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THE BRITISH SOCIETY OF RHEOLOGY

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EDITORIAL

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, TeX, LaTeX, WordPerfect, ASCII, RTF) but always provide a contact name, address, eMail, or telephone number in case of problems.

The next copy date will be in August 2006 and, as always, all contributions are gratefully received. Late copy can sometimes be accommodated, however the facilities of the BSR and ESR web sites may also be appropriate. Please contact the Editor for details (Bogdan Dobraszczyk, b.dobraszczyk@reading.ac.uk).

COVER ILLUSTRATION

The cover illustration shows a lava flow in Hawaii.

We are continually looking for colour or black & white pictures (preferably of a rheological nature!) for the front cover of the Bulletin and Rheology Abstracts. Please contact Bogdan Dobraszczyk (Bulletin Editor) or Nick Hudson (Abstracts Editor & Publications Manager). Suggestions are always welcome!

BSR NEWS

British Society of Rheology

**65th Annual General Meeting, Tuesday April 11th, 2006
Miskin Manor, Cardiff, Wales**

Report by the President, Professor Malcolm Mackley

I have been fortunate to take on the position of President for the BSR with the organisation in a healthy state and I immediately extend my thanks to Prof Geoff Maitland for his past significant contribution to the Society. In addition it is clear that Prof Mike Webster has made outstanding efforts in relation to both the development of the BSR web page and collecting annual subscriptions from the membership. All other sections of BSR activities are also in a healthy state and all the committee are to be congratulated for their efforts.

In Easter 2005 both a BSR Annual award lecture by Prof. Justin Cooper White and a Gold medal address by Prof. Jan Mewis was made at the Welsh Institute of Non Newtonian Fluid Mechanics meeting held at the beautiful location of Lake Vyrnwy.

In Easter 2005 The ESR also held a very successful annual meeting at Grenoble where over 400 delegates enjoyed both the ambiance of the foothills of the Alps together with good and varied rheology topics. Encouragingly, some of the French representatives introduced additional flavours of microstructure to the meeting. In the Spring of 2005 there was a small BSR Microsymposium on flow induced crystallisation held in Cambridge, followed by a successful BSR December Rheology Winter Meeting that was attended by over 50 people. During the winter meeting Professor Russell Davies gave a BSR 2005 annual award lecture and Dr Roel van Os gave a Vernon Harrison prize presentation.

An important development of the BSR has been the emergence of Rheology Reviews and both Ken Walters and David Binding are to be thanked for all their efforts in getting this off the ground. The quality of the articles in the reviews are very high and BSR members are strongly encouraged to acquire copies. Ken is now stepping down as guest editor and we are very fortunate that Prof Roland Keunings has agreed to take over. If you would like to write a review article please do contact him.

The BSR has “inherited” the Non Newtonian Club from Dr Steve Beckett and Phil James has done a good job in getting this going within the BSR. Jason

Stokes has now taken over responsibility for it and his idea is to use it as an informal “roadshow” with say 2-3 meetings a year in different UK locations. He is hoping various instrument makers will sponsor each meeting!

Both the Bulletin and Rheology Abstracts continue to appear on time and with full content and Nick Hudson and Bogdan Dobraszczyk are to be thanked for these time consuming tasks.

An important future aspect for the BSR is the further development of the BSR web page. Hopefully in the next year members will see this develop with current news items and up to date conference information. In addition we are exploring building up a rheology data base and also an educational portal, all of which will add value to BSR membership. In order for this to happen more than one individual needs to be involved and so if you have ideas on how we should advance and what we should include please let us know.

Finally I can report that “entente cordiale” between the BSR and the ESR seems good at present. There remains the belief that individual countries need strong National Societies and I very much hope that all BSR members will continue to actively support the BSR. Your country needs you!

Malcolm Mackley April 2006

New Council Members



Dr Helen Wilson



Dr Xue-Feng Yuan

Dr Helen Wilson was voted onto the BSR Council as an ordinary member at the 317th Council meeting held at Miskin Manor, 12th April 2006.

Helen Wilson started her academic career in Cambridge, where she studied Mathematics as an undergraduate, then Part III and finally received her Ph.D. on "Shear flow instabilities in viscoelastic fluids", working with John Rallison. She moved to Boulder, Colorado for two years, working on rough particle suspensions with Rob Davis in Chemical Engineering before returning to the UK to take up a lectureship in applied mathematics at the University of Leeds. In 2004 she moved to the mathematics department at UCL, where she continues to work on both viscoelastic flows and suspension mechanics.

Dr Xue-Feng Yuan was voted onto the BSR Council as an ordinary member at the 317th Council meeting held at Miskin Manor, 12th April 2006.

Xue-Feng Yuan is a reader in Biochemical Physics at Manchester Interdisciplinary Biocenter and School of Chemical Engineering and Analytical Science, the University of Manchester. He obtained a BSc in Materials Science and Applied Chemistry from the National University of Defence Technology, People's Republic of China, in 1983, and was awarded a PhD in Theoretical Chemistry by the Victoria University of Manchester, United Kingdom, in 1989. He has more than twenty years research experience in studying soft condensed matter/complex fluids including theory and molecular simulation, flow-induced phase transitions, experimental characterization of copolymers, surfactant solutions and human bloods, and modelling of viscoelastic fluid flows. He currently works on rheology of biofluids/biomaterials in microscopic flows and its applications in biomedical areas.

**Dinner Speech at the Lodge Commemorative Meeting
By Professor Joachim Meissner, April 11th 2006**



Ladies and Gentlemen,

I would like to thank Ken Walters for asking me to say a few words at the dinner of this Arthur Lodge Commemorative Meeting. I immediately accepted Ken's invitation because firstly Arthur was one of my very best friends, if not THE best friend I ever had in my life, such that I really feel deeply moved and have difficulties to accept that he is no longer in the midst of us, talking to us, discussing with us, and making his famous, insurmountable, as I called them *typical Arthur jokes*.

But before I speak about the main subject of my talk with the headline something like: MY LIFE WITH ARTHUR, I would like to tell you that the second reason why I accepted Ken's proposal is that he represents the "background man" of this meeting of the British Society of Rheology. Because of the fact that I am something like an antique member of this Society with a membership of nearly 50 years, Ken presently seems to be my boss and I have to

obey him. In fact, I owe very much to this Society and to his members who published what they knew, sometimes in a way that was too complicated to be understood by a beginner in this field like me, but that is a different story.

You will be surprised when I tell you that my life with Arthur started here in Wales, not in the Cardiff area but in Llandudno in 1961. There was a meeting of the British Society of Rheology (BSR) that I visited. I arrived with my wife Lieselotte (in American English *Liza*) and my first three year old son Frank in a Volkswagen from Ludwigshafen, Germany, crossing the North Sea by boat, turning around Piccadilly Circus in London twice until I found the correct direction to Shrewsbury, and finally ended up in Llandudno. But this was not the end, because there was no accommodation available for us. So we turned around, drove back and ended in the Welsh forest area in a place called Betws-y-Coed. There the Craig-y-Dderwen hotel was just marvellous, and we got a glimpse of why the British empire functioned: it was the 10 o' clock evening tea for which all the hotel guests were together in front of an open fire, most of them were retired officers from the different parts of the empire, and they exchanged their experience they had made in this world.

In Llandudno I met Arthur for the first time. I also met other members of the BSR, important to me like Prof. Karl Weissenberg and Mr. W.F.O. Pollett. All three invited me to visit them: so I visited Arthur three years later in Manchester (Sept. 1964) and met his charming wife Helen. (I also saw little Timmy who is now Professor Tim Lodge). Mr. Pollett was another interesting person to me. He had built his own rheogoniometer that really worked with polymer melts. Therefore I visited him in Gravesend near London. His instrument impressed me, but it looked so complicated that I decided to purchase the commercial version of the Weissenberg Rheogoniometer (WRG) made by Farol in Bognor Regis. Prof. Weissenberg had invited me to his home in London, but I met him more often in Bognor Regis. I visited this place every half year during a period of three or four years because of my trouble with our WRG. In Ludwigshafen it took me eight years with an excellent mechanic to repair or redo our WRG until it really worked as it was intended to do. At that time I could have made a living by working as an International Repairman for the WRG!

In November 1967 Arthur visited me in Ludwigshafen to have a look at the modifications I had made to the WRG. But I think one more important reason for his visit was the question whether he should devote his future life completely to the field of rheology, because he had the invitation from Madison, Wisconsin. He accepted and went to Madison where he started the now famous Rheology Research Center (RRC) in 1968. One good thing of the RRC was that —at that time — they had money to invite visiting Professors. The first visiting Professor was our friend Hermann Janeschitz-Kriegl, with whom I already had a good

connection and we had a continuous exchange of views. When Hermann was in Madison (in 1970), I had finished a paper on polyethylene melt elongation written in German, a preprint of which I had sent to Hermann, who reported about our new method and the results in a meeting of the RRC. Arthur must have been delighted because one of his PhD students (Hui Chang) had just calculated the elongational behaviour of Arthur's rubberlike liquid model and had predicted a stress-strain behaviour similar to that which we had experimentally found with polyethylene melts. Up to that time there was only steady state shear flow and disagreement: the theoretically predicted constant shear viscosity, independent of shear rate, and the experimentally found tremendous viscosity decrease with increasing shear rate. The theoretical breakthrough by Manfred Wagner's damping function did not yet exist. I should not follow Manfred's development here because that would open a different, new chapter.

Back to Arthur and to me. After Hermann Janeschitz, the RRC with Arthur as its chairman invited me to come to Madison as a visiting Professor. They had purchased a WRG, and (no wonder) it just did not work. They needed me as THE Repairman for that instrument. For me this was THE challenge: I worked half-day for Arthur's research group, and the other half day I could fill my empty knowledge in theory by running to the lecture courses of the famous people in Madison: Arthur Lodge, Bob Bird, Millard Johnson, and John Ferry. I must say that it was very generous of the company I worked for that they gave me not only the permission but also support to go to Madison for one year. In fact, this one year was the best year in my life and that of my family. On August 4, 1971, we left Europe via Reykjavik by Icelandic Air (the cheapest airline at that time). In New York the plane arrived much too late, so I called Arthur and explained the situation, viz, that there was only one way to proceed travelling by flying through the night to Milwaukee, arriving there at 4 a.m. the next day. Arthur agreed and immediately promised to pick us up in Milwaukee. And there he was with a huge station wagon. The back was filled with two air mattresses for our two kids and what followed was a beautiful one hour drive through the night with a full moon shining. I could not resist looking out whether there were not Red Indians on horseback following our car in this wonderful area of Wisconsin. When we arrived in Madison, there was a home for us, there were beds for sleeping and the fridge filled with food. This was our arrival in Madison and the reception by Arthur and Helen.

Practically every second day, there was a discussion between Arthur and me on experimental problems but also about the behaviour of polymer melts. We often disagreed but that only helped to heat-up the discussion. Arthur enjoyed it when I told him "Wrong Arthur", and the discussion went on until we found some agreement. But often these discussions abruptly ended when Arthur stated at 4 or 4.30 p.m. that he had to drive home for tea with Helen. It was years later that I

heard another version, that Arthur went home because he wanted to see the TV series ‘Hogan’s Heroes’, movies full of fun, at least for Arthur. Those of you who know this series may remember, those who don’t can live without it and do not miss too much.

At the end of our year in Madison, we, the Meissner family, wanted to make the Big Trip to the West Coast. All our leftovers, including the two kids were put in our car that was a huge station wagon. When Arthur heard about this plan, he immediately offered us a small tent such that we could stay alive should we get stranded somewhere. As a preliminary exercise he insisted that the Meissners and the Lodges went for an — as he called it —experimental camping. Obviously, Arthur was a great experimentalist, also in his personal life. So at end of May, it was still cool, we drove altogether to North Wisconsin, near the Crystal Lake. I learned to set up the tent whereas Arthur made a big fire (he always liked to do this during camping in the woods). Out of her food box Helen lifted a big steak, and Arthur was happy that he could prepare our out-of doors-dinner. The night in the tent was a hard training because it was bitterly cold. Fortunately Arthur had known this and had given to Liza a huge cap. Otherwise her head would have been changed into an ice block! When Arthur asked her the next morning ‘How was it?’ she answered by one of Arthur’s phrases ‘It could have been worse’. You certainly understand that Arthur was pleased with that immediate response.

In fact, on our trip to the west we needed Arthur’s tent twice: (i) in the Rocky Mountains National Park north of Denver, and (ii) in the Grand Canyon National Park. In the latter the campsites were all occupied. But when we drove around the area for a second time, all of a sudden a person jumped out at my car and said: ‘you certainly look for a place: my campsite is big enough for two tents, if you want to stay here, accept my invitation’, which we did. This example demonstrates how spontaneously helpful the normal American citizens are.

I want to finish my speech with thanking Arthur once more. He was my friend, he was my teacher, and also the teacher of my family, particularly when it comes down to the British version of the American language, as I liked to tease Arthur. You should know that my wife Liza has a little notebook with the headline “Phrases from Arthur”. For the ladies here, who might already wait long enough that I finish, I like to quote only one of Arthur’s phrases: ‘Fashion’ Arthur often told her and this is in Liza’s notebook ‘fashion is the first step to slavery’.

Arthur, I thank you for your friendship, and I thank you all here for your patience in listening to me.



Prof. Arthur S. Lodge (right) being awarded the Bingham Medal at the 42nd Annual Society of Rheology Meeting at The University of Tennessee, Knoxville. President of the Society, Prof. Hershel Markovitz presented the award. Mrs. Lodge is in the background.

Death of Art Metzner

The rheology community lost a great friend when Art Metzner passed away while on a trip to Washington DC. Art received the Bingham Medal in 1977, served as Editor of the Journal of Rheology from 1985-1995, and received the Distinguished Service Award in 1996.

Arthur B. Metzner, Sc.D., age 79, of Wilmington, DE, formerly of Newark, died suddenly on Thursday, May 4, 2006. A native of Alberta, Canada, he received his B.Sc. degree in chemical engineering from the University of Alberta in 1948 and his Sc.D. from MIT in 1951. His academic teaching career began with instructorships at MIT and Brooklyn Polytechnic Institute. He came to the University of Delaware in 1953 and served as chairman of the Department of Chemical Engineering from 1970 to 1977. He was later named to the H. Fletcher Brown Professorship (now Emeritus). Dr. Metzner's industrial and governmental associations of substantial duration have been with Air Products, Alyeska Pipeline Service Company, Colgate, the Defense Research Board of Canada and the Canadian Defense Research Establishment, Dow, General Motors, Mobil, Merck, NASA, Union Carbide and Westvaco. His research studies were primarily in the areas of fluid mechanics, heat transfer and the processing of polymers and composites. His 130 research publications earned awards from the American Institute of Chemical Engineers, the Society of Rheology, the American Society for Engineering Education and the American Chemical Society. He was elected to the National Academy of Engineering in 1979 and received honorary doctorates from the Katholieke Universiteit Leuven and the University of Delaware. His distinction as a educator and researcher was also recognized when he was presented with the University of Delaware's highest faculty honor, the Francis P. Alison Award, in 1981. Dr. Metzner served on the advisory councils for chemical engineering at McGill University, MIT, Pennsylvania State University and Princeton. He also served on the boards or executive committees of the Chemical Heritage Foundation, the American Institute of Physics and the Society of Rheology. A charter member of St. Paul's Lutheran Church in Newark, Dr. Metzner was a member of St. Stephen's Lutheran Church in Wilmington. He is survived by his wife of 58 years, Elisabeth "Betty" Kruger Metzner; daughter, Elisabeth Faulkner of Charlottesville, VA; son, Arthur P., daughter-in-law, Yemisrach, and grandson, Samuel Metzner, of Fort Washington, MD; daughter, Rebecca, and son-in-law, R. Jeremy Clark, of Rome, Italy. A memorial service will be held at 2 PM on Thursday, May 11, 2006, at St. Stephen's Lutheran Church, 13th and Broom Streets, Wilmington. In lieu of flowers, the family suggests contributions to The McClellan Scholarship Fund of St. Stephen's Lutheran Church, 1304 N. Rodney Street, Wilmington, DE 19806.

British Society of Rheology The Vernon Harrison Annual Doctoral Prize

The Vernon Harrison Prize is awarded annually by the British Society of Rheology for the most distinguished PhD thesis in rheology. This aims to recognise excellence, creativity and novelty in research and is awarded to the postgraduate student who, in the opinion of the adjudicating committee, has made the most original and significant contribution to any branch of rheological research (experimental, computational or theoretical) leading to the award of a PhD degree in a given academic year. The prize is partly supported by the Vernon Harrison Bequest.

Entries are now invited for the 2006 award. The prize will be £500, an illuminated certificate and a copy of Rheology Reviews 2006. Any person who plans to submit and successfully defend a thesis in any area of rheology at a higher education institution in the United Kingdom between 1 September 2005 and 31st August 2006 is eligible.

Each entry should consist of:

- a two page summary of the research written by the candidate, emphasising in clear terms the key achievements which especially distinguish it as a candidate for this award;
- a letter from the thesis supervisor confirming the recommendation of the award of a PhD to the candidate and supporting the case for the award, highlighting the specific original contributions of the candidate;
- the name and address of the external PhD examiner, who should have been contacted by the supervisor to ensure that they are willing to give an independent reference if approached by the assessors.

The Committee may subsequently ask to see a copy of the final version of the thesis to help them reach their decision.

An Adjudicating Committee appointed by the Council of the British Society of Rheology will consider the entries. Particular attention will be given to the scientific originality and quality of the thesis, its coherence and overall presentation and the significance the research to the field in general. Theses where rheology is a major, but not the sole, scientific theme will be considered. Entries will be selected by the Adjudicating Committee for presentation at the Winter Meeting of the British Society of Rheology (date and venue to be decided). The Adjudicating Committee may award any number of first and secondary prizes. Travel funds will be available to assist candidates to attend the prize meeting.

Proposals for the 2005-6 Award
should be sent **by September 15th 2006**
to the Secretary:

Professor Tim Phillips
School of Mathematics
Cardiff University
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United Kingdom

Tel: +44 2920 874194
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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.



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Report on The 3rd Annual European Rheology Conference (AERC) Crete, 27 - 29th April 2006

Rheology in Crete



Rheologists enjoying a discussion between presentations at AERC 2006.

The 3rd Annual European Rheology Conference (AERC) was held on the beautiful island of Crete for a three day period 27 – 29th April 2006. Over four hundred delegates attended a very full programme with Plenary Lectures and five parallel sessions. There was a reasonable UK presence of some thirty people with Professor Tom McLeish giving one of the plenaries. The meeting was opened by Professor John Brady talking about the way microparticle movement can be used to make viscoelastic measurements and there was also an encouragingly large number of experimental papers. One highlight for this correspondent was nice work from the Nancy Rheology Group who developed a simple law for the ‘time to yield’ of a range of household foodstuffs. During the conference there was an interim meeting of the International Congress of Rheology and they reported that so far, only Grenoble had applied for European 2012 slot. An ESR meeting was also held where details for the 4th ESR 2007 (12-14 April) meeting in Naples was discussed. The ESR has formed a

collaboration with Springer Publishing and ESR members can now enter the Springer Rheology Portal for 50 Euros/annum.

The meeting was very well run by the Hellenic Society of Rheology and they are to be congratulated for maintaining the excellent standard that Annual ESR meetings have already reached. Professor Roland Kenning brought the meeting to an end with an excellent after dinner speech on the veranda of the Cretis Maris Hotel at Hersonossis, where the evening was a pleasant 20°C and the sea looked beautiful. Rheology in Europe is currently in good shape!

Malcolm Mackley May 2006

2005 Australian Prime Minister's Prize for Science awarded to Professor David Boger



As a young man at the University of Illinois, David Boger was offered a swag of lucrative chemical engineering jobs. Instead, his pioneering spirit took him to the newly established Monash University and a career in fluid mechanics. It was the right move. Today the research teams he created are solving industrial problems large and small - eliminating the tailing dams synonymous with mining and inventing new ways to use minute droplets of fluids in nanotechnology devices. Along the way he discovered a new kind of fluid that now bears his name.

For a lifetime of pioneering work in fluid mechanics, first at Monash and then at the University of Melbourne, David Boger receives the 2005 Prime Minister's Prize for Science.

Water flows consistently and reliably. It doesn't unpredictably turn to a paste but as you add particles to water, its properties change. Tomato sauce, paint, toothpaste, peanut butter, and mining slurries are good examples. They can behave as both solids and liquids and this can cause all sorts of problems - from getting the sauce out of the bottle, to blocking production lines or oil pipes. In essence, as you add particles to water it turns from being a Newtonian fluid to a non-Newtonian fluid and its flow becomes unpredictable. David realised he needed tools to predict how these fluids would behave so he synthesised 'perfect non-Newtonian' fluids, which are elastic but have constant viscosity. In 1974 David presented his first paper on the new

fluids. It was so influential in the field that his colleagues named them Boger fluids. At first the discovery was purely theoretical. But soon the practical applications appeared.

Because engineers in the mining industry prefer to work with predictable fluids that don't suddenly block up pipes, most mineral slurry is highly diluted, requires large and expensive processing vessels, and the end result includes large volumes of liquid waste. Millions of dollars could be saved by the mining industry if the slurry is concentrated - provided it keeps flowing. David could see that his new-found knowledge of non-Newtonian fluids could model and predict exactly how mineral slurry would behave. The mining companies could then design pipes, pumps and processes that used concentrated slurry and wouldn't block. These ideas were proven when David worked with Alcoa at their Kwinana alumina plant which was producing vast lagoons of bauxite residue (a caustic red mud). A six year investigation showed they could redesign the plant to remove the water but still keep the waste flowing. Now, with the help of one of David's students, Alcoa has taken the further step of pumping waste CO₂ through the caustic mud, sequestering the carbon and producing a less caustic waste that could potentially be re-used.

Not only did David's work help save the company \$10 million a year, the technology has now been transferred to many alumina plants around the world and dramatically improved the environmental footprint of alumina production. Today, Boger fluids are contributing to the custom design of fluids: inks for inkjet printers that can be delivered onto paper in incredibly fine droplets; insecticide chemicals that spread evenly on leaves; and new drug delivery systems using microfluidics and nanotechnology.

Of equal importance, David's work has led to Australia developing a substantial research capability, The University of Melbourne's Australian Research Council Particulate Fluids Processing Centre is just one example. This centre now boasts three Federation Fellows, two of whom were coaxed back from the USA. In addition, several of David's students are now leading research teams pursuing applications of Boger fluids across the country and the world.

What's next for David Boger? "My greatest satisfaction comes from seeing the achievements of the people we've nurtured over the last thirty years. Apart from my Gippsland farm and fly-fishing, my last big challenge is in mining." "I believe the ideas we first developed for Alcoa can be applied to almost any mining operation. We're now working to help the mining industry to eliminate tailing dams, and instead, convert their liquid waste into dry waste and useful products."

Autobiographical Details

- 1939 - Born in Kutztown, Pennsylvania, USA
- 1961 - B.S.Chem.Eng, Bucknell University, USA
- 1963 - M.S.Chem.Eng, University of Illinois, USA
- 1965 - Ph.D.Chem.Eng, University of Illinois, USA
- 1965-1971 - Lecturer, Chemical Engineering, Monash University
- 1970-1971 - Research Fellow, Chemical Engineering, University of Toronto
- 1971-1980 - Senior Lecturer, Chemical Engineering, Monash University
- 1976-1977 - Associate Professor, Chemical Engineering, University of Delaware
- 1980-1982 - Reader, Monash University
- 1980-1981 - Adjunct Professor, Chemical Engineering, University of Delaware
- 1982-present - Professor, Chemical Engineering, University of Melbourne
- 1988-1990 - Deputy Dean, Faculty of Engineering, University of Melbourne
- 1990-1992 - Associate Dean (Research), Faculty of Engineering, University of Melbourne
- 1991-1999 - Deputy Director, Advanced Mineral Products Centre
- 1991-2002 - Chairman, Trade Waste Acceptance Advisory Committee, Melbourne Water Corporation
- 1992-2002 - Research Program Leader, CRC for Bioproducts
- 1996-1999 - Board Member, GK Williams CRC for Extractive Metallurgy
- 1997-1999 - Head, Department of Chemical Engineering, University of Melbourne
- 1997-present - Advisory Board Member, Special Research Centre for Multiphase Processes, University of Newcastle
- 2000-present - Laureate Professor of Chemical Engineering, University of Melbourne
- 2000-2004 - Director, ARC Particulate Fluids Processing Centre
- 2002-2005 - Nanyang Professorship, School of Mechanical and Production Engineering, Nanyang Technological University, Singapore
- 2004 - Distinguished Scholar, National Science Foundation Particle Engineering Research Centre, University of Florida
- 2005 - Visiting Professor, National Science Foundation Particle Engineering Research Centre, University of Florida

- 2005-present - Adjunct Professor, Chemical Engineering, University of Florida
- International consultant for over 90 companies worldwide including 3M in the USA, Xerox and Alcan International in Canada, Statoil in Norway, and Tata RD&D Centre in India. Australian companies include BHP Billiton and Orica. Director of two companies - Divize Pty Ltd and Rheological Consulting Services Pty Ltd.

Career Highlights

- 2004 - Gold Medal of the British Society of Rheology
- 2004 - Named by the Institute of Engineers Australia as one of Australia's 100 Most Influential Engineers
- 2003 - Centenary Medal of the Commonwealth of Australia
- 2003 - Clunies Ross National Science and Technology Award
- 2002 - Victoria Prize
- 2002 - K L Sutherland Memorial Medal
- 2000 - Chemeca Medal, Institute of Chemical Engineers
- 2000 - Flinders Medal, Australian Academy of Science
- 1999-2003 - BHP Fellow
- 1998 - CSIRO External Medal
- 1995 - Alcoa (USA) Environmental Excellence Award
- 1995 - Walter Ahlström Environmental Prize, Finnish Academies of Technology
- 1994 - Australian Society of Rheology Medallion
- 1993 - Eureka Prize for Environmental Research
- 1985 - Royal Society of Victoria Medal for Research
- 1983 - Annual Award of the British Society of Rheology

Professional Affiliations

- Fellow, Australian Academy of Science, and Council Member
- Fellow, Australian Academy of Technological Sciences and Engineering
- Fellow, Institution of Chemical Engineers UK (1986-2003)
- Member, Institute of Non-Newtonian Fluid Mechanics, The University of Wales
- Member, American Society of Rheology
- Member, Australian Society of Rheology (Immediate Past President)
- Member, British Society of Rheology

Karl Weissenberg - The 80th Birthday Celebration Essays

Some years ago one of our members, Professor John Harris, arranged for a number of eminent scientists to write essays on various aspects of Karl Weissenberg's scientific career in honour of his 80th birthday. This was subsequently published. The executors and family of the late John Harris have asked that these essays now be made available to the rheological community as a whole, and the BSR are glad to be the agents for this. The essays will be published in the forthcoming issues of the BSR Bulletin.

Karl Weissenberg was born in Vienna in 1893 and studied at the Universities of Vienna, Berlin and Jena studying mathematics as his main subject. He later became Professor of Physics in the University of Berlin and has also held a variety of Professorships at other Universities. He has made fundamental contributions in both Crystallography and Rheology during a long and active scientific career.

This volume contains a collection of contributions by a number of well known scientific authors which gives the most comprehensive account available up to the present time of the range and depth of the scientific work of Weissenberg and locates his places in the development of both Crystallography and Rheology



The Isolation of, and the Initial Measurements of the Weissenberg Effect

Dr. R. J. Russell

B.P. Research Centre, Sunbury-on-Thames, Middlesex. U.K.

1. Introduction

In the mid 1940's it became necessary to establish design criteria for equipment to handle a class of non-Newtonian fluids which showed elastic after-effects on discontinuing application of shear. The range of conditions for which these design criteria were required covered a very wide range of rates of shear under steady flow conditions and also embraced unsteady state flow conditions as exemplified by pumping through nozzles. These latter conditions received considerable attention since the pressure drops encountered were much higher than anticipated from the conventional nozzle discharge formulae, and a detailed rheological study was undertaken to establish the causes of the discrepancy. The progress of this study, which is the subject of this paper, lead to the identification of the Weissenberg effect in the flow of viscoelastic fluids.

2. Characteristics of Fluids Tested

All the materials exhibited strong non-Newtonian flow characteristics, their viscosities, as determined in co-axial cylinder viscometers, decreasing very rapidly with increase of rate of shear. When an attempt was made to extend the upper limit of rate of shear by using capillary viscometers, large entrance and exit effects were found.

The variation of pressure with distance along the capillary showed that the end effects extended much farther into the capillary than would normally be expected. In addition, visual observation showed that the jet from the capillary exit always expanded to some extent.

There therefore appeared to be good reason to expect that the unusual flow effects encountered were a result of some form of elastic storage of energy. If this were so it was unreasonable to suppose that all the rheological behaviour that had been observed could be correlated in terms of a shearing stress/rate of shear relationship measured under steady conditions. Attention was therefore directed towards the quantification of the elastic phenomena observed and to ways of relating the elasticity effects with the behaviour observed in steady state flow.

3. Previous Work

Experimentally, it had been found possible ^{1, 2, 3} to measure the relative moduli of elasticity of sols and gels using vibrational test apparatus. The determination of absolute values had proved difficult owing to geometrical effects in the apparatus. Theoretical studies due to Hencky ⁴ and Weissenberg ^{5,6} had indicated that the presence of elastic strains in liquids might result in significant decreases of apparent viscosity with increase in rate of shear. It therefore appeared that, provided reliable methods of measuring the elastic properties of the fluids under study could be developed, it should be possible to:

- (i) check the theoretical deductions due to Weissenberg,
- (ii) develop a more complete mechanical characterisation of the fluids than would otherwise have been possible.

4. Experimental Programme

The programme of work fell into two main sections:

- (i) the measurement of rheological constants to characterise the mechanical behaviour of the fluids,
- (ii) a detailed study of the phenomena exhibited by the fluids when studied under laminar flow conditions.

5. Measurement Of Rheological Properties

5. 1. *Selection of Testing Procedures and Methods of Analysis*

Weissenberg's theoretical analysis indicated that under vibrational test conditions the vibrational frequency (expressed as angular velocity in radians/second) was equivalent to the rate of shear (expressed as reciprocal seconds) in stationary laminar flow. The analysis indicated that provided the imposed amplitude of the vibrational shear remained sufficiently small to ensure that the stress and strain tensors were essentially parallel to each other, the actual amplitude used in vibrational tests should not affect the frequency response of the liquid.

Alternatively, it was possible that the response of the liquid could be described in terms of the rate of shear (as for stationary laminar flow). In this case, since the displacement is given by the equation

$$\text{Displacement} = A \sin \omega t$$

and hence the instantaneous rate of shear

$$= \frac{\partial}{\partial t} \frac{\partial}{\partial r} \{A f(r) \sin \omega t\}$$

$$= A\omega \frac{\partial}{\partial r} (f(r) \cos \omega t)$$

where A = Amplitude
 r = radial distance
 f(r) = shape factor describing the change of amplitude with r
 ω = angular velocity.

Thus the instantaneous rate of shear (and hence the average rate of shear) in vibrational testing is proportional to the product of frequency and amplitude. Hence studying the response of the liquid to variations of frequency and amplitude was used to test the applicability of the Weissenberg approach. With all the materials examined the stress developed in vibrational tests varied linearly with imposed amplitude but the response to frequency was far more complex. This was in accord with Weissenberg's ideas, but not with the alternative hypothesis outlined above.

The complexity of the frequency response showed that several material constants would be required to fully describe the flow properties of the fluids. Therefore a general linear model of the form

$$\alpha_0 P + \alpha_1 \dot{P} + \alpha_2 \ddot{P} + \dots = \beta_0 S + \beta_1 \dot{S} + \beta_2 \ddot{S} + \dots$$

was postulated where P, $\dot{P}$ etc., are the stress tensor and its time derivatives and S, $\dot{S}$ etc., are the strain tensor and its time derivatives.

Substituting $(i\omega)$ for differentiation with respect to time in (1).

$$P \{ \alpha_0 + (-i\omega) \alpha_1 + (-i\omega)^2 \alpha_2 + \dots \} = S \{ \beta_0 + (-i\omega) \beta_1 + (-i\omega)^2 \beta_2 + \dots \}$$

which enables the frequency response of the liquid to be defined in terms of a complex compliance $r(=S/P)$ which is a function of frequency alone. Since the materials being tested were true liquids, $\beta_0=0$ and at low frequencies only terms up to the first derivative would be expected to be of importance. Under these conditions equation (1) reduces to

$$\alpha_0/\beta_1 P + \alpha_1/\beta_1 \dot{P} = \dot{S}$$

i.e. the Maxwell equation of state, with the elasticity modulus (E) equal to β_1/α_1 and the viscosity (η)= $\beta_1\alpha_0$. At higher frequencies this simple description will be expected to fail and much recent work has been aimed to get descriptions for the higher frequency behaviour of viscoelastic fluids which are parsimonious in their requirements for material constants. Thus, the experimental validation of the Weissenberg hypothesis was best undertaken under low frequency conditions. This factor considerably influenced the development of the apparatus for the vibrational tests.

5. 2. *Test Apparatus*

The characteristics of the fluid and the desire to avoid the problem of analysing complicated shear motions dictated that the test apparatus should in principle consist of a cylindrical sample holder, which was vibrated about its axis. The elimination of end effects was achieved by arranging the cylinder with its axis vertical. The upper surface of the fluid was thus open to atmosphere and hence negligible forces were transmitted to it while end effects at the lower end were eliminated by floating the fluid on an inviscid liquid (water or mercury).

For this geometry of test apparatus the dependence of displacement on radial distance can be calculated in terms of frequency, fluid density and the complex compliance. Appendix 1 develops the relationship. Evaluating it for various ratios of the real to the imaginary part of the complex compliance shows that provided the imaginary part is not too large, the dependence of amplitude on radial distance gives a standing wave pattern in which blurred “nodes” are easily observable (see Figure 8, which shows that at a dimensionless radius of about 3.8 the amplitude is zero in the purely elastic case but increases with increase of the imaginary (viscous) component. By measurement of the amplitude and radius of the first antinode and the first node, it is possible to calculate both the real and the imaginary part of the compliance modulus. In the experimental apparatus the amplitude/radius dependence was found by placing a very thin line of fine aluminium powder on the surface of the fluid. Typical traces observed are shown in Figures 1 and 2. The range of the apparatus was extended to very low frequencies (where the radius of the first node exceeded the cylinder dimension) by adoption of a conicylindrical apparatus with a sufficiently small gap to reduce the inertia effects in the liquid to be negligible values and then measuring the relative amplitude and phase of the inner and outer cylinders as a function of frequency. Using these two apparatus allowed the dependence of the complex compliance on frequency to be followed over the theoretically important range.

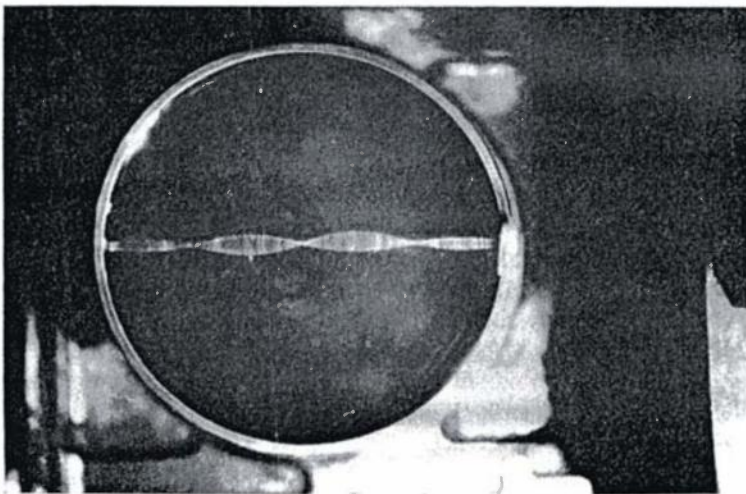


Fig. 1. Trace for liquid showing almost perfect elasticity.

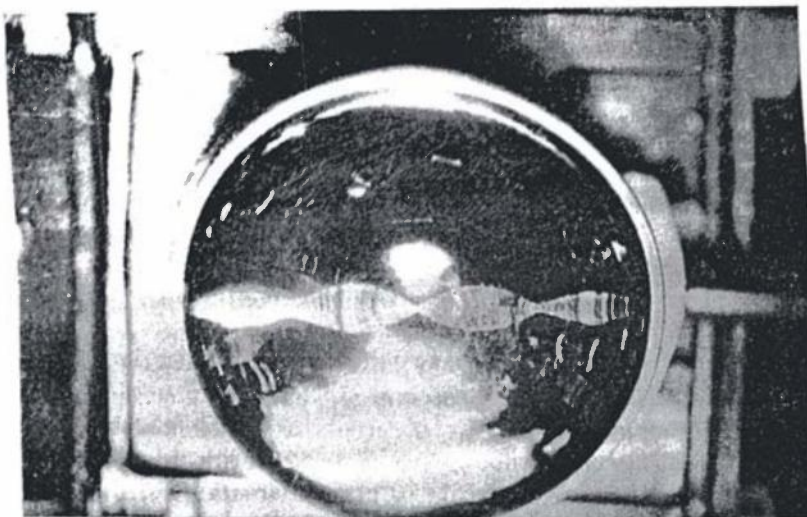


Fig. 2. Trace for liquid showing significant viscous damping of elastic wave.

All the fluids tested showed very similar variations of the compliance with frequency. Figure 3 shows typical curves for the real and imaginary components. The main features were:

- (i) At low frequencies the real part of the compliance became independent of frequency while the imaginary part varied inversely with the frequency.
- (ii) At high frequencies the real part decreased somewhat and then became constant. Over this frequency range the imaginary part ceased decreasing and became constant.

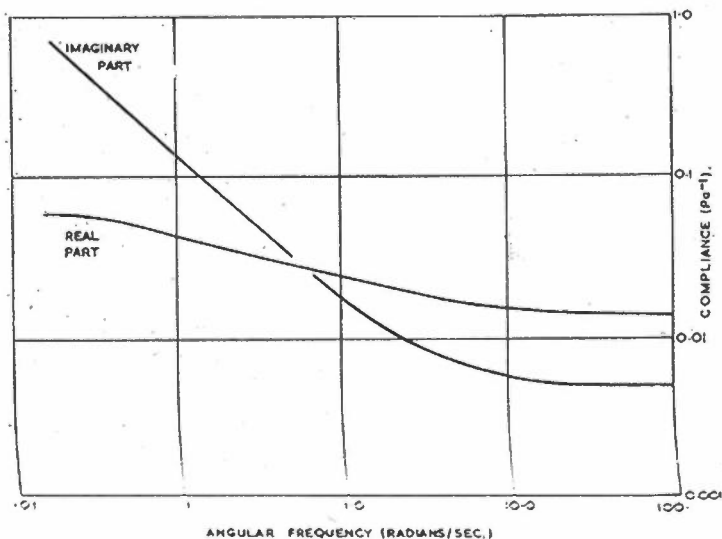


Fig. 3. Real and imaginary parts of complex compliance.

Thus the behaviour at low frequencies tended to that of a Maxwell body. Evaluation of the Maxwell viscosity was found to give the same value as calculated from very low rate of shear laminar flow tests. Weissenberg⁵ had calculated the expected performance of a Maxwell body under laminar flow and these calculations had indicated that significant decreases of apparent viscosity should occur when the dimensionless group

$$\frac{\eta \dot{\gamma}}{E}$$

was of the order of unity. This prediction was confirmed for all the materials tested, η and E being derived from the vibrational tests while $\dot{\gamma}$ was taken as the shear rate at which the first significant decrease of apparent viscosity occurred. At substantially higher rates of shear the Weissenberg prediction of the apparent viscosity were in general too low but at the equivalent vibrational frequencies the energy dissipated was higher than would have been obtained with the equivalent Maxwell body.

The close agreement between the observed laminar flow behaviour of the fluids tested and that predicted by Weissenberg's theoretical work suggested that a study to determine if the basis of Weissenberg hypothesis, the rotation of the stress tensor towards the direction of the streamlines of flow as the rate of shear was increased, could be demonstrated. Any such rotation would cause the presence of at least one normal stress component when the measurement axes were defined as being orthogonal to each other with one axis being along the streamlines. The study therefore had as its main objective the development of a technique to first isolate and then measure the magnitude of any such normal component.

6. Normal Stress Measurement Techniques

The main experimental problem involved in determining whether normal components existed was the likelihood that, if the measurement was attempted by any form of pressure gauge, the isotropic hydrostatic pressure component would change so that it exactly compensated the normal stress component developed due to shear. Although in principle such a change could be measured since it would cause a volume change of the liquid, in practical terms the volume change was expected to be so small as to be undetectable. Indirect methods of measurement were therefore sought and the most promising method appeared to be the study of the effects caused by curvature of the streamlines of flow. It appeared that a normal component of stress acting along the streamlines of flow (the P_{11} component) should act as a hoop stress and hence cause a build-up of pressure towards the centre of curvature.

7. TEST APPARATUS

The simplest technique to explore the postulated effect was to shear the fluid between two parallel discs, one stationary, the other rotating, as shown in Figure 4. The first apparatus built for the purpose is shown in Figure 5, which shows the two discs being forced apart by the hydrostatic pressure developed between them. This apparatus gave the first demonstration of the Weissenberg effect. It proved conclusively the existence of a normal stress component along the streamlines of flow and thus demonstrated the essential validity of the Weissenberg hypothesis.

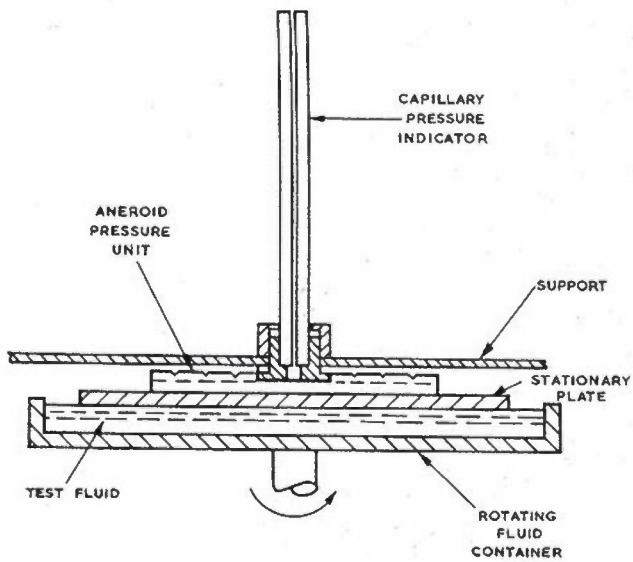


Fig. 4. Arrangement to measure normal component acting along streamline (P_{11} -Component),

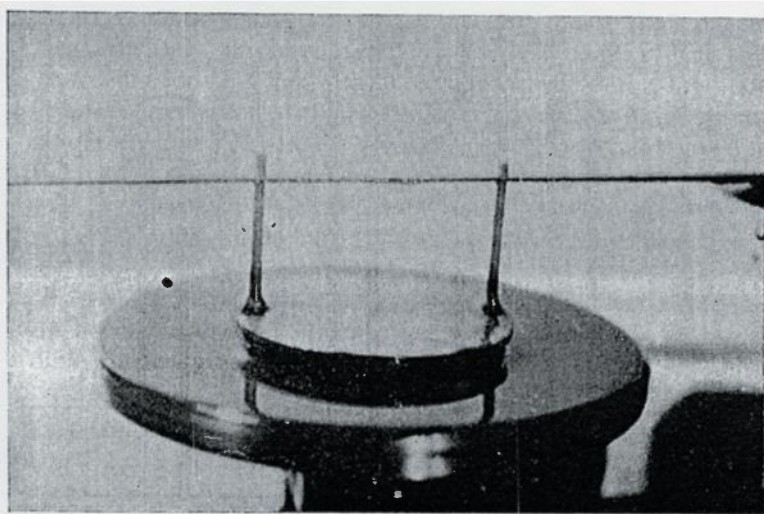


Fig. 5. Apparatus giving first demonstration of Weissenberg effect.

To determine whether normal stress components at right angles to the streamlines (P_{22}) existed, the radial distribution of stress on the plate was studied. To facilitate interpretation of the results, the simple parallel plate apparatus was replaced by a cone and plate system, shown in Figure 6, in which the pressure distribution was measured by a set of manometers. The pressure distribution was described by the relationship:

	P_r	=	$K \log R/r$
where	P_r	=	Pressure at radius r
	R	=	outside radius
	K	=	constant

This distribution is the one to be expected to arise from the action of a P_{11} component of stress with a zero P_{22} component. No direct method for measuring the third component of stress (P_{33}) was developed but no phenomena were observed which suggested that this component was other than zero. From a general view point it appears unlikely that the third normal stress component (P_{33}) should be other than zero when the second component is equal to zero.

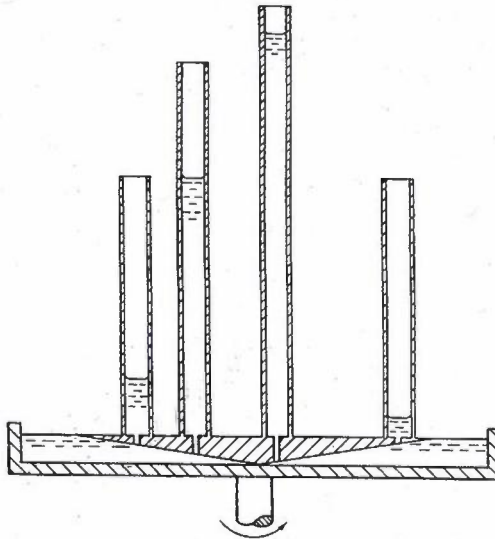


Fig. 6. Measurement of pressure distribution due to normal stress.

It was therefore concluded that the stress tensor developed during the shearing of visco-elastic fluid had the form:

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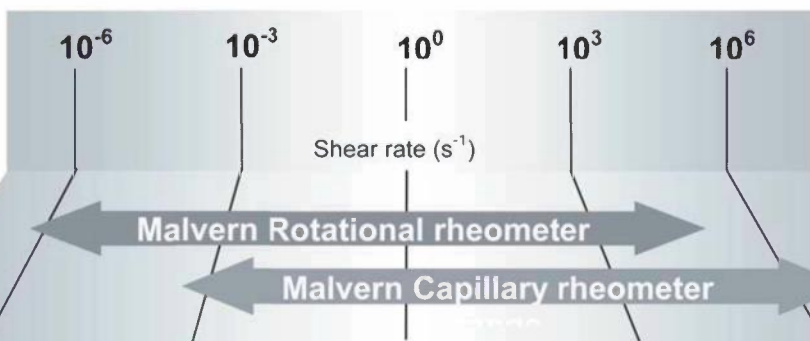
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$$\begin{vmatrix} P_{11} & P_{12} & 0 \\ P_{12} & 0 & 0 \\ 0 & 0 & 0 \end{vmatrix}$$

Breaking the tensor into a deviatoric and an isotropic part, i.e.

$$\begin{vmatrix} \frac{2}{3} P_{11} & P_{12} & 0 \\ P_{12} & \frac{1}{3} P_{11} & 0 \\ 0 & 0 & -\frac{1}{3} P_{11} \end{vmatrix} + P_{11}/3 \begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix}$$

suggests that the action of shearing increases the isotropic pressure. Hence the isotropic pressure should increase at points of high shear. This deduction is in line with observations made during vibrational flow measurements in the cylindrical apparatus where it was observed that at the nodes (the points of highest shear) the equilibrium liquid surface was slightly lower than at the antinodes. It also goes some way to explain the high nozzle pressure drops since the high shear rates within the nozzle would develop a hydrostatic pressure opposing flow.

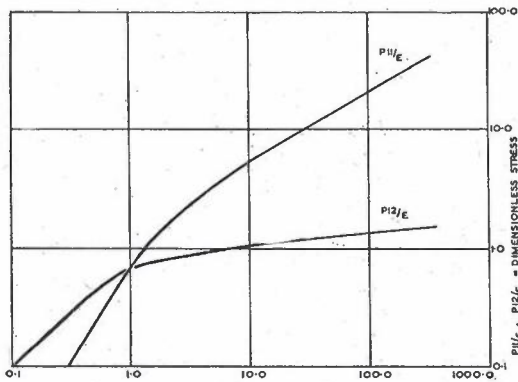


Fig. 7. Dimensionless stress components vs Dimensionless rate of shear.

It was found possible to obtain general relationships involving the normal and shear components of the stress tensor by plotting the dimensionless groups

P_{11}/E and P_{12}/E

against the group $\eta \dot{S}/E$. As shown in Figure 7 the correlations were valid over a wide range, although at the higher values of $\eta \dot{S}/E$ the effects of the different higher frequency behaviours was becoming significant.

When $\eta \dot{S}/E$ was less than 1 the relationships tended to the values given by:

$$P_{12}/E - \eta \dot{S}/E$$

$$P_{11}/E = [\eta / \dot{S} E]^2$$

Thus at low rates of shear the P_{11} component became progressively less important and the behaviour tended more and more to that of a normal viscous liquid.

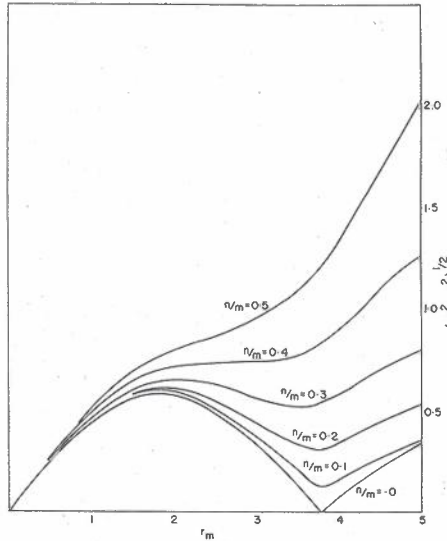


Fig. 8. Amplitude/Radius dependence for cylindrical apparatus.

8. CONCLUSIONS

The work described is considered to provide experimental evidence on the validity of the Weissenberg hypothesis on the effect of elasticity in laminar flow. It indicates that Weissenberg's early theoretical work ⁶, which analysed the effects to be expected from the rotation of the stress tensor when large elastic strains were developed on shearing a visco-elastic fluid, required a minor extension to make it fit experimental observation. This was the inclusion of a normal stress component acting along the streamlines of flow.

9. ACKNOWLEDGEMENT

The author would like to express his thanks for the advice and encouragement of Dr. K. Weissenberg during the course of the work and also Dr. H. R. Fehling and P. O. Rosin for their support for the study.

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APPENDIX

Calculation Of Amplitude/Radius Dependence For Vibration Of Cylindrical Visco-Elastic Body

The differential equation controlling the motion is obtained by balancing the shearing forces due to visco-elasticity against the inertia forces developed by the vibrational motion. This gives the equation:

$$\rho r^3 \frac{\partial^2 \theta}{\partial t^2} = \frac{1}{\Gamma} \frac{\partial}{\partial r} \left\{ r^3 \frac{\partial \theta}{\partial r} \right\} \quad (1)$$

$$\text{or } \rho \Gamma \frac{\partial^2 \theta}{\partial t^2} = \frac{\partial^2 \theta}{\partial r^2} + \left(\frac{3}{r} \right) \frac{\partial \theta}{\partial r} \quad (2)$$

The solution of (2) gives the displacement (D_r) at radius r as:

$$\begin{aligned} D_r &= r\theta \\ &= \frac{C}{\omega \sqrt{\rho \Gamma}} J_1 (\omega r \sqrt{\rho \Gamma}) \exp -i\omega t \end{aligned} \quad (3)$$

since the displacement is zero at $r=0$.

By definition $\omega\sqrt{\rho}\Gamma = m + in$

gives $J_1(\omega r\sqrt{\rho}\Gamma) = x + iy$

$$\text{Giving } J_1\{\omega r\sqrt{\rho}\Gamma\} = J_1\{r(m + in)\} \quad (4)$$

$$= f\{rm, n/m\}$$

The maximum
amplitude at

radius r is given by:

$$\text{Amp}(r) = C \left(\frac{x^2 + y^2}{m^2 + n^2} \right)^{\frac{1}{2}} \quad (5)$$

$$= C.F(rm, n/m)$$

where C is a constant.

Evaluation of $F(rm, n/m)$ gives the variation of amplitude with radius. Figure 8 gives the calculated relationship and shows that for small ratios of n/m an easily characterisable standing wave form is developed.

LIST OF SYMBOLS

J_1 = Bessel function of the first kind, order one.

ρ = density

r = radial distance

θ = angular displacement

Γ = complex compliance

ω = angular frequency

m = real part of $\omega\sqrt{\rho}\Gamma$

n = imaginary part of $\omega\sqrt{\rho}\Gamma$

x = real part of $J_1\{\omega r\sqrt{\rho}\Gamma\}$

y = imaginary part of $J_1\{\omega r\sqrt{\rho}\Gamma\}$



Recent Meeting - 6th June 2006

A Non-Newtonian Club Meeting took place on June 6th at the University of Nottingham, hosted by Dr. Karen M. Steel in the School of Chemical, Environmental and Mining Engineering. Speakers at the meeting included academic and industry-based scientists, as well as young scientists, presenting on a range of topics that involve rheology in a relatively informal and friendly environment.

BSR Non-Newtonian Club Meeting

Agenda

Time	Speaker	Title
10.00	<i>Coffee</i>	
10.30	Prof. John Mitchell <i>Food Sciences, Univ Nottingham</i>	Mouthfeel and taste perception from thickened foods. What is the relevant rheology ?
11.00	Dr. Bettina Wolf <i>Unilever Corporate Research</i>	Shear-thickening of an emulsion stabilised with hydrophilic silica particles
11.30	Dr. Karen Steel <i>Chem. Eng. Univ Nottingham</i>	High Temperature Rheology of Coal During Carbonization
12.00	Dr. Rob Poole <i>Engineering Univ of Liverpool</i>	Shear and extensional rheology of a wormlike surfactant solution
12.30	<i>Lunch & Posters</i>	
1.30	Fotis Spyropoulos	Rheological behaviour of aqueous phase-

	<i>Chem. Eng. Univ Birmingham</i>	separated polymer-surfactant blends
1.55	Anson Mawkam <i>Chem. Eng. Univ of Cambridge</i>	Carbon Nanotube suspension rheology
2.20	Nuno Sereno <i>Food Sciences Univ Nottingham</i>	Physically modified xanthan gum, from particle to polymer rheology
2.45	<i>Tea</i>	
3.00	Julia Telford <i>Unilever R&D Colworth</i>	Measuring the Rheology of Structured Fluids
3.30	Dr Amir Fahmi Mech. Eng., Nottingham	Rheological behaviour of magnetorheological materials: based on polymeric matrix in the presence of a varying external magnetic field
4.00	Dr Yuncheng Liang Chem. Eng., Nottingham	Rheological properties of nanoceramic suspensions in the presence of non-ionic surfactant
4.30	<i>Depart</i>	

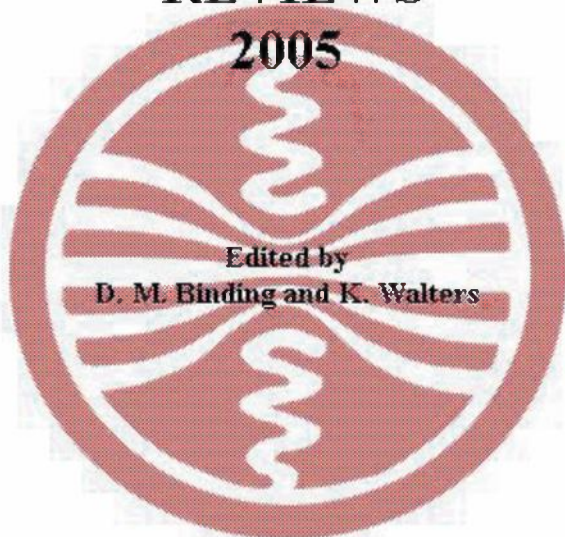
This event was sponsored by Unilever Corporate Research and the British Society of Rheology. As such there was no charge.

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RHEOLOGY REVIEWS

2005



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THE BRITISH SOCIETY OF RHEOLOGY

The field of rheology is extremely broad and continues to grow rapidly. With applications in almost every walk of life, important work is published in a very large number of journals and other media. Although modern computer-based technology enables the location of relevant studies satisfying certain criteria, it cannot determine the importance, or indeed, the significance of the studies. For this, it is necessary to tap the knowledge and experience of the world's most prominent specialists in rheology. This publication aims to achieve this.

The first issue (2003) contains 6 reviews in 233 pages covering over 560 references. It covers the following areas: the rheology of filled viscoelastic systems (Howard A Barnes); non-equilibrium thermodynamics (Anthony N Beris); the rheology of mobile interfaces (Gerald G Fuller); compressive rheology (Ross G de Kretser, David V Boger and Peter J Scales); finite element methods for integral viscoelastic fluids (Roland Keunings) and the modelling of entangled polymers (Tom C B McLeish).

The second issue (2004), containing 7 reviews in 223 pages and incorporating over 680 references, covers the following areas: Failure and recovery processes in polymer melts (Yogesh M Joshi and Morton M Denn), the rheology of food dispersions (Crispulo Gallegos, José M Franco and Pedro Partal), micro-macro simulation using models based on kinetic theory (Roland Keunings), the dynamics of liquid drops (Stefano Guido and Francesco Greco), drag reduction in turbulent flow of polymer solutions (Michael D Graham), breakup of non-Newtonian liquid jets (Michael Renardy) and flow past spheres and bubbles (Bruce Caswell, Octavio Manero and Baltasar Mena).

The 2005 issue contains 5 reviews in 240 pages and incorporates over 650 references. It covers the following areas: Visco-elasto-capillary thinning and break-up of complex fluids (Gareth H McKinley), rheology of solid polymers (Igor Emri), rheology and morphology development in immiscible polymer blends (Peter Van Puyvelde and Paula Moldenaers), bubble dynamics and cavitation in non-Newtonian liquids (Emil A Brujan and P. Rhodri Williams and applied rheology in the protective and decorative coatings industry (Richard R Eley).

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School of Chemical Engineering and Analytical Science
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Prof. Gerard Nash University of Birmingham

Rheological factors regulating the recruitment of white cells to the wall of blood vessels

Dr Ashley Izzard University of Manchester

Pressure-dependent responses in the microcirculation - implications in disease

Prof. Tom McLeish University of Leeds

Doing single molecule rheology with biopolymers

Dr Massimo Antognozzi University of Bristol

Imaging single biomolecules using the viscoelastic properties of a confined liquid film – how the recent developments in Scanning Probe Microscope made it possible

Prof. Jian Lu University of Manchester

Dynamic adsorption of proteins at biointerface

Prof. Simon Ross-Murphy King's College London

Biopolymer gels and gelation – recent progress

Dr Jeff Odell University of Bristol

Microrheology and biofluids

Prof. Mohan Edirisinghe University College London
Novel electrohydrodynamic processing and forming of biomaterials

Prof. Brian Derby University of Manchester
Inkjet printing biofluids and living cells

Further details of the meeting are available at:

<http://innfm.swan.ac.uk/bsr/frontend/home.asp>

Additional contributions for oral and poster presentations are invited. Please submit abstract by 1st October 2006 preferably via email to:

Dr Xue-Feng Yuan Tel.: +44-(0)161-306-4887
Manchester Interdisciplinary Biocentre Fax: +44-(0)161-306-4911
The University of Manchester xue-feng.yuan@manchester.ac.uk
131 Princess Street
Manchester M1 7ND, UK

Vinogradov Society of Rheology

At the beginning of 1960-s the outstanding Russian scientist Professor G.V. Vinogradov organized in the Institute of Petrochemical Synthesis a specialized laboratory of rheology which gave start to the modern rheological investigations in the former USSR. Since 1964 the annual Symposia on rheology were held. Many well-known scientists practically from all former Soviet Republics made reports at these Symposia. Later, in 1990 after death of Prof. Vinogradov the community of Soviet scientists was reformed into Vinogradov Society of Rheology. In the end of last century the Society adopted large group of researchers active in the field of biomedical rheology. Until this time the Society is a centre of rheological life for CIS.

The Society is a member of International Rheological Committee and European Rheological Society which facilitates active contacts between scientists of various countries.

Details of meetings are available on our website: <http://www.ips.ac.ru/rheo>

INSTITUTE OF NON-NEWTONIAN FLUID MECHANICS

CONFERENCE ON “WHITHER RHEOLOGY?”

Lake Vyrnwy Hotel, Mid Wales

April 2-4, 2007

Programme

The conference will commence at 12 noon on Monday April 2nd and finish at lunchtime on Wednesday, April 4th, 2007.

The theme of the Conference will be “Whither Rheology?” Each Plenary Lecture will outline the main thrusts and highlights in the field hitherto, followed by a discussion of where the field is heading (or ought to be heading) in the future. Distinguished rheologists who have already agreed to give plenary lectures include: D V Boger (Melbourne, Australia), Igor Emri (Slovenia), G G Fuller (Stanford, USA), A J Giacomin (Madison, USA), J C Hyun (Korea), T C B McLeish (Leeds), J R A Pearson (Schlumberger, Cambridge), T N Phillips (Cardiff), R I Tanner (Sydney, Australia) and M H Wagner (Berlin).

We shall attempt to cover a number of important areas of current Rheological research by inviting the plenary speakers to present 45 min. lectures on their particular expertise. This will be followed by supporting lectures on the same theme. In this connection, A Likhtman and R.Graham (both from Leeds) have already agreed to lecture.

Professor M.R.Mackley (Cambridge) will deliver his BSR Presidential address at the conference.

Venue

The meeting will be held at the Lake Vyrnwy Hotel near the village of Llanwddyn in Mid Wales. The hotel is situated in a 24,000 acre country estate with magnificent views overlooking the lake and the Berwyn mountains. It offers excellent accommodation with full conference facilities.

Costs

The total cost of the meeting (with meals and accommodation from Monday lunch to Wednesday breakfast) will be £380. Participants registering before 20 February 2007 will receive a £30 discount on their registration fee.

Accompanying persons sharing a room with a participant will be charged £100.

Organizers

The meeting will be organized by Dr G W Roberts and Professor K Walters FRS on behalf of the INNFM. Those wishing to present lectures should contact Professor Walters (kew@aber.ac.uk). Hotel bookings and registration matters should be addressed to Dr Roberts (g.w.roberts@bangor.ac.uk).

INSTITUTE OF NON-NEWTONIAN FLUID MECHANICS

CONFERENCE ON “WHITHER RHEOLOGY?”

Lake Vyrnwy Hotel, Mid Wales, April 2-4, 2007

Participants should return this form no later than 20th February 2007. Prospective speakers should send a 200 word Abstract to Professor Walters, no later than February 1st, 2007.

Block letters throughout please

Title.....

Surname.....

Forename(s).....

Organization.....

Full address.....

Tel Fax Email

- ☐ **Normal Registration.** I wish to attend the conference and I enclose a cheque for £380 made payable to the University of Wales Institute of Non-Newtonian Fluid Mechanics (after 20 February 2007).
- ☐ **Early Registration.** I wish to attend the conference and I enclose a cheque for £350 made payable to the University of Wales Institute of Non-Newtonian Fluid Mechanics (before 20 February 2007).
- ☐ I shall be accompanied by and I enclose a cheque for £100 made payable to the University of Wales Institute of Non-Newtonian Fluid Mechanics.
- ☐ I wish to present a paper and will provide an Abstract by the deadline.

Please return this form to:

Dr Gareth Wyn Roberts
Department of Mathematics
University of Wales Bangor
Dean Street, Bangor
Gwynedd LL57 1UT, UK

Tel: +44 (0)1248 382480 / 382686
Fax: +44 (0)1248 361429
Email: g.w.roberts@bangor.ac.uk

4th International Workshop on Nonequilibrium Thermodynamics and Complex Fluids 3-7th September 2006, Rhodes, Greece

Scope

The application of thermodynamics to complex fluids, like polymeric liquids, dispersions, emulsions etc. is by no means obvious. In fact, in the literature there exists at present an overwhelming amount of theories and a wide variety of approaches: Classical nonequilibrium thermodynamics with internal variables, Lagrangian methods, bracket formulations, continuum or rational thermodynamics, variational formulations, extended irreversible thermodynamics, the matrix model, network thermodynamics, and the recent GENERIC formalism. To bring together and unify this variety of approaches and to achieve a common framework, suited for applications, a first workshop was organized in 1996 in Montreal to discuss this matter (Workshop report by M. Grmela, JNNFM 69 (1997) 105-107). The common opinion was that it should be possible now to combine the various approaches in some kind of common generalized theory. In order to achieve this, a second and third international workshop were held in Oxford, 2000 and Princeton, 2003 (Workshop report by A. Beris and B.J. Edwards, JNNFM 120 (2004) 1-2). To help in the direction of bringing nonequilibrium thermodynamics to the same level of clarity and usefulness as equilibrium thermodynamics, the fourth international Workshop will take place in Rhodes, in September 3-7, 2006. The workshop is expected to highlight the most recent advances in the field, in particular, new theoretical developments and state-of-the-art modelling/simulation techniques founded on or guided by principles of non-equilibrium thermodynamics. Particular emphasis will be given to the description of new phenomena related to structure/morphology development and relaxation or dynamics in complex materials subjected to a deformation history at various length and time scales within a non-equilibrium thermodynamics framework. Adhering to a fundamental and strict non-equilibrium thermodynamics framework in order to establish self-consistent links between the different levels (each level addressing phenomena over a specific window of length and time scales) is something that we hope to have become absolutely transparent by the end of the Workshop. A special issue of the Journal of Non-Newtonian Fluid Mechanics (JNNFM) will also be devoted to the Workshop.

Invited speakers

Austen Angell *Arizona State University, USA*

Gregoire Nicolis *Universite Libre de Bruxelles, Belgium*

Akira Onuki *Kyoto University, Japan*

Speakers (tentative list)

Antony Beris *University of Delaware, USA*

Steve Berry *University of Chicago, USA*

Kurt Binder *University of Mainz, Germany*

Helmut Brand *University of Bayreuth, Germany*

Jose Casas-Vazquez *Universitat Autònoma de Barcelona, Spain*

Peter Constantin *University of Chicago, USA*

Peter Daivis *RMIT University, Australia*

Jaap Den Doelder *Dow Benelux B.V., The Netherlands*

Burkhard Dunweg *Max Planck Institute for Polymer Research, Germany*

Jean-Pierre Eckmann *University of Geneva, Switzerland*

Brian Edwards *The University of Tennessee, USA*

Pep Espanol *Facultad de Ciencias - UNED, Spain*

Denis Evans *Australian National University, Australia*

Ubo Felderhof *University of Aachen, Germany*

Alexander Gorban *Leicester University, UK*

Miroslav Grmela *Ecole Polytechnique de Montreal, Canada*

David Jou *Universitat Autònoma de Barcelona, Spain*

Ilya Karlin *ETH Zurich, Switzerland*

Markos Katsoulakis *University of Crete, Greece; University of Maryland, USA*

Ioannis Kevrekidis *Princeton University, USA*

Martin Kröger *ETH Zurich, Switzerland*

Kurt Kremer *Max Planck Institute for Polymer Research, Germany*

Daniel L'huillier *Universite Pierre et Marie Curie, France*

Manolo Laso *University of Madrid, Spain*

Claude LeBris *Ecole Nationale des Ponts et Chaussées, Paris*

Guiseppe Marrucci *University of Naples, Italy*

Vlasis Mavrantzas *University of Patras, Greece*

Hans-Christian Öttinger *ETH Zurich, Switzerland*

Harald Pleiner *Max Planck Institute for Polymer Research, Germany*

Jay Schieber *Illinois Institute of Technology, USA*

Doros Theodorou *National Technical University of Athens, Greece*

Billy Todd *Swinburne University of Technology, Australia*

Thanos Tzavaras *University of Crete, Greece; University of Maryland, USA*

Dion Vlachos *University of Delaware, USA*

Manfred Wagner *Technical University of Berlin, Germany*

Important dates

- April 30th, 2006** Registration
- April 30th, 2006** Submission of abstracts for oral or poster presentation
- August 10th, 2006** Submission of manuscripts for consideration to JNNFM special issue

Registration

Complete the registration form and payment information via website <http://www.complexfluids.ethz.ch/cgi-bin/CONF/c?registerform=on> and submit it by using one of the following: Mail to: IWNET 2006 Secretariat, Ms. Kleanthi Zacharopoulou, FORTH/ICE-HT, Stadiou Str., Platani, P.O. BOX 1414, GR 26504, Patras, Greece. Tel.: (+30) 2610-965 278, Fax: (+30) 2610-965 223, E-Mail: iwnet_2006@chemeng.upatras.gr

Polymer Processing Society (PPS) 2006 Annual Meeting, Yamagata, Japan

This year's twenty-second annual PPS meeting was held in Yamagata on 3 – 5 July 2006 where the meeting was attended by some five hundred delegates of which four came from the UK. The low attendance is a measure of changing times. Asia now leads in both polymer manufacture and processing; the UK has small pockets of academic processing ability but UK manufacturing appears to have lost its appetite to be involved in polymer processing innovation or technology development.

New areas of polymer processing technology now involve biomass based polymers such as polylactic acid and increasingly opto electronic devices figure in process development. There was also a significant number of papers on filled systems and nano clay suspensions figured highly. In Japan, Toyota are a strong driving force for technological innovation and a plenary lecture at the meeting told us how Toyota is planning “today for tomorrow”.

There was a lot of rheological content in the meeting and perhaps more British rheologists and polymer processors might be persuaded to attend the next PPS Meeting in Salvador, Brazil, 27 – 31 May 2007.

**Conference on Modelling Fluid Flow
(CMFF'06)
The 13th International Conference On
Fluid Flow Technologies**

**The next event in the series of International
Conferences on Fluid Machinery held in Budapest
September 6-9, 2006**

**Budapest University of Technology and Economics
Budapest, HUNGARY**

<http://www.cmff.hu>

Invitation

It is our privilege to invite you to take part in the 13th International Conference on Fluid Flow Technologies, entitled “Conference on Modelling Fluid Flow” (CMFF'06), the next event in the series of International Conferences on Fluid Machinery held in Budapest since 1959. The aim of the Conference is to respond to recent challenges in the rapidly developing fields of fluid mechanics. The Conference is a unique event designed to provoke and establish interactive symbiosis and efficient synergy of numerical flow simulation and physical modelling of flow processes using advanced measurement methods. It aims at defining the state of the art in CFD and advanced measuring techniques, inspiring both research and practical applications by promoting interaction between scientists and practitioners working in the computational and experimental fluid dynamics field. At CMFF'06, a particular emphasis will be given to the industrial aspects of flow modelling, reflected also in the subject of the invited lectures.

The conference was originally organised every fourth year. The last event in 2003, CMFF'03, was extremely successful. It attracted 220 delegates from 30 countries, who delivered 170 selected presentations. Thanks to the high quality of conference papers, Springer Verlag decided to produce a Selected Papers volume of CMFF'03, entitled “Modelling Fluid Flow – The State of the Art”.

CMFF'03 also provided a venue for special workshops organised by internationally acknowledged experts, discussing recent trends and provoking further questions in modelling fluid flow. This success, coupled with the rapid development of fluid mechanics, encouraged the conference organisers to increase the frequency of the events to every third year. The time frame of the paper

sessions has also been extended in comparison to the conference in 2003, to accommodate an increased number of presentations. The International Scientific and Programme Committee (ISPC) and the Local Organising Committee look forward to welcoming you to Budapest.

*Univ. Prof. Dr.-Ing. habil. R. Schilling Professor T. Lajos
Chairman of International Scientific Chairman of Local Organising
and Programme Committee Committee*

Conference Secretariat

Secretariat of Conference on Modelling Fluid Flow (Dr. János Vad)
Department of Fluid Mechanics
Budapest University of Technology and Economics
H 1111 Budapest, Bertalan L. u. 4-6, Hungary
T: +36 1 463 40 72 Fax: +36 1 463 34 64
e-mail: conference@ara.bme.hu
website: <http://www.cmff.hu>

Conference Venue

The Conference events will take place in the magnificent Central Building of the University (H-1111 Budapest, Műgyetem rkpt. 1-3) on the banks of the River Danube.

Conference Topics

The scope of the Conference includes the theoretical aspects of numerical simulation and physical modelling of flows as well as their practical use in research, product development, solving problems, and optimisation.

The main thematic areas of the Conference are

- Turbomachinery
- Heating, Ventilating and Air Conditioning
- Internal Flows
- Chemical and Process Engineering
- External Aerodynamics
- Power Engineering
- Combustion and Heat Transfer
- Fluid Power: Hydraulics and Pneumatics
- Environment Protection Problems
- Vehicles

Each thematic area covers research, development, design, new applications and equipment, case studies and future trends with particular emphasis on the use of CFD and advanced measurement methods.

Workshops And Exhibition

A speciality of recent CMFF conferences is the organisation of workshops. A workshop is a 100 minute event. Questions about challenges, recent trends and solutions related to fluids engineering are provoked by the Workshop Leader and are discussed by internationally acknowledged experts involved by the Workshop Leader, with active contribution of the audience. The Workshop Leader is in the capacity to invite presenting authors for illustration of the workshop topic, but it must be kept in mind that the workshop is principally different from a "traditional" paper session.

Conference Timetable

Welcoming Reception (September 6, Wednesday, 18:00-20:00)

The welcoming party, hosted by the Rector of Budapest University of Technology and Economics, will take place in the historic Aula of the Central Building.

Gala Dinner (optional) (September 7, Thursday, 19:00-22:00)

The Gala Dinner will be held in the Club of the Hungarian Academy of Sciences. This historic building is beautifully located on the banks of the River Danube and enjoys panoramic riverside views. In addition to the stimulating company of other participants and the impressive environment, delegates will enjoy the full menu of Hungarian food and wine provided.

Opening Plenary Session with Keynote Speeches (September 7, Thursday, 9:00-11:00)

The Conference will open with a stimulating Plenary Session which will include the opening address by Prof. Rudolf Schilling,

ISPC Chair, and the following Keynote Speeches:

- Prof. R. A. Van den Braembussche, Sint-Genesius-Rode : "Turbomachinery Design Systems"
- Prof. D. Thevenin, Magdeburg: "Modelling Internal Reacting Flows"
- Dr. S. Bross, Frankenthal: " Industrial Demands on Flow Modelling"
- Prof. J. Zierep, Karlsruhe: The Life of Ludwig Prandtl

Parallel sessions with oral presentation of papers; workshops; Closing Plenary: From September 7, Thursday to September 9, Saturday

Programme for Delegates and Accompanying Persons

The official travel agency for CMFF'06 organises tours and excursions. Representatives of the agency will be available at the conference venue.

Official Language

The language of the Conference is English.

Call For Papers

Submission of abstracts /Extended deadline: November 10, 2005/

Abstracts of papers (text only, body text between 200 and 300 words in English) are required before November 10, 2005 for review and selection. No special format requirements are set for the abstracts. The abstracts should be sent to the Secretariat by email in Word or pdf attachment to the address of conference@ara.bme.hu. The corresponding authors are requested to specify the list of authors with affiliation as well as the postal address, telephone, fax, and email address of the corresponding author in the submitted document.

Submission of full-length papers

Authors whose abstracts are accepted will be notified by November 20, 2005, and requested to submit the 6-page full-length papers by email by February 20, 2006 for review with a deadline of April 20, 2006. The revised final papers must be submitted by email no later than June 20, 2006. The detailed format requirements for the papers will be sent out together with acknowledgement of abstract acceptance. Once a paper has been submitted for publication, a registered author must present the paper at the Conference.

Publications

The Proceedings of the Conference will include the papers reviewed and accepted by the International Scientific and Programme Committee. A precondition for paper publication is the submission of the final paper and the payment of the registration fee by June 20, 2006. Upon registration, delegates will receive the printed materials which will also be available on CD-ROM.

Springer Verlag produced a Selected Papers volume of CMFF'03, which was entitled "Modelling Fluid Flow - The State of the Art". In addition, high quality CMFF'03 papers were published in the IMechE Journal of Power and Energy and in the Journal of Computational and Applied Mechanics. As for the previous Conference, opportunity for paper publication will be arranged also for CMFF'06.

So far, the Editorial Board of the International Journal of Heat and Fluid Flow agreed to edit a special issue including selected CMFF'06 papers. The organisation of such a special CMFF'06 conference issue of IMechE Journal of Power and Energy is also in process, with final decision in October 2005. The conference participants will be informed on the final conditions of journal publication via email and on the conference website.

Calendar

The Calendar of the Conference is as follows:

November 10, 2005 Deadline for submission of abstracts
November 20, 2005 Notification of abstract acceptance
February 20, 2006 Deadline for papers
April 20, 2006 End of paper review, communication
June 20, 2006 Deadline for submission of final papers
September 6-9, 2006 Conference in Budapest
For further details on the program, please visit the conference web site
<http://www.cmff.hu>.

Registration And Hotel Accommodation

To register for the Conference, please complete the Registration Form on the website and send by fax or by mail to the Secretariat.

This will also guarantee that you will receive further CMFF'06 news to your email address. If you intend to publish a paper, please ensure that the payment by bank transfer is carried out by June 20, 2006.

The Conference Secretariat has pre-booked comfortable rooms at various hotels within walking distance of the venue, or a short ride away. Please see the attached Registration Form or visit the Conference website for further information.

Conference Secretariat

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Budapest University of Technology and Economics
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T: +36 1 463 40 72 Fax: +36 1 463 34 64
e-mail: conference@simba.ara.bme.hu
web site: <http://www.cmff.hu>

2nd Eurosummer School on Biorheology & Symposium on Micro Mechanobiology of Cells, Tissues and Systems

Varna, Bulgaria, September 17-20, 2006

The Organizing Committee has the pleasure of inviting you to attend to the 2nd Eurosummer School on Biorheology & Symposium on Micro Mechanobiology of Cells, Tissues and Systems, which will be held in Varna, Bulgaria, September 17-20, 2006. The meeting is organized by the Bulgarian Society of Biorheology in cooperation with the European Society of Clinical Hemorheology.

The aim of the meeting is to get closer clinical and micro mechanobiological studies, promising new therapeutical developments and to focus researchers on the influence of the mechanical forces on cells and tissues and systems. The meeting aims to ensure continuity of the 1st Eurosummer School on Biorheology – a satellite meeting to the 12th European Conference on Clinical Hemorheology, held in 2003 in Sofia, Bulgaria and to strengthen the international collaboration and contacts in the field.

We are looking forward to welcoming you in Bulgaria in September 2006. We sincerely hope that you will find the meeting convincing and rewarding and Varna will ensure very good conditions for an extensive exchange of views and personal contacts.

On behalf of the Organizers:

Nadia Antonova, Ph D, Assoc. Res. Prof.

President of the Bulgarian Society of Biorheology

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78th Annual Meeting Society of Rheology

Portland, Maine, USA

8-12TH October 2006

The SOR 78th Annual Meeting will be held in Portland, Maine during the week of October 8-12, 2006. Abstracts for both oral presentations and posters must be submitted online at the newly revised abstract submission site (<http://www.rheology.org/sorabst>). The site is also accessible from links through the SOR home page at <http://www.rheology.org/sor> and the Portland Meeting home page at http://www.rheology.org/sor/annual_meeting/2006Oct. The deadline for submission of abstracts for oral presentations is this Friday MAY 12, 2006. For posters, the deadline is Friday AUGUST 11, 2006.

The plenary lectures will be given by Paul Janmey (University of Pennsylvania), Hans Christian Öttinger (ETH Zurich), and the 2006 Bingham Medalist, Robert C. Armstrong (Massachusetts Institute of Technology). The planned symposia are as follows:

- * Suspensions, Colloids and Granular Materials
- * Microfluidics, Confined Systems and Thin Films
- * Blends, Emulsions and Multiphase Flows
- * Non-Newtonian Fluid Mechanics, Instabilities and Turbulence
- * Microrheology
- * Biomaterials, Biological Systems and Self-assembly
- * Viscoelasticity of Solids, Thixotropy and Glasses
- * Paper, Pulp and Industrial Processes
- * Polymer Solution Rheology: Molecular-scale Modeling and Experiments
- * Rheology and Structure of Entangled Polymer Systems
- * General Papers

Details on the technical program and the session chairs can be found at:
http://www.rheology.org/sor/annual_meeting/2006Oct/program.htm.

INDUSTRY NEWS

Leading rheologists to participate in Malvern's new Rheology Forum

Scientific seminars delivered via the web focus on hot topics in rheology

On 30 January, Malvern Instruments launched a new monthly internet forum which will focus on novel or expanding areas of interest in rheology. Live web seminars are scheduled to take place each month, at which leading rheologists from academia and industry will present their work. The first of the web seminars was given by Dr Lynn Walker, Professor of Chemical Engineering at Carnegie Mellon University, and covered 'Shear alignment of nanoparticle arrays templated by block-copolymer mesophases'. This is now available on the Malvern website as a downloadable presentation that can be viewed anytime.

Excellent presentations to date have also included Dr Susan Muller, Professor of Chemical Engineering at the University of California, Berkley on the subject of 'Instabilities in viscoelastic flows'. Among the list of future speakers will be Dr Martin Sentmanat of Xpansion Instruments on 'Making extensional viscosity measurements of polymer systems'.

While Malvern is the manufacturer of Bohlin rheometers, the Rheology Forum is intended to be non-commercial. Participants are welcomed from every area. Potential speakers from all backgrounds and using any equipment are invited to submit an abstract for consideration. Presenters simply deliver the seminar across the internet from their own PC.

Malvern's objective is to increase awareness of rheology and its applications, and to afford people working in new or expanding fields the opportunity to gain more exposure and recognition in a global arena.

Full registration details to take part in the forum or to submit an abstract can be found at www.malvern.co.uk/rheologyfocus

Malvern Instruments wins Queen's Award for Enterprise in International Trade

It is with great pleasure that Malvern Instruments announces that the company is to receive the Queen's Awards for Enterprise, the UK's leading accolade for business success. Details of the winners of the 2006 Awards were announced today on the occasion of Her Majesty The Queen's 80th birthday. Malvern Instruments' award is in the category of International Trade, reflecting the company's increased export earnings, up by 76% through sustained growth over the past six years.

Malvern Instruments is a leading supplier of analytical solutions for particle characterization and rheological applications. Trading since 1971, this is Malvern's fourth such honour, having received: The Queen's Award for Technology in 1977; The Queen's Award for Export in 1981; and The Queens Award for Export and Technology in 1988.

Managing Director, Paul Walker, praised the efforts of Malvern's teams throughout the world. "I am pleased and very proud that the achievements of Malvern Instruments and everyone who works in and for the company are being recognised publicly. We operate in a highly competitive global marketplace and serve a wide range of industries. Maintaining a leading position requires us to stay ahead, not only in terms of technology, but also in the way we interact with and support our customers in their activities. I would like to thank everyone who has played a part in achieving this honour for the company."

Malvern products feature advanced technologies combined with robust mechanical designs and comprehensive software, to provide systems for material characterization (particle size distribution, particle shape, zeta potential, molecular weight, rheological properties) and bulk material properties. Operating from headquarters in the UK, Malvern has an established network of subsidiary organisations, local offices and distributors worldwide, and provides world class applications and technical support to its customers.
www.malvern.co.uk

Can rheology help you? Free Rheology Audit!

Many companies could save thousands of pounds a week by considering the rheology of their products, but fail to do so because this specialist knowledge is lacking within their company. Often people do not even realise that knowing the rheology of their product could save them money. Very few rheometers in industry are utilised to their full potential and can often be put to better use. If you are interested to learn how rheology could benefit both yourself and your company please contact *Steve Goodyer* by replying to this email or calling him on 07971 972502. info.gb@anton-paar.com <http://www.anton-paar.com>

Freeman Technology introduces 'real time' bulk density measurement

At ACHEMA 2006 (15-19 May 2006; Frankfurt, Germany) Freeman Technology will demonstrate a new capability for the FT4 Powder Rheometer – 'real time' bulk density measurement. New software developments for the FT4 now make it possible to measure bulk density during the course of a test program. No additional hardware or instrumentation is needed. Subtle changes in bulk density that occur during repeat testing as the sample stabilizes are monitored precisely. This variable can now be measured easily as a function of, for example, degree of aeration/air flow rate.

These new software elements are easily incorporated into an existing user's test program making this a valuable extension of the FT4's capability. For new users, bulk density measurement will be provided as an integral part of the software package delivered with the instrument. As with all other FT4 test programs, bulk density measurement is fully automated.

Because the FT4 methodology is based on repeatable conditioning and consolidation processes it can be used to generate highly accurate and reproducible bulk density measurements. Dynamic studies of bulk density, under different test conditions, afford additional insight into powder behaviour and give processors more information about this critical parameter. Changes in bulk density resulting from consolidation, which have been widely linked with powder flowability, and from aeration, are expected to be of particular interest. www.freemantech.co.uk

Thermo Haake MiniLab Micro Rheology Extruder

The newest Thermo Haake MiniLab Micro Rheology Compounder combines compounding and rheological measurement of micro amounts of material in one compact system. Ideal for new polymer development and testing of expensive additives, the Compounder combines the advantages of both a mixer and an extruder in a batch process. The HAAKE MiniLab micro-compounder needs a sample volume of 7 cm³ only. Compounding expensive materials such as nano-composites, biopolymers or pharmaceuticals is therefore no longer a problem. Simultaneously the rheological properties can be recorded to document structural changes. New Features: Increased hardness of barrel material and much easier cleaning of barrels because of changed geometry.

The HAAKE MiniLab product has been extended to include new feeders and dies for an increased performance of the system. The new force feeder for the MiniLab allows for a continuous compounding with the MiniLab for up to 3 g extrudate per minute. The feeder can be used for powders, middlings and pellets up to 2.5 mm.

Triton Technology Materials Science Seminar

Polymer Applications of DMA and DETA

Triton Technology will be holding a seminar relating to recent and novel application of Dynamic Mechanical Analysis (DMA) and Dielectric Thermal Analysis (DETA) in the fields of Material Science and Polymer Chemistry, on the 25th October in the East Midlands area (updated details to be provided on the website <http://www.triton-technology.co.uk>). An array of invited speakers will present some of their work at what is hoped will be a regular meeting hosted by Triton Technology Ltd. As well as a series of presentations, there will be a hands-on portion of the meeting showing the various features of both techniques. Immersion accessories for the DMA and controlled humidity options for both DMA and DETA will be demonstrated. Also, there will be an open discussion session to allow attendees to quiz leaders in this field with their own applications and issues.

CONFERENCE DIARY

2006	CONFERENCES
3-7 Sept Rhodes, Greece	4th International Workshop on Non-Equilibrium Thermodynamics and Complex Fluids , Ms. Kleanthi Zacharopoulou, FORTH/ICE-HT, Stadiou Str., Platani, P.O. BOX 1414, GR 26504, Patras, Greece Tel.: (+30) 2610-965 278, Fax: (+30) 2610-965 223, E-mail: iwnet_2006@chemeng.upatras.gr http://www.complexfluids.ethz.ch/cgi-bin/CONF/c?registerform=on
6-8 Sept Budapest Hungary	Conference on Modelling Fluid Flow (CMFF'06), the 13th International Conference On Fluid Flow Technologies: Department of Fluid Mechanics, Budapest University of Technology and Economics, H 1111 Budapest, Bertalan L. u. 4-6, Hungary; T: +36 1 463 40 72 Fax: +36 1 463 34 64 e-mail: conference@simba.ara.bme.hu ; http://www.cmff.hu
17-20 Sept Varna Bulgaria	2nd Eurosummer School on Biorheology & Symposium on Micro Mechanobiology of Cells, Tissues and Systems: http://www.biorheo2006.tobulgaria.info/
24-27 September Cape Town South Africa	SASOR 2006: 1st Southern African Conference on Rheology , Veruscha Fester, conference@sasor.co.za Conference Website: http://www.sasor.co.za
11-12 Dec Manchester UK	Dynamics of Biofluids and Biomaterials , Manchester Interdisciplinary Biocentre, School of Chemical Engineering and Analytical Science, The University of Manchester. Dr Xue-Feng Yuan , Tel.: +44-(0)161-306-4887, Fax: +44-(0)161-306-4911, E-MAIL: xue-feng.yuan@manchester.ac.uk
2007	
2-4 April Lake Vyrnwy Wales	Conference on "Whither Rheology" , Lake Vyrnwy Hotel, Mid-Wales, UK. Gareth Roberts, Tel. +44 (0)1248 382480/382686, Fax: +44 (0)1248 361429, e-mail: g.w.roberts@bangor.ac.uk
12-14 April Naples Italy	4th Annual European Rheology Conference, AERC 2007

2006	COURSES
25 October East Midlands UK	Material Science and Polymer Applications of DMA and DETA , Mark Phipps, Triton Technology Ltd., 0115 9375555, mark@triton-technology.co.uk ; www.triton-technology.co.uk
2007	
9-12 Jan Glasgow UK	Process Rheology Dr Nick Hudson, Dept P&A Chemistry, University of Strathclyde, 295 Cathedral St, Glasgow, UK. T: +44 (0) 141 5482162; F: +44 (0) 141 5484822. E: n.e.hudson@strath.ac.uk

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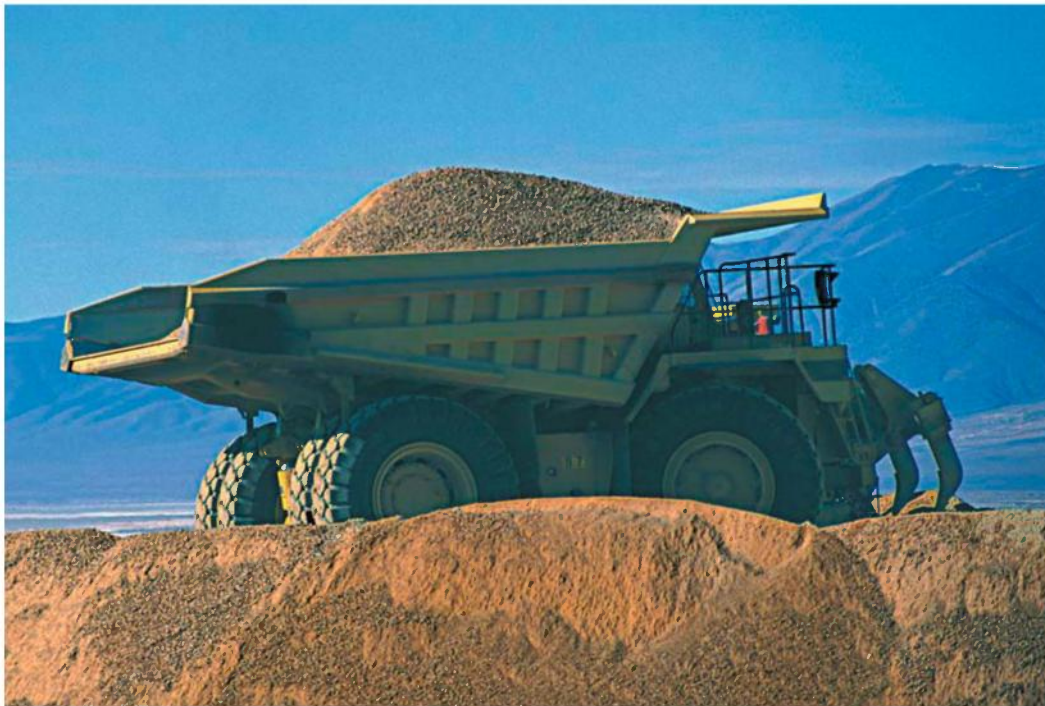
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