

BULLETIN



BRITISH SOCIETY OF RHEOLOGY

1980, Vol. 23, No. 4

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Hon. Editor:

Dr. C. R. DIMOND,
Morgan Thermic Ltd.,
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Bewdley Road,
Stourport-on-Severn.



FOREWORD

The recent Annual General Meeting of the Society held after the September Scientific Meeting was a very special occasion for not only was the Gold Medal presented to Professor Oldroyd and the Annual Award to Dr. Hinch but we were also able to listen to two very eminent rheologists in Professors Tanner and Metzner. I'm sure those who attended the meeting learnt a lot from it. A report of the meeting and details of the presentations will appear in the next issue.

The AGM was also the occasion to lose two very valuable members of Council, Neil Cogswell who has worked as Secretary and Martin Camina who served as Editor of the Bulletin—both will be missed as will our retiring President Mervyn Jones.

OFFICERS AND MEMBERS OF COUNCIL, 1980-1981

President: PROFESSOR J. R. A. PEARSON, Department of Chemical Engineering and Chemical Technology, Imperial College of Science and Technology, London.

Secretary: DR. C. J. S. PETRIE, Department of Engineering Mathematics, University of Newcastle upon Tyne, Newcastle upon Tyne NE1 7RU.

Treasurer: MR. A. EVANS, Department of Surgery, Royal Victoria Infirmary, Newcastle upon Tyne.

Membership Secretary: DR. D. C-H. CHENG, Warren Spring Laboratory, Stevenage, Herts. SG1 2BX.

Abstracts Editor: MR. J. ASTIN, Department of Applied Mathematics, U.C.W., Penglais, Aberystwyth.

Bulletin Editor: DR. C. R. DIMOND, Morgan Thermic Ltd., Technological Centre, Bewdley Road, Stourport-on-Severn.

Ordinary Members:

DR. T. E. R. JONES, School of Mathematical Sciences, Plymouth Polytechnic, Plymouth.

DR. H. A. BARNES, Unilever Ltd., Port Sunlight, Cheshire.

DR. D. MARSHALL, Institute of Polymer Technology, Loughborough University of Technology, Loughborough LE11 3TU.

DR. D. R. OLIVER, Department of Chemical Engineering, University of Birmingham, Birmingham.

DR. M. R. MACKLEY, Department of Chemical Engineering, University of Cambridge.

MR. T. A. STRIVENS, ICI Ltd., Paints Division, Slough.

MINUTES OF THE 40th ANNUAL GENERAL MEETING

Minutes of the 40th Annual General Meeting, held in the Gustave Tuck Lecture Theatre, University College, Gower Street, London, on 9th September, 1980, beginning at 17.30. The President took the chair and welcomed Drs. Boger and Bhattacharya of the Australian Branch and Professor Metzner from the USA. The meeting agreed to interchange items 3 and 9 on the agenda. There were 30 members present.

1. **The Minutes of the 39th Annual General Meeting**, held in Aberystwyth on 13th September, 1979, had been published in the Bulletin (Volume 22, number 4, pages 69-78), with some errata noted on the agenda for this meeting. The correct copy of the minutes was adopted and signed as an accurate record of the meeting.

2. There were no **matters arising from the minutes**.

3. There were no further nominations, so the list of candidates for election as officers was declared elected. There being seven nominations for the six places on Council, a ballot was held. Messrs. Aldhouse and Sothern were appointed as tellers. There was a tie in the voting for the sixth place and in accordance with rule 5(b) the election was decided by drawing lots. Council for 1980-81 consists of:

President (1980-82): Professor J. R. A. Pearson

Secretary: Dr. C. J. S. Petrie

Treasurer: Mr. A. Evans

Membership Secretary: Dr. D. C.-H. Cheng

Editor of the Bulletin: Dr. C. R. Dimond

Editor of Rheology Abstracts: Mr. J. Astin

Ordinary Members: Dr. H. A. Barnes

Dr. T. E. R. Jones

Dr. M. R. Mackley

Dr. D. E. Marshall

Dr. D. R. Oliver

Mr. T. A. Strivens

In the absence of Professor Pearson, who had sent his apologies, the retiring President, Dr. W. M. Jones, remained in the chair.

4. **The Secretary's report** is appended. Copies had been circulated and the Secretary highlighted a few items. Discussion and comment were invited but neither was forthcoming.

5. **The Treasurer's report** and the accounts for the year ending 30th June 1980 are appended. The accounts were circulated and the Treasurer read his report. Alfred Simmons & Co. of Redhill were reappointed auditors and a fee similar to this year's £35 was agreed. There was no discussion.

6. **The Membership Secretary's report** is appended. This was circulated. There was some discussion of subscription payment by foreign members. It was stated that (from many countries) they can send cheques in pounds sterling drawn on their own bank. In this way the Society receives the correct amount and the member pays the cost of converting from a foreign currency. It is also true that if many cheques in any one foreign currency are presented at one time the overall bank charge is reduced.

7. **The Editor of the Bulletin** reported the completion of his first full year in office. He remarked that there was a shortage of technical enquiries and of contributions from overseas. It was also observed that conference reports are invariably written by Council members. Dr. Bhattacharya informed the meeting that Australian members received the Bulletin by surface mail and often too late for action on items in it. This was apparently also the case for North American members. This news was received with some surprise by Council members, since Council had agreed (on 9th June 1978) that the Society's overseas mailings to members should be made by airmail. The matter would be investigated since the member expected to provide an explanation was not present. The possibility of sending copies in bulk by air freight was suggested.

8. **The Editor of Rheology Abstracts** reported that volume 22 (1979) had 770 abstracts (plus 40 unnumbered ones) and volume 23 (1980) has 620 abstracts in its first three issues with 200 received already for the fourth issue. There are thirty abstractors of whom 24 provide abstracts regularly. The Society owes these people a great deal (both scientifically and financially).

It was announced that Professor S. G. Ward, who had prepared the index for Rheology Abstracts for some years, had died recently. Dr. Oliver was asked to convey the Society's condolences to his widow. It was suggested that non-members who abstracted journals for Rheology Abstracts should be offered a year's free membership of the Society. (An entrance fee would not be required.) This was agreed. (The meeting had in mind the difficulties that rheologists in some countries have in paying in sterling, as well as the possibility of attracting new abstractors.)

9. **The Chairman** reported on his year's activities, including the presentation of a gavel to the Society of Rheology at its Golden

Jubilee Meeting. He mentioned the meeting of the International Committee on Rheology in Naples, of which a report appears elsewhere in the Bulletin. He thanked the officers and members of Council who had served during his two years in office, which had been enjoyable and had passed very rapidly. He emphasised the importance of a good working relationship between President and Secretary. He thanked the two retiring members of Council, F. N. Cogswell, who had served for four years as Secretary and for a further four years on Council and had also organised the scientific meeting held before this Annual General Meeting, and M. Camina with two years' service on Council and a further four years as Editor of the Bulletin. Thanks were also due to Dr. D. R. Oliver and Dr. J. J. Benbow for assistance in obtaining the gold medal and the annual award certificate respectively, and to the tellers for the election at this meeting.

10. The only **other business** was a vote of thanks to the President from the meeting, which was carried with acclaim.

There being no further business the meeting closed at 18.25.

Minutes submitted by C. J. S. Petrie.

SECRETARY'S REPORT, 1979-80

Last year's annual conference on "Applied Rheology" attracted 80 participants to Aberystwyth to hear 22 papers including four from the Netherlands and one each from Turkey and Sweden. There was also a small poster session, which does not appear to have been very successful, and a discussion of Science Research Council funding of research which was missed by many who had to catch trains after lunch on the final day. It is pleasing to record that the participants came from as far afield as Japan, Mexico and Israel. Thanks are due to the local "firm" of Astin, Jones and Jones for the organisation. At the end of October a substantial contingent from Britain attended the Golden Jubilee meeting of the Society of Rheology in Boston (See Bulletin, volume 23, number 1) and if we include our Australian branch we can claim credit for 25 out of the nearly 250 papers presented.

The Society's next event was the conference on "Practical rheology in polymer processing" at Loughborough organised jointly with the Plastics and Rubber Institute. This attracted 137 participants of whom nearly 50 were from abroad, to hear 21 papers of which nine were from abroad. The organising committee consisted of Miss P. C. Durston and Mr. J. Monk representing the P.R.I. and Dr. Marshall and the Secretary representing this Society. As an individual with a clear personal interest, the Secretary welcomes the critical note in the account of the meeting in the Bulletin (volume 23, number 2). Only by voicing criticism and stimulating discussion

will things be improved, either in programme organisation and paper presentation or in our understanding and appreciation of the work of others. The Society should welcome argument and controversy, conducted in an open-minded and honest way. For those who wish to study the papers at their leisure, the book of preprints is available from the Plastics and Rubber Institute, at a discount to members of this Society, and some of the papers are due to be published in the quarterly journal, *Plastics and Rubber Processing*.

As has been the custom, the Society has not organised a three-day autumn conference because there has been the VIIIth International Congress in Naples this year. Accounts of the Congress, and of the meeting of the International Committee on Rheology will appear in the *Bulletin*. As Secretary I am most aware of details such as that the group travel arranged by Express Boyd Ltd. only just managed to attract enough people. It appears, also, that the American Society had difficulties with their agent, and the question of whether there is any point in the Society taking time to collaborate with an agent should be faced. The September scientific meeting, for whose organisation we have to thank Mr. Cogswell, was arranged on the date chosen in order to make it possible to catch some visiting rheologists on their way home from Naples, and it is hoped that members will feel that Professors Metzner and Tanner are a satisfactory catch to add to our gold medallist and annual award winner.

Plans for the future include a joint meeting with the Belgian Group of Rheology on the "Rheology of Rubbery Materials and Rubber Compounds—Theory and Practice". This will be held in Liège next April, and Council awaits with interest the response to such a specialised meeting, since it has been argued that this sort of meeting is the correct objective in European collaboration. Next September there is to be a meeting on stretching flows and general rheology in Newcastle which the Secretary, of course, commends highly for the consideration of members.

The next conference on Deformation, Yield and Fracture of Polymers (for which the Society has a representative on the organising committee) is in Cambridge in the spring of 1982, shortly before a possible European meeting organised by the German and Austrian Societies in Graz. Discussions are also under way concerning a meeting on rheology and microstructure in September 1982 which, it is hoped, will be organised jointly by the Society and the Statistical Mechanics and Thermodynamics Section of the Faraday Division of the Chemical Society. Our Australian Branch is also believed to be planning its second national meeting for 1981 in Sydney. It seems appropriate to conclude the crystal-ball-gazing by noting that the imminence of this Society's Golden Jubilee in 1990 has been mentioned in Council on more than one occasion.

In summary, there is a continuing pattern of cooperation between rheological societies and with societies which have related interests. Council has reiterated the Society's view that it does not wish to be submerged in a European organisation and, at the time of writing, it seems very unlikely that a European Society as such will attract support from many countries. Of course, while maintaining the independence and individuality of the Society, Council will continue to seek more effective collaboration with other societies. It is particularly in conference organisation for specialised topics that the benefits of European collaboration are expected.

Council has met four times in the year, as required, in Sheffield, Loughborough, Birmingham and London. Apart from conference organisation and the matters which are primarily the concern of the other officers, the weightier decisions of Council have included the award of a gold medal to Professor Oldroyd and the annual award to Dr. Hinch. Honorary membership has been offered to, and accepted by, F. J. Rigby, V. G. W. Harrison, R. Meredith and A. G. Ward. The question of the Society's exchanges of journals with other organisations is being reviewed by Council and in particular it is hoped to compile a record of the Society's holdings and their locations. Many present and past members of Council receive journals on behalf of the Society, and with the regular changes of officers it is easy to lose track of some of these.

In conclusion the Secretary thanks those, Council and others, who have tolerated another year of his peculiar style of operation and hopes that the following year may be at least as full of controversial and fruitful discussion.

C. J. S. PETRIE
August, 1980

TREASURER'S REPORT

Financial year ended 30th June, 1980

You may remember that there were some exceptional items of expenditure last financial year which meant that the Society experienced a small deficit for 1978-79. This year you will be pleased to know that things have reverted to normal, with income comfortably in excess of expenditure again.

There is a small increase in both subscription income, and in our share of the profit from Rheology Abstracts. Although inevitably our fixed-interest investments do not benefit from the current high rates of interest generally, the bank deposit account interest and TSB interest are both at record levels. We also have a useful contribution from the most successful conference last Autumn in Aberystwyth, and our share of the surplus from the joint meeting in Amsterdam. Thus our total income is about £1300 more than last year, at just over £4850.

Council seem to have been most frugal in their travelling expenses, though predictably both the printing and circulation costs for the Bulletin have risen again. In fact both of these items are somewhat distorted, as the council expenses cover one less meeting than is usual, whereas there was one more issue of the Bulletin than usual. The other expenses require little comment, other than to report that the absence of the printing for the membership list means that this year's expenditure is about £400 less than that for last year. Consequently there is a surplus for the year of nearly £1200, which means that the Society's assets are once again comfortably in excess of two years' turnover.

In view of this I see no immediate need to implement my threat to increase the subscription from £2 per annum. However, to avoid possible financial embarrassment for my successor, it would probably be prudent to expect to have to pay an annual subscription of £5 starting in October 1981.

ANTHONY EVANS

Honorary Treasurer

9th September, 1980

BRITISH SOCIETY OF RHEOLOGY

BALANCE SHEET as at June 30th, 1980

	£	£
ASSETS		
INVESTMENTS		
Wandsworth Borough Council 12 $\frac{3}{8}$ % Bond		2,500
Redbridge 10% Bond		2,500
Trustee Savings Account		1,643
		6,643
CURRENT ASSETS		
Cash at Lloyds Bank:		
Deposit Account	2,054	
Current Account	2,112	4,166
Sundry Debtors		537
		11,346
LIABILITIES		
CURRENT LIABILITIES		
Sundry Creditors		447
NET ASSETS		£10,899
REPRESENTED BY : —		
General Fund as at 1st July, 1979		9,707
Add: Excess of Income over Expenditure for the year	1,049	
Trustee Savings Bank Interest	143	1,192
		£10,899

We have examined the books of account of the British Society of Rheology and report to the best of our knowledge the above Balance Sheet and Revenue Account are in agreement therewith.

We have not inspected the Membership Records.

Anthony Evans
Hon. Treasurer

Alfred Simmons & Co.
Chartered Accountants

The Market Hall,
Redhill, Surrey
2nd September, 1980

BRITISH SOCIETY OF RHEOLOGY

REVENUE ACCOUNT for the year ended June 30th, 1980

1978	1979			
		<i>EXPENDITURE</i>		
800	1,233	Council Expenses (mainly travel)		624
765	1,168	Bulletin production costs		1,860
		Expenditure by officers:		
45	93	Secretary	7	
2	18	Treasurer	8	
329	413	Membership Secretary & Circulation ..	594	609
36	68	Professional fees		93
20	20	Insurance		22
—	111	Conference travel		50
—	285	Annual Awards		306
—	678	Miscellaneous		103
1,997	4,087	Total Expenditure		3,667
3,158	-622	Excess of Income over Expenditure for the year		1,049
				<u>£4,716</u>
		<i>INCOME</i>		
1,166	1,072	Annual Subscription and entrance fees ..		1,229
1,989	1,343	Publisher—Rheology Abstracts		1,568
35	50	Bulletin Subscriptions		49
		Investment Income:		
30	76	Bank Deposit Account Interest	237	
208	211	Wandsworth Bond	221	
55	167	Redbridge Bond	179	
253	187	Inland Revenue (Tax repayments) ..	170	807
1,352	309	Conferences: Net Surplus per account ..		989
—	50	Miscellaneous		74
5,155	3,465	Total Income		<u>£4,716</u>
		<i>CONFERENCE ACCOUNT</i>		
		Surplus Aberystwyth less expenses ..		734
		Surplus Loughborough less expenses ..		73
		Amsterdam share of surplus		182
				<u>£989</u>

MEMBERSHIP SECRETARY'S REPORT 1979-80

The current membership stands at 630, composed of 400 home, 167 overseas and 63 Australian Branch members. This compares with last year's total of 619. The changes are as follows:

	1979/80			1978/79	
	home	overseas	Australian branch	total	total
New members	25	11	10	46	46
Resignations	6	2	7	15	4
Deaths	5	—	—	5	—
Membership ceased by Rule 4(d)	6	6	3	15	9
Net gain in members	8	3	0	11	33

With last year's totals given for comparison, there is no decrease in new entrants, but the loss was almost trebled.

Included in the total membership are 36 in arrears with the 1979/80 subscriptions, compared with 41 last year.

The following Honorary Members have been elected: Dr. V. G. W. Harrison, Prof. R. Meredith, Mr. F. J. Rigby, Prof. A. G. Ward and Mr. W. H. Copley of Australian Branch.

The Membership Secretary wishes to remind members to notify him of any changes in address so that the Society's journals and communications can continue to be delivered without interference.

Also, the subscription for 1980/81 is due on 1st October 1980. It is not the practice of the Society to issue demands, but invoices will be provided to those members who specifically request it. Many members pay by Banker's Standing Order. Others wishing to do so can obtain a pro forma from the Membership Secretary. Payments may also be made direct to the Society's account, No. 0180985, at Lloyds Bank Ltd., Leatherhead; please ensure that your name is clearly stated on the advice.

The Membership Secretary aims to be helpful, but tracing the movements of itinerant members and sending out subscription reminders are very time consuming affairs. Members can assist by early notification of changes in address and prompt payment of membership dues.

D. C.-H. CHENG

8th INTERNATIONAL CONGRESS ON RHEOLOGY

NAPLES, SEPTEMBER 1980

An early breakfast, a ride to the harbour in Sorrento and a sea crossing to Naples; this was the start of a day at the eighth International Congress on Rheology. And what a masterpiece of organisation it was—highlighted on the first day by an escort of police outriders through the streets of Naples!

Most rheologists had taken the Sorrento option, and the tropical gardens in which the Parco dei Principi and Cocumella hotels were situated provided the reason, a need for calm after the bustle of the day. Sorrento, of high rock cliffs and donkey carriages, Ischia of subtle beauty, Pompeii of frozen decadence and the mystical Capri were all within easy reach. The long coach ride from Naples to Sorrento became familiar after the first day or two, but the temptation to take a day off was not always resisted!

The University of Naples provided a block of six lecture theatres, the upper three having adjoining coffee facilities and a compact display of rheometers and equipment. Six parallel sessions called for some mental and physical agility; inevitably there were clashes of times when only one interesting lecture out of several could be heard. This serious deficiency of major congresses requires attention. Should poster sessions be used to limit the total number of lectures? Should the organisers apply rigid time limits or some form of refereeing? Joint presentations (of which more later) may also offer possibilities for congress streamlining.

If a lecture was missed, however, the congress Proceedings bridged the gap: ten pounds of literature which the organisers had available on the first day of the meeting. Great credit is due to both the editors and the authors, who maintained a high standard of presentation throughout the three volumes.

The main subject headings covered, with numbers of lectures in brackets, were Theory (23), Fluid dynamics (36), Rheometry (21), Polymer solutions (28), Polymer melts (31), Suspensions (20), Polymer processing (27), Rubber (7), Solids (52), Biorheology (27) and Miscellaneous (21). This illustrates broad general support for most of the topics, though "Rubber" did not attract much interest. Biorheology continues to thrive, but the important topic of Food rheology was represented by a mere couple of papers! Another sub-topic which continues to develop is that of elongational flow in its various forms (30 papers). This provided one of the most interesting instruments on view and also one of the most novel presentations, that by C. J. S. Petrie and J. M. Dealy on elongational flow of modern polymers. These authors narrowed the gap between theory and practice with a fine "double act" in which

well-timed interruptions and useful comments enlivened a comprehensive review by both speakers. This technique should become more common in the future. J. Ferguson and M. K. H. El-Tawashi described a spin-line elongational viscometer first developed at the University of Strathclyde. The instrument only works with fluids which are highly resistant to extension; the demonstration liquid was a form of motor oil with an unusually large amount of polymer additive. Several onlookers were surprised to see that at various low rates of stretching, with beautifully smooth drawdown, the stretching force remained too low to measure (low extensional viscosity). Above a threshold stretch-rate, however, the stretching force rose rapidly, much more rapidly than the strain rate itself (solid-like behaviour). It is unusual to discover for oneself such a striking effect in a display instrument. Another novel paper was that by D. M. Binding et al on reversed squeeze film flow of viscoelastic liquids (separating plates). Initially, the plates separate faster than one would expect on the basis of the viscous behaviour of the liquid, but thereafter the rate of separation is markedly delayed. The initial part of the process is stated to be beneficial to lubrication processes, since a fairly abrupt rise of film thickness first occurs and the bearing surfaces are thereby protected.

The city of Pompeii fascinates visitors; on return it seems larger and more modern. The increase of size may not be illusory, since excavation is a continuous process. Bathing took place in heated comfort, water flowed in lead pipes and was carefully filtered; the rooms of the houses were decorated by fine paintings. Even now, when shadows lengthen, spectres tread the boards of the open amphitheatre. Pleasure had become a way of life before the eruption, they gambled, played cards and drank hot liquor; in byways dark-skinned ladies plied their trade. A remarkable equation of a man's physical proportions and his material wealth, implied by one of the paintings, says little for the Romans' spiritual or cultural values which perhaps, by this time, had passed their zenith.

A macabre touch is provided by the plaster cases of bodies, new examples now being exhibited as earlier ones are sent to museums around the world. Someone had noted the hollow sound from cavities in the crusty ash, and by filling them with plaster obtained some of the world's most interesting relics. The newer finds seem to be in relaxed, sleeping positions; perhaps they were overcome by fumes before the roof fell in!

At the Congress, much interest was shown in a well-presented review lecture by de Gennes on models for entangled polymer melts, in which the reptation model of Doi and Edwards was explained in physical terms. The succeeding lecture by Bird (actually presented by Hassager) departed completely from the printed text and provided an alternative bead-rod model for entangled melts

leading to the same basic constitutive equation as the Doi-Edwards model. A less well remarked paper by Acierno et al provided a non-isothermal model for polymer melts based on rate-equations for free volume, showing very satisfactory comparison with experiments on extensional flow. Although the newcomer to the subject might still be confused by the apparently wide range of theoretical approaches to constitutive equations, it can now be concluded that the relative status of various theories is adequately understood. The separate contributions and requirements of continuum mechanics, thermodynamics, kinetic theory, molecular physics and rheological measurement can be simultaneously accommodated; which aspect is emphasized depends upon circumstances and the interests of the worker concerned.

Papers on fluid dynamics showed that little progress has been made in tackling the one outstanding problem in the mechanics of non-Newtonian fluids: that of stability. It was almost symptomatic that the invited lecture on melt fracture (Coleman) was withdrawn. Most attention is now being paid to difficulties encountered in direct numerical solution of elastico-viscous flow when the Deborah (or Weissenberg) number reaches values of order unity; it is now thought by various workers (Tanner, Walters, Crochet, Caswell—private discussions) that problems of numerical stability and convergence may well correspond to points of bifurcation in the true solution. Now that the type of constitutive equation needed to model polymer solutions and melts is generally agreed upon, necessary analytical investigations can be pursued more vigorously to uncover the complexities of high-Deborah number flow. Any progress made along these lines will have direct application to polymer-melt processing flows.

Silberberg gave an interesting view of some aspects of bio-rheology, including the manner in which ciliary hairs cause mucous movement on the palate of a frog. This area is certainly not dominated by high-powered theories. Likewise, that practical mathematician, Professor Walters, gave a stimulating talk on anomalous extensional flow effects in commercial rheometers. One point of interest was the effect of the length of the jet of fluid in cup efflux viscometers (ie it matters how far the cup is above the vessel receiving the fluid or, in simpler terms, it is recommended that the height of the technician be recorded with every efflux time). The difficulties caused by secondary flows, and the mathematical possibility of non-uniqueness with its computational problems, were associated and the failure of numerical techniques to predict the observed increase of drag in converging flows was discussed.

Crochet, later in the conference, presented work on the numerical solution of flow into a contraction, reviewing the difficulties and

speculating as to possible resolutions of the disagreement. The current activity in this field was evident in many discussions, and the excellent presentation by Crochet leads one to hope that he will be invited to give a full review of the subject in Mexico in 1984.

This was an absorbing but complex meeting. Some items not originally planned were added when the financial position became healthy; the conference dinner and the presentation of a silver-mounted cameo brooch to each lady were two such bonuses. The presentation by Professor Pearson of bouquets to the Italian ladies (whose work at the Congress had been outstanding) provided a touch of gallantry after a rumbustious evening.

Gianni Astarita, Pino Marrucci and Gino Nicolais gave us the opportunity to meet old friends and make new ones, to talk about rheology sometimes, and to savour Neapolitan hospitality. Thank you for your total dedication. Acapulco, here we come!

D. R. OLIVER

J. R. A. PEARSON

C. J. S. PETRIE

REPORT OF THE MEETING OF THE INTERNATIONAL COMMITTEE ON RHEOLOGY

Naples on September 2nd, 1980

1. The request of the Israel Society of Rheology to join ICR was granted unanimously. The Israeli representative joined the meeting.

2. Agreed, *nem con*, that the 9th International Congress on Rheology should be held in Acapulco (Mexico) probably in October when the weather is relatively mild.

3. Section 2d of the bye-laws was amended to allow the representatives of national or multinational organisations not members of ICR, to attend ICR meetings as Associate members. Also the practice of granting honorary Life membership (without vote) was regularised by introducing a bye-law to cover honorary Life membership. Both these amendments to bye-laws will have to be ratified by national societies.

4. At the time of the meeting the honorary Life members were Dr. Scott Blair and Dr. Burgers. It was agreed that Dr. Marvin should be granted the same status.

5. Dr. Ziabicki (Poland) and Professor Meissner (Switzerland) were granted Associate membership of ICR.

6. The European Committee of Rheology was briefly discussed and it was agreed that the European Societies should first decide

the type of organisation which they required and then the decision should be brought to ICR for report. (A meeting of representatives of the European Societies was later called and Dr. Petrie, the Secretary of B.S.R., attended. His report follows.)

7. It was agreed to compile a trilingual dictionary of rheological terms. Dr. Tschoegl agreed to produce the English version and the French and German representatives agreed to produce the appropriate French and German translations of these terms. (Dr. Tschoegl will use the various glossaries and so on, that have already been produced by several organisations.)

8. It was agreed to compile a directory of rheological laboratories. A questionnaire will be sent to national societies to help with this.

9. The German representative suggested "Rheological Documentation" should bear an imprint showing it was sponsored by ICR. It was suggested that Rheology Abstracts should bear a similar imprint. It was agreed that the British Society should take up a position on this point before anything is done by ICR.

10. Officers for the following four years were elected. Chairman: Professor Astarita; Secretary: Dr. Tschoegl; Past Chairman: Dr. Kubat.

It was decided that a Treasurer was not needed just yet, but that the post might become necessary as ICR undertook additional work, e.g. the Dictionary of Terms.

W. H. JONES—September 1980

Footnote to the I.C.R. meeting

On Friday, September 5th, representatives of most of the European rheological societies met in Naples, with the secretary of the ICR (Professor N. W. Tschoegl) in attendance. There was an informal discussion of possibilities for closer liaison and co-operation from which two definite decisions emerged.

- a. "A provisional committee of European delegates to the International Committee on Rheology" has been formed. The secretary will be Dr. C. J. S. Petrie (Department of Engineering Mathematics, The University, Newcastle upon Tyne, NE1 7RU, England) with the role of "an intelligent post-box" (quoting one delegate).
- b. The German and Austrian societies invite all other European societies of rheology to join them in organising a joint meeting in Graz from 14th to 16th April, 1982. Suggestions for topics for the meeting are invited from the societies, since it is not planned to hold a meeting covering all aspects of rheology in depth. The language of the meeting will be English.

The intention (as your secretary sees it) is that the provisional committee may evolve into a committee with a less cumbersome title, approved by the European societies. It is expected that each society will appoint the same delegate to this committee as to the I.C.R. so that delegates would have the opportunity of becoming better acquainted. In addition the committee members will be the recipients of information from other societies on behalf of their own societies (more intelligent post-boxes), and may prompt the joint organisation of meetings (perhaps on specialist topics). It is hoped that the delegates will meet yearly (probably on the occasion of a conference of interest to some delegates), and that the committee will act in other ways if (and only if) it identifies particular needs.

C. J. S. PETRIE—October 1980

ANNUAL CONFERENCE OF GROUPE FRANCAIS DE RHEOLOGIE

The conference will be held in Paris on 3rd and 4th December, 1980.

Papers to be presented, in French, will include :

- E. Kroner (Stuttgart); Statistical continuum mechanics and applications to linear elasticity.
- P. Suquet (Paris); Methods of homogenisation in the mechanics of solids.
- M. Berveiller and A. Zaoui (Paris); Self-consistent methods in the mechanics of heterogeneous solids.
- Y. Bamberger; A model of a material with microcracks, and its application to concrete and rocks.
- B. Cambou; Structure and behaviour of granular media.
- G. Cordier and K. Dang Van; A microscopic approach to the damage of polycrystalline metals.
- F. Darve; The mechanical behaviour of granular media in association with their structure.
- J. C. Faugeras and R. Gourves; The distribution of stresses on the particles of a granular medium submitted to an isotropic field.
- R. Houpert and F. Homand-Etienne; The mechanical behaviour and structure of rocks.
- J. M. Jalinier and B. Baudalet; Damage and rheology.
- M. Lucius et al; Study of a rheological model expressing the characteristic viscoelastic principals of blood in the transitory regime.

Its relation with the network of red corpuscles (a film).

- C. Legrand; The flocculent state of cement pastes before setting, and its consequences on rheological behaviour.
- T. Mathia and N. Fayolle; Viscoelastic properties, structure and action of abrasive composites.
- R. Mazet; On the equilibrium and progressive creep of an isotropic heteroplastic medium under slowly increasing load.
- C. Rey and P. Franciosi; A study of inter-crystalline hardening and the influence of interfaces on the low temperature plasticity of pure metals.
- M. Suery and B. Baudelet; The rheology of super-plastic materials.
- Further information from: M. E. Absi; CEBTP, 12 rue Brancion, 75737 Paris, Cedex 15, France.

LETTERS TO THE EDITOR

I.C.I. Ltd.

Research Department

Polymer Science Division

21st July, 1980

Dear Editor

Professor Pearson has shown me a copy of his letter of 11th July and I am grateful for the correction. I feel that, as Professor Pearson suggests, my original lack of appreciation stems from the difficulty in understanding the physical arguments underlying such detailed mathematical treatments and most strongly support the argument for a careful objective study of the various approaches which have been advocated.

Finally I offer my apologies that by expressing my concern and confusion I have caused offence.

Sincerely,

F. N. COGSWELL

Postscript to Letter

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PLASTICS DIVISION

RESEARCH DEPARTMENT

Some Account of Injection Moulding

Should anyone feel tempted to take up the challenge of reviewing the analysis of injection mould filling the following papers, to which I am certain other correspondents will be able to add, may be considered in addition to those cited in this correspondence.

G. Williams and H. A. Lord "Mould filling studies for the injection moulding of thermoplastic materials, 1. Flow of plastic materials in hot and cold walled circular channels, and 2. Transient flow of plastic materials in the cavities of injection-moulding dies". *Polym. Engng. and Sci.* 15, 8, 553-582 (1975).

P. C. Wu, C. F. Huang "Simulation of the mould filling process" SPE Conference Downingtown p. 197-211 (1973)

E. C. Kalinchev and B. E. Vostorgov "Calculation of pressure loss in nozzles of injection moulding machines" *Plast. Massy* 8, 17 (1972).

E. Broyer, C. Gutfinger and Z. Tadmor "Theoretical model for the cavity filling process in injection moulding" *Trans. Soc. Rheol.* 19, 3, 423-444 (1975).

J. L. White "Rheological phenomena in injection moulding" *Proc. 7th Int. Congr. Rheol.* 514 (1976).

I. I. Felipchuk, N. I. Basov and V. Samorlov "Mathematical description of the mould filling process in injection moulding of disc shaped parts" *Plask u Kant*, 23, 7, 527-529 (1971).

P. C. Wu, C. F. Huang, C. G. Gogos "Simulation of mould filling" *Polym. Engng. Sci.* 14, 3, 223-230 (1974).

J. C. Berger and C. G. Gogos "Numerical simulation of the cavity filling process with PVC injection moulding" *Polym. Engng. and Sci.* 13, 102 (1973).

J. C. White "Fluid Mechanical analysis of injection mould filling" mould filling studies" *Polym. Preprints* 15, 1, 720-725 (1975).

L. R. Schmidt "Injection moulding of glass filled polypropylene: mould filling studies" *Polym. Preprints* 15, 1, 720-725 (1975).

A. Casale, A. Moroni and I. Ronzoni "An approach for the processing engineer: rheotechnics" *Polym. Engng. and Sci.* 14, 9, 651-655 (1974).

H. J. Rienzner "Injection moulding of rubber: rheological considerations and economic implications" *Ind. D. Gomma.* 18, 4, 36-40 (1974).

G. Astarita "Correlations between polymer processing technology and rheology" *Chimica E. Ind.* 55, 2, 964 (1973).

M. R. Kamal, Y. Kuo and P. H. Doan "Injection moulding behaviour of thermoplastics in rectangular cavities" SPE 32nd ANTEC (1974) p. 539-544.

S. Matsuoka and P. Hubbauer "Model flow studies for injection moulding" SPE 32nd ANTEC (1974) p. 371-373.

M. J. Sleeman and G. H. West "Runner flow in injection moulds" *Br. Polym. J.* 5, 2, 91-99 (1973).

L. Sors "Rheologische Dimensionierung der Anguss kanale und Anschnitte von Spritzgiesswerkzeugen" *Kunststoffe* 65, 10 (1975).

P. Thierel and G. Menges "Mathematical and experimental determination of temperature, velocity and pressure fields in flat moulds during the filling process in injection moulding of thermoplastics" *Polym. Engng. and Sci.* 18, 4, 314 (1978).

C. Austin "The Moldflow System" HQ and Computer Centre, 3 Stanley Street, The Basin, Victoria 3154, Australia.

R. J. Crowson, M. J. Folkes and D. W. Saunders "The rheology of short glass fibre filled thermoplastics at very high shear rates" (a study in an injection moulding machine) paper presented at the Society's meeting at Plymouth 1978.

H. Janeschitz-Krieger "Injection moulding of Plastics: analytical solution of heat transfer problem" Johannes-Kepler University, Linz 1979.

The Cornell University programme which has received considerable advertisement recently and is, I believe, based on the work of J. F. Stevenson.

As well as comparing the different analytical solutions and their predictions it would be extremely helpful to have a statement of the physical factors which a complete model should consider. Amongst these factors which may potentially be significant but which often receive only limited treatment are: temperature profiles within the mould as well as the polymer; surface heat transfer at the polymer/metal interface; heat transfer in highly oriented system; and the influence of hydrostatic pressure on volume and viscosity.

F. N. COGSWELL

CONFERENCE ANNOUNCEMENTS

British Society of Rheology—Australian Branch

A Seminar on Rheological Measurements and Applications in Process Industries is to be held in Melbourne on October 4th 1980. The meeting is to be followed by the AGM and buffet dinner.

The 2nd National Conference on Rheology is to be held in Sydney on May 13th-14th 1981. Abstracts of the papers will be published in Rheology Abstracts.

Fourth International Congress on Biorheology July 27th-August 1st 1981

This conference to be held in Tokyo, Japan, has a scientific programme which includes all aspects of deformation and flow in

biological systems: (a) blood (plasma, cellular elements, coagulation, etc.), (b) blood vessel and blood flow (hemorheology), (c) bio fluids (mucus, synovial fluid, sputum, etc.), (d) biosolids (bone, cartilage, joint, tooth, etc.), (e) muscle, lung, skin and other organs and tissues, (f) biopolymers, (g) membrane and interface, (h) cellular and subcellular rheology, (i) experimental methods, (j) theories, and (k) clinical biorheology. Topics in the wide area of biorheology such as electrical phenomena related to mechanical deformation, rheology of cells and tissues of plant, and rheology of edible substances except industrial products may also be included

Contribution of Papers

Registered members of the Congress can contribute papers to the Congress. All fields of biorheology can be covered. In principle, all abstracts will be accepted and published in the Abstracts Volume except for those that the Committee considers to be incongruent with the objective of the Congress. Each person will be allowed to present only one paper, although he/she may be a co-author of other papers.

Submission of Abstract

Those who wish to contribute a paper should send the abstract to the Secretary General together with the registration form. The deadline for the submission of the abstract is January 31st 1981. Each abstract will be limited to the length of one page, typed single space on 22 x 28 cm (8½ x 11 inches) plain paper, with a border of 3 cm (1¼ inches) on all sides. Paper title, authors' names, affiliation and addresses must be typed at the top. Authors must prepare camera-ready copies of abstracts to be photographed for reproduction.

Registration

Contact Prof. Y. Matunobu, Secretary General, The Fourth International Congress of Biorheology, Department of Physics, Keio University, Hiyoshi, Kohoku-ku, Yokohama 223, Japan.

Fifth International Conference

Deformation, Yield and Fracture of Polymers

March 29th-April 1st 1982

Call for Papers

The conferences held in 1970, 1973, 1976 and 1979, which were all fully subscribed, have established this triennial event as the most important international conference on its subject world-wide. The fifth conference is being organised by a committee representing the following societies:

British Society of Rheology
Institute of Physics Material and Testing Group
Institute of Physics Polymer Physics Group
Institution of Metallurgists
Materials Science Club
Plastics and Rubber Institute
Royal Society of Chemistry and Society of Chemical Industry
Macromolecular Division

The programme will comprise from 30 to 40 papers on original research, arranged in six sessions, allowing 20-25 minutes presentation time and 10-15 minutes discussion for each paper. Those interested in submitting papers for presentation at the conference are asked to complete the attached form and send it to the Secretary, Plastics and Rubber Institute, 11 Hobart Place, London SW1W 0HL. Detailed outlines of papers, 300-500 words in length, will be required not later than August 1st 1981 and the committee will select papers for inclusion in the programme on the basis of these outlines.

British Society of Rheology—Annual Conference 1981

The conference, entitled *Stretching Flows and General Rheology*, is to be held in Newcastle on September 8th-11th 1981.

Offers of papers to be sent, as soon as possible, to Dr. C. J. S. Petrie, Department of Engineering Mathematics, University of Newcastle upon Tyne.

MEMBERSHIP NEWS

The following applications were approved by Council at its last meeting:

Dr. Th. F. Tadros, B.Sc., M.Sc., Ph.D.

D. Heath, B.Sc.

both interests: p,et,sa, D,F,G.

both at: I.C.I. Plant Protection Division, Jealott's Hill Research Station, Bracknell, Berkshire, RG12 6EY.

The Secretary has been informed of the deaths of Dr. W. G. Wearmouth and Mr. S. J. Higgs.

The following B.S.R. members (Australian Branch) have resigned as of June 19th 1980: Dr. J. S. Carr, Dr. W. H. Cogill, Mr. P. J. Kettle, Mr. J. V. Parekh, Mr. B. J. Pullman, Mr. T. J. Richards.

AUSTRALIAN BRANCH—NEW MEMBERS (as of June 1980)

Dr. R. P. Burford. C,D.	University of New South Wales, School of Chemical Technology, P.O. Box 1, Kensington, N.S.W. 2033.
Dr. R. A. Duckworth. G,N.	C.S.I.R.O., Division of Mineral Engineering, Clayton, Vic. 3168.
F. Giurco. B,C.	Olympic Tyre & Rubber Co. Pty. Ltd., P.O. Box 1, West Footscray, Vic. 3012.
Dr. R. R. Horsley. G,H.	Royal Melbourne Institute of Tech- nology, Dept. of Mech. & Production Engng., P.O. Box 2476V, Melbourne, Vic. 3001.
Dr. P. W. Johnson. G,H.	Royal Melbourne Institute of Tech- nology, Dept. of Mech. & Production Engng., P.O. Box 2476V, Melbourne, Vic. 3001.
Dzuy Nguyen. G.	Monash University, Dept. of Chemical Engineering, Clayton, Vic. 3168.
Dr. P. G. Lehman. C,D.	I.C.I. Australia Ltd., Central Research Laboratories, Newson Street, Ascot Vale, Vic. 3032.
H. P. Schlanger. B,C.	Olympic Tyre & Rubber Co. Pty. Ltd., P.O. Box 1, West Footscray, Vic. 3012.
N. W. Smith. G.	Davy McKee Pacific Pty. Ltd., 480 St. Kilda Road, South Melbourne 3205.
Dr. B. Stanmore. G,H,N.	University of Melbourne, Dept. of Chemical Engineering, Parkville, Vic. 3052.

RHEOLOGICAL INSTRUMENTS

Elongational Viscometer

A new elongational viscometer has recently been introduced by Sangamo Schlumberger. Essentially the instrument uses the principle of extruding fluid from a spinneret nozzle and extending it on a rotating drum. The force generated is measured by the deflection of the thin walled tube through which the fluid passes. This is achieved by a combination of mechanical amplification (through a pivot) and sophisticated electronics using a LVDT transducer measuring system similar to those in the Rheogoniometer. Load output is displayed digitally, and/or recorded. In order to obtain elongational stress it is necessary to measure the fluid profile. This can be done either using a travelling microscope or photographically. The same measurements enable the rates of elongation along the extending fluid filament to be determined. Alternatively, average values of elongation rates can be found knowing the rates of fluid flow from the nozzle and the drum speed. The latter is accurately controlled over a wide range from 0 to 2,000 rpm. Position of the drum, and hence fluid filament length can be varied from 25 mm to 250 mm. This is achieved electronically by push button control. The instrument is housed in an environmental chamber capable of controlled operation up to 100° Celsius.

It provides a powerful tool for rheological research into polymer solutions and fluids used in the Food, Oil, Rubber, Paint, Pharmaceutical, Detergent, Adhesive and Fibre Industries.

DIARY

1980

December 3-4. Paris. Rheological behaviour and structure of materials.

December 12. BSR Council Meeting.

1981

February 22-26. Williamsburg. 52nd Annual Meeting (Society of Rheology).

April 7-9. Liège. Rheology of Rubbery Materials and Rubber Compounds—Theory and Practice (Belgian Group of Rheology and British Rheology Society Joint Conference).

May 13-14. Sydney. Sydney 2nd National Meeting (Australian Branch of the British Society of Rheology).

July 2-August 1. Tokyo. 4th International Congress on Biorheology.

September 8-11. Newcastle. Stretching Flows and General Rheology (British Society of Rheology—Italian Society of Rheology).

1982

March 29-April 1. Cambridge. Deformation, Yield and Fracture of Polymers (Plastics and Rubber Institute with the British Society of Rheology and other societies).

April 14-16. Graz. Topic(s) to be decided (Austrian, German and other rheological societies).