton Laboratory[1]. The minutes of this meeting contain the following statements:

> ...there was a need for a specialised conference on the computational aspects of magnet design...
>
> …and it was resolved by the committee to mount such a meeting early in 1976 for the exchange of ideas and information between workers at the forefront of this field.

Indeed the guiding principle at the outset was to try and bring together researchers from at least three communities namely, Academia, Industry and the so called National Laboratories specialising in the design of magnets for large scale scientific experiments e.g. CERN, Argonne National Laboratory (ANL), Rutherford Appleton (RAL). This mix of activity was reflected in the steering committee members.

The first meeting took place in Oxford in April 1976 and was considered a success so that a second Compumag conference was immediately planned to be held in Grenoble in September 1978. Thus the series was launched with meetings held approximately every two years. See Table I for some statistics. The broad aim of the conference series was and is to review the most recent developments in the computation of electromagnetic fields that are of central importance to industry and research. From the very beginning the planners insisted on the avoidance of parallel sessions to allow delegates the opportunity for full involvement in all aspects of the conference; however since Genoa (1983) poster sessions have been included which have proved very popular and are, for many researchers, the preferred way of communicating the details of their results. Indeed a technical conference

[1] See Appendix A

should be the place where both successes and failures can be discussed in a friendly and constructive manner and, furthermore, it does not necessarily follow that incomplete or 'work in progress' brought to the conference for discussion should be of transaction quality. Thus the conference allows for second thoughts, often suggested at a poster session by other delegates working in similar 'fields', which can later lead to real advances. This means that not all of the papers discussed at the meeting and reported in short form in the conference record will appear in the transactions.

Some Statistics

No.	Date	Venue	Days	Oral	Poster	Papers Published	Number of Delegates
1	Apr. 76	Oxford, UK	3	40[2]	-	67	213
2	Sep. 78	Grenoble, France	3	45	-	60	180
3	Sep. 81	Chicago, USA	4	47	-	76	152
4	May 83	Genoa, Italy	4	64	44	98	174
5	Jun. 85	Fort Collins, USA	4	72	62	106	171
6	Aug. 87	Graz, Austria	4	58	103	143	232
7	Sep. 89	Tokyo, Japan	4	59	162	177	290
8	Jul. 91	Sorrento, Italy	4	46	178	193	319
9	Nov. 93	Miami, USA	4	29	273	225	361
10	Jul. 95	Berlin, Germany	4	25	332	266	377
11	Nov. 97	Rio, Brazil	4	30	381	308	371
12	Oct. 99	Sapporo, Japan	4	29	417	279	316
13	Jul. 01	Evian, France	4	32	393	?	?

Table 1: Compumag Statistics

A histogram of the number of conference delegates per papers published in the proceedings is shown in Fig. 1. It is interesting that, apart from the initial transient, this ratio has become nearly constant. The first two meetings were to some extent 'evangelical' with a smaller number of researchers involved in actual developments. One inference that can be drawn from this result is consistent with the notion that most delegates are themselves heavily involved in either technical developments or in the validation of computational techniques by application to interesting and novel devices. Although the number of

[2] Only 39 were presented orally the remainder were included in the proceedings

delegates has risen significantly, particularly from Asia and Eastern Europe, there are very few spectators.

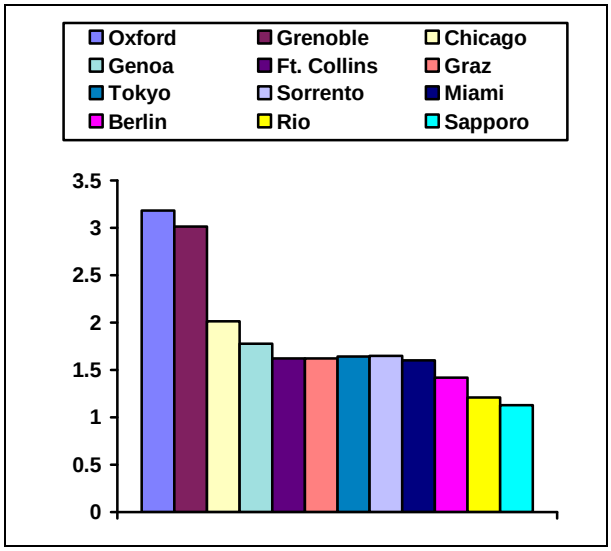


Figure 1: Ratio of the number of delegates to the number of published papers

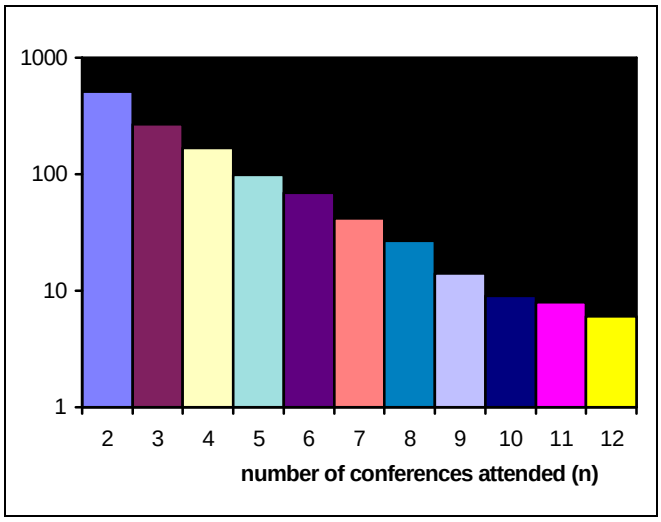


Figure 2: Number of delegates attending at least n conferences

At least 515 researchers have attended 2 conferences and over the twenty-five year period there have been 6 who have attended all twelve

meetings, see Fig. 2. On the other hand at least 25 people have attended every meeting since Graz. The distribution of delegates over country is shown in Fig. 3 and demonstrates thestrong international character of the conference with USA, Japan, UK, France, Italy and Germanywith over 100 attendees. There has been a significant regional attendance from Scandinavia (41) and the formerEastern Europe (99).

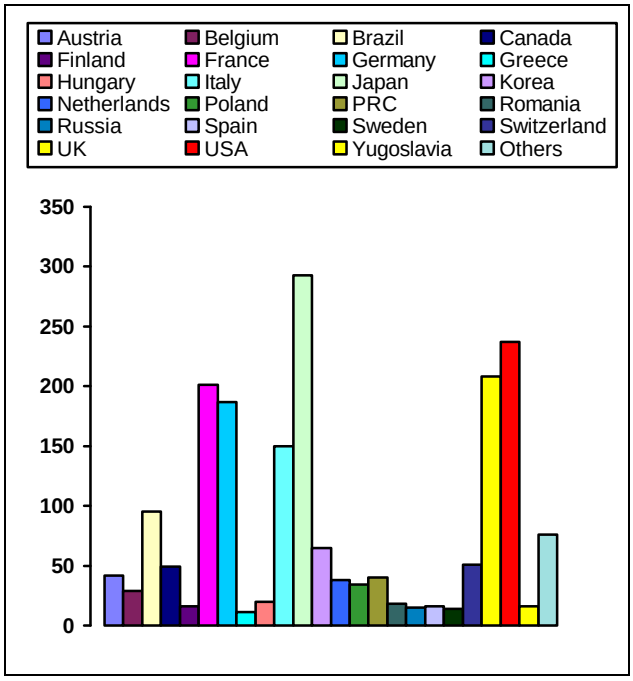


Figure 3: Country distribution of delegates (cut-off =10)

Technical Topics

The topics of interest covered by the conference are shown in Table II. The table shows the distribution of published papers over subject areas and indicates a 'time line' of activity across the years, which corresponds to the advances in computer power. It is reassuring to note that the core activity of investigating new algorithms for solving the field equations, i.e. topics 1 & 2 has been the mainstay of the conference throughout the period. Also, the realisation of these new developments in interesting applications, topic 9, has kept pace as it must do if the innovations are to be exploited by industry. In this context the emphasis the conference has always placed on numerical and software methodologies has been seminal in the development of robust and effective systems for electromagnetic design.

	Conference	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
	Topic	76	78	81	83	85	87	89	91	93	95	97	99	01	
1	Static	22	19	17	18	15	13	16	17	27	25	26	23		238
2	Time Varying	31	22	26	30	33	35	26	33	34	28	38	27		363
3	Wave Propagation									29	28	28	21		106
4	Optimisation Problems		2	2			6	9	20	16	36	45	38		174
5	Material Modelling	6	2	7	7	6	6	5	5	11	20	16	20		111
6	Coupled Problems			1	3	2	13	12	15	35	30	38	39		188
7	Numerical Methods		3	6	11	14	13	36	39	20	27	43	39		251
8	Software Methodology	2	5	3	9	9	20	21	12	17	13	14	12		137
9	Applications	4	7	14	20	27	37	52	52	36	41	52	50		392
10	EMC										18	8	8		34
11	Education												2		2
	Total	65	60	76	98	106	143	177	193	225	266	308	279		1996

Table 2: Numbers of published papers over topics

The period has seen an enormous increase in computing power to the extent that the treatment of coupled problems and automatic optimisation is now possible and the growth of submitted papers in topics 4 and 6 reflects this. On the other hand papers in material modelling have

remained a small but constant activity. Lastly, the introduction of wave propagation (Miami, 1993) opened up new and exciting opportunities for cross benefits to both low and high frequency CEM alike.

Although computational eletromagnetics is the overall concern of the conference there has been a rich diversity of topics involved which is only hinted at in Table II. Firstly there are the basic methods used in field computation, i.e. differential and integral methods and the many ways these have been discretised, secondly the underlying mathematical techniques e.g. linear algebra a vast subject in itself, and thirdly the underpinning software methodologies ranging over data base techniques, geometric modelling, graphics, Neural Networks, Intelligent Knowledge Based Systems (IKBS) and many more. All of these activities have been included in the conference, which has also invited experts from other relevant disciplines to keep the community abreast of new developments.

Technical Advances

The conference proceedings are cited in the reference section and apart from the first two meetings, see references [1], [2], the proceedings have been published in the IEEE Transactions in Magnetics [3-12]. Also each conference organiser has published a conference record, which contains all the papers accepted for presentation at the conference either orally or as a poster. There have been many interesting new developments reported at the conference. These include, in no particular order of importance, the following:

- *Three-dimensional solutions using the finite element method (FEM) initially in Statics (non-linear) now extended to time dependent problems with a good understanding of the gauge problem.*
- *Two & three-dimensional solutions using the boundary element method (BEM). The conference has pioneered this integral method but the debate continues as to the relative advantages over the FEM.*
- *Edge (Whitney) Elements as the basis functions for both FEM & BEM has been a notable innovation of the conference. This approach, in many ways a generalisation of the more traditional nodal methods, provides a sound physical framework for discretised 'field' variation and continuity.*
- *New Functionals for FEM have been introduced including energy upper and lower bound solutions and the constitutive (Ligurian) method.*

- *Treatment of the exterior problem by various methods, in particular the Kelvin transformation used in conjunction with the FEM has been very widely adopted.*
- *Automatic Mesh generation been a constant theme and has now become a 'routine' procedure.*
- *Error Analysis has been another recurrent theme for the conference and this technique, in conjunction with automatic meshing, is rapidly becoming common.*
- *Software environments for CEM community has been a special concern from the beginning and the ground rules for CAD systems for CEM, including the use of animation techniques for exploring solutions, have been largely established by the conference.*
- *Optimisation is now a growth area and there have been many innovations reported including applications of both direct and stochastic methods.*

A very important issue that has become associated with the conference has been the Testing of Electromagnetic Analysis Methods (TEAM) workshops [13]. This activity began with the fusion magnet community in USA who identified that the increasing use of computational solutions needed experimental validation. International workshops have been held in conjunction with Compumag since 1985 with regional workshops in between.

Impact on industry

The community is only doing its job if its technical developments find their way into industry. Computational Electromagnetics is an enabling discipline making possible efficient designs of electromagnetic devices avoiding costly prototypes. The conference has reported improved computer based techniques for designing devices of all kinds. This range from micro machines to turbo-generators, domestic electron beam focusing systems to large scale particle accelerators and fusion machines, NDT and remote sensing probes, computers and peripherals, industrial processes, communications and many more.

The conference has been influential in encouraging the implementation of algorithms and software into 'packages', which are available commercially. A regular feature of Compumag has been the exhibition where both commercial vendors and academic researchers have been able to demonstrate their latest developments. The conference has been well attended by industrial designers, which has helped to keep the developers in close contact with requirements.

Future trends

It is possible to be optimistic about the future. Over the years it has not always been easy to convince managers in industry and device designers that CEM tools could be useful. This has been partly because their use was indeed problematic owing to technical limitations but is also a matter of culture in the changing world of computers. The limitations are disappearing as the new technical developments become available in software but the most significant change stems from the expectations generated by the computer literacy of younger professionals. However there is another limitation which is partly cultural and partly technical and this is the question of the class of tools provided by the developers ? a general purpose package or a customised program for a specific device? The difficulty is that the former class is not truly general whereas the latter tool is often too specific and lacks flexibility. The cultural challenge here is to persuade the developers to place equal emphasis on structures, standards and synthesis to allow communication between modular systems not only in electromagnetics but across the other disciplines involved, i.e. structural, and thermal and fluid mechanics etc.

The last few years have seen a major upsurge of interest in the use of the Internet for the dissemination of information and knowledge. The

benefit to computational electromagnetics is, of course similar to other areas, and is both technical and social. There is no doubt that the use of E-mail is now playing a crucial and effective role in communications and can be counted as a notable success. Also the use of bulletin boards, special interest forums in which knowledge and information is exchanged has both technical and social side. In many ways computer specialist are isolated and introverted. On the other hand there is a downside owing to technical limitations that degrade access and speed and the high costs involved when using commercial providers. Furthermore there is much confusion and chaos in both finding appropriate sites and the over use of redundant pictorial information on the World Wide Web.

Looking a little further ahead one may speculate that the challenging list of problems for the future will include the following:

- 3D EM analysis with rigid body motion? the use of Integral methods and parallel processing.
- 3D Wave propagation in non-linear media? hybrid Differential and Integral methods.
- Global optimisation? competing objectives and non-linear constraints.
- Integration of knowledge data bases and intelligent design systems to create industrial design environments
- Variational geometric modelling, Boolean operators and adaptive automatic meshing.
- Hysteresis? including minor 'loops'. Greater attention to material modelling is needed as computational accuracy is often limited by imperfect modelling data.
- Parameter extraction and coupling electric networks with E-M devices. System analysis is an essential part of studying new devices, i.e. transient motion of electrical machines.
- Integration and coupling electromagnetic fields with the other disciplines required for device design, i.e. Thermal, Structural and Fluid flow.
- Visualisation of '3D-fields', use of graphics & colour and virtual reality ideas.
- The development and promotion of workable international data standards to service all of the above.

It is obvious that much more research is needed in areas like optimisation and coupled problems. It is interesting to speculate if the established methods for field computation like FEM, BEM etc. will still be the popular techniques in the generations to come?. This may be

unlikely, in fact there has now been nearly three decades of the use these methods so they can now be viewed as classical and are rather limited when the challenging problems are considered. Undoubtedly further advances will be made in computer performance and the range of applicable problems using classical methods will be extended but new approaches are needed.

There are some early signs of radical methods appearing already, as these proceeding for the latest conference demonstrate. For example, the use of intelligent systems to automatically generate devices to meet design goals, the use of non-deterministic methods in optimisation and the use of new ideas like wavelet transforms borrowed from signal processing, to represent fields.

Together with other conferences and activities specialising in computational electromagnetics, e.g. the IEEE sponsored Computational Electromagnetic Field Conference (CEFC) [13], the Applied Computational Electromagnetics Society ACES [14], and the International Compumag Society (ICS) [15] it seems likely that the Compumag conference will continue to play a leading role in all these developments.

Finally the way electromagnetic fields are formulated are coming under scrutiny with the introduction of 'differential forms' into computational electromagnetics [16] which by associating the appropriate space metrics with the field quantities achieves a clarification in field theory and the field equations which may in time lead to improved numerical procedures.

References

[1] J Simkin, ed., *Proceedings of Compumag Conference on the Computation of Magnetic Fields, Oxford, 31 March to April 2, 1976.* Rutherford Appleton Laboratory, Chilton, Oxon, UK, 1976.

[2] J C Sabonnadiere, ed., *Proceedings of Compumag Conference on the Computation of Magnetic Fields, Grenoble 4,5,6 September 1978*, Laboratoire d' Electrotechnique, ENSEGP, Grenoble, France, 1978.

[3] L. Turner, ed., *Proceedings of Compumag Conference on the Computation of Magnetic Fields, Chicago, USA, 14-17 September 1981,* IEEE Trans. Magn, vol. 18 (2) 1982.

[4] G. Molinari ed., *Proceedings of Compumag Conference on the Computation of Electromagnetic Fields, Genoa, 30 May-2 June, 1983,* IEEE Trans. Magn., vol. 19 (6) 1983.

[5] W. Lord ed., *Proceedings of Compumag Conference on the Computation of Electromagnetic Fields, Fort Collins, Co, USA, 3-6 June, 1985,* IEEE Transactions on Magnetics, vol 21 (6) 1985.

[6] K Richter, ed., *Proceedings of Compumag Conference on the Computation of Electromagnetic Fields, Graz, Austria, 25-28 August, 1987,* IEEE Trans. Magn., vol 24 (1) 1988.

[7] K Miya, ed., *Proceedings of Compumag Conference on the Computation of Electromagnetic Fields, Tokyo, Japan, 3-7 September, 1989,* IEEE Trans. Magn, vol 26 (2) 1990.

[8] R Martone, ed., *Proceedings of Compumag Conference on the Computation of Electromagnetic Fields, Sorrento, Italy, 7-11 July, 1991,* IEEE Trans. Magn., vol 28 (2) 1992.

[9] D A Lowther, ed., *Proceedings of Compumag Conference on the Computation of Electromagnetic Fields, Miami, Florida, USA, 31 October - 4 November, 1993,* IEEE Trans. Magn., vol 30 (5), 1994.
[10] Biro, ed., *Proceedings of Compumag Conference on the Computation of Electromagnetic Fields ,Berlin, Germany,* to be published in IEEE Trans. Magn., 1996
[11] N Ida, ed., *Proceedings of Compumag Conference on the Computation of Electromagnetic Fields Rio de Janeiro, Brazil,* to be published in IEEE Trans. Magn.,
[12] T Takagi, ed., *Proceedings of Compumag Conference on the Computation of Electromagnetic Fields ,Saporro, Japan,* to be published in IEEE Trans. Magn.,
[13] T Nakata (ed), "3-D Electromagnetic Field Analysis", COMPEL, vol. 9, Supplement A, pp 191-318, 1990.
[14] CEFC
[15] *ACES*
[16] J. Sykulski, ed, *International Compumag Society Newsletter,* Dep. Elect. Eng. University of Southampton, SO17 1BJ, UK, vol 1 & 2, 1993-1995.
[17] D Baldomir, D and P Hammond, "Geometrical formulation for variational electromagnetics", *IEE Proceedings*, A137, (6), 321-330, 1990.

2. Oxford 1976

Background

The idea of hosting a conference on field computation had been germinating for some time and arose out of the work we doing in developing computer based tools for designing the high precision magnets used in particle physics applications[3]. By 1963 the group transferred to the newly formed Rutherford Laboratory where the work on nuclear structure and high energy physics research was to be concentrated.

For us a number of important events happened in the mid sixties. One was the high field bubble chamber project led by David Thomas which began with great enthusiasm but unfortunately, for many reasons, political, financial etc. turned out to be a paper study only; however, it spawned a number of activities which were to become very significant for us. At this time we acquired the TRIM program from LRL Livermore, TRIM was written by Alan Winslow[1] and was a tour de force in those days. He derived a numerical algorithm for solving Poisons Equation over an irregular triangular mesh in three ways (a) using a resistor network analogy, (b) a finite difference scheme and (c) a variational method. This last approach was in fact the finite element method in a different guise! So I think Alan Winslow was the first to develop a Finite Element (FE) package for non-linear electromagnetics applications.

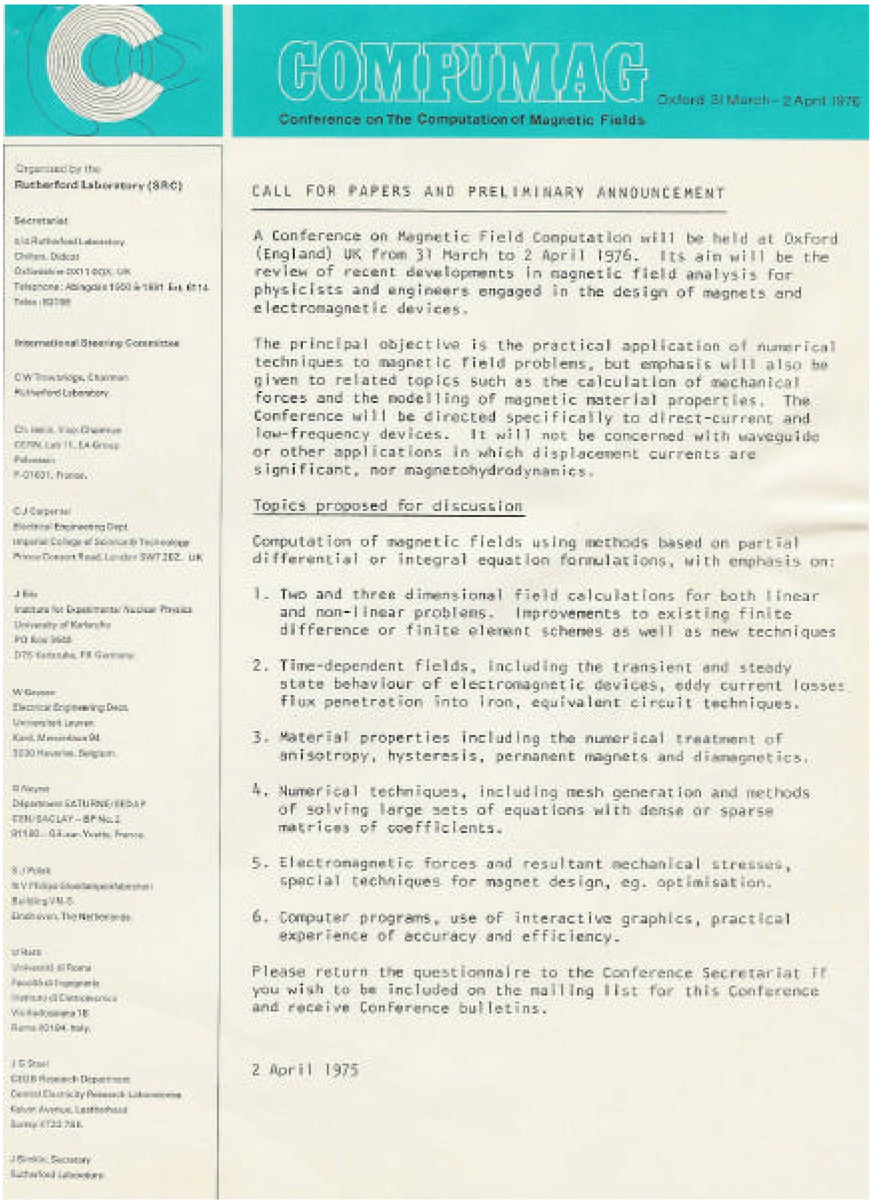
Another event which in retrospect I feel was seminal was the 2nd International Conference on Magnet Technology at Oxford in 1967.We were strongly influenced by the work of three pioneers from the USA. Firstly there was Andrew Halaczy, professor of electrical engineering at Reno, who described his work using integral equations for solving three dimensional field problems, next John Colonias, of LRL Berkeley, who using a CDC 6600 together with a CRT display showed user interaction with the boundaries and meshes produced by the field program TRIM, and finally Klaus Halbach, also from LRL, who amazingly presented inverse problem solutions using a least square technique with the TRIM program which he named MIRT.

[3] Bill Trowbridge, A Career in Field Computation: A personal view of computational electromagnetics, ACES

At this same conference we presented some results on computing fields and mechanical stresses in high field superconducting coils and we needed to extend these calculations to include iron saturation and three dimensional geometries and there were the long discussions with John Colonias on how to modify the TRIM program to do this, but the problems of 3D meshes seemed too daunting at that time. Nevertheless TRIM and its later extension POISSON continued to be used for many years.

It was about this time that we formed the Computing Applications group which brought together Jim Disserens, John Collie, Mike Newman and Alan Armstrong. In 1969, despite some opposition we acquired a device known as a COMPUTEK 400/15 Storage tube display which could be connected via a satellite computer (Honeywell DDP224) to a IBM 360/75 main frame to allow single user interactive computing. Using this environment the first version of an interactive program (GFUN) was developed which allowed us to enter graphical primitives representing conductors and other materials in two dimensions. In the first version semi analytic techniques were used to compute the fields which could be displayed on the screen. The geometric shapes could be modified interactively and new solutions obtained. To day of course this is routine but then it was considered rather novel and we received much encouragement. The interaction was achieved by using a new command language processor written by Mike Newman and subsequently this work, in itself, proved to be a rich development and the principles are still relevant today.

In 1970 I met Larry Turner for the first time at Argonne National Lab during the Bubble chamber conference and I discovered that he had been investigating field solutions using magnetization integrals independently of Professor Halaczyand in fact had some original ideas on how to extend this formulation. This was just what we needed in order to re-design our code to have, firstly a full non-linear algorithm for saturable materials in both 2D and axisymmetry and secondly a possibility of solving three dimensional problems without the burden of generating complex meshes. This is because the magnetization method is an integral equation approach and only requires a discretisation in the active parts of the model. The next two years were productive. Larry Turner came to Oxfordshire to work with us and together we developed what we believed to be one of the first examples of a three dimensional non linear code using an interactive environment. We presented our results at the third Magnet Technology conference at Brookhaven in 1972[2].


COMPUMAG

Conference on The Computation of Magnetic Fields

Oxford 31 March – 2 April 1976

Organised by the

Rutherford Laboratory (SRC)

Secretariat

International Steering Committee

CALL FOR PAPERS AND PRELIMINARY ANNOUNCEMENT

A Conference on Magnetic Field Computation will be held at Oxford (England) UK from 31 March to 2 April 1976. Its aim will be the review of recent developments in magnetic field analysis for physicists and engineers engaged in the design of magnets and electromagnetic devices.

The principal objective is the practical application of numerical techniques to magnetic field problems, but emphasis will also be given to related topics such as the calculation of mechanical forces and the modelling of magnetic material properties. The Conference will be directed specifically to direct-current and low-frequency devices. It will not be concerned with waveguide or other applications in which displacement currents are significant, nor magnetohydrodynamics.

Topics proposed for discussion

Computation of magnetic fields using methods based on partial differential or integral equation formulations, with emphasis on:

1. Two and three dimensional field calculations for both linear and non-linear problems. Improvements to existing finite difference or finite element schemes as well as new techniques

2. Time-dependent fields, including the transient and steady state behaviour of electromagnetic devices, eddy current losses flux penetration into iron, equivalent circuit techniques.

3. Material properties including the numerical treatment of anisotropy, hysteresis, permanent magnets and diamagnetics.

4. Numerical techniques, including mesh generation and methods of solving large sets of equations with dense or sparse matrices of coefficients.

5. Electromagnetic forces and resultant mechanical stresses, special techniques for magnet design, eg. optimisation.

6. Computer programs, use of interactive graphics, practical experience of accuracy and efficiency.

Please return the questionnaire to the Conference Secretariat if you wish to be included on the mailing list for this Conference and receive Conference bulletins.

2 April 1975

Figure 4: The First Call for Papers

The alternative approach to extend the finite element method to 3D which had recently been applied to electrical machine design by M V Chari and P. P Silvester [3], would entail the enormous problem of generating 3D meshes for both the active (iron, conductors) and free space (air) regions. Furthermore even in 2D the necessity for far field

discretisation in an FE approach made the integral equation method more attractive at this time.

The team now concentrated on improving the algorithm, Jim Diserens added a new axisymmetry option and presented our results at the last of the Reno conferences presided over by Andrew Halaczy with attendees from most of the North American groups. This gave us the idea of trying to start an international forum for field computation which would bring together researchers from Academia, National Laboratories and Industry. Many other extensions to GFUN including eddy currents and the introduction of higher order basis functions were planned and it was at this stage that John Collie developed his methods for evaluating fields and potentials of linearly varying current or magnetization in a plane bounded region.

The work on superconducting magnets for particle accelerators, detectors and eventually MRI devices was well underway at Rutherford by this time and number young graduates joined the lab to work in this area. One of these was John Simkin who began by using our techniques but he quickly established himself and was soon making major developments himself. He eventually joined the group and we began a partnership that is still in place today. We resolved to bring the idea of an international conference into being and we were strongly supported by David Thomas and also by our first European collaborator Simon Polak from the Philips Company who was building up a similar group in Eindhoven.

Towards organizing a conference

We invited several prominent workers in the field and appointed an international steering committee (ISC)[4] and had our first meeting at Rutherford Lab in 1974 and I was elected the first chairman with John as the secretary. Among the members was John Carpenter (Imperial College) one of the most outstanding theorists in EM fields whose deep knowledge and enthusiasm have had a considerable influence on our work. Also involved and representing the Academic community were W Geysen (University of Leuven), U Ratti (University of Rome) both foremost specialists in electrical power engineering. To cover the national laboratories we invited Ch Iselein from CERN, G Neyret from Sayclay and J Erb from Karlesruhe all using computational methods for designing magnets used in Physics experiments. Finally Industry was represented by Simon Polak (Philips Eindhoven) and John Steel (CERL

[4] Not to be confused with the later ICS (International Compumag Society formed in 1993)

Leatherhead). Both Simon and John headed active groups in developing methods for industrial applications.

At our second meeting hosted by John Steel at CERL, Leatherhead (26 Nov. 1974) George Neyret proposed the name COMPUMAG for the conference which was immediately adopted. Over the next year we had several meetings in which our collective ideas were refined and the many of the features that the Compumag retains to this day were worked out. In parallel with the work of the international steering committee we appointed an organising committee within RAL chaired by Frank Telling a distinguished administrator. We decided to host the conference in Oxford using one of the colleges and after checking availability and resources we decided to use St Catherine's, a relative new college with, for those days, good facilities. The college had a modern lecture theatre to accommodate 200 delegates and a significant number of student rooms to provide relatively cheap accommodation. There was also adequate ancillary space for an exhibition, and relaxation. During the period leading up to the conference the ISC met more times several times, CERN (13 Feb 1975), EUR Rome (21 April, 1975), CEN Saclay (22 May 1975), RAL (1 Dec 1975) and finally, Philips Eindhoven 12 Jan 1976. Thus were determined that lack of adequate planning should not militate against the success of the conference.

One important task was to establish a mailing list of possible participants and, to this end, members of the committee provided names and addresses of over 1000 people. By April 1975 the call for papers (Figure 4) setting the pattern that has been largely followed since was circulated. From the beginning the committee was concerned to make the quality of submitted papers as high as possible as the following extract on reviewing procedures shows:

REFEREEING OF PAPERS[5]

Dr Isel in suggested that we should first establish the rules for refereeing of papers. Mr Carpenter was concerned that we allow sufficient time for this, emphasised that a great deal of work would be involved and that we should aim for as high a standard as possible. Dr Polak suggested that at least two members of this committee should see all the papers submitted. In the end the following program for refereeing was decided upon:

1) Papers to be divided up and distributed to members of the Committee, according to the rule two members to see each paper.
2) Abstracts (2 page summary) deadline October. 31 1975.

[5] Item 7 from Minutes of 4th meeting of ISC for Compumag held at EUR on 21 April 1975

3) Each referee to submit his comments in writing as soon as possible and in any case before the first meeting. (See 4 below.)

4) First meeting to discuss comments and decide on selection of papers 10.30 Monday 24 November 1975 at Rutherford Laboratory. Any doubtful papers which may be accepted on clarification by authors to be referred to the second meeting. (See 5 below.)

5) Second meeting: Monday 12 January 1976, Venue to be decided, to fina1ise on selection of papers.

The committee also gave careful consideration to the 'invited speakers', many suggestions were made and possible speakers contacted. Finally we were able to secure the services of Prof. P Silvester (McGill University, Montreal) to present an overview of the current status in field computation, Dr Richard Stoll (University of Southampton) on recent developments in Eddy Current computation, Dr H Zylstra (NV Pbilips, Eindhoven) on material modelling and Mr M Newman (Rutherford Laboratory) on CAD techniques in Electromagnetics.

The reviewing procedure was completed in November 1975 with 65 papers accepted but in those pre-poster days it was only possible to have 39 presented orally over the three days with the remaining 27 included in the proceedings only. The committee decided that each paper should be allotted 30 minutes with discussion, it was also agreed that selected questions and answers from the discussion should be included in the proceedings.

The conference fee was set at £25 which would include the proceedings but not the cost of the dinner (~£6). Over 200 persons had replied positively to the announcement bulletins and the preliminary conference program circulated in January 1976 thus the scene was set.

St Catherine's College, 31 March – 2 April 1976

The attendance exceeding our expectations, the meeting attracted over 200 participants from universities (66), government laboratories (90) and Industry (58). Of these 15 participants were from the USA/Canada, 5 from USSR and 191 from Europe including 89 form the UK. The conference was opened by Dr G Manning[6] the deputy director of Rutherford Laboratory; in his welcome to the delegates he remarked on the importance of electromagnetic devices in current scientific research (Figure 5).

Figure 5: Dr Geoff Manning Opens Compumag Oxford

The first lecture was given by Prof Peter Silvester who reviewed the current status of the Finite Element method, see Figure 6. The lively discussion following this paper set the tone of the whole meeting as the subsequently published proceedings illustrates where the text of the questions and answers can be read, see reference [1]. As most delegates were staying in the college itself there were opportunities for making friends and exchanging ideas during the evening. The five delegates from USSR made a strong impression on us as they invite John Simkin and I to their room for a midnight feast. They opened up a suitcase to reveal ample quantities of Vodka and caviar, their leader said, 'we have come prepared as we did not know if you would be able to feed us'. They were a charming group but, as was common in those pre glasnost days, they

[6] Director of Rutherford Appleton Laboratory, 1980-85

were always appeared together as a group clearly under the direction of a 'political' supervisor.

Figure 6: Peter Silvester gives the first invited lecture[7]

Another feature of the conference was a series of demonstrations of software for field computation. Rutherford laboratory provided a remote terminal and a GEC 4080 workstation coupled to the RL IBM 360/195[8] main frame which attracted great interest. In addition to the work of the RL group both Imperial College London and CERL Leatherhead were able to demonstrate their work(see Figure 7).

Several papers stand out in the memory with many by authors that are prominent in our community. These included, in no particular order; Christoph Iselin, Simon Polak, Theo Tortschanoff, Ted Deeley, Percy Hammond, Eric Munro, John Carpenter, Konrad Reichert, Zol Csendes, Giorgio Molinari, Sandro Viviani, Bill Lord, Richard Stoll, Tom Preston, David Jacobs, Peter Johns, Dave Lowther, Alain Bossavit, Peter Lawrenson, J C Nederlec, Ernie Freeman, Larry Turner, and many others.

There were some notable new developments reported for example the introduction of the Boundary Element method to electromagnetics[9]

[7] Also in the picture sitting at the table left are the session chair (Bill Trowbridge) and secretary (John Collie)

[8] In 1976 state of the art but now a dinosaur!

[9] J Simkin & C W Trowbridge, 'Magnetostatic Fields Computed using an Integral Equation derived from Green's Theorems'

and the use of non-divergent vector finite elements for magnetic field calculations[10].

Figure 7: Online demonstrations[11]

At this first conference there was only one social function and that was a conference dinner served in the college refectory. This was memorable, I have been repeatedly told over the years, about the rubbery nature of the 'Duck' served but I was too busy talking to notice! The weather was very fine and everyone enjoyed the early spring sunshine and the many interesting sights in and around Oxford. At the closing ceremony Konrad Reichert made a fine speech to thank the organisers and the delegates for coming and said finally, 'I hope we can all meet again in Oxford soon'. That has not happened exactly, yet but we have been meeting more or less every two years or so at many interesting places in the world ever since as the rest of this booklet will record.

A photo image of the report on the conference appearing in the Rutherford Laboratory's Bulletin gives a summary of the event, see page 44. This short article also appeared in the CERN Courier where it was acknowledged that the technical discussions at Oxford had made a significant contribution to magnet design for particle accelerators and fusion devices as well serving the broader activities in the electrical power industry.

[10] Z Cendes, "Non-Divergent Vector Finite Elements for Magnetics Field Calculations'

[11] Mike Newman on the left and John Simkin on the right.

Rutherford Laboratory

bulletin 7

12 April - 3 May 1976

COMPUMAG 76

Highlight of the recent COMPUMAG conference on the computation of magnetic fields was the specially set up magnet design workstation, shown in the photograph. Based on a GEC 4080 computer linked by a 4800-baud Post Office line to the Rutherford Laboratory's IBM 360/195 computer, the workstation enabled delegates to use the Laboratory's GFUN magnet design software running on the IBM computer together with additional computer-aided design programs running on the GEC 4080 machine. Teams from RL, Imperial College, and CERN demonstrated the capabilities of these magnet design facilities.

The first truly international conference of its kind to be held, COMPUMAG - organised by RL and held at St Catherine's College, Oxford - from 31 March to 2 April, attracted 210 delegates from 15 countries, from as far afield as the USA, Japan and the USSR.

Apart from the Conference dinner, there was little time for relaxation, some 40 papers being read in the three days. Indeed the middle day turned out to be something of a marathon, starting at 0900 & ending at 22.30. The delegates however from many comments received, found it all very worthwhile. Many also commented very favourably on the smooth and efficient organisation of the Conference Office, operated by members of the RL stimulated by a good supply of coffee and perhaps by the nearby and attractive Junior Common Room Bar!

Magnet design work began at RL as part of its High Energy Physics development programme, but its potential for applications in other fields was soon realised, and the GFUN software has now been used by several outside organisations and research centres, including British Rail and International Research and Development Co, for applications in such fields as magnetic levitation and Tokamak magnets for fusion experiments.

The wide interest in the subject was reflected by the attendance at the conference, which brought together experts from industry and universities as well as other research centres. Topics covered included Magnetostatics, Magnetic Materials, Steady State and Transient Eddy Currents and Computer-Aided Design, while applications described included High Energy Physics, Fusion Studies, Electrical Machines and Magnetic Levitation.

The COMPUMAG International Steering Committee chaired by Bill Trowbridge is to meet in the near future to decide on the location of the next conference, scheduled for 1978.

Figure 8: Compumag 76 reported in the RAL Bulletin

3. Compumag Grenoble

Where to next

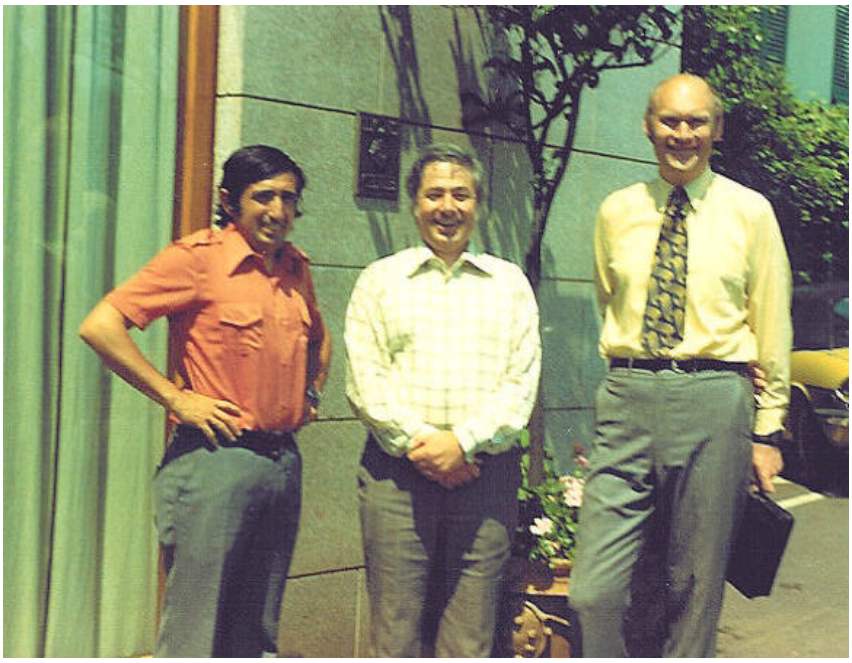


Figure 9: J C Sabonnadiere with Bill Trowbridge & Peter Silvester[12]

The ISC, after the Oxford experience decided to try and repeat Compumag in two years. In Oxford we invited Peter Silvester (University of McGill, Canada) and Konrad Reichert (AG Brown Boveri, Switzerland) to join the committee which they readily agreed to do. But who could we get to host it? The solution to this problem came about primarily through a small specialist conference held in Santa Margherita Ligure in Italy in June 1976; this meeting was organized by the CAD specialist Prof Frisiani (ICCAD, International Centre for Computer Aided Design, Genoa) under the auspices of the publishing house Wileys as an adjunct to their journal IJNME. The leading Finite Element method researchers Olec Zienkiewicz and Richard Gallagher (founders and joint editors of IJNME) were keen to produce a book based on the meeting which would address the use of Finite Element in Electromagnetic Field

[12] Outside the Imperial Palace Hotel, Santa Margherita

problems. They invited Peter Silvester and M V Chari to edit the book; Chari had been a collaborator with Silvester and indeed had written the first paper on apply Finite Elements to electrical machines[13]. For some time Olek had been a consultant to the Rutherford group and indeed we had collaborated with him on applying the FE technique in 3d magnetostatic problems and he suggested that I might like to participate.

In the event Prof Frisiani invited many leading researchers some of whom had attended Compumag Oxford these included, M Chari, Al Wexler, Peter Silvester, Bill Lord, Zol Cendes, K, Reichert, Sandro Viviani , Peter Lawrenson, Simon Polak and Jean Claude Sabonnadiere. The latter was the leader of a strong group of young researchers at Institut National Polytechnique de Grenoble. He knew about Compumag Oxford from Peter Silvester and others but we had not met before. He broached the subject of hosting the next conference and over the next few days I became convinced that this would be good idea. This meeting at Santa Margarhita with many of the major players in field computation proved to be very enjoyable with animated debates on the relative merits of FE, TLM and Integral methods. As all ready noted many of the papers from this conference were later published in book form and helped to publicize the work of a growing international community[14].

I subsequently visited Grenoble as an external examiner in January, 1977 and had further discussions with Jean Claude and I agreed to consult the ISC to see if they would agree to Grenoble hosting the second Compumag Conference.

---

[13] M Chari and P P Silvester, *Finite element analysis of magnetically saturated dc machines*, IEEE Trans. PAS, 90, 2362 1971

[14] *Finite Elements in Electrical and Magnetic Field Problems* Ed. M V Chari and P P Silvester,Wiley, New York 1979

Compumag moves to France

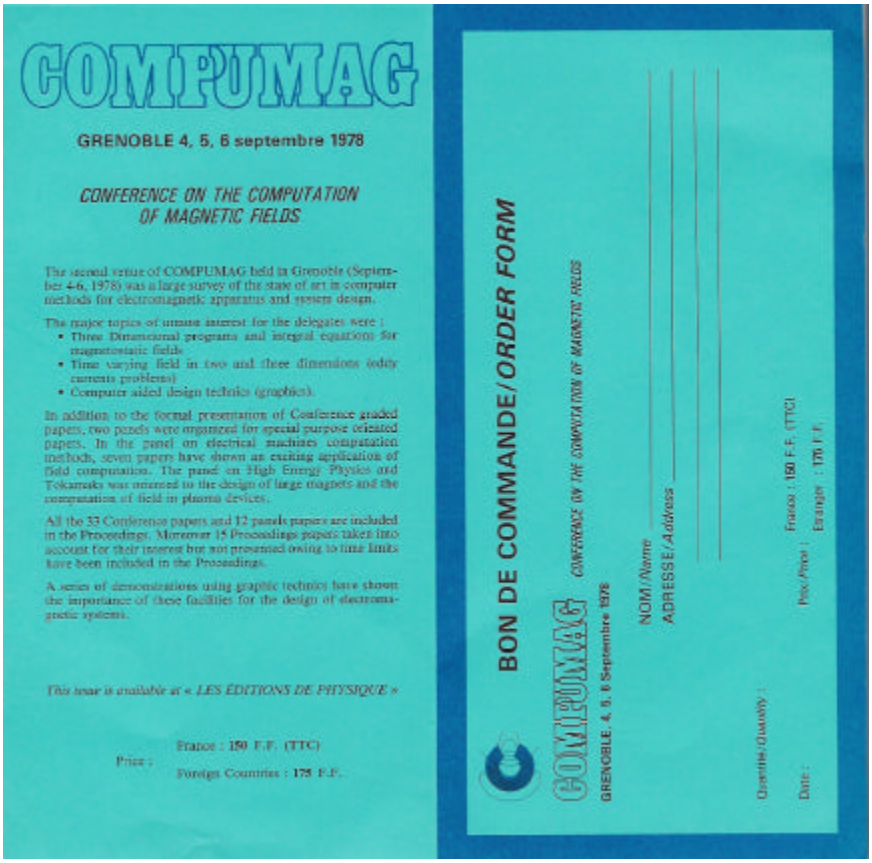
Left to right: B Ancelle (LOC), Bill Trowbridge, Ch. Iselin, John Carpenter, Joe Erb, Jean Claude Sabonnadiere, John Stœl, G Sacerdoti, George Neyret, J L Coulomb (LOC), Simon Polak, P Rafinejad (LOC)

Figure 10: ISC & LOC Grenoble, April 1978

The ISC confirmed the choice of Grenoble for the second conference and an inaugural meeting was held at Rutherford Laboratory to set the main parameters and arrange the hand over of material[15]. Prof. Sabonnadiere was elected chairman of the ISC and Prof G Sacerdoti (Frascati, Rome) replaced Prof. Ratti who had to retire owing to other commitments. Jean Claude proposed that the conference should be held in September 1978. The committee decided as sufficient experience had now been gained there would be fewer planning meetings particularly as the style and timetable evolved for Oxford would be substantially repeated. It was agreed that the crucial paper reviewing and the program planning meeting would be held in Grenoble on 25 April 1978.

[15] The minutes have been mislaid but the meeting must have occurred some time in the spring of 1977.

At the planning meeting it was decide to introduce two panel sessions on specialist areas; one on electrical machines and other on Higher Energy Physics applications. In the event there were 60 papers accepted for presentation at the conference, 33 presented orally, 12 presented during the panel sessions and 15 additional papers appearing in the proceedings only. The date for the conference was now fixed for 4, 5, & 6th September 1978 and would be held at The Laboratoire d'Electrotechnique centre. Student style accommodation, as in the case of Oxford, would also be available.



COMPUMAG

GRENOBLE 4, 5, 6 septembre 1978

CONFERENCE ON THE COMPUTATION OF MAGNETIC FIELDS

The second venue of COMPUMAG held in Grenoble (September 4-6, 1978) was a large survey of the state of art in computer methods for electromagnetic apparatus and system design.

The major topics of utmost interest for the delegates were :

- Three Dimensional programs and integral equations for magnetostatic fields
- Time varying field in two and three dimensions (eddy currents problems)
- Computer aided design technics (graphics).

In addition to the formal presentation of Conference graded papers, two panels were organized for special purpose oriented papers. In the panel on electrical machines computation methods, seven papers have shown an exciting application of field computation. The panel on High Energy Physics and Tokamaks was oriented to the design of large magnets and the computation of field in plasma devices.

All the 33 Conference papers and 12 panels papers are included in the Proceedings. Moreover 15 Proceedings papers taken into account for their interest but not presented owing to time limits have been included in the Proceedings.

A series of demonstrations using graphic technics have shown the importance of these facilities for the design of electromagnetic systems.

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Figure 11: Compumag Grenoble - Flyer

The conference attracted over 180 delegates with several representatives from leading groups in USA, Canada, Japan as well as

most countries in Europe. The conference Chairman wrote in his forward to the proceedings:

> The second venue ofCOMPUMAG held in Grenoble (September 46 1978) was a large survey of the state of art in computer methods for electromagnetic apparatus and system design.
>
> The major topics of utmost interest for the delegates were:
>
> - Three Dimensional programs and integral equations for magnetostatic fields
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>
> A series of demonstrations using graphic technics have shown the importance of these facilities for the design of electromagnetic systems.
>
> The exhibitors: Comeda !UK) and CISI (France) as private firms, Rutherford Laboratory, Imperial College of Science and Technology (UK) and Laboratoire d'Electrotechnique de Grenoble as governmental organizations are acknowledged for the quality of their exhibitions.
>
> I must express my appreciation to the delegates, the invited speakers, and members of various committees for their effort in making the Conference a success, and Prof. Bloch chairman of the Ecole Nationale Superieure d'Electrotechnique et de Genie Physique who greeted the Conference. Finally my thanks to the Delegation Generale 11 la Recherche Scientifique et Technique and the Centre National de la Recherche Scientifique without whose support this Conference could not have taken place.

The conference included a number of invited speakers including Prof. O C Zienkiewicz one of the founding fathers of the finite element method who addressed in his talk the fundamental problem of dealing with open boundary problems and proposed a hybrid solution to the problem in which classical differential finite elements are coupled to integral elements using a boundary representation. David Jacobs from CERL surveyed some recent developments in the solution of large systems of equations including the seminal ICCCG method of Meijerink and van der Vorst[16] and M Lucas from Laboratoire IMAG, Grenoble, surveyed the state of the art in CAD appropriate to CEM.

[16] J A Meijerink and V der Vorst, "An Iterative solution method for systems of which the coefficient matrix is a symmetric **M** matrix", *Maths. Comp*., 31, 148 (1977)

Figure 12: Prof. Bloch with Jean Claude Sabonnadiere at the conference reception

Figure 13: Exhibition area

4. Chicago 1981

Compumag Crosses the Atlantic

After two successful European based conferences the committee decided it was time to look further a field. The ISC chairman Jean Claude Sabonnadiere wrote on 8th January 1979 to all members as follows:

> Dear Colleague,
>
> As you remember, at our last meeting in Grenoble we foresaw some places for the venue of Compumag III.
>
> After some contacts have been taken by Bill Trowbridge and myself, we have now a proposal of Larry TURNER to hold it at Argonne National Laboratory in Illinois, U.S.A in Spring 1981. This seems to be an excellent way to stimulate the international interest of our Conference to hold it once in North America and then come back into Europe.
>
> To know officially your opinion about this proposal I would suggest you write me back your opinion before February the 8th (with the rule no reply = agreement) .If every body agrees I shall give a positive reply to Larry Turner; on the opposite if a discussion seems necessary I will propose a meeting during February or March 1979 to make the decision.
>
> Looking forward to hear from you at your earliest convenience I wish you a happy and successful year 1979.
>
> Yours sincerely,
>
> J C Sabonnadiere

As there were no objections to this, indeed the offer from Argonne National Laboratory (ANL) was very welcome by the committee. Larry and I had worked together for three years in the early seventies and is a leading figure in Computational Electromagnetics (CEM) in USA.In order to arrange a smooth transition Larry Turner came to London to attend the first meeting on 2nd July 1979 held at Imperial College[17]. Larry was chosen as Chairman of the ISC; and Richard P Smith, also of ANL, was chosen secretary. Ch. Iselin resigned as Vice-Chairman. Peter Silvester was chosen to succeed him as Vice-Chairman.

The membership of ISC had further changed as at the end of the Grenoble Compumag John Carpenter and Willie Geysen resigned and were replaced by David Lowther (Imperial College) and Ron Holsinger (New England Nuclear, USA) respectively. David had been a graduate student of John Carpenter at Imperial but had recently become Peter

[17] Minutes of ISC Meeting, 2 July 1979

Silvester's principal co-worker and would be joining him in Canada. The committee wished to strengthen membership from North America and the inclusion of Larry, Ron and now David would do that. To fill the vacancy from Imperial College who through John Carpenter had been such and important factor in the evolution of Compumag the committee wished to retain their involvement so Professor Ernie Freeman, head of the CEM activities at Imperial volunteered to serve. Ernie apart from his work on field calculations was very much involved in the IEE and power engineering activities in the UK. Konrad Reichert also resigned owing to pressure of work in transferring to the Swiss Institue for Technology,, Zurich.

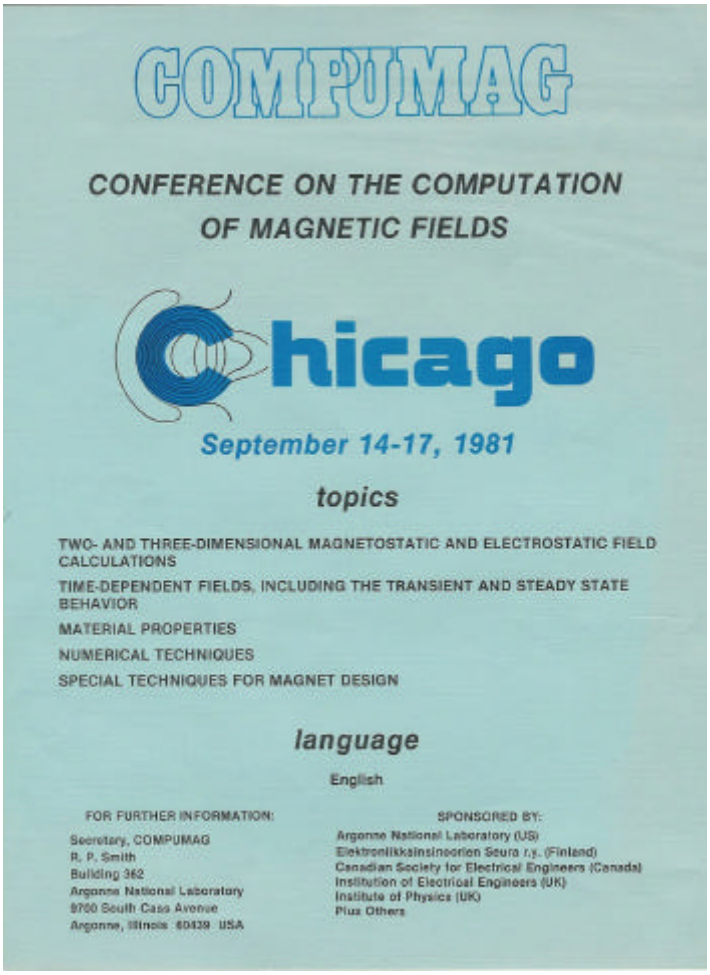

Figure 14: Comupmag Chicago Poster[18]

[18] Another first for Compumag Chicago

The new committee reviewed the conference topics and made some changes. For example the limitation on magnetostatic and low frequency fields was removed and in future all Electromagnetic field calculations would be covered, with the exceptions of semiconductors and of antennas and similar low power-high frequency devices. It was also decided to have four-day conference in order to avoid parallel sessions or evening sessions if there were sufficient good papers. The date for the conference was scheduled for September 1981 but plans for the venue, either AANL itself or downtown Chicago were still to decided. The biggest innovation for Compumag Chicago was however the decision to publish the proceedings in the IEEE Transaction on Magnetics. The committee warmly endorsed this as the exposure for our work would dramatically increase but it was stressed that a satisfactory agreement must be reached on the refereeing process.

Figure 15: ISC Members Enjoying Lunch, Feb 1981[19]

Just six months before the conference the ISC met in Chicago[20] in order to referee the submitted abstracts, finalize the program and ratify the good work carried by the ANL organization over the planning period of the previous year. Larry throughout had been ably assisted by his ANL

[19] From left to right: Simon Polak, Dave Lowther, Ron Holsinger, Author

[20] Minutes of the ISC, Feb 16-17, 1981

colleagues Bob Lari and Rich Smith. The preliminary notice and call for papers had been sent out and 79 abstracts had been received. At the meeting it was announced that the conference would take place at the Chicago Pick-Congress Hotel. The conference fee would set at approximately $185 which would include the conference dinner and a copy of the proceedings.

Plans and rules for refereeing the final papers for Magnetic Transactions were then discussed. The IEEE rules for publishing conference proceedings in those days were less onerous than today as only one reviewer per paper was required. The committee decided that each committee member will be responsible for having ten papers reviewed, preferably before leaving the conference. WE were also informed that the IEEE is planning to publish in IEEE S-MAG Transactions in March 1982.

The abstracts (paper summary) were then refereed by the committee. All abstracts were reviewed twice and this task was completed prior to the end of the first day of the meeting. Next a paper by paper resolution of the two reviews was carried out with detailed discussion if necessary. On the second day the final program was drawn up with 47 papers accepted for oral presentation, 26 for proceedings only and 4 rejected[21]. The meeting end with the committee expressing their thanks to Bob Lari, Rich Smith, Larry Turner and last but not least to Miriam Holden the manager of Conference planning at Argonne.

At Compumag in Chicago

Figure 16: Opening Compumag Chicago, Gail Pewitt & Larry Turner

[21] How easy it all seems in those days compared to now!

Figure 17: Compumag Chicago Underway at the Pick-Congress

The third Compumag was opened Gail Pewitt, Deputy Director of Operations, ANL, see Figure 16. Larry summed up the conference as follows:

> THE 1981 COMPUMAG-Chicago Conference hosted by Argonne National Laboratory from S 14-17, 1981 at the Americana-Congress Hotel in Chicago, IL, USA, included participation 155 attendees It was a pleasure both to greet old acquaintances who had attended the previous MAG Conferences at Oxford (1976) and Grenoble (1978) and to meet new attendees, many representing American industrial concerns. In all, half the attendees were from the United States from elsewhere.
>
> The principal objective of COMPUMAG is to publicize the practical application of numerical techniques to magnetic field problems and related topics As at the previous COMPUMAG Conferences, the number of papers presented orally was strictly limited so that parallel sessions were not required. Including contributed papers not presented orally, the Conference Proceedings contain 76 papers involving the work 142 authors. The organizers have chosen for the first time to publish the COMPUMAG Proceedings in IEEE TRANSACTIONS ON MAGNETICS, the journal of the IEEE Magnetics Society. In anticipating of the benefits to COMPUMAG from the wide circulation and eminent reputation of this journal, it is hoped this cooperation between COMPUMAG and the Magnetics Society will prove durable and mutually beneficial
>
> Seven invited talks were presented at the Conference, and they reflected much of the interest in the theoretical foundation of computational techniques as well as the formulation of practical solutions. Bruce Montgomery, Phillipe Masse, Dave

Lowther, and Bob Lari touched on the many different aspects of obtaining useful solutions from computer codes and digitalhardware, while John Simkin, M.VK Chari and Simon Polak considered specific aspects of the various mathematical techniques found to give solutions to magnet design problems

Figure 18: Scenes from Compumag Chicago

Conference participants enjoyed the many opportunities during the session breaks and social functions to meet colleagues and discuss calculational problems of mutual interest. Much benefit was derived from the software exhibits on display during the Conference and from the tours to the nearby Fermi Accelerator Laboratory and Argonne National Laboratory, where major projects in superconducting magnet technology are underway.

The organizers are indebted to the members of the International Steering Committee for their review of abstracts and papers, and are deeply grateful for the considerable support of Argonne Laboratory and the Laboratory's Accelerator Research Facilities Division.

In addition to the events mentioned in Larry's report a major technical advance was reported at this conference which was the introduction of 'edge' finite elements to the CEM community by Alain

Bossavit & Jean Claude Verite[22] . Another broad development was the use of single user computers and new packages for field computation with contributions by groups from McGill, Rutherford Lab, ANL, GEC(USA) , GEC Power (UK), NV Philips, and Grenoble. Several University groups also taking a leading role including Prof Nakata's team at Okayama Japan and Dave Rodgers from Bath, UK.

The social events and excursions were very popular. The conference Banquet was held at the famous 95th floor of the John Hancock centre and after the feast we were entertained by a well known local singer, Alene Robertson who sang a selection songs form Broadway musicals. This was a very enjoyable experience though in common with most conference banquets not everything was perfect as several delegates said that the 'pears' served in the suite were rather tough—shades of the rubber duck at Oxford.

Plans for the next Compumag were discussed at meetings held during the conference. There were two front runners, Trinity College Dublin and the University of Genoa. The following extract from the minutes[23] relates the discussion and decision:

> 3. Venue of COMPUMAG-4
>
> Larry prefaced the discussion with the remarks that hopes for a COMPUMAG meeting again in two years are jeopardized unless a venue can be chosen before the Committee disbands at this Conference.
>
> Bill, along with Simon, talked to John Miller and learned that John expects a formal reply to his proposal since he has been sponsored by others in Dublin. John has agreed to the points raised by the ISC, vis, ISC Chairmanship, ISC choice of Proceedings publishers, and in fact John offered to hold COMPUMAG in Galway one year from now if the ISC so desired.
>
> Bill received the desired concrete proposal from the Italians. They proposed three possibilities:
>
> a. The Conference can be held near Genoa, at Santa Margherita on the Italian Riviera, in the Miramara Hotel. This resort hotel has a meeting room adequate for about 200, and hotels of other classes exist for lodging as well.
>
> b. The Conference can be held at Genoa International Fair, which accommodates 800; several hotels would be required for rooms. The costs would be about the same as at Santa Margherita.
>
> c. The Conference can be held at the University of Genoa where there are two lecture halls of 300 seats each (for parallel sessions if desired). There are no accommodations there, but buses to the city exist. This might be the most economical alternative.
>
> The Italians are flexible concerning the Proceedings, and can perhaps obtain subsidy from the Electricity Board.

---

[22] Alain Bossavit and Jean-Claude Verite, A Mixed Fem-Biem method to solve 3D Eddy Current Problems, *IEEE Trans, Mag.* Vo; 18, No 2, March 1982, p431

[23] Minutes of the Ad-Hoc Meeting for the consideration of Venue for Compumag-4, Wednesday Sep 16 1981

> Bill believes the Italians are sincere, and guesses they would re-extend their invitation two years hence if they are passed over this time.
>
> It was judged that John Miller will advertise heavily, but Simon remarked that attendance at NASECODE is smaller than at COMPUMAG.
>
> Jean-Claude reminded the Committee of the importance of having a host team that is professionally involved in magnetic computation. His point was acceded to by all, and after Some discussion of the point Ernie proposed that the ISC accept the Italian proposal.
>
> Bill remarked that the recent Italian meeting as well run.
>
> Chris articulated the Committee's consensus: "The Committee accepts the Italians' offer for COMPUMAG two years from now." The Committee will convey privately to John its decision and will convey to him a recommendation that the Committee consider Dublin for COMPUMAG-5.

Thus the decision was made. At the final wrap-up meeting, two days later, Sandro Viviani (University of Genoa) was elected to the ISC to replace G. Sacerdoti who had resigned. Also Sandro's close colleague Professor Giorgio Molinari was welcomed as the conference secretary. Giorgio Molinari described in more detail the possible sites for the conference and after some discussion the committee agreed to the Santa Margharita option. The choice of date and detailed planning would be discussed at the next ISC meeting in Genoa on 12 November 1981.

5. Genoa (Santa Margharita)

ISC Meetings in Liguria

Figure 19:Compumag Genoa: Sandro Viviani with Bill Trowbridge after the ISC meeting in Genoa

The ISC met in Genoa to start planning Compumag 4 in the ancient and beautiful Ligurian city of Genoa appropriately on 150th anniversary of Maxwell's birthday, Nov 13th which that evening was celebrated by the committee in the Hotel Londres in fine style.Apart from Sandro Viviani our host and new chairman and Giorgio Molinari the new secretary we welcomed one new member, Taka Nakata a very distinguishedresearcher from Okayama in Japan which was an important step of the conference organization to take in making us more international. Furthermore during the run up to Compumag Genoa Ch isele C Iselen resigned as he had been transferred to other work at CERN, he recommended that he be replaced by Theo Tortschanoff who was active in accelerator magnet design.The number of members remained at

14 as both Prof Sacerdoti and John Steel also resigned after Compumag Chicago, see Appendix B.

The most important innovation decided by the committee was the introduction of Poster Sessions. This allowed our tradition of no parallel sessions to be maintained but with the advantage of including more papers. The members also felt that the poster papers should be in no way regarded as second class and indeed would provide a more intimate and meaningful discussion of new work.

Further meetings during the build up to the conference were held principally to decide the contents of the announcement bulletins, finally to review the submitted summaries. The second bulletin reported that the response to the conference announcement was encouraging with over 100 papers from authors from 19 countries and it was anticipated that over 180 persons would attend. Again the final proceedings would be published in the IEEE Transactions on Magnetics after a final review. The conference venue would be at the Hotel Miramare in Santa Margherita Ligure, near Genoa on 30 May to 2 June, 1983. The final bulleting issued early in 1981 published the programme of events:

Sunday 29 May	Monday 30 May	Tuesday 31 May	Wednesday 1 June	Thursday 2 June
	Registration 8.00 - 19.00	The Conference Desk is open every day 8.30 - 19.00		
	A1 Magnetostatics 8.50 - 10.30	C1 Magnetostatics 9.00 - 10.30	F Material Properties 9.00 - 10.30	J Coupled Problems 9.00 - 10.30
	A2 Magnetostatics 11.00 - 12.40	C2 Magnetostatics 11.00 - 12.20	G Software Methodology and CAD 11.00 - 12.20	K Numerical Techniques 11.00 - 12.40
	B1 Steady State Magnetodynamics 14.30 - 16.00	D Transient Magnetodynamics 14.10 - 16.30	H Numerical Techniques 14.10 - 16.30	L1 Practical Experience 14.30 - 16.10
Registration 16.00 - 21.00	B2 Steady State Magnetodynamics 16.30 - 18.30	E Poster 17.00 - 18.00	I Poster 17.00 - 18.00	L2 Practical Experience 16.40 - 18.30
Reception 18.00 - 21.00			Conference Dinner 19.00	

Figure 20: Conference Programme

At the Conference

Figure 21: Compumag moves to Italy

Most delegates came by air or train but some decide to sail, not across the Atlantic as the picture shown in Figure 21 suggests, which shows the symbolic Compumag trajectory from Oxford, Grenoble, Chicago, Genoa and into the future to Fort Collins in Colorado, USA, but from Marseilles to Santa Margherita in a yacht chartered by Jean Claude Sabonnadiere crewed by Compumaggers, Lowther, Polak and Deeley. Santa Marherita in June was delightful and spirits were high and meeting finally got underway on Monday May 30th but not before a reunion and reception held by the pool the night before.

The conference was opened by Professor G Biorci, head of Electrical Engineering Department of the University; in his welcoming address he made the following remarks

Figure 22: Sandro Viviani, conference chairman, at the openning session with Vice Chairman Jean Claude Sabonnadiere on his right

I am very glad to welcome you to this Conference both as Head of the Electrical Engineering Department of the University of Genoa, for the recognition that this implies to the Department and to their persons working in the field, and as Vice President of the Italian National Research Council, for the successful matching of high and recognized scientific standard with practical and industrial usefulness that this series of Conferences has been able to reach.

There is certainly no need to remind you of the increasing importance of electromagnetic phenomena in a variety of areas, including the development of better or innovative sources of energy fusion reactors, high energy magnets, MHD generators, and super conducting devices are only the most challenging classes of electromagnetic apparatuses which increasingly interact with our everyday life, and which span the most diversified applications, such as magnetic recording and high energy physics.

A successful answer to the challenge of applications so varied and often demanding lies heavily and increasingly on the availability of powerful, sophisticated, and flexible tools for computer-aided design and computer-aided engineering. The scientific and industrial community consider therefore with great interest Conferences such as COMPUMAG, which provide an international and interdisciplinary forum where industry, universities, and research laboratories present, evaluate, and discuss the latest developments in the field in an atmosphere of cooperation.

> Because of my specific interest on the theme of applications of computer science, I am particularly p)eased to address a welcome to an audience which is timely exploiting to its upper limits the power of modern computers, certainly one of the most significant technological revolution of the last decades.
>
> Wishing that the synergy of your research work with the developments in computer science could significantly contribute to the solution of the energy problems of our time, I hope that the Conference will get the success that the importance of the arguments today certainly deserves.

The conference is wellsummed up in the introduction to the proceedings by Sandro Viviani and Giorgio Molinari:

> The 1983 Compumag-Genoa Conference, hosted by the Electrical Engineering Depart University of Genoa, was held at the Miramare Hotel in Santa Margherita Ligure, on the Italian Riviera, and included participation by 175 attendees from 19 countries, nearly balanced as to affiliaton between universities and industrial/research organizations The Conference Proceedings contains 98 papers, which were presented either in oral or in involving the work of 186 authors. Poster sessions, first introduced at COMPUMAG-Genoa, have been very wellreceived by the audience.
>
> Seven invited talks were presented at the Conference, reflecting either some of the most important issues in the theoretical formulations of computational techniques or the "state of the art" of the applications in some important areas. R. D. Pillsbury, J. Penman, and J. L. Coulomb highlighted advanced topics on three-dimensional eddy current formulations, dual and complementary methods in electromagnetism, and the evaluation of magnetic forces, torques, and stiffness. T. W. Preston, W. Lord, J. P. Tual, and J. D. Lavers devoted their well documented lectures to the survey of achievements and open problems in numerical field computation for the design of electrical machines, for electromagnetic methods in nondestructive testing, for magnetic recording and printing, and heat applications.
>
> Aside from the oral and poster sessions, an exhibition of computer software for electromagnetic problems was also active, with six exhibitors from Europe, the USA, and Canada, coming either from research organizations, or industrial firms. The exhibition was very wellreceived and allowed many participants either to get more detailed information or to obtain working demonstrations of some of the most advanced codes for electromagnetic computation available at present
>
> The relaxed mood of S Margherita Ligure provided a very effective environment to enjoy meeting colleagues and friends during breaks and off-session time and to discuss problems of mutual interest. The courtesy, efficiency, and devotion of the secretarial and technical staff was also appreciated, contributed to make the Conference a smoothly running one The organizers are indebted to the members of the International Steering Committee for the review of summaries and papers and for the significant overhead of big and small problems they have patiently accepted to share in the numerous committee meetings. The organizing committee particularly to thank the secretaries, the technical personnel, and all those who helped to cope with details before, during, and after the Conference, as well as the group "Citta di Genova" for providing the Conference dinner, very appealing entertainment, a dim reflection of which could be seen the pictures of the following pages.

Indeed some of these pictures are reproduced here

Figure 23: Outside the Hotel Miramare,
Ernie Freeman with Taka Nakata

Figure 24: Relaxing on the Miramare Terrace
L to R: ?, Lowther, Torschanoff, Rita Trowbridge, Irene Lowther, Nakata,Turner, ?, Hazel Freeman

Figure 25: Giorgio Molinari, Bela Konrad et al at the conference exhibition

Figure 26: Folk Dancing at the Banquet

The conference was a technical success with for several papers introducing new methods in Computational Electromagnetics. These

included fundamental work on Dual Energy methods, a classic method but here used in conjunction with the finite element method and applied to electromagnetics. The authors demonstrated that error bounded solutions are obtainable when complementary pairs of functionals are extremised.[24]. Also a paper for 3D Eddy Current Calculation using a network method has proven since to be ahead of its time as in recent years there has been a renaissance of methods using complimentary Electric and Magnetic meshes, this paper was also notable of providing the community with one of its famous benchmark problems, the so called Bath Cube[25]. Several authors presented work on eddy current computation using the boundary element method which had hitherto been confined to static's problems[26] [27]. A boost to the important area of computing forces was made in a paper in which the principal of virtual work is compared to a new method that evaluates the second derivative of the stiffness matrix. The latter method only requires a single field solution and is a least as efficient as the Maxwell Stress method and much easier to apply[28]. The now ubiquitous use of Delaunay meshing was also introduced to the CEM community[29]. It must be emphasised that this list is a personal selection which has ignored the many exciting software, CAD and applications papers presented. One final comment to make it was during Compumag Genoa that Dr J Rikabi, currently at Imperial College London, had the idea for a new error based finite element functional which later was to have an important effect on FE based methods. He named his functional 'The Ligurian' in honour of the region[30].

The ISC committee met many times during the conference mainly to select the hosts for the next conference. There were a number of outstanding bids to host the next Compumag. These included the Plasma Fusion Center at MIT, case presented by Bob Pillsbury; Lawrence Berkeley Laboratory, case presented by John Colonias; Los Alamos, case

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[24] J Penman & J Fraser, *Dual and Complimentary Energy Methods in Electromagnetics*, IEE Trans. Mag., Vol 19, No 6, 1983

[25] J A Davidson and M J Balchin, *Three Dimensional Eddy Current Calculation Using a Network method*, loc cit

[26] W M Rucker & K R Richter, *Calculation of Eddy Current Problems with Boundary Elements*, loci cit

[27] A Nicolas, *A Boundary Integral Equation for Eddy Current Calculation*, loc cit

[28] J L Coulomb, *A Methodology for the determination of Global EMech. Quantities from a FE Analysis…*, loc cit

[29] Z Cendes et al, *Magnetic Field Computation using Delaunay Triangulation and Complementary FE Methods*, loc cit

[30] Tragically Dr J. Al Rikabi was killed during the Gulf War in 1990, see also, J Rikabi et al, *Error–based derivation of complementary formulations for the eddy current problem*, IEE Proc, 135 Pt A,4, 1988.

presented by Herbert Vogel; all of these were well received and the fact that three major labs in the US were making these bids was considered to be extremely encouraging to the future. In the event the committee reluctantly decided on none of these as there was a fourth bid from Colorado State University in Fort Collins presented by Bill Lord which had a slight edge over the others because the scientific development work in CEM at that time was felt to be less orientated to large scale applications and was directed toward applications in NDT a subject of critical industrial importance.

Figure 27: Dr Rikabi Inventing the 'Ligurian'

6. Fort Collins, 1985

ISC visits the Rockies

Figure 28: Bill Lord, Chairman Compumag Fort Collins

Bill Lord convened the first planning meeting for Compumag Fort Collins on Monday, October 24, 1983 at Colorado State University[31] those present were: W. Lord, D. A. Lowther, J. Erb R. Holsinger, S. Polak, C. W. Trowbridge, L. R. Turner, A. Viviani. Giorgio Molinari was also co-opted on to the ISC because of his experience in the organisation of Compumag Genoa technical programme and reviewing. Nathan Ida, the original secretary, would be movingto the University of Akron in Ohio and Bill Lord decided that to ease the transition Nathan and Satish Upda would act as joint secretaries. David Lowther was also appointed vice chairman.

Simon Polak suggested that the time for reviewing summaries of papers submitted be increased and it was felt that papers should be sent to the reviewers as soon as possible after they are received. The modus operandi was, however, left to the discretion of the

[31] Minutes of ISC Meeting, October 24th 1983, in possession of the author.

hosts. It was also agreed to use the word "Preliminary Short Version of Paper" instead of "Summary" or "Abstract" The following schedule for the 1985 Conference was approved:

- Preliminary Announcement and January 1984 Call for Papers
- First Call for Papers May 1984
- Final Call for Papers August 1984
- "Short Version" Deadline October 10, 1984
- "Short Version" Meeting December 10, 1984

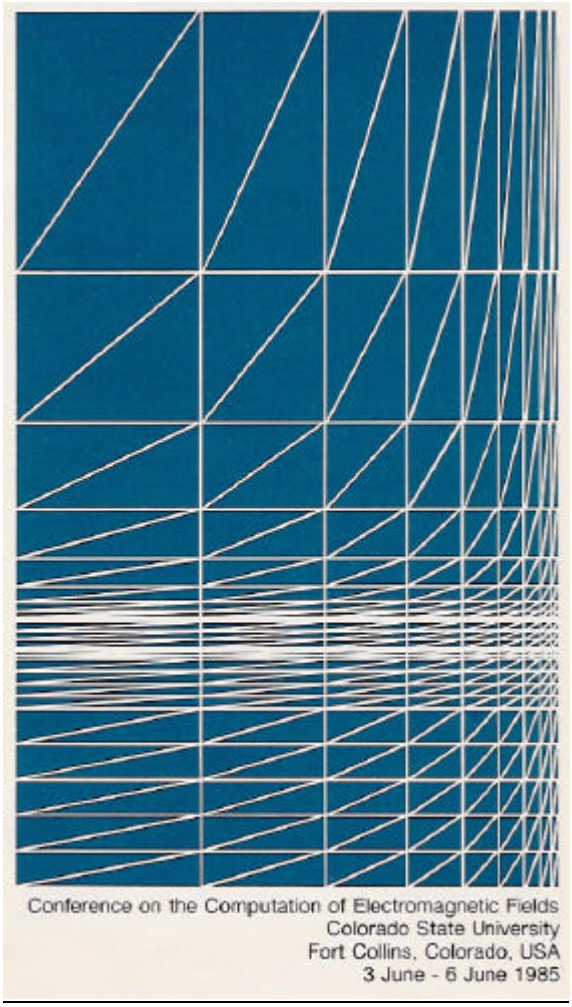

Figure 29: The Prize Winning Poster

It had been muted for some time that each conference should have a unique poster and to this end Bill Lord had consulted Dale Rosenbach, Art Director, University Communications, Colorado State University, who along with student interns working with him, presented a total of six COMPUMAG poster designs for the committee's consideration. The poster designers explained their motivation behind the choice of layout and the colour scheme. The Steering Committee members were polled and the poster designed by Genine was judged as the one most suitable for expressing the objectives of the conference as well as being aesthetically pleasing. However, it was agreed that the style of the text be altered and the style used in the past be retained. The Committee expressed their admiration and thanks to Dale and the artists for a job well done.

The old format of the preliminary announcement and the call for papers was found acceptable in general. However, it was decided to include topics relating to semiconductors, antenna and other high frequency, low power devices. It was also decided to include recording heads, nuclear fusion and power electronics devices under topic 5 in the preliminary announcement and that topic 7 be strengthened. In addition to the emphasis on the calculation of forces the term "other terminal parameters" is to be included under topic 6.

After lunch and a walking tour of the 1985 COMPUMAG Conference facilities and student housing, a discussion was held on the ISC membership. Concern was expressed that the nature of the COMPUMAG Conference requires an active involvement on the part of the ISC members. Refereeing and planning duties associated with the conference preclude "honorary membership". Indeed, during the discussion it was agreed that ISC membership be increased to fifteen (15) and that a board or panel of referees be established at the next ISC meeting in Eindhoven to help with reviewing procedures. It was also agreed that review of all final full-length papers be carried out at the 1985 conference site even if an additional day is needed to complete the task. These measures should not only serve to speed the reviewing process, but also provide a source of new ideas and members for future COMPUMAG conferences. It was unanimously approved, effective as of the next ISC meeting on April 6, 1984, that failure to attend three consecutive ISC meetings by any ISC member be

interpreted as a withdrawal of the member's services and, that barring extenuating circumstances, such membership be revoked.

Finally the committee unanimously endorsed Dr. M.V.K. Chari as a potential ISC member. Chari was well known as a pioneer of the application of FE methods to electrical machine design and it was felt his appointment would strengthen the conferences ties with industry. He would be replacing Georges Neyret who had announced his retirement at the end of Compumag Genoa. The membership of the ISC for Compumag Fort Collins is shown in Appendix B. Further meetings were arranged in April 6, 1984 at Eindhoven, Netherlands and in December 10 to 12, 1984, Fort Collins, CO, U.S.A.

Figure 30: ISC Meeting in Fort Collins, December 1984[32]

[32] Nathan Ida reorting on the arrangements with clockwise: David Lowther, Larry Turner, Author,Simon Polak, Ernie Freeman, Jean Claude Sabonnadiere, Taka Nakata, Satish Upda, Sandro Viviani and Bill Lord.

At the Conference

Figure 31: Compumag Colorado in Session[33]

By the time we met in Eindhoven the conference budget had been agreed and the conference fee was set at $100 per delegate and the estimated charge for publishing in the proceedings was $13,000 again the major item of expenditure. At the final planning meeting Fort Collins in December 1984 the reviewing processfor the short versions was mostly completed and the conference programme roughly worked out.In the published proceedings the Chairman wrote:

> Approximately 200 people attended the COMPUMAG Colorado Conference hosted by the Electrical Engineering Department at Colorado State University, June 3-6, 1985. Attendees from 21 countries represented industrial and university research and development organisationswith the largest groups from the U.S.A. (82), U.K (26), France (16), Italy (13), Canada (II), Japan (11) and China (10). Oral and poster presentations were made at the conference areas of magnetostatics, time dependent fields, materials, applications, andcomputational considerations. As in the previous COMPUMAO conferences held in Oxford (1976), Grenoble, Chicago (1981), and Genoa (1983) the number of papers was strictly limited to avoid parallel sessions.
>
> Six invited presentations were given by E M. Freman (UK), W. Muller (FRG). N. Ida (US.A), A. Konrad (US.A.), M S. Shephard (USA), and W.H.A Schilders (The Netherlands), covering a variety of application, computational, and theoretical aspects of the subject. Poster and exhibitor sessions were interspersed with the oral

[33] David Lowther opening the conference, as Vice Chairman he had to deputise for Bill Lord, you can just make out the Compumag Flag draped over the lecturn made by Irene Lowther for the Yacht in Compumag Genoa.

> presentations to provide adequate opportunity for the discussion of ideas so important at specialized meetings of this type
>
> These transactions contain papers from the oral and poster sessions, in approximately the same order as given at the Conference. It is hoped by publishing the COMPUMAG-Colorado proceedings in this form that the reader will be provided with a timely overview of the subject for archival reference.
>
> As with all conferences of this nature the most valuable exchanges occurred during the less formal parts of the program when old friendships were renewed and new contacts made. In this regard the conference organizers were particularly pleased to welcome the ten participant's People's Republic of China. For those so inclined, adequate opportunity was provided to learn of the unusual history of this corner of the Rockies and to sample the lifestyle of the wild and woolly west.
>
> The Chairman of the International Steering Committee is particularly grateful to Satish Upda for assuming the mantle of Conference manager under rather trying circumstances. Thanks are also extended to Dave Lowther for taking over during the Chairman's absence and to all members of the reviewing panel for their efforts in meeting the publication deadline.

As Bill Lord hints in his remarks above he himself experienced a personal loss as his mother had just died in England which meant he had to miss the first three days of the meeting. But the planning had been so thorough that the delegates were hardly aware of the problem owing to good planning and the expertise of his staff. An interesting highlight of the meeting for me was to meet Alan Winslow again, the first researcher to apply the Finite Element method to an electromagnetic problem in the early 1960's[34]. Alan and I first met in 1970 and he had a considerable influence on our work at Rutherford when the code based on his method, known as TRIM was in use for many years. Alan's comment after listening very carefully to all he papers was, "I have been out of the 'field' for over ten years now but I can see the problems we were solving then are still challenging now but I was surprised find that the basic methods are still the same'. The conference banquet was the usual 'curate's egg affair'[35]. The lady who gave the after dinner talk on her early pioneering days in Fort Collins went on a little too long despite the growing restlessness of some delegates. The flavour of the Wild West was sustained by a old style 'cook-out' in the foot hills where delegates were treated to a feast of 'pork & beans' accompanied by Country and Western singing.

There many technical innovations reported during the conference. The theme of edge elements first proposed in Compumag Chicago by

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[34] A.A. Winslow, "Magnetic Field Calculations in an Irregular Triangle Mesh", UCRL-7784-T Rev-1, Aug. 23, 1965 and A.A. Winslow, "Numerical Solution of the quasi-linear Poisson equation in a non-uniform triangular mesh", J. Comp. Phys., 1, 149, 1971

[35] 'Good in Parts'

Figure 32: Pingree Park[36]

Alain Bossavit & Jean Claude Verite was extended in two ways firstly by G Mur & A De Hoop from the University of Delft who showed how to derive a consistently linear set of edge tetrahedral elements[37] and J S van Welij who developed edge elements for hexahedral elements[38].There were also many applications of the FE and BE methods respectively, particularly to 3D eddy currents with new work reported from many of the leading groups to numerous to mention. Several computer codes were also described and demonstrated at the exhibition,

[36] Members of the reviewing team preparing to leave Fort Collins, L t R John Webb, Clive Bryant, John Simkin, Author, Sandro Viviani, Giorgio Molinari and Alain Nicolas.

[37] G Mur & A de Hoop, "A Finite Element Method for Computing Three-Dimensional Electromagnetic Fields in Inhomogeneous Media", IEEE Trans Mag, Vol 21, No 6, Nov 1985

[38] J S Van Welij, "Calculation of Eddy Currents in Terms of H on Hexahedra", loc cit

these included Flux3d from Cedrat, France, Magnet from Infolytica, Canada and Carmen from Vector Fields, UK.

Bill Lord returned in time for the last day and organised the local trip up into the Rockies for the reviewing meetings which were to be held in Pingree Park. This turned out to be an enjoyable excursion at a mountain resort where we could combine work with walking above the tree line. The final task was to choose the location for next conference which ICS had decided should be in Europe in 1987 there had been several bids and the interviews were conducted during the conference. The winning bid was made by Professor Kurt Richter from the Technical University of Graz who began is presentation with the remark, "I persuaded Lufthansa to underwrite my expenses to Colorado on the hope that the next Compumag would come to Austria…", so how could we disagree! This special pleading however was superfluous as his presentation was masterly and his group in Graz had built up an outstanding reputation

Appendix A

STEERING COMMITTEE FOR A PROPOSED MAGNETIC FIELD COMPUTATION CONFERENCE

MINUTES OF IST MEETING HELD AT RUTHERFORD LABORATORY'S GUEST HOUSE - COSENER'S HOUSE, ABINGDON -ON 8 OCTOBER 1974 AT 2.30 PM.

Present: Mr C W Trowbridge (Chairman)
Mr C J Carpenter
Dr Ch. Iselin
Dr G Neyret
Dr S Polak
Mr J G Steel
Mr J Simkin (Secretary)

INTRODUCTION

Mr Trowbridge opened the first meeting by explaining that he had for some time felt the need for a specialised conference on the computational aspects of magnet design. He envisaged a small conference for the exchange of ideas and information between workers at the forefront of this field. He suggested that the Rutherford Laboratory should be formally approached to see if they would be willing to sponsor such a conference.

Dr Polak proposed that Mr Trowbridge be elected Chairman of the Steering Committee. This proposal was seconded by all members and Mr Trowbridge was elected Chairman.

SCOPE OF THE STEERING COMMITTEE

A list of subjects for discussion at the first meeting was compiled. These were treated in order of importance.

1. Topics !or the conference and its objects

The main subjects which the conference would cover are magnetostatics; magnetodynamics; forces and stresses; stored energy and explicit problems which should be stated in the description of the conference~ e.g. anisotropy, hysteresis, hard materials, convergence, accuracy numerical analysis, boundary conditions, quenching of superconducting coils, material modelling.

Mr Steel proposed that pure numerical analysis papers should not be accepted and that the topics should be confined to magnet design. This was accepted by all present. It was further decided that the request for papers should indicate the special interest in computational analysis of magnetic fields and that some subjects should be specifically excluded. i.e. wave guide theory, MHD and hardware. However, though weighted towards computation the conference should try to relate techniques to physical problems which require solution.

The object of the conference was to be a review of the 'state of the art' and the exchange of new ideas. It should be aimed specifical1y at research workers engaged in the general area of computer aided design and simulation of magnets; the aim should not be basic education.

2. Magnitude of the Conference

Dr Polak and Mr Carpenter thought that a reasonable size would be 150- 200 people. This was agreed as plausible. It was suggested that the conference should be aimed at the European community but should not exclude people from America who are making significant advances.

3. Time and place

It was decided that Oxford would be the first choice for the venue of the conference however the final decision would depend on the body which agreed to sponsor the conference.

Date for conference Easter 1976

Probable length 3 days.

4. Sponsorship.

The Rutherford Laboratory will be formally approached by Mr Trowbridge to see if they are willing to sponsor this type of conference. If the Rutherford Laboratory does agree it was hoped they would supply the necessary administrative staff. Other possible sponsors would be the Institute of Physics or the IEE. Dr Polak indicated that The Philips Company might consider sponsoring such a meeting.

5. Organisation

The Steering Committee would be the main decision making body below this would be a British Organising Committee and a Local Committee in the various European countries. The British Organising Committee will take charge of detailed arrangements involving the venue, etc., and would meet frequently. The Local Committees will consist of one member from the Steering Committee plus one or two others. The members' should be experts in fields related to the conference and should be capable of refereeing the papers submitted to the conference. It was hoped that Dr Geysen would be a member of the Steering Committee and arrange a local committee in Belgium. perhaps in conjunction with Dr Polak who will take care of Holland.

Two more members of the Steering Committee must be found from Germany and Italy.

Papers submitted to the conference will be circulated to the Local Committees according to their specialist knowledge.

6. Publication of the Proceedings

Papers should be submitted well before the conference and it was hoped that copies would be available at the conference. No decision was taken on publication of the Proceedings.

7. Advance publicity

Before the next meeting each member agreed to submit a list of people who might be interested in this type of conference. Mr Trowbridge will prepare a draft copy of a letter to be circulated to people on the lists. The final version of this letter will be agreed by the Stering Committee.

Note: the lists of people should extend beyond the national boundaries of the Local Committees.

Length of papers for the conference- probably 15-20 minutes plus 20 minutes for discussion.

Total number of papers ~ 18[39]

The proposed dates for the conference will be checked against a conference list for 1976.

NEXT MEETING

Provisionally fixed for 26 November 1974 at 2.00 pm at the Central Electricity Research Laboratories, leatherhead. Mr Steel will be the host. Travel to the Laboratory from Heath Row can' be arranged by Mr Steel.

J Simkin .
Rutherford Laboratory
21 October 1974

DISTRIBUTION: Those present + Dr D B Thomas

[39] A slight under estimate!

Appendix B - Past Members of the ISC

Oxford 1974-1976

Name	Affiliation	Country
C J Carpenter	Imperial College	UK
J Erb	IENP, Karlesruhe	Germany
W Geysen	Katholieke Uni. Leuven	Belgium
C Iselin	CERN, Geneva	Switzerland
G Neyret	CEN, Saclay	France
S J Polak	NV Philips, Eindhoven	Netherlands
U Ratti	Univ. Rome	Italy
J Simkin (Secretary)	Rutherford Laboratory	UK
J Steel	CERL Leatherhead	UK
C W Trowbridge (Chair)	Rutherford Laboratory	UK

Grenoble 1976-1979

Name	Affiliation	Country
C J Carpenter	Imperial College	UK
J Erb	IENP, Karlesruhe	Germany
W Geysen	Katholieke Uni. Leuven	Belgium
C Iselin	CERN, Geneva	Switzerland
G Neyret	CEN, Saclay	France
S J Polak	NV Philips, Eindhoven	Netherlands
P Rafinijad	ENSEGP, Grenoble	France
K Reichert	AG Brown Boveri, Baden	Switzerland
J C Sabonnadiere (Chair)	ENSEGP, Grenoble	France
G Sacerdoti	C.N.E.N. Rome	Italy
P P Silvester	McGill University, Montreal	Canada
J Steel	CERL Leatherhead	UK
C W Trowbridge	Rutherford Laboratory	UK

Chicago 1979-1981

Whole Name	COMPANY	COUNTRY
J Erb	IENP, Karlesruhe	Germany
E M Freeman	Imperial College	UK
R Holsinger	NE Nuclear, N.Billerica	USA
C Iselin	CERN	Switzerland
D A Lowther	McGill University, Montreal	Canada
G Neyret	CEN, Saclay	France
S J Polak	NV Philips, Eindhoven	Netherlands
J C Sabonnadiere	ENSEGP, Grenoble	France
G Sacerdoti	C.N.E.N. Rome	Italy
P P Silvester	McGill University	Canada
R P Smith (Secretary)	ANL, Chicago	USA
J Steel	CERL Leatherhead Surrey	UK
C W Trowbridge	Rutherford Laboratory	UK
L R Turner (Chair)	ANL, Chicago	USA

Genoa 1981-1983

Whole Name	COMPANY	COUNTRY
J Erb	IENP, Karlesruhe	Germany
E M Freeman	Imperial College	UK
R Holsinger	NE Nuclear, N.Billerica	USA
D A Lowther	McGill University, Montreal	Canada
G Molinari (Secretary)	University of Genoa	Italy
T Nakata	Okayama University	Japan
G Neyret	CEN, Saclay	France
S J Polak	NV Philips, Eindhoven	Netherlands
J C Sabonnadiere (Vice Chair)	ENSEGP, Grenoble	France
P P Silvester	McGill University	Canada
T Tortschanoff	CERN	Switzerland
C W Trowbridge	Rutherford Laboratory	UK
L R Turner	ANL, Chicago	USA
A Viviani (Chair)	University of Genoa	Italy

Fort Collins 1983-1985

Whole Name	COMPANY	COUNTRY
M V Chair	GEC, Schenectady	USA
J Erb	IENP, Karlesruhe	Germany
E M Freeman	Imperial College	UK
R Holsinger	NE Nuclear, N.Billerica	USA
N Ida (Joint Sec.)	CSU, Fort Collins	USA
W Lord (Chair)	CSU, Fort Collins	USA
D A Lowther (Vice Chair)	McGill University, Montreal	Canada
G Molinari	University of Genoa	Italy
T Nakata	Okayama University	Japan
S J Polak	NV Philips, Eindhoven	Netherlands
J C Sabonnadiere	ENSEGP, Grenoble	France
S R Satish (Joint Sec.)	CSU, Fort Collins	USA
P P Silvester	McGill University	Canada
T Tortschanoff	CERN	Switzerland
C W Trowbridge	Rutherford Laboratory	UK
L R Turner	ANL, Chicago	USA
A Viviani	University of Genoa	Italy

Appendix C