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EDITORIAL

Another European edition and an opportunity to reminisce a little more about the ICR held in Cambridge last August. A few more articles, a few more photographs, and another letter from Dr Watson.

Best wishes, and read on...

Paul Doody

SUBMISSIONS TO THE BULLETIN

Submissions to the Bulletin may be made by any practical means – post, email, disk, fax, pigeon, donkey, et cetera but electronically is preferred (saves typing...). Most packages supported (Word, WordPerfect, ASCII, RTF, PDF) but always provide a contact name, address, eMail, or telephone number in case of problems.

Copy dates are now fixed at 15 December, 15 April, and 15 August. This should allow me to publish in January, May, and September and, as always, all contributions gratefully received.

Late copy can sometimes be accommodated however the facilities of the BSR and ESR web sites may also be appropriate. Please contact Editor for details.

COVER ILLUSTRATION

I'd like to remind everyone that suggestions for Black & White or colour pictures (preferably of a rheological nature!) are welcomed by myself (Bulletin Editor) or Nick Hudson (Abstracts Editor). Suggestions are always welcome!

BSR NEWS

New Council Member – David Binding

David graduated from the University of Wales Aberystwyth in 1973 after studying Applied Mathematics. He gained his Ph.D from the same university in 1976 with a thesis on the rheology of lubricants.

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After leaving university, he took up a post as visiting lecturer in the Faculty of Engineering of the National Autonomous University of Mexico in Mexico City. During six years in Mexico he continued with research in the field of rheometry but also became involved with the National (Mexican) Academy of Engineering, being at one time the Secretary of the Academy and was a founder and first Editor of the Journal of the Academy. His last three years in Mexico were spent as Head of Theoretical and Applied Mechanics in the Postgraduate Division of the Engineering Faculty

On returning to Britain in 1983, he took up a research position at the University of Wales Aberystwyth with the Rheology group led by Prof. Ken Walters. His principal research interests are in the area of rheometry, in particular elongational rheometry. His work in this area was recognised in 1988 when he received the Annual Award of the British Society of Rheology. More recently, his work has been directed more towards the needs of the processing industries with on-going projects in food rheology and on the effects of high pressure.

To some extent, research was put on hold last year, to make way for his involvement as Congress Administrator for the XIIIth International Congress on Rheology that was held in Cambridge.

CONFERENCE REPORTS

INTERNATIONAL CONGRESS ON RHEOLOGY 2000

CAMBRIDGE, UK - SNAPSHOTS

This was the first International Congress that I had attended and I have to say I was impressed in several ways. Although this is by no means a full report of the event, I hope that some of the impressions help to give something of the flavour of the event.



Prof Gary Leal receives the Bingham Medal
from the President of the Society of Rheology, Prof Gerry Fuller.

- The venue was suitably august – I would hazard a guess that Cambridge is a reasonably unique location for any event. With lectures based at the Sidgwick site, and accommodation at Newnham, St John's and Robinson Colleges, the Congress also helped give a taste of the "Cambridge Experience". This was further developed by other events later in the week.
- The conference was opened by the Master of Ceremonies (Prof Peter Townsend) and was followed by the Introduction by Prof Daniel De Kee and the Welcoming address by Prof Ken Walters.
- There followed the Citations for the three medals presented at the ICR – the Bingham Medal of the Society of Rheology, awarded to Prof L. Gary Leal; the BSR Gold Medal, awarded to Prof Roger I Tanner; and the ESR Weissenberg Medal, awarded to Dr Hans Martin Laun (citation is published in the ESR Newsletter).
- After a short pause, the first set of plenary lectures commenced, starting with a lively talk on filament stretching rheometry by Prof Gareth McKinley, of MIT. Prof John Hinch (speaking on his home turf) then posed interesting, philosophical questions in the basis of rheological phenomena, and our classification of such. After coffee, the last plenary lectures of the morning (by Prof Roland Keunings and Prof Michael Cates (of Louvain and Edinburgh respectively) finished off the first morning and paved the way for the rest of the conference programme.



Prof Roland Keunings
giving his plenary lecture



Prof Mike Cates giving his plenary lecture

- Overall, the standard of accommodation was rated “good” and certainly the meals (lunches at Robinson in my case) were also good. Indeed, the walk from Robinson to the Sidgwick site was an excellent opportunity, not just to clear the mind, palate, and lungs, but also to meet, discuss, and socialise with colleagues about a variety of different subjects. It was quite amusing to see the “Great and the Good” of our discipline engaged in deep rheological equations whilst hurrying back for refreshment. The very air itself was thick with tensors...
- The standard of the lectures was, as I am sure you would expect, slightly variable. Whilst generally enlivening and interesting, sometimes it seems that the objective of a lecture (communication of

concepts and ideas) is sometimes forgotten... Having said that, however, there were some real highlights (at least from my viewpoint). It was also interesting to note that, more than ever, Rheology is a cross-functional discipline.

- The Proceedings of such an enormous number of lectures (581) came as a (very) weighty four-part publication and it was amusing to note how quickly the offer of a CD-ROM alternative was taken up, particularly by those with long flights or weak shoulders...
- The organisation was first-rate and the “conference daze” that can often be experienced at large events was non-existent (at least in my experience!). The setting for the Congress (Sidgwick site) was fine, although the large numbers of stairs that needed to be negotiated at twenty-minute intervals certainly increased fitness levels!
- The exhibition of rheological companies was quite impressive. The location also ensured a captive audience (betwixt the Main Hall and the Lecture Theatres).
- Video Conference links finally seem to have come of age – not too many glitches!
- The Concert in King’s Chapel was superb. Congratulations to Malcolm Mackley for organising that part.
- Finally, congratulations to all of the Stewards and Organisers for putting on a very impressive event. Echoing the thoughts of the majority of attendees, particular thanks to David Binding.
- Looking forward to the next one...

Paul Doody
September 2000

BANQUET GRACE

Tom McLeish and Chris Petrie provided the “Rheologist’s Grace” at the banquets held on 24th August. This is reproduced here.

Oculi omnium in te sperant, Domine,
a facie cuius montes fluxerunt ipsi
et terra mota est ipsa
ut serva tua cantavit Deborah.
Aperis tu manum tuam,
et imple omne animal benedictione.
Benedic, Domine, nos et dona tua,
quae de tua largitate sumus sumpturi.
Per Christum Dominum nostrum, Amen.

BANQUET SPEECHES

Two speeches were given during the Banquet, one in each Hall. Below is reproduced the text of Prof Crochet's speech.

PROF MARCEL CROCHET NEWNHAM COLLEGE

Dear friends, ladies and gentlemen,

The last time I gave a speech related to rheology was in 1996; I was addressing the audience of the IUTAM international congress in Kyoto, in a relatively easy endeavour to convince them of the beauty and challenges of non-Newtonian fluid mechanics. A bifurcation of my academic life has prevented me from giving further lectures on the same topic; as far as lectures are concerned, I have now specialised in the opening of various meetings, from medieval philosophy to automatic control or psychiatry, and in a number of addresses to freshmen or new graduates of all disciplines, to newly appointed or retiring academics and, of course, to potential patrons of our university. Our board recently confirmed that I am standing on a stable branch until retirement; I was thus honoured and delighted when my friend Ken Walters called me a couple of months ago, wondering whether I could attend the present banquet to meet my friends of many years and deliver a few words of conclusion. In a way, it is for me another chance to praise the beauty of rheology and to make some of its challenges conspicuous, without this time resorting to slides or equations.

Isn't it wonderful that 800 specialists have decided to attend the present Rheology 2000 meeting? It shows the excellent health and the attractiveness of our field, while so few people know about its essence and its beauty, as you have probably experienced whenever you were asked about your favourite pastime. It's almost time they did! While preparing these few comments, I logged on some of the best-known sites of internet with the simple keyword « rheology ». The champion was Altavista.com, with 106,000 entries; by comparison, particle physics is named 150,000 times, while an obvious palm is awarded to biotechnology with 1,460,000 citations.

I believe that rheology is a beautiful science, in view of its contents as well as the way in which it has been practised all along this ending century. Rheology has indeed anticipated a number of developments of

modern science. Let me point out four features which, among others, justify my proposition.

First, I would like to point out the multidisciplinary character of rheology. Despite the antagonism of a good portion of the academic community to this recent evolution, it is quite clear that tomorrow's discoveries will emanate from the cross-fertilisation of diverse scientific disciplines; biotechnology and nanotechnology are obvious examples. Research in rheology has created, from its early stage, a remarkable precedent. It lies at the crossing of chemistry, physics, mathematics, mechanics, numerical analysis or chemical engineering. Its discoveries open the path to progress in material science, processing science, biotechnology or oil recovery. In rheology, the fact that one cannot possibly segregate fundamental research from its applications has been a key ingredient to success. It reminds me of a citation by the French biologist François Jacob in his book entitled « The mouse, the fly and the man ». « If, at the stone age » he writes « one had wanted to develop engines to cut or to slice, one would have produced stone axes, of all shapes and prices, but one would not have discovered bronze! ».

Secondly, it is clear that our field has anticipated another major trend of science, which is the obvious necessity of networking research centres throughout the world. I am well placed for defending such an assertion. As a young scientist in the early 70's, I was quite early introduced to the active circles where one could exchange ideas, compare theoretical and computational results to their experimental counterparts, discuss applications and industrial needs. I know that some of you share my fond memories of the 1972 IUTAM symposium organized in Naples by the late Gianni Astarita, of the 1974 meeting of the British Society of Rheology held in Cambridge and organized by Anthony Pearson, or of the preparation, with Ronald Rivlin and Ken Walters, of the 1978 IUTAM meeting in Louvain-la-Neuve. During that meeting, a few of us decided to launch a series of workshops devoted to the progress of numerical methods in non-Newtonian fluid mechanics. The first workshop was hosted by Bruce Caswell at Brown university in 1979; 21 years later, it is noteworthy that the series has never been interrupted! I couldn't possibly omit my early enjoyable visits to Aberystwyth at Ken's invitation, at a time when one changed trains several times before reaching one's destination. These friendly encounters, and many more, led to exciting discussions, progress and discoveries; they were the key to

joint European programs and to the establishment of an efficient research network covering all continents.

Thirdly, I would like to point out the very special relationship that rheology has weaved with industry. Quite clearly, industrial needs have emerged at a very early stage and may even be at the origin of our field. Polymer and rubber processing, food industry, oil recovery or the transport of suspensions have led to an inescapable commitment to know more about fluid and flow properties. However, we have been faced with a segment of industry where the people in charge were willing to come up with fundamental problems while the academic community concerned with rheology was coping with what some would call real problems. I could name many friends, from the industrial as well as the academic world, who have been extremely active in this cooperation; the list would be too long and I would risk to omit some of the major actors. I could also quote a number of successful industrial inventions which found their origin in a deep scientific rheological investigation. Once again, I believe that the proximity between industry and university is a specific and essential feature of our science which is full of promise in today's world.

Finally, I wish to claim that rheology enjoys, with other branches of science, a very essential character: it is fun! I will long remember the exciting Friday morning sessions in Ken's office or those with Art Metzner in Delaware when we would discuss all sorts of problems, the meetings with David Boger, at various places of the world, when we would compare his latest observations of corner vortices with our calculations, or our discussions with Dan Joseph on delayed die-swell or critical Weissenberg numbers. Today, the emergence of micro-macro techniques at the junction between continuum mechanics, particle dynamics and numerical analysis opens new paths which, among other topics, promise many enjoyable developments.

Some of you who are interested in the management of universities may have read a recent book edited by professors Werner Hirsch, from UCLA, and Luc Weber, from the University of Geneva, entitled « Challenges facing higher education at the Millenium ». They are numerous while some critics, such as the management guru Peter Drucker, don't hesitate to write that « thirty years from now, the big university campuses will be relics. Universities won't survive ». As you might expect, I don't share such a pessimistic view. Universities will survive, provided their actors recognise the rapid change of the world and adapt to new requirements. I do believe in particular that rheologists

will have a very special role in overcoming some of the new challenges. Let me comment on three of them.

« Globalisation and, in particular, the rapid growth and development of the knowledge industry will profoundly change the educational system as the ability to move information more quickly and economically becomes greater and more widespread. These developments will require a repositioning of the university », say Hirsch and Weber. Moreover, the exploding information and telecommunication technologies offer new potential for producing or distributing knowledge. Distance learning and digital courses will be part of our future landscape. I think that our long tradition in rheology of exchanging knowledge with great openness should allow us to constitute networks where we share our efforts in order deliver the most recent and qualified information throughout the university system.

Another challenge has to do with new missions assigned to universities : lifelong learning, technology transfer, or a greater sensitivity towards sustainable development. Once again, the rheological community should be proud of its past and pursue its efforts in offering workshops, cooperating with national societies of rheology, participating to research projects with industry or being preoccupied by environmental problems. I believe that our freedom and, above all, the quality of our offer should allow us to face commercial competition with great success.

Finally, how are we going to face the challenge of renewing our academic staff, in particular within European universities where university expansion occurred in the early seventies? I think that our community should enhance student and professor exchanges, offer databases for the availability of postdoctoral and academic positions and, once again, reinforce the world-wide network which was installed many years ago by our predecessors.

I am convinced that rheology is facing a great future. « Rheology 2000 » was the ideal title for the present International Congress. It emphasises our consciousness of new challenges and our will to move forward. Its location is also symbolic: at the heart of the United Kingdom, where so much was discovered, and within Cambridge University, which, for so many centuries, has developed a model of scientific research.

To conclude, I sincerely hope that the younger generation will enjoy, as much as we did, a passion for rheology! I thank you for your patience and your attention.

MORE OBSERVATIONS FROM ICR 2000

The Editor recently had the following communication passed to him by a colleague of the author. It was suggested that the cited authors might wish to comment on the observations of the Master Detective. All responses will be published herein.

BREAKING POINT DR J H WATSON

When I had consulted my colleague about attending the XIIIth International Congress on Rheology, Holmes had begged to be excused. "It is not that I do not wish to accompany you Watson, but it is quite impossible for me to leave Yorkshire during the Headingly Test, where I consider my presence to be absolutely indispensable. I should certainly have liked to see what progress has been achieved in the field of morphorheology since the Brussels Congress¹ eight years ago." Secretly, I had not been disappointed at his decision. Rather than attend the sessions on blood, sludge and custard that Holmes considered to be the very essence of rheology, I would be able to concentrate on those subjects that particularly interested me such as 'The Mystery of the Mechanism of Sharkskin'².

It was late on the Friday evening, as I was arranging my dress shirts in my portmanteaux that a somewhat breathless Holmes returned to our cottage. "So Holmes," I greeted him, "your presence at Headingly was not indispensable after all."

"Quite the opposite, my dear Watson," retorted the travel-stained cricket-lover. "I took the liberty of taking the CD ROM preview of the Conference Proceedings with me, which I scanned on my lap-top between overs. Recognising the importance of the Cambridge meeting, I passed my observations about swing bowling, the weather and the state of the pitch to the England dressing room. As a result, the match was successfully concluded in two days instead of the scheduled five. Thus, I am able to accompany you after all."

Perhaps my disappointment was apparent. "Do not worry," he continued. "I shall be entirely inconspicuous and not interfere with your plans."

Thus it was that we travelled together to that notable seat of learning. Truly the organisers had done a splendid job in handling the logistics of such a large gathering. Indeed, the efficiency of the marshals and tickets for everything meant that Holmes, who was not registered, was obliged to subsist on a diet of complimentary hot chocolate and cookies by courtesy of St John's College,

where I was billeted. As for the lectures, Holmes wished to hear very few. Those that especially interested him he attended by the simple expedient of donning a red sweatshirt.

“Techniques have certainly moved on in the last eight years, and not just rheological techniques. I was most impressed by the hologram of Professor McKinley in the first of the plenary lectures,” observed Holmes. “I could almost believe that he was real.” I too had been impressed by the computer-generated slides with inset videos, but I confess that I had assumed that the speaker had been with us in person.



Prof Gareth McKinley - “or is it?”

When the second plenary lecture by Professor Hinch entitled ‘Non-Newtonian Liquids are more than just Viscoelastic’ was announced, I felt Holmes tense beside me. “This is the lecture that the organisers have tried to suppress,” he hissed into my ear. “You will notice that they have censored it from the Proceedings; I suspect the influence of Moriarty.” I had indeed noticed the absence of that paper from the printed proceedings, but I had presumed that this was because of the pressure of other work or a simple oversight by the author. That there had been any skulduggery had been far from my mind. But

Holmes has an understanding of the workings of the criminal mind and so I paid especial attention to what Hinch said.

Certainly, the contents of the lecture were chilling. Explaining one of the greatest disasters of the last decade – the nightmare squashed fly graph showing the results of a round-Robin evaluation of elongational viscosity of a polymer solution – Professor Hinch announced that the reason for that debacle was that “It (meaning elongational viscosity) doesn’t exist”.



“If I had submitted my lecture to the Editor, the Proceedings would have been this thick” explains Prof John Hinch

The fact that he then went on to describe brilliant successes based on the balancing of shear and elongational flows caused a number of his audience to shift uncomfortably in their seats. Had this been the concern of my colleague?

“Not at all,” replied Holmes. “Professor Hinch had simply implied that, under the conditions of measurement, no equilibrium state had been achieved for that particular system. No, Watson, the problem was more fundamental than that. Do you recall when that distinguished academic said ‘You all know what happens when you hit Silly Putty with a hammer’?”

“Of course,” I responded. “He said: ‘it will bounce.’”

“Exactly so Watson,” agreed Holmes, “but, just as he said it, his delivery faltered, and I saw a shadow move in the wings of the lecture theatre. In short, as your friends of the Turf would say: ‘He was nobbled!’”

Noting my astonishment Holmes went on to explain: “We all know what really happens when you hit Silly Putty with a hammer: it shatters into a thousand pieces.”

Indeed, Holmes had once demonstrated this to the delight of my grandchildren, whom he had thoughtfully equipped with safety spectacles, and to the despair of Mrs Hutton, who undertook certain domestic maintenance on our behalf. The furore over the cleaning of the fragments from the carpet had nearly precipitated a crisis. Hearing her lamentations, Holmes had emerged from his study with a small frost-coated phial held in a pair of tongs. "Trouble yourself not, Mrs Hutton," he declared. "I shall simply pour a little liquid nitrogen on the spot and then it will easily brush out."

"You will do no such thing," responded the redoubtable Mrs Hutton. "Every night when Mr Hutton comes home from the pub, he goes out into the garden to give his prize leeks 'a drop of nitrogen', and I know exactly what that means. You shall most certainly not do the same indoors in broad daylight and in front of the children too. Why, I ought to call that nice Inspector Lestrade and have you arrested for even suggesting it!" Holmes retreated to his study and left Mrs Hutton to her soap and water; the mark remains to this day.

"Surely Holmes," I protested, "you are not suggesting that prominent academics should concern themselves with fracture processes in liquids. Where pray would be the elegant mathematics in that?"

"Since the classical work of Griffith, their solid state cousins have found no difficulty," responded Holmes. "Indeed, without the field of fracture mechanics, I suspect that the unemployment statistics amongst theoreticians would be substantially greater."

"Now Watson," he continued, "I must move behind the scenes to ensure that there is no further interference with the important business of the Congress. We shall meet again when we return to Yorkshire to compare our findings." So saying, the master of disguise melted into a sea of red sweatshirts. His movements for the rest of the conference were hard to follow; there were reports of someone answering to his description, attended by a flock of camera-bedecked oriental tourists, being pursued by college bulldogs after an impromptu cricket match had been organised on the lawn of St John's College.

I returned home to find that Holmes had preceded me. The kettle was boiling and my colleague was preparing muffins with freshly gathered blueberries. With such a welcome, I could not refuse his request to share my discoveries with him.

"As you expected, the area of 'morphorheology' is indeed prospering," I opined. "This is largely due to the development of techniques where you can

simultaneously watch structure development and measure rheological response. For example: Peters (1-304) and Wassner (1-183) showed fascinating studies of flow induced crystallisation. But the trouble with such a large meeting is that one cannot be in seven parallel sessions at once, so I did not give this subject the attention that it undoubtedly deserves.”

In respect of the issue of fracture behaviour in melts that had so interested my colleague, I had been impressed by the contributions of Chai (1-298), Bechtel (3-35), Maia (1-186 & 189), Rutgers (3-179) and especially the Weissenberg Medal Lecture by Laun (1-55). “Both ductile and brittle fracture mechanisms have been detected during extensional flows,” I told him: “ductile failure is associated with the classical Considère construction; brittle fracture occurs above a critical tensile stress of about 1MPa.”

Holmes nodded thoughtfully. “I congratulate you on a remarkably concise summary, Watson. I anticipate that your theoretical cousins will manage to complicate that picture in the next few years.”

“Surely,” I observed, “this is not the first occasion that such phenomena have been reported.”

“Maybe not,” agreed Holmes. “However, it is the first time that so many authors have said the same thing within so short a space of time; I especially expect that the gravitas and distinction of the Weissenberg Medal lecturer will ensure that such phenomena are taken seriously in future.”

Next, I enthusiastically related the latest results by Professor Wang (3-164) on the ‘spurt’ phenomenon in linear polyethylene melts and how it only occurred in that polymer because of the very high level of entanglement. Holmes listened patiently, but seemed unconvinced. “Did you observe the careful juxtaposition of the contributions of Robert (3-158) and Perez-Gonzalez (3-176) in the poster session?” he enquired. I acknowledged that I had indeed visited the densely packed poster sessions, where I had felt that the organisers might have been a little more generous in the space that they allotted to the contributors – if only to make breathing easier. “Did it not strike you as interesting that, in the contribution by Perez-Gonzalez, the shear stress level at the onset of the spurt phenomenon is virtually identical to the shear stress at which the capillary blocks – presumably due to stress-induced crystallisation - during low-temperature extrusion?” he continued. I had indeed remarked on this to Dr Perez-Gonzalez himself, but the author did not consider that to be anything other than a coincidence. Holmes looked quizzically at the data and then directed me to the paper by Robert. “I pray you Watson, look carefully at the velocity profile measurements shown in Figure 7 (3-160). Does it not occur to you that, during the so-called Branch 1 part of the flow curve,

approximately a quarter of the die cross section has been occluded, possibly by a static stress-crystallised layer?" This I had noticed, but the authors had assured me that they believed the observation to be an artefact caused by diffraction of the laser beam in the highly oriented molecules near the die surface. "Indeed!" snorted Holmes. "How curious that Münsterdt and his colleagues (1-251) do not see a similar anomaly in their measurements. I very much hope that this matter can be clarified – and that it proves not to be an artefact."

After a pause whilst we silently ate the freshly baked muffins, Holmes enquired: "Tell me, Watson, what did you make of the paper (3-143) by Hatzikarios entitled 'Gross Melt Fracture Elimination during the Extrusion of Polyolefines'?"

"Dashed unsporting!" I expostulated. "Do you know that the bounder said: 'If we cannot understand the phenomenon, we had better eliminate it.' He then showed how the addition of a very precisely defined amount of finely dispersed, non-agglomerating, non-adhering Boron Nitrate would eliminate all known flow defects. Just what does he suppose graduate students are to do for the next fifty years!"

"Remarkable," breathed Holmes. "Whilst I can see it being of inestimable value in a foamed product, surely the incorporation of so much free surface within the material is not without some disadvantage to the service performance?"

"No such details were given," I replied. "However, I was given to understand that the system has not been exploited commercially. That, at least, allows me to hope that we shall not be denied further discussion of such fascinating topics as the 'Mystery of the Mechanism of Sharkskin'."

"Ah yes," said Holmes pouring me another cup of Earl Grey tea. "I can see that you are bursting to relate the latest findings on that topic."

I needed no further encouragement. "There were indeed some truly astonishing results! For example: Santamaria (3-197) demonstrated a case where an extrudate with 'sharkskin' bifurcated after leaving the die with each branch having perfectly formed 'sharkskin'!"

"In respect of the mechanism for formation of this defect," I continued, "Wang (3-164) conclusively demonstrated that it is simply a case of incipient 'spurt'."

"But I thought that you said Wang had also showed why 'spurt' only occurred in very highly entangled melts like linear polyethylene," interrupted Holmes.

“Surely ‘sharkskin’ is seen in all manner of polymers. Does that not preclude his explanation?”

“Someone did ask him about that,” I replied, “but the Professor is determined that is not a problem, although I could not follow his explanation. He assured us that his explanation of ‘a periodically oscillating (between slip and partial slip) boundary condition at the exit wall’ is correct and that those who continue to believe that a true melt rupture occurs on the skin of the extrudate are ~~stu~~ misguided. Of course, not everyone was convinced. Shaw (3-170) reported a number of carefully designed experiments to verify the theories of Wang but was unable to substantiate it. He concluded: ‘Disturbances inside the die reflect the sharkskin outside. They do not initiate it.’ Perhaps the most convincing contribution from the supporters of ‘melt rupture of the extrudate skin’ came from Rutgers (3-179). From birefringence studies and analysis of the of the streamlines, she concluded that during flow with ‘sharkskin’ the extensional stress level about 50 microns below the surface of the extrudate reached 0.7Mpa, which she independently measured as the rupture stress for the melt with which she was working. Her analytical work also demonstrated that, in highly elastic melts, relaxation allowed the stress level at the exit to be reduced.”

“That is indeed a worthy piece of forensic science,” commented Holmes. “And what does she see for the future?”

“Ah yes,” I enthused. “Professor Rutgers soon expects to be able to explain why ordinary long chain branched Low Density Polyethylene does NOT show ‘sharkskin’.”

“That will undoubtedly be a great comfort to Howells and Benbow,” remarked Holmes. “I presume, Watson, that you now see why I was so interested in the recognition of the importance of brittle fracture in liquids. Perhaps at the next International Congress in Korea we shall hear that the phenomenon that, these days, is usually called ‘Gross Melt Fracture’ is due to rupture of the streamlines when the tensile stress in the converging flow region of the die exceeds the rupture strength of the melt.”

“J P Tordella!” I exclaimed, practically choking on my seventh muffin.

References:

- 1 “The Case of the Missing Industrialist, Part 2: the Waterloo Syndrome” Bulletin of the British Society of Rheology 35, 3, 80-83 (1992)
- 2 “The Mystery of the Mechanism of Sharkskin” Journal of Rheology 43 (1), 245-252 (1999)

J H Watson (Dr)

ANNOUNCEMENTS OF THE EUROPEAN SOCIETY OF RHEOLOGY (ESR)

THE WEISSENBERG AWARDEE OF THE YEAR 2000

Dr HANS MARTIN LAUN

Citation for the ESR Weissenberg Award given by Prof. Manfred H Wagner, Secretary of the ESR and President of the German Rheological Society (DRG) at the Opening Ceremony of the XIIIth International Congress on Rheology, Cambridge, United Kingdom, 21st August, 2000

“The creation of the Weissenberg Award was greeted by the rheological community of Europe with an especially warm welcome. This was no doubt due to the proud history of rheology in Europe, as evidenced from the namesake of the award: Karl Weissenberg has been a distinguished rheologist with not only European but world format, living at one time or another, in Austria, Germany, Britain and the Netherlands, thus embodying the rich, if at times difficult history of Europe in the last century.

Another reason no doubt has been the prominence of the first recipient of the award, Prof. Giuseppe (Pino) Marrucci, as is the prominence of the second recipient of the award: it is with great pleasure that I introduce to you the Weissenberg Awardee of the year 2000, Dr. Hans Martin Laun.

Hans Martin was born at Heilbronn, Germany, in 1944. As some other notable German rheologists, he studied physics at the University of Stuttgart, where he graduated in 1971 with a diploma thesis on “Dislocation movement in aluminium single crystals”. (Some might think that this is metal physics, but it is, of course, rheology to the best of its definition.)

Moving from metals to polymers, he finished his PhD in 1974 under the supervision of Prof. Pechhold at the University of Ulm with a thesis on the “Deformation behaviour of solid polyethylene during elongation”.

In the same year, as successor of Joachim Meissner, who was just leaving for the ETH in Zürich, he joined BASF AG in Ludwigshafen as rheology researcher in the polymer physics department. Within a few years, Hans Martin became one of the most prominent experimental polymer melt rheologists worldwide, certainly helped by the legacy left behind by Joachim of trained technicians and of, at the time, unique experimental devices, but mainly due to his ingenious and idiosyncratic approach to

rheology based on his insight into polymer physics. It was a time when the personal computer did not yet exist, and, as Hans Martin remarked at his plenary lecture on the occasion of the International Congress on Rheology in Brussels in 1992, "... a time, when experimental rheology was not yet impeded by software". His trust in commercial rheometers is rather limited, and he likes to remark with characteristic candidness: "Some people buy a rheometer, and think that they have bought a solution, but really, they have bought a problem." It is not necessary to reiterate his scientific achievements here; just open any polymer rheology textbook published after 1980, and you will find graphs taken from one of Hans Martin's many fundamental publications on elongational rheology, transient elastic strains in shear and elongation, rheology of concentrated suspensions, new experimental techniques like squeeze flow, to name just a few areas of his extensive research interests.



Dr Martin Laun receives the Weissenberg Medal
from the President of the ESR, Prof Ken Walters

7TH NEWSLETTER OF THE EUROPEAN SOCIETY OF RHEOLOGY

In 1981, Hans Martin Laun (together with Meissner, Münsterdt and Wagner) was awarded the Annual Award of the British Society of Rheology. He is Chairman of the Polymer Physics section of the German Physical Society (DPG), Chairman of the Rheology Group of the German Association of Engineers (VDI), Chairman of the IUPAC working party on Structure and Properties of Commercial Polymers. Dr. Laun was promoted several times at BASF, and in 1998 was made Scientific Director as one of only 4 in the BASF organisation.

As we shall see at his keynote lecture and during this conference, Hans Martin is a lucid lecturer and an expert questioner. Here we have again an Award winner at the very top of his profession, universally respected and admired, a man of warmth, charm and character.

My sincere congratulations to Dr. Hans Martin Laun and his crew!"



Dr Laun receives the citation for the Weissenberg Medal from the President Elect of the ESR, Prof Jean-Michel Piau

Prof Manfred Wagner
August 2000

**THE 3RD INTERNATIONAL CONFERENCE OF THE
HELLENIC SOCIETY OF RHEOLOGY (HSR)
PATRAS, GREECE, JUNE 10-14, 2001**

The meeting is open to all scientists and engineers conducting research or being interested in the fields of RHEOLOGY and FLUID MECHANICS.

Topics include:

- polymer melts and solutions
- structure and dynamics of polymers
- colloids and suspensions
- molecular modelling and numerical simulations
- experimental, theoretical and computational fluid dynamics

The program will consist of plenary lectures, invited lectures, and oral contributions. Also, a special session will be dedicated to Professor Andreas Acrivos on the occasion of his retirement from the Levich Institute.

A number of prominent rheologists and fluid mechanicians from around the world have also accepted to participate in the Meeting, as “surprise” invited lectures, honouring Prof. Acrivos.

For more information, please visit the web page of the Hellenic Society of Rheology and of the Meeting:

<http://esperia.iesl.forth.gr/~hsr/HSR.html>

With our very best regards,

Vlasis Mavrantzas
(Chairman of the Organising Committee)

John Tsamopoulos
(Chairman of the Scientific Committee)

7TH EUROPEAN SCHOOL OF RHEOLOGY

SEPTEMBER 10-14, 2001

organised by the
European Society of Rheology and
the Belgian Group of Rheology

A short course on

RHEOLOGICAL MEASUREMENTS

APPLICATION TO POLYMERS, SUSPENSIONS AND PROCESSING

hosted for the 4th time by the K.U. Leuven, Department of Chemical Engineering

AIM

The aim of the course is to give practising engineers and chemists, as well as young PhD students an understanding of

- the fundamentals of rheology
- principles of rheological measurements
- applications to problem solving

FACULTY

Prof. G.G. Fuller, Stanford University

Prof. R. Keunings, University Catholique de Louvain

Prof. C.W. Macosko, University of Minnesota

Prof. G. Marrucci, University of Naples,

Prof. H.E.H. Meijer, T.U. Eindhoven,

Prof. J. Mewis, K.U. Leuven,

Prof. P. Moldenaers, K.U. Leuven,

Prof. J. Vermant, K.U. Leuven

For more information on the course or to request a detailed program brochure, check the web page at:

<http://www.cit.kuleuven.ac.be/cit/ltrk/course.html>

or contact Peter Van Puyvelde

peter.vanpuyvelde@cit.kuleuven.ac.be

**SUMMER SCHOOL ON
"ANALYTICAL AND NUMERICAL METHODS IN NON-
NEWTONIAN FLUID MECHANICS"
25-29 JUNE, 2001
UNIVERSITY OF MINHO, GUIMARAES, PORTUGAL**

OBJECTIVES

The University of Minho and the University of Wales Institute of Non-Newtonian Fluid Mechanics are organising a Summer School with the aim to interest young researchers into the field of Rheology and Non-Newtonian Fluid Mechanics by helping to bridge the gap between the available theoretical tools and the existing problems of a mathematical nature in industry and academia.

LECTURERS AND LECTURE FORMAT

K. Walters, University of Wales

A. R. Davies, University of Wales

M. H. Wagner, Technical University of Berlin

G. Marrucci, University of Naples

R. Keunings, Catholic University of Louvain

F. P. T. Baaijens, University of Eindhoven

The School will take place in the Azurem Campus of the University of Minho and will consist in morning and afternoon lectures, with some time allotted for the discussion of subjects of particular interest to the audience.

INFORMATION

For more information on the course, please check the web page at:

<http://www.ecum.uminho.pt/SummerSchool>

or contact the Secretariat at

s.school@ecum.uminho.pt

**GOLDEN JUBILEE MEETING OF THE
GERMAN SOCIETY OF RHEOLOGY (DRG)
14-16th MAY 2001**

On-line registration for the Golden Jubilee Meeting of the DRG,

Berlin, May 14 to 16, 2001,

is now available at

http://www.bam.de/partner/drq/anm_form.html

The programme will include plenary lectures by H. Rehage (Essen), H. Münstedt (Erlangen-Nürnberg), M. Modigell (Aachen), and E. Windhab (Zürich), contributed papers, poster sessions, an exhibition, and a jubilee banquet.

The conference language will be German; contributions in other European languages are welcome.

A number of travel grants for Ph D students presenting papers are available; for details on how to apply see

http://www.bam.de/partner/drq/ank_2001.html

BGR

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Prof. P. Moldenaers (KUL)

Prof. R. Jérôme (Ulg)

Dr. F. Ruttens (Agfa Gevaert)

<http://www.kuleuven.ac.be/cit/ltrk/bgr.html>

Report of the annual Meeting of the BGR :
Louvain-la-Neuve, Dec.2000

The annual meeting of the Belgian Group of Rheology (BGR) took place CESAME Research centre, Louvain-la-Neuve, on December 8th, 2000. Its main theme was advances in theoretical and applied rheology. After registration and coffee there was a short welcome by Prof. R. Keunings, President of the BGR. Sachin Velankar (KU Leuven) had the honour of starting the day with his lecture “Rheology and Structure of Model Compatibilized Blends” and he immediately set the tone of the day: very well presented and cutting-edge science. Christophe de la Chapelle (Un. P&M Curie - Paris 6) initiated us into the secrets of “Non-Linear Viscoelastic Measurements on Complex Polymer Systems”. Adrien Leygue (UCL) closed the morning session with a gripping tale about “Constitutive Equations for Linear Melts Inspired by Reptation Theory and Non-Equilibrium Dynamics”: very difficult subject matter but made understandable by Mr. Leygue.

After an appetite-inducing walk through the lovely, lively and inviting town of Louvain-la-Neuve, it was time for lunch. To make sure that everybody stayed awake after such a sumptuous meal, there was another walk through the university, which was celebrating its 575th birthday.

The afternoon session started again with a high point, the keynote lecture by Prof. Tom McLeish (IRC, Univ. Leeds): Vortices, Fangs and Swell: Simulation of Molecular effects in Bulk Polymer Rheology. During the ensuing coffee break a poster session was held.

BGR

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The topics varied from “Numerical Simulation of Twin-Screw Extruders” to “Flow Induced Morphology in Immiscible Blends: from Simple Flow Fields towards Processing Flows”. Thomas Jansseune (KU Leuven) enthralled us with “Rheological Behavior of Immiscible Polymer Blends with Newtonian Components: Prediction of Component and Interfacial Contributions”. Atalik Kunt (UCL) concluded the day with a not to be missed and scientifically intriguing lecture: “A Temporal Nonlinear Stability Analysis for Viscoelastic Plane Shear Flows”.

Report prepared by Filip Oosterlinck, KU Leuven, winner of the best poster award

Upcoming activities:

- The KU Leuven will host the 7th European School of rheology in September 2001 . More information can be obtained through the BGR website. Dr. Peter Van Puyvelde is in charge of the practical organisation.
- In November 2001, the BGR will organize a joint meeting with the Dutch Society of Rheology (NRV). The meeting will be held at Solvay, Neder-Over-Heembeek, close to the Brussels airport.. The topic of the meeting will be “Advances in polymer rheology”. More information will be made available through the BGR website.
- An annual meeting of the BGR will be organized in spring 2002. The topic of the meeting will be aimed at gathering a strong participation from industry. It will be “Rheology as a characterization tool” and will be hosted at Shell-Research in Louvain-la-Neuve.



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GERMAN SOCIETY OF RHEOLOGY (DRG)

The Golden Jubilee Meeting of the German Society of Rheology (DRG) will take place from May 14 to 16, 2001, at the Bundesanstalt fuer Materialprüfung (BAM), Berlin, where the DRG was founded in 1951. The DRG is the fourth-oldest rheological society (after SoR, BSR, and NRV).

The programme will include plenary lectures with historical reflections on experimental and theoretical aspects of rheology, contributed papers, an exhibition, and a jubilee banquet.

M.H. Wagner



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The 3rd International Meeting of the HSR is going to be held in Patras, Greece, June 10-14, 2001.

This meeting is dedicated to Professor Andreas Acrivos on the occasion of his retirement from the Levich Institute and CUNY.

For information please contact:

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GROUPE FRANÇAIS DE RHEOLOGIE (GFR)

35th annual general meeting of the French Group of Rheology (GFR)

This meeting took place in Grenoble on October 23rd during the Conference “Rheology and Innovation”

Pr Patrice Flaud has been reelected President and two Vice Presidents have been elected : Pr Jean-Louis Grossiord and Dr Jean-Luc Moranzaïs representing l’Oréal company.

Francesco Chinesta was appointed new Treasurer of the GFR, while Jean-Louis Doublier and Jacques Bouton were confirmed in their respective functions of General Secretary and International Delegate.

More information on the new board of the GFR and on our activities can be obtained from our internet site: <http://www.univ-lemans.fr/sciences/wgfr>.

36th annual GFR Conference: «Rhéologie : génie civil et environnement»

This next GFR annual conference will be held in Marne-la-Vallée 10-12 October 2001. It will be organised in association with the Canadian Group of Rheology. Any further information can be obtained from: e-mail: philippe.coussot@lcpc.fr
Web: <http://www.enpc.fr/GFR2001>

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Jacques BOUTON
GFR International Delegate



2000
35ème Colloque Annuel du
Groupe Français de Rhéologie

« Rhéologie et Innovation »
Grenoble
23-25 Octobre 2000

Président:

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Compte Rendu

Le 35ème colloque du Groupe Français de Rhéologie s'est tenu à Grenoble du 23 au 25 Octobre 2000. Il a été organisé par le Laboratoire de Rhéologie, en concertation avec les sociétés Grecque et Italienne de rhéologie, autour du thème « Rhéologie et Innovation ». Cette manifestation a regroupé 156 participants, représentant les communautés scientifiques de 6 pays différents. 57 communications, orales et par voie d'affiches, ont été présentées. Les conférences invitées ont été l'occasion de faire le point sur les développements récents et de discuter les enjeux scientifiques futurs, à travers la vision qu'en ont des chercheurs réputés du monde académique et des industriels.

Jean-Michel PIAU, actuel Président de la société Européenne de Rhéologie a assuré l'ouverture du colloque à travers une conférence intitulée « Quels sont nos moteurs? », à nous autres rhéologues. Giuseppe MARRUCCI, de l'Université de Naples, nous a parlé de théorie en rhéologie en présentant des lois de comportement basées sur des modèles moléculaires. Evan MITSOULIS, de l'Université d'Athènes a donné une conférence intitulée « Recent advances in the numerical simulation of polymer



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processing ». Côté français, Martine MEIRELES, chercheur CNRS à Toulouse a présenté une conférence sur la mise en œuvre et l'élaboration de matériaux naturels dans des opérations de filtration. Fabrice TOUSSAINT de la société Lafarge Coppé, nous a présenté un point de vue industriel sur les apports et les limites des systèmes modèles, illustré par l'exemple des matériaux granulaires industriels. Les grands instruments, un point fort de la recherche à Grenoble, étaient également représentés. Peter LINDNER, de l'Institut Laue Langevin, a montré à travers de nombreux exemples, les avancées remarquables que permet la diffusion de neutrons aux petits angles, appliquée notamment aux fluides complexes sous cisaillement.

Tout au long des trois jours, l'ensemble des conférences a permis de couvrir les thématiques Procédés, Systèmes Dispersés, Matériaux Naturels, Grands Instruments et Techniques Nouvelles, Lois de comportement et Simulation. Ce colloque a ainsi été une vitrine des pratiques et des innovations en rhéologie. Il a de plus favorisé les échanges entre des communautés scientifiques d'horizons variés, durant les conférences bien sûr mais également pendant les pauses café et les pauses déjeuner.

Mardi après-midi, 70 personnes ont participé à la traversée des paysages du Vercors en automne et à la visite des grottes de Choranche qui s'est achevée par un son et lumière. Le soir même, le banquet a réuni 110 personnes au Château de la Commanderie. A cette



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occasion, le Groupe Français de Rhéologie, à travers son Président Patrice FLAUD, a désigné ses lauréats. Georges BOSSIS, directeur de recherche au CNRS, de l'université de Nice – Sophia Antipolis, s'est vu décerné le Grand prix du GFR pour ses travaux en électrorhéologie. Le prix de thèse a récompensé Arnaud Rollé, pour ses travaux sur le comportement thermo-mécanique de préparations concentrées d'amidons au laboratoire Ingénierie Moléculaire et Sensorielle de l'Aliment sous la direction du Professeur Martine Le Meste de l'université de Bourgogne.

Mercredi, outre les conférences scientifiques, le site internet du GFR (<http://www.univ-lemans.fr/sciences/wgfr>) a été présenté par Jean-François TASSIN de l'université du Maine.

Le colloque a été clôturé vers 17h et nous avons été invités à participer au 36ème colloque du GFR, qui se déroulera à Marne la Vallée, du 10 au 12 octobre 2001, autour du thème « Rhéologie : génie civil et environnement ».

En conclusion, les organisateurs veulent encore une fois exprimer leurs remerciements sincères aux conférenciers, aux exposants, aux participants, aux sponsors, ainsi qu'à tous les membres du Laboratoire de Rhéologie qui se sont mobilisés pour que le 35ème colloque du GFR se déroule avec succès.

Nadia El Kissi

Chercheur CNRS

Laboratoire de Rhéologie - Grenoble.



2000
35th Annual Meeting of
Groupe Français de Rhéologie

Rheology and Innovation
Grenoble
23-25 October 2000

Conference Report

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<http://www.univ-lemans.fr/sciences/wqfr>

The 35th conference of the French Group of Rheology was held in Grenoble from 23 to 25 of October 2000. It was organized by the « Laboratoire de Rheologie », in association with the Hellenic and the Italian societies of rheology. The meeting was open to all aspects of rheology under the topic « Rheology and Innovation ». This conference gathered 156 participants, representing the scientific communities of 6 different countries. 57 papers were presented. 6 Keynote papers were the occasion to give a progress report on the recent developments and to discuss the future scientific stakes, through the vision that have respected specialists from academia and industry.

The conference was launched by the first plenary lecture given by Professor Jean-Michel PIAU, current President of the European Society of Rheology, with a title of, « Quels sont nos moteurs? ». Professor Giuseppe MARRUCCI (Università di Napoli) gave a lecture about theory in rheology by presenting constitutive equations based on molecular models. Recent advances in the numerical simulation of polymer processing were described by Professor Evan MITSOULIS (University of



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Athens). Doctor Martine MEIRELES (CNRS, Toulouse) introduced the session devoted to dispersed systems through a conference dealing with elaboration and processing of natural materials in filtration. Fabrice TOUSSAINT (Society Lafarge Coppé), presented to all participants an industrial point of view on the contributions and the limits of model systems, illustrated by the example of industrial granular materials. The large instruments, an important field of research in Grenoble, were also represented. Peter LINDNER (Institut Laue Langevin), showed through many examples, the remarkable projections and advances allowed by small angle neutron scattering, applied in particular to complex fluids under shear.

Throughout the three days, papers were split to make 5 sessions, including « Processes », « Constitutive equations and simulation », « Large instruments and new techniques », « Dispersed systems », and « Natural materials ». This conference was thus a window of the practices and innovations in the field of rheology. It allowed for covering subjects of fundamental as well as technical interest. It also supported the exchanges between scientific communities of any edge, during the conferences of course but also during the coffee breaks and daily over lunch.

Tuesday afternoon, 70 people took part in the crossing of the landscapes of Vercors in autumn and in the visit of the « Grottes de Choranche » which was completed by a pleasant « sound and light ». On the evening, the banquet



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brought together 110 people at the « Château de la Commanderie ». During this banquet, the GFR's award for 2000 was presented by Professor Patrice FLAUD, current President of the GFR, to Professor Georges BOSSIS, of the university of Nice, for his work in the field of electrorheology. Professor Patrice FLAUD also presented « Le prix de Thèse » to Arnaud ROLLE, for the work he achieved during his PhD with Professor Martine LE MESTE (Université de Bourgogne).

Wednesday, in addition to the scientific conferences, the web site of the GFR (<http://www.univ-lemans.fr/sciences/wgfr>) was presented by Professor Jean-François TASSIN (Université du Maine).

The conference then closed around 5 p.m. with the invitation to join the 36th conference of the GFR, which will be held in « Marne la Vallée », from 10 to 12 October 2001, under the topic " Rheology: civil engineering and environment ".

Finally, the organisers would like to gratefully acknowledge the efforts of lecturers, exhibitors, participants, sponsors, as well as Laboratory staff who were mobilised so that the 35th conference of the GFR is held successfully.

Nadia El Kissi

Chercheur CNRS

Laboratoire de Rhéologie - Grenoble.

BSR ANNOUNCEMENTS

<http://www.bsr.org.uk/> and <http://www.rheology.org.uk/>

THE INSTITUTE OF NON-NEWTONIAN FLUID MECHANICS

THE BRITISH SOCIETY OF RHEOLOGY

INDUSTRIAL FOOD PROCESSING: EXPERIMENTS AND NUMERICAL SIMULATION

**A CONFERENCE TO BE HELD AT THE UNIVERSITY OF
PLYMOUTH, UK**

9th – 11th APRIL 2001



Local Organising Committee

Prof. T. E. R. Jones
Dr P. W. James
Dr J. M. Davies
Dr C. Brennan
Dr J. Summerscales

Scientific Committee

Dr. P. Sadd (RHM)
Mr G. Tucker (CCFRA)
Prof. M. F. Webster (University of Swansea)
Dr. P. R. Williams (University of Swansea)
Dr P. W. James (University of Plymouth)
Prof. T. E. R. Jones (University of Plymouth)

PROGRAMME

Monday 9th April

12.00 – 1400 Registration and Buffet Lunch

RHEOLOGICAL CHALLENGES

14.15 H A BARNES

"An overview of food rheology"

14.40 I D ROBERTS

"Industrial perspectives on rheological problems in food processing"

15.05 A S BURBIDGE

"Modelling the rheology of highly concentrated food systems"

15.30 – 16.00 Tea & Coffee

SQUEEZE FILM FLOW

16.00 D R OLIVER

"The compression of foods between circular parallel discs"

16.25 N M YATES, M BARIGOU, P J FRYER & S MOORE

"Squeeze flow rheometry of semi-solid food materials"

18.15 Bus leaves Copthorne Hotel for National Marine Aquarium and Evening Meal

Tuesday 10th April

FLOW MODELLING

9.00 P SADD

"Technical challenges in dough mixing"

9.25 D M BINDING & M R COUCH

"On the peeling of doughs from solid surfaces"

9.50 M F WEBSTER, A BALOCH, D DING & K S SUJATHA

"On the modelling of dough mixing flows"

10.15 T AVALOSSE, B ALSTEENS & Y RUBIN

"Numerical analysis for the design of a food mixer"

10.40 – 11.15 Tea & Coffee

HEAT AND FLOW MODELLING

11.15 A R DAVIES

"Some case studies in the mathematical modelling of food"

11.40 C DUCHANOY & T JONGEN

"Detailed modelling of liquid/solid flows with applications to food processing"

12.05 U BOLMSTED

"Heat transfer and flow behaviour modelling in heat exchangers"

12.30 – 13.45 Lunch

IN-CONTAINER PROCESSING

13.45 G TUCKER

"Using the rheology of foods to optimise thermal processing"

14.10 M VANDENBERGHE

"Agitation in axially rotated cans"

14.35 J HUGHES, T E R JONES & P W JAMES

"Simulations of in-container mixing processes in axial and end over end rotations"

15.00 – 15.30 Tea & Coffee

FOOD BIOPOLYMERS AND RHEOLOGY

15.30 C J CARRIERE & G E INGLETT

"Constitutive analysis of the non-linear rheological behaviour of cellulosic fibre gels"

15.55 G BROWNSEY

"Food Rheology -A view from the bulk to the interface"

16.20 G BRENNAN

"Rennet coagulation and curd rheology of milk products with fibre additions"

18.45 Bus leaves Copthorne Hotel for Conference Dinner (sponsored by TA Instruments Ltd) at St Mellion Golf and Country Club.

Wednesday 11th April

RHEOMETRY

9.00 C F SHOEMAKER

"Rheological characterization of food dispersions with an on-line rheometer"

9.25 P R WILLIAMS, R LI WILLIAMS, R JONES, A AI-HUSSANY & S RAVJI

"New rheometry for sol-gel characterisation-mechanical measurements and fractal characteristics"

9.50 C O'DONNELL

"Evaluation of process viscometry systems for food process applications"

10.15 C SERVAIS

"The food rheologist's need for new rheometry"

10.40 – 11.15 Tea & Coffee

FOOD PRODUCT RHEOLOGY

11.15 M LESER

"Rheology of cubic phase systems"

11.40 C GALLEGOS, C VALENCIA, M C SANCHEZ & A CIRUELOS

"Rheology and processing of tomato products"

12.05 I M AFONSO, L MELO & J M MAIA

"Rheological and thermal behaviour of stirred yoghurt during manufacturing"

12.30 – 13.45 Lunch

END OF CONFERENCE

**INDUSTRIAL FOOD PROCESSING:
EXPERIMENTS AND NUMERICAL SIMULATIONS**

**REGISTRATION FORM
(This form may be photocopied)**

**I wish to attend the Conference at the University of Plymouth
from 9th – 11th April, 2001.**

The cost of the conference will be £340 payable by February 1st 2001. The fee includes accommodation at the Copthorne Hotel, located very close to the conference venue. Accompanying persons may share rooms free of charge but meals taken must be paid for separately. The fee also includes all meals, a visit to the National Marine Aquarium and the conference dinner.

Payment of the Registration fee may be made by one of the following methods.

By cheque made payable to the University of Plymouth.

By telegraphic transfer, with costs being paid by the remitter, to Midland Bank, City Centre Branch, Plymouth, U.K., to the credit of account No 61485946 (Bank Code 40-36-22). Please quote reference conf. 81291.

Further information may be obtained from Professor T.E.R. Jones, Department of Mathematics and Statistics, University of Plymouth, Drake Circus, Plymouth, PL4 8AA, UK

(Tel: 01752 232735, email: ejones@plymouth.ac.uk).

Signed _____

Name _____

Address _____

Please return this form and cheque (if applicable) to:

**Professor T. E. R. Jones
Department of Mathematics and Statistics
University of Plymouth
Drake Circus
Plymouth PL4 8AA
Devon, UK**

OTHER ANNOUNCEMENTS

3RD PACIFIC RIM CONFERENCE ON RHEOLOGY

VANCOUVER, BC, CANADA, JULY 8-13, 2001

After two successful events in Kyoto, Japan, and Melbourne, Australia, the Pacific Rim Conference on Rheology is moving to Vancouver for its 3rd meeting. This will take place at the Westin Bayshore Hotel (downtown Vancouver) in July 8-13, 2001. The Conference is sponsored by the Canadian Rheology Group and it is aimed in continuing the tradition of the international conferences on rheology.

CONFERENCE COMMITTEE

Prof John M Dealy (McGill University): Prof Jeffrey Giacomini (University of Wisconsin): Prof Savvas G Hatzikiriakos (The University of British Columbia): Prof David James (The University of Toronto): Prof Daniel Klingenberg (University Of Wisconsin): Prof Gareth McKinley (MIT): Prof Evan Mitsoulis (National technical University of Athens): Prof Anoush Poursartip (The University of British Columbia): Prof Alexandro Rey (McGill University): Prof Eric Shaqfeh (Stanford University): Prof U.T. Sundararaj (The University of Alberta): Prof Kostas Tzoganakis (The University of Waterloo): Prof John Vlachopoulos (McMaster University): Prof Paula Wood-Adams (McGill University)

INTERNATIONAL ADVISORY BOARD

Prof Pierre Carreau: Dr Chi-Ming Chan: Dr Ian Dagley: Prof Morton M Denn: Prof Geoff G Duffy: Prof Ti-Qian Jiang: Prof Jae Chun Hyun: Prof Ta-Jo Liu: Prof R A Mashelkar: Prof Toshiro Masuda: Prof Baltasar Mena: Prof Chi Tien: Prof Ken Walters, FRS

TOPICS

Applied Polymer Rheology with Applications to Polymer Processing: Rheology and Thermodynamics of Polymer Blends and Composites: Extensional Polymer Melt and Solution Rheology: Rheology of Metallocene Polyolefins: Flow Instabilities – Melt Fracture-Wall Slip and Related Phenomena: New Experimental Rheological Techniques: Modeling of Polymer Flows and Numerical Simulations: Rheology of Complex Fluids: Rheology of Suspensions, Emulsions and Colloids: Biorheology

INVITED SPEAKERS

Tanner R - History of Rheology: Vlassopoulos D - Rheology and Thermodynamics of Polymer Blends: Munstead H - Extensional Melt Rheology: Denn MM - Melt Fracture and Wall Slip Instabilities: Goldsmith – Biorheology: Watanabe H - Rheology of Complex Fluids: Boger D – Suspensions: Lee SJ - Polymer Processing: Hasegawa T - Polymer Solutions

ORGANIZED BY

The Canadian Rheology Group
and The University of British Columbia

FOR MORE INFO PLEASE VISIT: www.prcr3.com

BSR MEMBERSHIP NEWS

OBITUARY

Dr William H. Banks, a society member since 1940, and latterly an honorary member, passed away in November 1999 aged 89.

We are advised by his son that Dr Banks had maintained his interest in rheology long after his retirement. Indeed he had been in the process of gathering material for a theoretical paper on pastes and emulsions as lubricants until shortly before his death.

AIMS OF THE SOCIETY

The way liquids flow and solids deform affects all aspects of life.

Extraction and processing of crude oil, moulding of plastics, use of toothpaste, spreading of margarine, painting and the lubrication of joints in the human body are all examples of processes depending upon rheological behaviour. Rheology is defined as the science of the deformation and flow of matter.

If your work is concerned with rheology in any way, then you have much to gain by joining the British Society of Rheology - publications, conferences and access to fellow members who, while working in a different discipline or industry, may be facing similar problems to yours.

The Society is non-profit making and is registered as a charity.

RECRUITMENT OPPORTUNITIES

(other opportunities may be found at
<http://www.ncl.ac.uk/rheology/jobs/index.html>)

PhD studentship with Nestlé in Extrusion Modelling

JOB POSITION :

Nestlé, the World Food Company, offers an attractive and dynamic international working environment with constant opportunities. The Nestlé Product Technology Centre in Orbe, Switzerland is looking for a student to undertake a 3-year project in the area of food extrusion modelling towards a PhD.

PROJECT DESCRIPTION :

Extrusion cooking is used in the food industry for producing crunchy, porous products with a wide variety of forms and textures. It involves a complex interaction of thermal, chemical and rheological properties, which is why many trials are often required when developing a new product.

Computer modelling provides a promising approach for speeding up this development and it will be the task of the student to develop a model of die extrusion including the necessary physics, such as the vapour expansion, in the framework of an existing CFD code. Throughout the project the successful candidate will gain valuable experience working with an industrial research team in addition to receiving academic supervision.

EDUCATION AND EXPERIENCE REQUIRED :

To meet this challenge the successful candidate will need a strong background in fluid mechanics and rheology, transport phenomena, numerical methods and programming (Fortran, C or Pascal on PC and Unix workstations) with a good diploma/degree in either Mechanical/Chemical Engineering, Applied Mathematics, Physics or a related field.

LANGUAGES NEEDED :

English and if possible French

OTHER SKILLS REQUIRED :

Ability to work well in a multidisciplinary team environment, problem solving and strong writing, presentation and communication skills.

DATE NEEDED : As soon as possible**CONTACT :**

Please send your application with CV to:

Laurent Tornare
Human Resources
Nestlé Product Technology Centre Orbe
NESTEC Ltd CH-1350 ORBE
Switzerland
Phone: +41 24 442 7286
Email: laurent.tornare@rdor.nestle.com

INDUSTRY NEWS

Rheometric Scientific, Inc. Forms A Strategic Alliance To Market All Of Camtel Ltd's Instruments And To Secure An Exclusive Option To Acquire The Company In The Future.

PISCATAWAY, NJ-January 25, 2001 - Rheometric Scientific, Inc., Piscataway, NJ (RSI) (OTC:RHEM) announced today that it has signed an exclusive agreement to form a strategic alliance with Camtel Ltd. (CL) to be the sole marketer and distributor for all Camtel Ltd. instruments. In addition, under the terms of the agreement, Rheometric Scientific, Inc. has an exclusive option to acquire all the shares of Camtel Ltd. for the next 15 months for cash and shares of Rheometric common stock.

CL based in Royston, UK and established in 1993, is a leading manufacturer of Interfacial Rheology and Contact Angle Tensiometry instrumentation, software and services. CL is also a recognised leader in the application of these techniques. CL's products are based on a proprietary technology for which CL has an application exclusive license.

CL's interfacial rheology technology measures the stability of foams and emulsions. Interfacial tension and contact angle provides sophisticated information on the wetting properties of a liquid and its ability to adhere to a solid. Potential customers cover many fields from food, cosmetics, paints, pharmaceuticals, inks, household and personal care products.

Manfred Herzog, Managing Director of Rheometric's European operations stated: "The alliance with Camtel Ltd. enables Rheometric to broaden its product range to embrace one of the newest technologies in the rheology field, in a matter of months".

Carole Moules, Managing Director of Camtel Ltd., stated: "CL looks forward to the new opportunities presented through its alliance with Rheometric. Rheometric's 30-year presence in the physical properties and material characterization instrumentation marketplace plus its worldwide infrastructure will permit us to better serve our customers with existing and new products and comprehensive technical support."

Sources from the company indicated that this strategic alliance extends RSI's physical property measurement capability beyond rheology, viscosity and thermal analyses into new instrumentation areas in the material characterization market place.

Details of the transaction (which is not material for financial reporting purposes) and financial information relating to Camtel Ltd., which is a privately held company, were not disclosed. The Boards of Directors of both

companies have approved this exclusive alliance and the future option to acquire Camtel Ltd.

Rheometric Scientific, founded in 1970, manufactures instrumentation and provides laboratory services for material characterization. The Company's products and services are sold to numerous markets such as the petrochemical industry, academic and government research laboratories, and the food, pharmaceutical, biotechnology, and semiconductor industries worldwide. The Company is headquartered in Piscataway, New Jersey and has operations in the United Kingdom, Germany, France, Italy and Japan. More information about Rheometric Scientific can be found on the World Wide Web at www.rheosci.com; information about Camtel Ltd. can be found at www.camtel.co.uk.

New User Friendly Rheometer From Brookfield

Brookfield Engineering, the world leading in Rheometer and Viscometer instrumentation, introduces the R/S Rheometer for rheological evaluation of materials through the direct measurement of viscosity, yield stress, and thixotropic response.

Designed to provide controlled stress and shear rate analysis at an affordable price, the R/S Rheometer is available with cone/plate, plate/plate or coaxial cylinder measurement geometry. Powerful flow characterisation tools include shear ramp, loop, and single point testing.

Specifically engineered to accommodate the high throughput required in quality control laboratories, the R/S Rheometer also offers sophisticated flexibility for research environments.

Effective for a wide range of applications - from petrochemicals, food products, and polymers to cosmetics, coatings, and chemicals - the R/S Rheometer from Brookfield features rapid spindle attachment and easy cleaning. The user-friendly keypad allows simple stand-alone operation while the PC interface provides user-defined remote control operation. Brookfield's Rheo 2000 Analysis Software enhances the utility of the R/S Rheometer through rapid PC control and data analysis.

"The Brookfield R/S Rheometer brings precision viscosity measurement to the laboratory at a very affordable price", said Robert G. McGregor, Sales and Marketing Manager. "With simple operation, choice of measurement geometries and stand-alone or PC controlled operation, the R/S Rheometer is a viable choice for labs around the world."

CONFERENCES

You are also advised to visit the BSR home pages where an extensive list of conferences is maintained by Chris Petrie: <http://www.bsr.org.uk/>

2001	
2-3 Apr Bristol GB	STRUCTURE AND DYNAMICS IN SHEAR FIELDS Organised on behalf of the Colloid & Interface Science group of The Royal Society of Chemistry Dr I D Robb, North East Wales Institute, Mold Rd, Wrexham, UK T: +44 (0)1978 293133 F: +44 (0)1978 290008
9-11 Apr Plymouth GB	INDUSTRIAL FOOD PROCESSING: EXPERIMENTS AND NUMERICAL SIMULATION Organised by The Institute of Non-Newtonian Fluid Mechanics and The British Society of Rheology Professor T. E. R. Jones, Department of Mathematics and Statistics, University of Plymouth, Drake Circus, Plymouth PL4 8AA, Devon, UK T: 01752 232735 E: ejones@plymouth.ac.uk Info: http://www.ncl.ac.uk/rheology/conferences/plym_apr01
22-25 Apr Sofia BG	BALKAN SEMINAR ON RHEOLOGY AND IXTH NATIONAL RHEOLOGY WORKSHOP Contact: Prof Ya Ivanov or R Kostilkova E: balkan_rheology@eudoramail.com Info: http://www.ncl.ac.uk/rheology/conferences/Bulgar9.html
23-25 Apr Liege BE	4TH INTERNATIONAL ESAFORM CONFERENCE ON MATERIAL FORMING – SYMPOSIUM ON DIE EXTRUSION SIMULATION AND OPTIMISATION Contact: Colette Verbist, Dept MSM, Université de Liège E: Colette.Verbist@ulg.ac.be Info: http://www.msm.ulg.ac.be/esaform/esaform.html
26-27 Apr Shawbury GB	POLYMER RHEOLOGY '01 – A PRACTICAL APPROACH TO QUALITY CONTROL FOR THE RUBBER AND PLASTICS INDUSTRIES Contact: Sharon Garrington, RAPRA. E: sgarrington@rapra.net
9-11 May Freiburg DE	2ND WORKSHOP ON INVERSE PROBLEMS IN RHEOLOGY AND RELATED EXPERIMENTAL TECHNIQUES. Participation in Benchmark tests on MWD determination and estimation of relaxation time spectrum Contact: chf@fmf.uni-freiburg.de

2001	
9-11 May Le Mans FR	8TH INTERNATIONAL SEMINAR ON ELASTOMERS Themes: Chemistry, Surface & Interfaces, Rheology, Natural Rubber. Rheological co-ordinator: Prof J L Leblanc. Secretariat: Luce Clayton T: +33 (0)2 43 39 46 44 F: +33(0)2 43 39 46 47 E: lclayton@cttm-lemans.com
13-16 May Minneapolis, MN US	FOOD STRUCTURE & FUNCTIONALITY SYMPOSIUM 2001 Contact: Dr Marcel Paques, Ede, The Netherlands E: paques@nizo.nl Info: http://www.ncl.ac.uk/rheology/conferences/food2001
14-16 May Berlin DE	GOLDEN JUBILEE MEETING OF THE DEUTSCHEN RHEOLOGISCHEN GESELLSCHAFT (DRG) Info: http://www.bam.de/partner/drq/anm_form.html E: drq@bam.de
10-14 Jun Patras GR	3RD INTERNATIONAL MEETING OF THE HELLENIC SOCIETY OF RHEOLOGY Dedicated to the retirement of Prof Andreas Acrivos Info: esperia.iesl.forth.gr/~hsr/hsr.html
8-13 Jul Vancouver, BC CA	3RD PACIFIC RIM CONFERENCE ON RHEOLOGY Organised by The Canadian Rheology Group and The University of British Columbia Info: www.prcr3.com
9-13 Jul Nice FR	EIGHTH INTERNATIONAL CONFERENCE ON ELECTORHEOLOGICAL FLUID AND MAGNETORHEOLOGICAL SUSPENSIONS Organised by The University of Nice-Sophia-Antipolis. Contact: G Bossis E: Bossis@unice.fr Info: http://www.unice.fr/ERMR2001/
16-19 Jul Edinburgh GB	CALCIUM ALUMINATE CEMENTS (CAC) Organised by IOM Communications Ltd on behalf of The Institute of Materials. Technical Enquiries: Raman Mangabhai E: raman.j.mangabhai@learnfree.co.uk
23-27 Sep Melbourne AU	6TH WORLD CONGRESS OF CHEMICAL ENGINEERING Meeting Planners, 108 Church Street, Hawthorn, Victoria 3122, Australia T: +61 (0)3 9819 3700 F: +61 (0)3 9819 5978 E: chemeng@meetingplanners.co.au Info: http://www.meetingplanners.com.au/chemeng

2001	
8-10 Oct Marne-la-vallee FR	36TH COLLOQUIUM OF THE GROUPE FRANÇAIS DE RHEOLOGIE – «RHEOLOGIE – GENIE CIVIL ET ENVIRONNEMENT» Contact Dr P Coussot, Laboratoire des Materiaux et des Structures du Genie Civil (LCPC/CNRS), Cite Descartes, 2 alle Kepler, 77420 Champs-sur-Marne, France T: +33 (0)1 40 43 50 00 F: +33 (0)1 40 43 54 50 E: phillippe.coussot@lcpc.fr
21-25 Oct Bethesda, ML US	73RD ANNUAL MEETING OF THE SOCIETY OF RHEOLOGY Details will be added when available.
2002	
1-6 Sep Erlangen DE	EUROPEAN CONGRESS ON RHEOLOGY Details will be added when available.
9-11 Sep Edinburgh GB	FARADAY DISCUSSION – COMPUTATIONAL RHEOLOGY Details will be added when available.
T: Telephone; F: Facsimile; E: Email; Info: WWW URL	

COURSES

2001	
27-28 Mar Malmö SE	GRUNDKURS I REOLOGI (BASIC RHEOLOGY, PART 1 – held in Swedish) Presented by Annika Sahlström, MSc Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se
2-3 Apr Malmö SE	FORTSÄTTNINGSKURS I REOLOGI (BASIC RHEOLOGY, PART 2 – held in Swedish) Presented by Annika Sahlström, MSc Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se
4-5 Apr Malmö SE	GELS, GELLING AND THICKENERS Presented by Dr James Goodwin & Dr Paul Reynolds Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se

24-25 Apr Malmö SE	EXPERIMENTAL TECHNIQUES IN COLLOID & INTERFACE SCIENCE AND THEIR APPLICATIONS Presented by Prof Tharwat Tadros Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se
7-8 May Malmö SE	DISPERSION OF POWDERS IN LIQUIDS & STABILIZATION OF SUSPENSIONS Presented by Prof Tharwat Tadros Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se
14-15 May Malmö SE	INTRODUCTION TO ADVANCED RHEOLOGY Presented by Annika Sahlström, MSc Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se
29 May – 1 Jun Loch Lomond GB	THEORETICAL, EXPERIMENTAL AND INDUSTRIAL ASPECTS OF RHEOLOGY Dr N E Hudson, Dept of Pure & Applied Chemistry, University of Strathclyde, 295 Cathedral St, Glasgow G1 1XL, UK T: +44 141 548 2162 F: +44 141 548 4822 E: n.e.hudson@strath.ac.uk
4-8 Jun Minneapolis MN USA	26TH ANNUAL SHORT COURSE ON RHEOLOGICAL MEASUREMENTS: APPLICATION TO POLYMERS, SUSPENSIONS, AND PROCESSING Directed by Chris Macosko. Contact David Giles, University of Minnesota, Department of Chemical Engineering and Materials Science, 421 Washington Avenue SE, Minneapolis, MN 55455, USA T: +612 625 0880 F: +612 626 1686 E: giles002@tc.umn.edu
25-29 Jun Minho PT	SUMMER SCHOOL ON "ANALYTICAL AND NUMERICAL METHODS IN NON-NEWTONIAN FLUID MECHANICS" Organised by The University of Minho and the University of Wales Institute of Non-Newtonian Fluid Mechanics Contact the Secretariat. E: s.school@ecum.uminho.pt Info: http://www.ecum.uminho.pt/SummerSchool

10-14 Sep Leuven BE	7TH EUROPEAN SCHOOL OF RHEOLOGY Organised by the European Society of Rheology and the Belgian Group of Rheology. Contact Peter Van Puyvelde E: peter.vanpuyvelde@cit.kuleuven.ac.be Info: http://www.cit.kuleuven.ac.be/cit/itrk/course.html
23-24 Oct Malmö SE	GRUNDKURS I REOLOGI (BASIC RHEOLOGY, PART 1 – held in Swedish) Presented by Annika Sahlström, MSc Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se
6-7 Nov Malmö SE	APPLIED RHEOLOGY FOR THE PROCESS INDUSTRIES Presented by Prof Howard Barnes Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se
12-16 Nov Glasgow GB	PROCESS RHEOLOGY Dr N E Hudson, Dept of Pure & Applied Chemistry, University of Strathclyde, 295 Cathedral St Glasgow G1 1XL, UK T: +44 141 548 2162 F: +44 141 548 4822 E: n.e.hudson@strath.ac.uk
12-13 Nov Malmö SE	WETTING, SPREADING & ADHESION Presented by Prof Tharwat Tadros Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se
19-20 Nov Malmö SE	EMULSION SCIENCE & TECHNOLOGY Presented by Prof Tharwat Tadros Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se
21-22 Nov Malmö SE	NANOEMULSIONS & MICROEMULSIONS Presented by Prof Tharwat Tadros Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se
26-27 Nov Malmö SE	INTRODUCTION TO ADVANCED RHEOLOGY Presented by Annika Sahlström, MSc Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se

3-4 Dec Malmö SE	PARTICLE CHARACTERIZATION Presented by Dr Terence Allen Calmia AB, Box 2161, SE-220 02 Lund, Sweden T/F: +46 (0)46 211 00 20 E: calmia@calmia.se Info: www.calmia.se
2002	
3-6 Jun Loch Lomond UK	THEORETICAL, EXPERIMENTAL AND INDUSTRIAL ASPECTS OF RHEOLOGY Dr N E Hudson, Dept of Pure & Applied Chemistry, University of Strathclyde, 295 Cathedral St, Glasgow G1 1XL, UK T: +44 141 548 2162 F: +44 141 548 4822 E: n.e.hudson@strath.ac.uk
11-15 Nov Glasgow UK	PROCESS RHEOLOGY Dr N E Hudson, Dept of Pure & Applied Chemistry, University of Strathclyde, 295 Cathedral St, Glasgow G1 1XL, UK T: +44 141 548 2162 F: +44 141 548 4822 E: n.e.hudson@strath.ac.uk
T: Telephone; F: Facsimile; E: Email; Info: WWW URL	

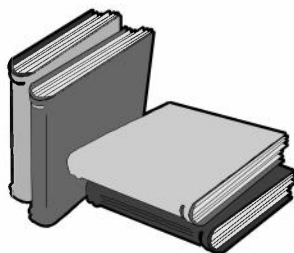
ONES THAT GOT AWAY...

2001	
14-15 Feb Hilton Head SC US	72ND ANNUAL MEETING OF THE SOCIETY OF RHEOLOGY (SOR)
4-9 Mar Ventura, CA US	GORDON RESEARCH CONFERENCE ON CAE IN POLYMER PROCESSING Contact: Charles L Tucker, Urbana, Illinois Info: http://www.grc.uri.edu/programs/2001/cae.htm
T: Telephone; F: Facsimile; E: Email; Info: WWW URL	

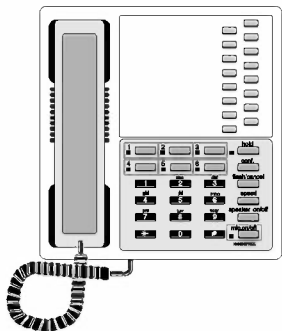


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