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THE BRITISH SOCIETY OF RHEOLOGY

BULLETIN



1986, VOL. 29 No. 1

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EDITORIAL



We are reliably informed via an impeccable source that the Weissenberg Rheogoniometer has been bought from Sangamo by Charimed. They in-end to continue supporting the past models, market the present model and to develop the machine which has, in the past, been considered the standard British rheometer. For connoisseurs we must report that Roy is part of the deal!

Also in the commercial scene, well done Lief Bohlin on your write-up in the FT.

John Hutton's disquiet at the quality (or rather lack of it) in some of the visual aids presented at the Alpe d'Heuz meeting (see p.3) highlights an all too common complaint of hastily produced unreadable overheads. By the way, this was the only conference so far to suffer a black-out inside the conference hall, and a white-out outside, during a blizzard.

News of a national meeting in China is included in this issue. Chris Macosko provided a write-up. This was corrected by Professor Chan Man Fong (an old Aberystwyth boy!) who has been in Peking University for many years. He tells me that although the name of the city has been changed, the University has retained the old name. A full list of papers is available, but space only permits the list of invited speakers.

Our thanks to Jack Astin for an interesting background article on the well-known (to some) Green function and the man behind it.

Howard Barnes



FIRST CHINESE CONGRESS ON RHEOLOGY

The first rheology congress to be held in China took place November 11-14, 1985 in Chang Sha, Hunan Province. Over 180 people attended and 127 papers were presented. Attendees came from 21 of China's 23 provinces from 48 universities, 33 research institutes and 12 manufacturing locations. The average age of the attendees was about 40 with many young professors and graduate students giving papers. Seven instrument manufacturers took part in an exhibit at the congress (Brabender, CEAST, Contraves, Göttfert, Rheometrics, Rhesca and Viscometers, UK). Some representatives of the manufacturers gave papers.

The congress was organized jointly by the Chinese Chemical Society and the Chinese Society of Applied and Theoretical Mechanics. Professor Chan Man Fong of Peking University was the Chairman, Professor Yuan, Longwei of Xiangtan University (Hunan Province), Vice Chairman and Dr Xu, Yuanze of the Academia Sinica Beijing, Secretary.

Below is a (partial) listing of the titles of the papers read at the conference. The names are in the usual Chinese order, last name first. The titles indicate that the program was quite diverse. Proceedings of the meeting will be published in Chinese in April 1986. A session on nomenclature was also held and a committee formed to establish uniform notation. A Second National Congress is expected in 1987. Anyone interested in receiving the proceedings of the first Congress or in future meetings should write to Dr. Xu.

It is interesting to note the impact of China's visiting scholar program which began in 1978. Nearly all of the invited lecturers were visiting scholars. Han studied with Becker at Darmstadt. Fan worked with Bird at Wisconsin, Jiang with Metzner at Delaware, Xu with Schummer at Aachen and Gu with Tanner in Sydney. Chan Man Fong is a repatriated Chinese who did his Ph.D. with Ken Walters in Aberystwyth and lectured on Mechanics until 1979 at Reading. Professor Jin is originally from Korea.

PROGRAM OF THE FIRST NATIONAL CONGRESS ON RHEOLOGY

Changsha, Hunan CHINA

November 11-15, 1985

INVITED LECTURES

- IL-1: History and Prospects of Rheology
C.F. Chan Man Fong, Fan Chun
Peking University, Department of Mechanics
- IL-2: Application of Rheology on Fracture, Metallurgy and Traditional Chinese Medicine
Yuan, Long Wei
The Department of Mechanics Xiangtan University, Hunan
- IL-3: Advances in Stability of Non-Newtonian Flow
Han Shifang
Institute of Mathematical Sciences, Chengdu Branch Academia Sinica, Chengdu
- IL-4: Prospects about Relationships between Viscosity, Composition and Deformation of Multiphase Polymer Alloys by Cluster Theory
Jin Riguang
Beijing Institute of Chemical Technology, Polymer Science Department, Box 61, Beijing
- IL-5: Review of Molecular Theory in Polymer Rheology
Fan Xijun, Xu Yuanze
Department of Chemical Engineering, Hangzhou
- IL-6: Progress and Application of Transfer processes of Non-Newtonian Fluids
Jiang Tiquin
East China Institute of Chemical Technology, 130, Meilong Road, Shanghai 200040
- IL-7: Advances in Rheological Measurements
Xu Yuanze, C.F. Chan Man Fong
Institute of Chemistry, Academia Sinica, Box 2709. Beijing
- IL-8: On Numerical Simulation and Experimental Investigations of Viscoelastic Flow
Gu Dashi
Chengdu University of Science and Technology, Chengdu

VISCOELASTICITY OF POLYMERIC LIQUIDS

PROCESSING OF POLYMER SOLUTIONS AND MELTS

International Conference held under the auspices of Centre National de la Recherche Scientifique, Groupe Francais des Polymeres, Groupe Francais de Rheologie, and Euromech 206.

ALPE D'HUEZ (Grenoble) 13-16 January 1986

Most rheological conferences are memorable, particularly the international ones, and this international conference will be one of the most memorable of its type. In years to come those who attended will remind each other of "the time when", and those who did not attend will have their ears bent by "did you hear about"

The organising body was the Institute de Mechanique de Grenoble, a national research laboratory with a strong rheology department. The initiators and organisers were Professors Jean-Michel Piau and Pierre Carreau who fully deserve our thanks and congratulations. Their first master-stroke was to perceive the need, at this time, for a meeting between academic and industrial workers; their second was to gather together many of the leading scientists, both pure and applied; their third was to site the conference in a village 6000 ft. up in the French Alps with all the sporting facilities imaginable. About 160 attended and many applications had to be turned down (40, according to one source). The conference programme allowed for presentation of papers in the morning and early evening, followed by poster presentations and a general discussion. The afternoon was free for winter sports. On the fourth, and last, day the programme was modified after lunch and included an organ recital at 6 p.m. The Conference Dinner on the third evening was presided over by the Director of IMG, Mme Monique Piau.

It was a very busy time for those who tried to do it all. Every day but one it snowed, at a rate of 30cm. a day so it was said. (Shunting snow and digging out motor cars figure largely in the local economy.) The snowstorms severely restricted skiing and, perhaps, accounted for the very good attendances at the 4.15 p.m. sessions. Outdoor swimming in a heated pool did not provide serious competition. The clear day was the fifth, when most people had to leave by 9 a.m. for the journey home. As if to taunt us, the sunrise came over Pic Blanc blood-red. And your reporter's camera battery was flat!

The first talk at each session was a specially-invited lecture. It is worth mentioning all these. All were first-class.

"New experimental methods for the study of non-linear viscoelasticity" by J M Dealy (McGill University).

As an engineer, Dealy considered that the large-strain, large-strain rate region was the most important. He was much in favour of sliding-plate rheometers, which are basically simple devices capable of very high shear rates. Flow instability and fracture are attainable. The normal stress function is obtained by flow-birefringence. A transducer set in one plate surface allows shear stress to be measured avoiding edge effects.

"Rheological behaviour of complex industrial polymeric materials" by J L White (University of Akron).

This was about polymeric liquid crystals and particle-filled polymer melts. Many experimental observations made on liquid-crystal systems were described. For example, orientation occurs in shear and disorientation occurs when shear is stopped, but the rate of decay of stress is much faster than the structural change. A liquid crystal system seems to have a yield stress. Similarly, putting in 20% v/v or more of particles in a melt produces yield phenomena.

"Microscopic basis of viscoelasticity of polymeric materials" by M Doi (Tokyo U.)

Doi gave a review of the Doi-Edwards theory, starting with Edwards' model of a molecule confined in a convoluted tube and de Gennes' idea of reptation, that is, diffusion along the tube. These concepts lead to two relaxation processes. A third is introduced through consideration of entanglement and the Bueche-Ferry concept of a critical entanglement length. The stress tensor is obtained by applying the principle of virtual work, and an equation of the K-BKZ form can be derived. The stress-optical law can be generalised to include infra-red dichroism and nuclear magnetic resonance as indicators of the state of stress. There are shortcomings, e.g. an M^3 law of melt viscosity, rather than a 3.4 power. Expectations for the future include treatments of polydispersity and chain-branched molecules.

"Constitutive equations in slow flows" by G Marrucci (University of Naples)

The Doi-Edwards theory predicts the ratio of (minus) second to first normal stress coefficient to be $2/7$. This implies a negative Weissenberg effect. For a positive effect this ratio must be $< 1/4$. The D/E theory uses the so-called independent alignment approximation, which Marrucci considers is unnecessary. He then showed that by avoiding this approximation the ratio is $1/7$ and the Weissenberg effect is therefore correctly predicted.

"Computation of molten polymer flows in extrusion dies" by J F Agassant & B Vergnes (ENS des Mines, Paris).

Agassant gave a generalised treatment of die flow which is dominated by zero Reynolds Number, viscous heating, shear-thinning and, sometimes, viscoelastic effects. In most dies a two-dimensional flow can be assumed and the geometry can be simplified to a straight channel. Often the temperature can be taken to be uniform across the channel, in which case the problem becomes one-dimensional. Numerical solutions can then be obtained. The work has shown that some defects in extrudates can be ascribed to temperature effects and cured by small changes in the control temperature.

"Flow characteristics associated with abrupt changes in geometry in the case of highly elastic liquids" by K Walters (University of Wales, Aberystwyth).

New results from laser flow visualisation experiments were discussed in conjunction with earlier results published by Walters, Boger, Giesekus and others. The situation is complex and unresolved. The formation of lip-vortices (at the rim of an orifice) cannot be predicted with certainty. Sometimes they appear only in a narrow range of variables and will have been missed in earlier work. It has been proved that when a Newtonian liquid and an elastic liquid flow together, vortices characteristic of elastic liquid flow can be made to occur in the Newtonian.

"Numerical simulation of polymer flow" by M. Crochet (Catholic University, Louvain la Neuve)

Until recently numerical simulation procedures "blew up" when the Deborah Number went beyond about 1. The calculations failed to converge. Now it is possible to treat flow through abrupt contractions up to Deborah Numbers of 10. A main reason for the early failure was the unsatisfactory algorithm for evaluating the stress field.

"Flow stability of viscoelastic liquids" by M M Denn (University of California, Berkeley).

The author reviewed melt-fracture phenomena in extrusion flow. The three main forms are sharkskin, stick-slip and wavy fracture, but they are not always easily observable in all polymers. Denn is very critical of numerical predictions of instability and thinks that most of them are built into the algorithm used. He is impressed by the experimental work of Ramamurthy who has demonstrated the beneficial effect of certain materials of construction of commercial dies. Denn considers that wall-effects must be of major importance.

Lack of space and inclination precludes mention of other papers. All contributions will be refereed prior to publication in a special issue of The Journal of Non-Newtonian Fluid Mechanics.

There are two last points to be made. First, the successful poster sessions. Conventionally, these things are minor disasters. At Alpe d'Huez they worked well because they were ready when the audience had just finished a session, they were close by, and there was nothing else on. Finally, the conference failed to gain the highest rating because, owing to the incompetence of the speakers concerned, combined with poor acoustics, far too many of the minor talks were incomprehensible. What is it that makes an author come to the lectern with enough material for two hours fast talking and try to cram it into 25 minutes? Is it immaturity, or arrogance, or indifference? It is not the tyro who is to blame, it is the experienced conference-goer. Your reporter thinks the time has come for conference organisers to take action and suggests that one visual aid per 3 minutes is an acceptable norm. A past-President, also at Alpe d'Heuz, thinks that slides and viewgraphs should be sent in with the abstract for approval before a conference. Perhaps the Bulletin Editor should invite suggestions.

If the rheological community decides to do something effective about this disagreeable aspect of conferences, the Alpe d'Huez conference would be one of the most memorable yet.

When I was an undergraduate at Nottingham University everybody had heard of Green's theorem (the two dimensional form of the Divergence theorem), most had heard of the Green-Gauss divergence theorem and Green's extension much used in vector analysis and some had even heard of Green's functions and their use in solving differential equations but nobody seemed to have heard of Green.

That Green was little known in Nottingham was very odd considering that he was without doubt the leading Mathematical Physicist in Britain in the early part of the last century and that his birth place was Nottingham.

If I had been an undergraduate a hundred years prior to my actual student days, this ignorance could perhaps have been understandable since Green's memoir on electricity and magnetism published in 1828 was not publicised until after 1845, when it had been rediscovered by William Thomson (later Lord Kelvin) by which time Green was already dead (Ref 1).

Who then was Green of Nottingham? George Green was born in July 1793, his birth was registered in the Parish Church of St. Mary's in Nottingham. His father was a baker and landowner. George Green seems to have had very little formal schooling, being registered as a day pupil in 1801 but by the middle of 1802 he was back helping at his father's bakery. During this time parts of Nottingham rapidly developed into slums (Ref 2); the bakery was attacked by hungry mobs in 1800. In 1807 the family bought land at Sneinton, then a country area out of town and erected a mill on it, some ten years later they built and moved into the house which stands next to the mill. In 1828 Green published privately his memoir on Electricity and Magnetism. There were 52 subscribers; it appears to have met with total lack of interest. During 1829 his father died and in 1833 he sold the mill and thus being moderately well off he enrolled as a student at Gonville and Caius College, Cambridge, perhaps hoping that he now would find a more fertile field for his ideas. He produced a series of papers for the Cambridge Philosophical Society culminating in 1839 with the award of an M.A. and a fellowship to his college.

However, during 1840 Green returned to Sneinton, in ill health and one year later at the age of 47 he died.

Although George Green never actually married he seems to have been faithful to Jane Smith from Radford, who bore him seven children all of whom bore the name Green Smith, the first in 1824 and the last in 1840 and his will made provision for all of them. Clara his last surviving child died in 1919 - she bequeathed her property to a sister who had already died, all Green's property thus went to the Crown. At this point George Green's remaining scientific, business and personal papers were then burned by the neighbours as 'rubbish'.

Green's mill survived more or less intact until 1947 when it was gutted by a fire. It remained in this state until 1972 when rumours that it was to be demolished stirred up local interest in Green and his mill. Discussions with the local planning department and considerable local enthusiasm brought about the George Green Memorial Appeal with Professor Lawrie Challis as chairman (see Ref 3). Thanks to a great deal of effort by many people, the mill was formally opened in July 1985 as a Science Centre and a Green Museum. Recognition is some times slow in coming but it is all the more welcome when it comes. The mill and museum is of enormous importance not just as a memorial to George Green but as a vital, scientific and educational

centre. The mill welcomes visitors and more details can be obtained from Mr D Plowman, Keeper of Green's Mill, Nottingham. What then is the significance of Green's work for Rheologists? There is a threefold input into Rheology coming directly from the work of George Green:

- 1) he introduced the notion of the potential function so important in ideal fluid flow,
- 2) he was the virtual founder of vector analysis and
- 3) his contribution of the ideal of using an auxiliary function (the Green function) to aid in solving differential equations is now well used and well developed both for rheological and other applications.

He was also important in a more general way in his attempts to fuse mathematical modelling and physics.

In all his writings he was well ahead of his time. His works were finally published at Cambridge thirty years after his death in 1871 (Ref 4).

Thankfully one hundred years later when the mill was about to be reduced to 'rubbish' Nottingham was woken up and realised the genius of the Sneinton Miller's son (Ref 5).

REFERENCES

1. Essay on the Application of Mathematical Analysis to Theories of Electricity and Magnetism

Private Publication 1828

Referred to by William Thomas in his diary 1845.

Republished by William Thomson in Crelle's Journal, 1846.

2. The making of the English Landscape, W. G. Hoskins 1955.
3. Phys. Bull. 36 (1985) p299-301 'Green's Mill and Science Centre', S Croft.
5. The Works of George Green, Cambridge 1871.
5. George Green Miller Snienton, City of Nottingham Leisure Services, 1976, reprinted 1980.

A SIMPLE EXAMPLE OF THE USE OF GREEN'S FUNCTION

If we have a time dependent linear system subject to a time-varying force then the solution to the differential equation involved is:

$$x(t) = \int_0^t G(t, \xi) F(\xi) d\xi$$

where $F(t)$ is the time-varying force and $G(t, \xi)$, the Green's function, is the solution of the problem due to an impulsive blow at time. That is, physically we think of time-varying force as a series of single blows and we obtain the reaction as the sum of all these blows. Note this involved the notion of the Dirac δ -function long before the time of Dirac. Though the idea may seem straight forward, the problem of finding the Green's function for a given differential system can be extremely difficult. For the non-mathematical practitioners a simple example will suffice to illustrate the technique. Consider the equation:

$$\frac{dx}{dt} + kx = F(t)$$

The Green's function satisfies:-

$$\frac{dG}{dt} + KG = \delta(t - \xi)$$

where solution is:-

$$G = H(t - \xi) e^{k(\xi - t)}$$

where H is the unit-step function (Heaviside's function)

The solution of the original equation is thus:-

$$x = \int_0^{\infty} H(t - \xi) e^{k(\xi - t)} F(\xi) d\xi$$

which becomes

$$x = \int_0^{\infty} e^{k(\xi - t)} F(\xi) d\xi$$

I give this only as an example of the use of Green's functions, it has one major drawback:- How do we find G ? In this case that is almost as difficult as the original problem which, in any case can be solved more easily by the integrating factor method and is thus like using a sledge hammer to crack a nut. However I hope this gives some feel for the method.

J ASTIN

BRITISH SOCIETY OF RHEOLOGY

BALANCE SHEET as at 30th JUNE, 1985

<u>ASSETS</u>	<u>1985</u>	<u>1984</u>
<u>Fixed Assets</u>		
Microcomputer at cost	2174	2174
Less: Depreciation to date	<u>1302</u> 872	<u>868</u> 1306
<u>Investments</u>		
Redbridge 9½% Bond	2500	2500
Trustee Savings Account	<u>2409</u> 4909	<u>2277</u> 4777
<u>Current Assets</u>		
Cash at Lloyds Bank:-		
Deposit Accounts	13911	7344
Current Account	<u>1840</u> 15751	<u>2339</u> 9683
Sundry Debtors	316	3866
	<u>21848</u>	<u>19632</u>
<u>LIABILITIES</u>		
<u>Current Liabilities</u>		
Sundry Creditors	138	240
<u>Net Assets</u>	<u>£21710</u>	<u>£19392</u>
	<u><u> </u></u>	<u><u> </u></u>

Represented by :-

General Fund as at 1st July 1984	19392	14875
<u>Add: Trustee Savings Bank Interest</u>	<u>131</u>	<u>178</u>
	19523	15053
<u>Add: Excess of Income over Expenditure</u>	<u>2187</u>	<u>4339</u>
	<u>£21710</u>	<u>£19392</u>
	<u><u> </u></u>	<u><u> </u></u>

 Hon. Treasurer

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

Chancery House,
3 Hatchlands Road,
REDHILL, RH1 6AA
4th September 1985


Chartered Accountants.

BRITISH SOCIETY OF RHEOLOGY

REVENUE ACCOUNT for the year ended 30th JUNE 1985

<u>Expenditure</u>	<u>1985</u>	<u>1984</u>
Council Expenses	1556	1271
Bulletin Production Costs	1184	1996
Expenditure by Officers :-		
President	35	38
Secretary	54	21
Treasurer	53	9
Membership Secretary & Circulation	<u>639</u>	<u>983</u>
	781	1051
Professional Fees	138	138
Insurance	45	49
Annual Awards	300	845
Miscellaneous	372	114
Depreciation :-		
Microcomputer	<u>434</u>	<u>434</u>
	4810	5898
Excess of Income over Expenditure	<u>2187</u>	<u>4339</u>
	<u>£6997</u>	<u>£10237</u>

Income

Annual Subscription and Entrance Fees	2584	3220
Publisher - Rheology Abstracts	2650	2484
Advertising Revenue	93	-
Bulletin Subscriptions	135	55
Leaflet Circulation	-	111
Investment Income :-		
Bank Deposit Account Interest	926	398
Redbridge Bond	171	171
Inland Revenue (Tax Repayments)	<u>72</u>	<u>73</u>
	1169	642
Conferences : Net Surplus per account	<u>366</u>	<u>3725</u>
	<u>£6997</u>	<u>£10237</u>

Conference Account

Surplus: Cambridge Conference less expenses	-	273
Birmingham Conference less expenses	230	546
London Conference less expenses	(5)	2878
Aberystwyth Conference less expenses	141	-
Sundry : re Newcastle 1982 Conference	<u>-</u>	<u>28</u>
	<u>£366</u>	<u>£3725</u>

MEMBERSHIP NEWS

The following applications for Membership were approved at the Council Meeting on 13th December 1985.

Dr Martin Charles BARKER ICA, ICI Agricultural Division P.O. Box 1, Billingham, Cleveland, TS23 1LB	B.Sc., M.Sc., Ph.D. fea DFGJ
Mr Anthony Gordon BUXTON Newsco Well Service Ltd., Boundary Road, Harfreys Industrial Estate, Great Yarmouth, Norfolk.	LRIC, B.Sc. peta 6
Prof. Sir Sam EDWARDS F.R.S. University of Cambridge Cavendish Laboratory, Madingley Road Cambridge, CB3 0HE	 ptsa BCDEFGHIJKL
Mr Rex James FIELD Technical Service Group, Grace GmbH In der Hollehecke 1, Postfach 449, D-6520 Worms, WEST GERMANY	B.Sc. (Hons.), M.Sc. fetsa DEGN
Mr Abraham Samual GOLDBERG Powder Advisory Centre P.O. Box 78, London NW11 0PG	B.Sc. Tech.(Hons.), C.Eng., etc. fea GH
Dr Michael James HEY Department of Chemistry, The University, Nottingham NG7 2RD	B.Sc., M.Sc., Ph.D. petsa FGL
Dr Sin Yau LIN Unilever Research Ltd., Port Sunlight Laboratory Bebington, Wirral, Merseyside, L63 3JW	Ph.D., MPRI fetsa BDL
Mr Stephen LOBLEY Hythe Chemicals Ltd., Charleston Industrial Estate, Hythe, nr. Southampton, Hants, SO4 6ZG	 pesa DFJ

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Cambridge, CB2 3RA

B.Sc., M.Sc.

fets DN

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Norfolk

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petsa DFGHJ

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Glasgow, G12 8QW

M.A., Ph.D.

ptsa CN

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University of Leeds
Leeds, LS2 9JT

C.Chem., MRSC, M.Phil

feta GH

Dr Christos TSENOGLOU
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Stevens Inst. of Technology,
Hoboken,
New Jersey 07030
U.S.A.

Dip.Chem.Eng., M.S, Ph.D.

fetsa BCDFLMN

oo0oo

RESIGNATIONS

Mr H Archer - On retiring from Donald MacPherson Group. Joined in 1964

Mr D Heath - ICI Plc, Jealott's Hill Research Station. Joined in 1980

oo0oo

1986 Annual Award

Society Members are invited to
make nominations for
the award. Proposals should
be sent to the Secretary
as soon as possible.

THE INSTITUTE OF PHYSICS

Tribology Group

in collaboration with

THE INSTITUTION OF CHEMICAL ENGINEERS (Particle Technology Subject Group)

THE INSTITUTION OF MECHANICAL ENGINEERS

THE ROYAL SOCIETY OF CHEMISTRY (Faraday Division)

THE PLASTICS AND RUBBER INSTITUTE

One day meeting on

TRIBOLOGY IN POWDER CONVEYING AND PROCESSING

3. "POWDER COMPACTION AND INTERFACE SHEAR"

Wednesday 26th March 1986

SCHOOL OF POWDER TECHNOLOGY, UNIVERSITY OF BRADFORD, WEST YORKSHIRE

Programme:

Papers on

"The Adhesion of Solids" - Prof D Tabor

"The Role of Interface Friction in the Compaction Maize"

- Dr B J Briscoe et al

"Die Wall Friction Effects in the Compaction of Polymer Granules"

- Dr D P Isherwood

"Tribological Consequences of Compaction and Interface Shear of Micronized Powders"

"Uniaxial Powder Compaction" - Dr N G Stanley-Wood

"Powder Compaction at High Rates of Strain" - Dr S T S Al-Hassani

"Explosive Compaction of Non-metallic Powder Mixtures"

- Dr T Z Blazynski

"Computer Simulation Experiments on Particulate Materials"

- Dr C Thornton

ORGANISERS:

LOCAL ORGANISER:

Dr B J Briscoe (Imperial College)
Tel: 01-589-5111

Dr M J Adams (Unilever Research)
Tel: 051-645-2000

Dr N G Stanley-Wood
SCHOOL OF POWDER TECHNOLOGY
University of Bradford
Bradford
West Yorkshire BD7 1DP
Tel: 0247 733466

VISCOMETER TRAINING COURSE

The Viscometer Department of Contraves Industrial Products Limited of Ruislip, Middlesex, are to hold their 4th Viscometry Training Course on 9th-10th April 1986.

Delegates on this course will be introduced to the basic principles of viscometry and manual techniques through lectures and workshop sessions providing 'hands on' experience and demonstrations. During these practical sessions the full range of Contraves rotational viscometers will be made available for use by delegates.

Lectures will deal with the definition of viscosity and the relationships which exist in both Newtonian and non-Newtonian (time independent and time dependent) flow. Special attention will be given to the principles which are involved in both coaxial cylinder and cone-and-plate geometries. Comprehensive notes will be provided.

Guest speaker - Dr. D.C-H. Cheng, Warren Spring Laboratory.

Practical sessions will involve demonstrations of different flow properties and measurements of different materials by the delegates. Delegates may bring samples for testing during the evening session. Contraves staff will be in attendance at the hotel for informal consultancies.

The two-day course fee of £150.00 (+ VAT) is inclusive of accommodation, meals and documentation.

To allow for close individual training and supervision, the course will be restricted to twelve delegates.

Further information and registration forms are available from Mrs. C.A. Moules, Contraves Industrial Products Ltd., Times House, Station Approach, Ruislip, Middlesex, HA4 8LH.
Telephone: 08956 30196. Telex: 935129

● **Jun 16/20, 1986**

Finite Element Methods in Flow Properties 6th international symposium

Antibes France

Sponsors: Avions Marcel Dassult; Breguet Aviation;
Electricite de France; Laboratoire National
d'Hydraulique; French National Research Institute in
Computer Science and Automation

Contact: INRIA, Service des Relations Exterieunes,
Rocquencourt, B.P. 105, 78153 Le Chesnay Cedex,
France

Topics: Viscous flows, turbulent flows, thermal convection;
compressible flows; shallow water problems. Free surface
flows; geophysical flow problems; seepage flows in porous
media; non-Newtonian flows; combustion; stability and
bifurcation; computational techniques; vector mechanics and
parallel algorithms; spectral methods. In French and English.
Simultaneous interpretation available.

● **Jun 17/20, 1986**

European Rheologists 2nd conference

Prague, Czechoslovakia

Sponsors: Czechoslovak Chemical Society Group of
Rheology; Czechoslovak Academy of Sciences Institute of
Hydrodynamics

Contact: 2nd EURO-RHEO Conference, Institute of
Hydrodynamics, Czechoslovak Academy of Sciences,
Podbabska 13, 166 12 Prague, Czechoslovakia

Topics: transport phenomena in rheological systems;
rheometry; solids and composites; rubber; suspensions;
polymers rheology and processing; biorheology and medical
applications; food rheology and processing. In English.

RESEARCH OPPORTUNITIES IN
FIBRE REINFORCED PLASTICS

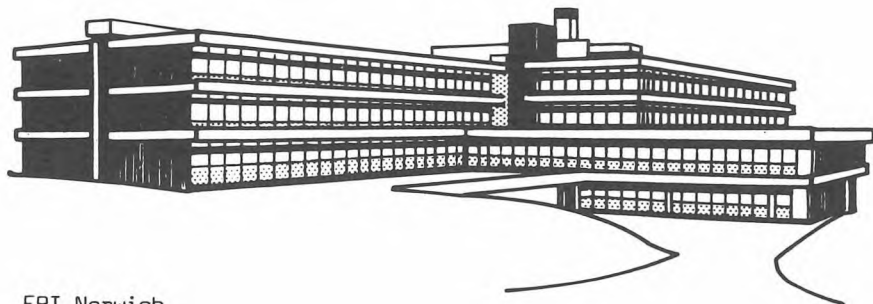
Applications are invited from suitably qualified Applied Mathematicians for posts at both the Post-doctoral and Research Studentship levels. The project is financed by ICI and involves theoretical studies into the Rheology of, and Flow Processes in, Fibre Reinforced plastics.

The positions, which are for up to three years, are tenable from 1st October 1986 at either the Department of Mathematics, University College of Wales, Aberystwyth, or the Department of Theoretical Mechanics, University of Nottingham.

Further particulars and application forms may be obtained from either Professor K Walters at the University College of Wales, Aberystwyth, or Professor A J M Spencer at the University of Nottingham.

Closing date for applications is April 14th, 1986.

YOUR LAST REMINDER ABOUT THE FORTHCOMING
CONFERENCE ON



FRI Norwich

Food Rheology

CONFERENCE AT THE UNIVERSITY OF EAST ANGLIA

15 - 18 APRIL 1986

CONTACT: DR G J BROWNSEY
FOOD RESEARCH INSTITUTE (NORWICH)
COLNEY LANE
NORWICH
NORFOLK, NR4 7UA

Tel: 0603 56122, ext. 201