

BULLETIN



BRITISH SOCIETY OF RHEOLOGY

1978, Vol. 21, No. 4

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Hon. Editor:

M: CAMINA,

Paint Research Association,

Waldegrave Road,

Teddington,

Middlesex.

FOREWORD

Many thanks to Dr. T. E. Jones for organising the successful Conference at Plymouth.

Sadly, Dr. John Benbow has now ended his two years of office as President and the members of Council thank him for his chairmanship and conciliating occasional opposing views. We now welcome Dr. W. M. Jones of U.C.W. as President of our Society.

Neil Cogswell has retired as Secretary but not, we are glad to say, from Council. The work of Secretary is quite onerous but Neil has accomplished much. His innovating style has furnished the Bulletin with much information. Dr. Cheng now leaves the Council and I thank David for his many articles.

We welcome Dr. C. Dimond from Sheffield University to the Council and hope that he will not be intimidated by the old hands.

OFFICERS AND MEMBERS OF COUNCIL, 1978-1979

President: DR. W. M. JONES, Physics Department, U.C.W., Penglais, Aberystwyth.

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

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

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

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

Bulletin Editor: MR. M. CAMINA, Paint Research Association, Teddington, Middlesex.

Ordinary Members:

MR. F. N. COGSWELL, I.C.I. Ltd., Plastic Division, Welwyn Garden City.

MR. T. C. DAVENPORT, B.P. Research Centre, Sunbury-on-Thames, Middlesex.

DR. C. R. DIMOND, Department of Building Science, University of Sheffield, Sheffield, S10 2TN.

DR. J. FERGUSON, Department of Fibre Science, University of Strathclyde, Glasgow.

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

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



Mr. R. W. Whorlow (right) receiving the first annual award
of the Society from Dr. W. M. Morgan
(see letters to the editor)

THE BRITISH SOCIETY OF RHEOLOGY

Minutes of the 38th Annual General Meeting of the Society

The 38th A.G.M. of the Society was held at the College of St. Mark and St. John, Plymouth, on Thursday, 7th September, 1978. The President took the chair at 17.30. Thirty-two members were present.

The Minutes of the 37th A.G.M., held in Edinburgh on 8th September, 1977, had been published to the membership in the Bulletin and, on a motion from the floor, that publication was accepted as a correct record, adopted and signed.

The Secretary reported that the Society had pursued and is continuing an active conference programme with substantial collaboration with other learned societies.

During the year the very successful conference on "General Rheology and Stretching Flows" was concluded at Edinburgh. The finances of the Society had benefited greatly from the labours of Dr. Ferguson and his colleagues. Following the conference Dr. Petrie acted as guest editor for a special issue of the Journal of Non-Newtonian Fluid Mechanics in which several of the papers were published. In January the Society joined with the Faraday Division of the Chemical Society for their conference on "Molecular Interactions, Microstructure and Rheology" organised by Dr. Roberts at Cranfield. In April Dr. Oliver arranged a one-day "Rheology Colloquium" within the Institute of Chemical Engineers "Prodex 78" congress at Birmingham. Dr. Jones, Dr. Beazley and Dr. Dimond were to be congratulated on the organisation of the present meeting. The members of the Society have been active in disseminating rheological ideas to the general scientific public in other actions outside the main activities of the Society. In particular Council had noted with pleasure the reports which it had received on "How to use your rheogoniometer on the banks of Loch Lomond" sponsored by Sangamo Ltd. and organised by Professor Walters and Dr. Ferguson and the training courses on Fluid Rheology which are organised by Dr. Cheng at the Warren Spring Laboratory. This has been an active year for the Society and its members both in advancing our knowledge and in advertising it to the general scientific public.

Next year shows a continuing activity. Plans for a joint meeting with the Cybernetics Society on "the Measurement and Control of Rheological Processes" (5th January) are progressing smoothly under the guidance of Dr. Warburton and Dr. Sherriff. Dr. Wetton is acting as the representative of the Society on the organising committee of the conference on "Deformation, Yield and Fracture in Polymers" to be held at Cambridge 2nd-5th April. Dr. Bancroft is assisting the Dutch Society who are acting as hosts to the Italian

Society and ourselves at Amsterdam (18th-20th April). The title of the meeting is the "Rheology of Associating, Structured and Biological Systems". The Australian Branch is organising its first national three-day meeting at Monash (28th-30th May) and would be pleased to welcome British members. Next year's autumn meeting will be at Aberystwyth (11th-14th September) and entitled "Applied Rheology": Mr. Astin and Dr. Marshall are organising the meeting. Plans for a further joint meeting with the Plastics and Rubber Institute on "Polymer Rheology" in the spring of 1980 are already well advanced with Dr. Marshall and Dr. Petrie in charge. 1980 also sees the VIIIth International Congress on Rheology to be held in Naples in September. There is thus a further broad programme but there is still room in the calendar for further short specialised meetings if members would care to suggest appropriate titles.

In the area of Polymer Rheology one outcome of the discussions with the Plastics and Rubber Institute and the Polymer Engineering Directorate has been the setting up of a B.S.I. committee on "Rheological Testing of Polymers" chaired by Dr. Marshall and joined by Dr. Petrie and Mr. Cogswell on behalf of the Society.

To promote the exchange of information between the sister Societies of Rheology, Council passed a resolution proposed by Mr. Davenport that "Any rheologist in good standing in his own Society who is temporarily working in the United Kingdom is eligible for acting membership of the Society and to receive the Bulletin and concessionary rates at conferences without a subscription." Further to facilitate the rapid transmission of information we are now air-mailing Society communications to overseas members.

Arising from the last A.G.M., members were invited to comment on the proposal to institute an Annual Award. Sixty-two replies were received in favour of this proposal and nineteen against. Several nominations were also received. As a result of this vote and in deference to the views expressed by members, Council decided to make an award this year to Mr. R. W. Whorlow in recognition of his outstanding services to the Society and for his work in the teaching and science of rheology.

Also during the year Council sought the collective wisdom of the membership to investigate possible trends in our science and Society. Members were asked to look ahead fifteen years. Eighty-eight members responded and the results which were comprehensively analysed by Dr. Petrie would be presented in the Bulletin. Council is grateful to those members who replied and for the many constructive suggestions. The principal conclusion of the survey is that no major changes in the policy of the Society are called for. Council hopes that the publication of the conclusions will prompt a discussion in the Bulletin and will assist members in planning their activities over the next fifteen years.

Finally, this meeting concludes the term of the present Secretary of the Society. He observed that the post of Secretary of a society can prove an onerous one, sometimes being synonymous with "he who is expected to do all the work", but was pleased to report that this is not the case with this Society. During his term he had been able to find able volunteers for each task which had needed to be done. When taking over the duties of Secretary he had felt that some changes in the policy of the Society were appropriate, but he had been chastened to find that the Society has a very particular will of its own and that the policies which it follows are the policies of the body of the membership and not simply those of a small Council. It is the fact that so many members care about the Society that is its enduring strength. Finally, he acknowledged his debt: to his employers, I.C.I., who had encouraged him in his duties; to his family who had surrendered of his free time; and above all to the membership of the Society who had made his term a stimulating and pleasant experience.

The Treasurer observed that the finances of the Society were in an unprecedentedly healthy condition with assets in excess of £10,000, largely due to Rheology Abstracts and the Edinburgh Conference. A full report is appended. In the atmosphere of relative financial security the Treasurer invited the membership to suggest new or extended activities for the Society.

Several possible alternative activities were discussed. Dr. Tattersall suggested that the Society should aim not to make a profit from conferences; Dr. Jones confirmed that this was indeed the intention with the present meeting. Dr. Tattersall requested that any sale of the membership list should be for strictly relevant purposes: the Membership Secretary confirmed that all reasonable precautions were taken. Mr. Davenport suggested that Council should consider regular publication of the autumn meeting proceedings. Dr. Petrie observed that this would involve a large amount of additional work for the organiser, and that many authors would prefer to publish their papers in special journals. Dr. Lenk suggested that an honorarium for the officers of Council would be an appropriate use of funds, but Mr. Davenport felt that this might only prove to be a way of transferring the funds of the Society to the Inland Revenue and Dr. Tattersall felt that it would undermine the amateur traditions of the Society. Dr. Tattersall pointed out that it is wholly appropriate for Council to make payments for work carried out on behalf of the Society, so relieving officers of the more tedious part of their work. During next year it would be appropriate to make travel grants for the Amsterdam meeting and the amount of such grant should be determined by Council. Members are invited to communicate any suggestions for further activities either to the Secretary or to the Editor of the Bulletin for wide publicity.

On the motion of Dr. Tattersall, seconded by Mr. Davenport, Alfred Simmons and Co. were appointed auditors for the coming year.

The Membership Secretary reported that membership now stood at 586, comprising 370 home members and 216 overseas. This was an increase of eight on last year. Thirty-five new members have been elected of which 13 were from the UK and 22 from abroad. Six people had resigned and 21 people were asked to resign due to non-payment of membership subscription. Twenty-one members are currently in arrears for the 1977/78 subscription.

Mr. Whorlow observed and the Secretary confirmed that while membership was remaining static overseas subscriptions were increasing. Dr. Bancroft and Dr. Tattersall observed that the best way of recruiting new members was through personal contact and by members reporting the activities of the Society in Journals to which they contributed. Council was asked to seek more publicity for the Society in such journals as *Nature*.

The Editor of the Bulletin had made a change in format during the year by introducing a green cover consistent with *Rheology Abstracts*. He had also introduced a feature on sharing problems. He thanked those who had contributed articles during the year and would welcome more articles and items of interest for the future.

The Editor of Abstracts reported that this journal was now picking up after a difficult period when material had been short. There were 24 regular abstractors and six occasional contributors. Approximately 100 journals were covered and members were asked to consult the list which would be published to seek omissions, particularly of overseas periodicals. The President observed that it is impossible to overstate the importance of this journal to the Society.

Dr. Cheng outlined a proposed set of rules to govern the Annual Award. After a brief discussion Dr. Oliver proposed, Mr. Davenport seconded and the meeting unanimously carried a resolution that the proposed rules be adopted. The meeting further requested that Council use its discretion in fixing the monetary value of the award for the coming year. The President invited nominations for next year's award, asking that these be sent to the Secretary.

Dr. Lenk proposed a motion expressing the meeting's concern at the failure of a signatory of the Helsinki agreement on human rights to implement that agreement and asking Council to consider if it might take an appropriate action. Dr. Lenk introduced the motion with profound sorrow, noting that while he had a deep personal regard for the scientists of the state concerned, he nevertheless considered that the Society, as a responsible body, should not undertake any actions which might lend comfort to a

repressive regime. A member enquired if it were appropriate for the Society to consider "political" motions. Seconding the motion, Mr. Camina observed that the meetings of the Society suffered when individuals who had offered papers for its meetings were obliged to withdraw them at the last minute because they were not permitted to travel to the meeting to present their work. At the request of the meeting the Secretary read the objects of the Society as defined by the Constitution. Many members expressed their sympathy with the motion but several also expressed their unease that the Society should venture into such unfamiliar ground, noting that those who attempted to do the most good sometimes ended up doing considerable harm. Rather than proceed to a vote in which it appeared that the meeting would divide more on the constitutional nature of the motion than on its substance, the President ruled that Council should clarify its constitutional implications.

The President called for nominations for the officers and members of Council. There were no nominations for officers additional to those nominated by the retiring Council and the following were elected to serve:

President	Dr. W. M. Jones
Secretary	Dr. C. J. S. Petrie
Treasurer	Mr. A. Evans
Membership Secretary	Mr. T. E. R. Jones
Editor of the Bulletin	Mr. M. Camina
Editor of Rheology Abstracts	Mr. J. Astin

There were seven nominations for the remaining six places on Council, namely: Mr. Cogswell, Mr. Davenport, Dr. Dimond, Dr. Ferguson, Dr. Marshall, Dr. Oliver and Dr. Sherriff. Dr. Khanna and Dr. Bancroft were appointed to act as tellers for the vote, as a result of which Mr. F. N. Cogswell, Mr. T. C. Davenport, Dr. C. R. Dimond, Dr. J. Ferguson, Dr. D. E. Marshall and Dr. D. R. Oliver were elected to serve.

The President thanked Dr. Cheng who had completed four years' service as an ordinary member of Council. He also thanked Mr. Cogswell who had served the Society as Secretary during the last four years.

Dr. Tattersall proposed a vote of thanks to Dr. Benbow who had guided the Society as its President during the last two years. The proposal was greeted with acclaim.

There being no further business the meeting ended at 1910.

Minutes submitted by F. N. Cogswell.
fnc 11th September, 1978.

B.S.R. TREASURER'S REPORT — SEPTEMBER 1978

It is most gratifying after my first year as Honorary Treasurer to be able to report that the Society's finances seem to be in an unprecedentedly healthy condition. From the balance sheet for the 1977-78 financial year (appended) it will be seen that our assets are now in excess of £10,000 or, say, £20 per member, and I therefore propose that the subscription should remain unchanged at £2 per annum.

From the Revenue Account it will be seen that our total expenditure for the year was much the same as for last year. Slight increases in Council expenses and the circulation costs have been offset by reduced Bulletin printing bills, and the absence of any assistance to students wishing to travel to conferences this year.

However, the income for the year has virtually doubled, due principally to a very large cheque from Pergamon Press for our share of the Rheology Abstracts profits, and a substantial surplus from the Conference Account arising largely from last year's very successful Edinburgh meeting. An increase is also to be seen in the subscription income, though this does conceal the fruits of two paid circulations to the membership, which almost completely cover the increased circulation expenditure noted above. Perhaps I should include these as a separate item next year. The apparent bonus from the tax-man is real enough, though it will not be sustained in the coming years as it is due to a change in the way in which income tax deducted at source from investment income is allotted to the various financial years.

Returning to the balance sheet, the large sum in Debtors is mostly the Pergamon cheque, which I have now received, and the investment income tax which I am recovering at present. When the Brentwood bond expired, I reinvested the proceeds together with £1,000 of the Edinburgh surplus with Redbridge, who offered the highest rate of interest at the time. Now that the Pergamon cheque has arrived we once more have rather too much in the bank, and so a further investment may be necessary.

This year's excess of income over expenditure of over £3,000 is clearly going to be exceptional, though I am confident that there should be another surplus at the end of the present financial year. Perhaps members might like to suggest to Council what, if any, new or extended activities the Society should consider in this atmosphere of relative financial security.

4th September, 1978.

Anthony Evans,
Honorary Treasurer.

BRITISH SOCIETY OF RHEOLOGY

Balance Sheet as at 30th June, 1978

ASSETS

INVESTMENTS

Brentwood U.D.C. 12% Bond		Repaid
Wandsworth Borough Council 12 $\frac{1}{8}$ % Bond		2500
Redbridge 10% Bond		2500
Trustee Savings Account		1826
		6826

CURRENT ASSETS

Cash at Lloyds Bank		
Deposit Account	423	
Current Account	773	
		1196
Sundry Debtors		2242
		10264

LIABILITIES

CURRENT LIABILITIES

Sundry Creditors		37

NET ASSETS

£10227

Represented By:

General Fund		
As at 1st July, 1977		6961
Add: Excess of Income over		
Expenditure for the year	3158	
Trustee Savings Bank Interest	108	
		3266
		£10227

Anthony Evans, Hon. Treasurer.

We have examined the above Balance Sheet and annexed Revenue Account together with the books and vouchers of the Society, and certify them to be in accordance therewith. We have not inspected the membership records.

The Market Hall,
Redhill, Surrey.
29th August, 1978.

Chartered Accountants.

BRITISH SOCIETY OF RHEOLOGY

Revenue Account for the year ended 30th June, 1978

1977	EXPENDITURE		
	Committee Expenses mainly travel):		
679	Council	800	
18	Polymer Processing Sub-Committee	—	800
		—	
846	Bulletin Production Costs		765
	Expenditure by Officers:		
58	Secretary	45	
15	Treasurer	2	
221	Membership Secretary and Circulation	329	
		—	376
32	Professional Fees		36
20	Insurance		20
150	Conference Travel		—
			—
2049			1997
570	Excess of Income over Expenditure for year		3158
			—
2620			£5155
			—

INCOME

976	Annual Subscriptions and Entrance Fees		1166
1027	Publisher—Rheology Abstracts		1989
32	Bulletin Subscriptions		35
	Investment Income:		
26	Bank Deposit Account Interest	30	
117	Brentwood Bond	59	
205	Wandsworth Bond	208	
—	Redbridge Bond	55	
144	Inland Revenue (Tax Repayments)	253	
		—	605
52	Conferences—Net Surplus per account		1352
15	Miscellaneous Income		8
			—
2620			£5155
			—

Conference Account

Surplus from Autumn 77 (Edinburgh) Meeting	1317	
Payment from Italian Society Rheology		
Spring 1977 (Pisa) Meeting	75	
	—	1392
Less: Expenses Plymouth Meeting including cash float		40
		—
Net Surplus		1352
		—

PERSONAL NOTE

President — Dr. W. M. Jones

Academic and Professional:

B.Sc. (1st Class Hon., Physics) University College of Wales

D.Phil.(Oxon)

F.Inst.P.

Career:

Started as a Junior Research Officer working on problems of corrosion arising from diffusion of UF_6 through porous materials (with Professor F. E. Simon, F.R.S.). Two years at Harwell on Electron Microscopy and X-ray diffraction. Appointed to lecturing post at Aberystwyth in 1948, been there ever since. University Reader since 1969. Research topic at Aberystwyth began with flow of gases and vapours through porous materials, particularly the contribution of flow in the adsorbed phase to the total flow. Noticed that relaxation of the vibrational mode of the CO_2 molecule affected the stability of gas flow in porous materials and this led to the investigation of the effects of relaxation of large molecules on the stability and drag of the flow of dilute solutions of such macromolecules in various geometrics. And to a profitable co-operative research programme with Professor K. Walters of Applied Maths. Work has been done in co-operation with C.D.E.E. (Porton), B.P. and Shell and now more recently with R.A.E. Problems on oil recovery, shapes of molecules in solution, and the relationship between the cavitation in liquids and their rheological properties (with Dr. D. H. Trevena).

Lecturing topic: Thermodynamics (at all levels) and experimental and theoretical rheology to physicists.

Appointments: Been Chairman of S. Wales Branch Inst. of Physics, on S. Wales Committee of Institute for several years and on National Committees (e.g. Membership Committee) of Institute. Been on W.J.E.C. Physics Panel for several years. Was Governor of U.W.I.S.T. and U.C.W. Been Dean of Faculty of Science and served on Senate, Council.

Social: Now Chairman of Aberystwyth Housing Association. President of U.C.W. Staff Sports and Social Club. Regional Scientific Adviser to Home Office. Treasurer Cardiganshire Labour Party.

Relaxations: from football (round ball) for University of Wales and an Oxford University XI through cricket and squash to gardening and hill walking.

Dr. C. R. Dimond

Chris Dimond was educated at Barry Grammar School and graduated in 1971 from Sheffield University with a degree in Physics and Pure Mathematics. He then joined the Department of Building Science where he gained his Ph.D. for work on the rheological properties of cement pastes. After spending one and a half years working in the Materials Research Group at Taylor Woodrow's he rejoined the Department of Building Science to undertake the development of a practical two-point workability test suitable for high workability concretes. At present he is a Research Fellow in the Department of Building Science and is engaged on research work concerned with the rheology of cement pastes and concretes.

He has been a member since 1972 and an abstractor since 1973. He is married and his hobbies include gardening, most sports and enjoying the British countryside.

REPLY TO TECHNICAL ENQUIRY

On Bingham Plastic Fluids: Theory and Practice

May I respond to the question posed in the column, "Technical Enquiry", in the Bulletin, 1978, Vol. 21, No. 2: "Does anybody know of any material that has truly Bingham flow?"

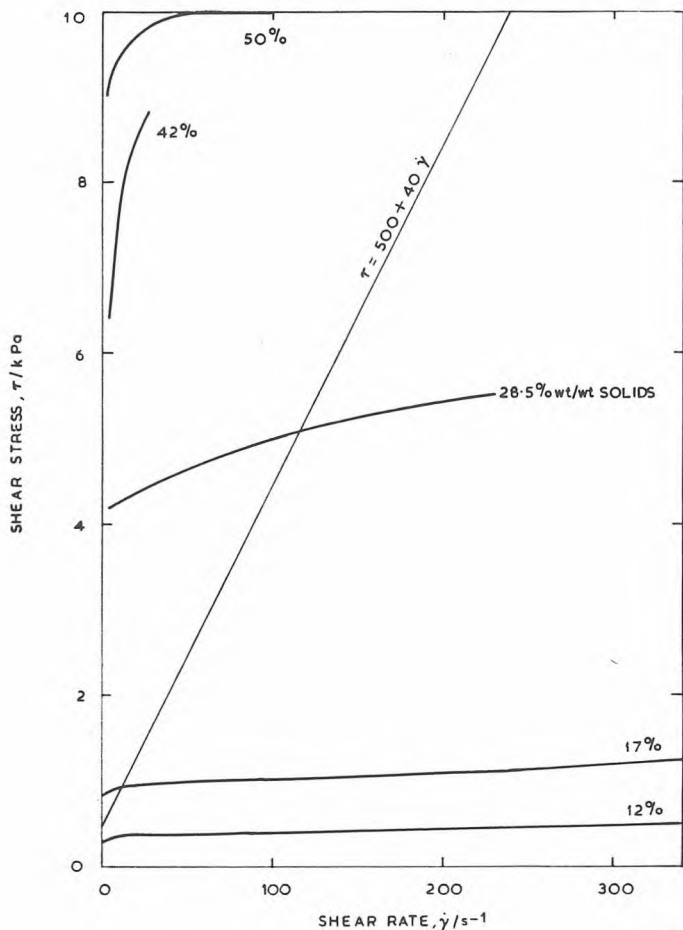
In their paper, Brookes and Whitmore (1969) stated that "no perfect Bingham plastic is known to exist". I would like to echo this by emphasising that no real material, as opposed to the theoretical model, is truly Bingham plastic in the sense that it obeys the governing equation over the entire shear rate range from zero to infinity. Examples of Bingham plastic fluids described in the literature always relate to a finite range of shear rate which at the lower end falls far short of zero. Those examples that do extend to sufficiently low shear rates usually show that the flow curve in fact curves ever downwards, so that the shear stress is less than the value given by extrapolating the straight line formed by the high shear rate data. This curving portion is often ignored in further treatment or application of the viscosity data. Brookes and Whitmore (*loc. cit.*) described this as "only a material approximating to (the Bingham plastic) could be used". But other workers (e.g. Shangraw et al (1961), Worrall and Tuliana (1964), Barry (1971) and Cheng (1973)) recognised the existence of the curved portion and developed modifications to the Bingham plastic equation to describe this phenomenon. Others (such as Casson (1959), Moore (1959) and Peter (1964)), although not specifically aimed at this phenomenon, have also obtained equations that relate to it. (As a matter of interest, this is one of the topics that we discuss at the B.S.R.-approved Training Courses in Fluid Rheology held annually at our Laboratory.)

Some years ago, it was a common occurrence for discussions at B.S.R. meetings to be diverted into the question of whether the yield stress exists as a well-defined quantity. Some asserted that yield stress does not exist: that is the flow curve does not intersect the shear-stress axis, but that the downward curving of the flow curve really becomes asymptotic to the axis, so that at very low shear rates the phenomenon becomes creep. Viscometry is usually carried out using shear rate-controlled apparatus. Those of the yield-stress-does-not-exist school therefore argued that, no matter how low a shear rate is reached in these measurements, it does not really get within the creep regime. They conclude that the yield value obtained by extrapolating to zero shear rate is not real and that creep experiments must be carried out if one is interested in nearly zero shear rate behaviour. The reply from the yield-stress-exists school was perhaps more pragmatic than rigorous. They argued that if a fluid does not show appreciable deformation for as long as one cares to wait, then it possesses a yield stress as far as concerns an engineering operation or industrial process which takes place over a matter of minutes or hours.

In some fluids, the flow curve bends *upwards* at low shear rates, the shear stress taking on a minimum value at some shear rate value. This phenomenon is not well documented, very possibly because workers do not understand it and therefore do not report on it. I have observed it in certain aqueous bentonite slurries. Recently, Jones (1978) found it in Laponite suspensions. It may well have some relevance to the different yield values obtained on certain materials under dynamic as opposed to static conditions. I am sure that there is some valuable insight to be gained into the basic physical and chemical bases of suspension rheology if rheologists learn to read the signs.

Even if no truly Bingham plastic *material* exists in the sense defined earlier, truly Bingham plastic *behaviour* can be obtained under certain conditions. We require firstly a fluid that obeys the Bingham plastic equation over some shear stress range. Then truly Bingham behaviour can be demonstrated in the coaxial cylinder viscometer, provided that the shear stress everywhere in the gap is restricted to the stated range. Departure from truly Bingham flow would be observed if the shear stress range, and so the corresponding shear rate range, is exceeded. The demonstration is even better in the cone-and-plate geometry because, provided the cone angle is less than about 5° , the shear rate variation is even less than the coaxial cylinder of the same gap width. The chosen fluid would not, in principle, show truly Bingham plastic behaviour, for example, with the falling sphere, or in tube flow or in torsional flow between parallel plates, because the whole of the flow curve down to zero shear rate is involved in defining the overall flow characteristics.

On the same page of the Bulletin quoted above there is a "Wanted" notice for a Bingham plastic fluid with a yield stress of about 500 Pa and a plastic viscosity of 40 Pa.s. Following the dictum of Brookes and Whitmore that only a material approximating to Bingham plastic could be used, I have searched through the record of viscosity data we have obtained over the years at the Laboratory. The nearest I can find are shown in the accompanying figures. Most other fluids have lower yield values and lower viscosities than desired.



10332

FIG.1 FLOW CURVES FOR BENTONITE + WATER MIXTURES

Figure 1 shows the variation of flow curves with concentration of solids in bentonite+water mixtures. A yield stress of 500 Pa can be obtained at about 15% wt/wt solids, but the plastic viscosity (which I interpret as meaning slope viscosity) is far less than the 40 Pa.s required. At above 40% solids, a plastic viscosity equalling 40 Pa.s can be obtained over restricted low shear rate ranges, but the yield stress, actual or extrapolated, is far in excess of 500 Pa.

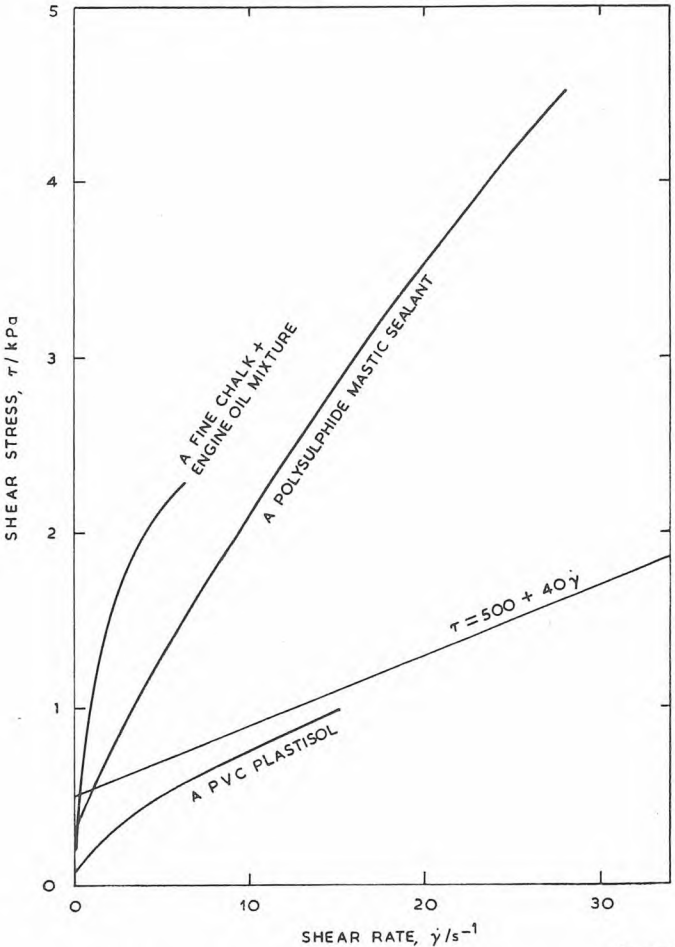


FIG.2 FLOW CURVES FOR THREE OTHER MATERIALS 10333

In Figure 2, we have two materials of yield stress in the region of 500 Pa, but their plastic viscosity is much *greater* than 40 Pa.s. Unfortunately we do not have data on how these flow curves vary with composition of the mixtures.

The third material on Figure 2 appears to be the most promising. Although the true yield stress (i.e. the intercept on the shear stress axis) is just a little less than 100 Pa and unfortunately the available data do not extend beyond about 15 s^{-1} in shear rate, it seems that the high shear rate asymptote could well closely match the 500 Pa/40 Pa.s specification. But whether or not this example would turn out to the material sought would depend on whether the shear rate range over which the flow curve obeys the equation $\tau = 500 + 40\dot{\gamma}$ matches the shear rate range over which the material is to be put to use.

It can readily be concluded from this brief survey that, unless one is lucky enough to have the flow curve data of a material with the desired properties already measured in some data bank, it would not be a simple task to search for a material with some particular yield stress and plastic viscosity combination. One might think that a simple procedure would be to vary the composition of a mixture until the desired properties are obtained. But as we can see from the bentonite data of Figure 1 and other data, the variation of yield stress with plastic viscosity is coupled in any homologous series of materials. A random choice of material is therefore unlikely to give the right combination of properties. If one needs in addition to specify the shear rate range, it would be even more difficult to match the desired properties. At present there is just no systematic approach that one could follow to find the right material.

A further difficulty to advice on the matter is not knowing the purpose for which the material is being sought. Is it for viscometer calibration or for use as a model or a simulate to assess processing equipment performance? For viscometer calibration, there are routes that one can follow without the need to use standard or calibration fluids. This is a subject that W.S.L. had investigated over the years and recently more intensively under the Rheological Research Service, but that is a separate story to tell. For the study of processing equipment, may be the actual material to be processed is its own best simulate!

D. C. H. Cheng,
Warren Spring Laboratory,
Stevenage, Herts.

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NOTES FROM EDITOR OF ABSTRACTS

(a)

Acknowledgment

The Editor of Rheology Abstracts would like to thank the following abstractors whose dedication and hard work have been in no small measure responsible for the continuing success of the Abstracts.

J. Astin.	D. W. Hadley.
D. M. Bancroft.	J. F. Hutton.
K. M. Beazley.	R. S. Jones.
C. F. Chan Man Fong.	T. E. R. Jones.
D. C. H. Cheng.	R. S. Lenk.
F. N. Cogswell.	F. M. Leslie.
M. M. Cross.	D. E. Marshall.
M. F. Culpin.	D. R. Oliver.
P. Currie.	R. Parker.
A. R. Davies.	A. J. Palfrey.
C. R. Dimond.	C. J. S. Petrie.
A. Evans.	R. N. F. Pinfold.
J. Ferguson.	M. Sherrif.
P. Freakley.	

(b)

Rheology Abstracts

During the last five years the following journals have regularly been covered by Rheology Abstracts:

List 1

Acta Mech.	J. Non-Newtonian Fluid Mech.
Acta Phys. Sinica.	J. Oil Col. Chem. Ass.
Acustica.	J. Paint Tech.
Adhesive Age.	J. Pharm. Soc.
Adv. Polym. Sci.	J. Phys.
Agr. Biol. Chem.	J. Phys. Chem.
Appl. Mech. Rev.	J. Phys. Soc. Japan.

Appl. Polym. Sym.	J. Polym. Sci.
Appl. Sci. Res.	J. Sci. Food & Agri.
Arch. Rat. Mech & Anal.	J. Text. Inst.
Aus. J. Dairy Tech.	J. Texture Studies.
Baker's Digest.	Kant. Gummi. Kunststoff.
Ber. Deut. Keram Ges.	Kolloid Z.
BIOpolymers.	L'industrie Ceram.
Biorheology.	Lubric. Eng.
Brit. Ink Maker.	Matrix & Tensor J.
Brit. J. Appl. Phys.	Mech. Teor. i Stos.
Bull. Am. Ceram. Soc.	Med. Biol. Eng.
Bull. Am. Soc. Test. Matr.	Nature (London).
Cah. Grpe fr. Rheol.	Nature Phys. Sci.
Carbon.	N.L.G.I. Spokesman.
Cement & Concrete Res.	Paper ja Pau.
Cereal Chem.	Paper Tech. & Ind.
Cereal Sci. Today.	Papir a cellulosa.
Chem. Eng.	Periodica Polytechnica.
Chem. Eng. Sci.	Pharm. Acta Helv.
Chem. Eng. J.	Phil. Mag.
Chem. Ing. Technik.	Phys. Fluids.
Colloid & Polym. Sci.	Phys. Today.
Colloid J.	Polymer.
Concrete.	Polym. Eng. Soc.
Cr. hebd Seanc Acad. Sci. Paris.	Polym. Letters.
Dairy Ind.	Polym. Mech.
Das Papier.	Polym. & Plast. tech. Eng.
European Polym. J.	POLym. Sci. U. S.R.
Fibre Chem.	Plaste u Kautsch.
Fluid Mech. Sov. Res.	Plastics & Polym.
Food Products Dev.	Proc. Camb. Phil. Soc.
Food Tech.	Proc. Roy. Soc.
Glass Tech.	Process Tech. Int.
Graphic arts Finland.	Q. J. Appl. Math & Mech.
Gummi. Astbest. Kunststoffe.	Q. J. Appl. Maths.
Helv. Phys. Acta.	Rep. Prog. Polym. Phys. Japan.
Indust. Eng. Chem. Fundam.	Rev. Sci. Instrum.
Int. J. Heat & Mass Transf.	Rheol. Acta.
J. A. I. Ch. Eng.	Rubber Chem. Tech.
J. Am. Ceram. Soc.	Russ. J. Phys. Chem.
J. Am. Concrete Inst.	Russ. Ultrasonics.
J. Appl. Mech. Tech. Phys.	Scientia Sinica.
J. Appl. Phys.	Silicates Ind.
J. Appl. Polym. Sci.	Svenska Majer.
J. A. S. A.	Svenska Pappers Tidning.
J. Basic Eng.	Syn. & Phy. Chem. of Polym.
J. Biochem.	T.A.P.P.I.

J. Chem. Eng.
 J. Chem. Eng. Data.
 J. Chem. Educ.
 J. Coating Tech.
 J. Coll. interface Sci.
 J. Comp & Fluids.
 J. Dairy Res.
 J. Eng. Phys.
 J. Fluid Mech.
 J. Food Sci.
 J. Inst. Rubb. Ind.
 J. Macromol. Sci-Phys.
 J. Matr. Sci.
 J. de Mec.
 J. Mech. Phys. & Sol.

Textile Res. J.
 Trans. A.S.M.E.
 Trans. Brit. Ceram. Soc.
 Trans. Faraday Soc.
 Trans. Soc. Rheol.
 Ukraine J. of Phys.
 Ultrasonics.
 Vysokomolek Soed. Ser. B.
 Wear.
 Wood Fibres.
 Wood Sci. & Tech.
 Z.A.M.M.
 Z.A.M.P.
 Z. Phys. Chem. Lpzg.

ABSTRACTORS NEEDED

The following journals are now without abstractors. Would anyone willing to act for these or any other journal not in List 1 please contact J. Astin, Department of Applied Mathematics, U.C.W., Aberystwyth, Wales.

List 2

Acustica.
 Au. J. Dairy Sci.
 Brit. J. Applied Phys.
 Bull. Am. Soc. Test. Matr.
 Carbon.
 Cereal Chem.
 Chem. Ing. Technik.
 Colloid & Polym. Sci.
 Colloid J.
 Cr. hebd Seanc Acad. Sci.
 Dairy Ind.
 European Polym. J.
 Food Tech.
 Glass Tech.
 Int. J. Heat & Mass Transfer.
 J.A.S.A.

J.Chem. Eng.
 J.Dairy Res.
 J.Inst. Rubb. IND.
 J.Phys. Soc. Japan.
 J.Polym. Sci.
 J. Texture Studies.
 Periodica Polytechnica.
 Phys. & Chem. of Glass.
 Plaste u Kautsch.
 Polymer Sci. U.S.S.R.
 Process Tech. International.
 Russian Ultrasonics.
 Trans. Faraday Soc.
 Wood Fibre.
 Wood Sci. & Tech.

CALL FOR PAPERS

International Conference

PRACTICAL RHEOLOGY IN POLYMER PROCESSING

26th/27th/28th March, 1980

at Loughborough University of Technology

The British Society of Rheology and the Plastics and Rubber Institute are jointly sponsoring the above conference which aims to review the practical application of polymer rheology in relation to processing and product performance, and to bring together practising rheologists, polymer engineers and industrial fabricators in an international forum to discuss how they may work together to solve problems of common interest.

Contributions of papers are invited, particularly in the following broad subject areas:

- The effect of polymer rheology on product performance
- Machine design and process efficiency
- Rheological measurement techniques and their relevance

Offers of papers on these and associated topics should be sent, preferably accompanied by a synopsis of approximately 250 words, by 1st February, 1979, to:

Dr. D. E. Marshall, Institute of Polymer Technology, University of Technology, Loughborough, Leicestershire, LE11 3TU.

CHE 1304S

POLYMER RHEOLOGY COURSE

Department of Chemical Engineering, University of Toronto
Toronto, Ontario, Canada M5S 1A4

This graduate course is normally offered in the spring terms of even years (1978 . . .), in the evening. It may also be given in the spring terms of odd years (1977 . . .), in the day, if there is sufficient enrolment.

Course description

Stress and strain defined. Rheology: the study of how these are related. Elastic viscous and elasticoviscous materials. Viscometric methods: capillary, cone-and-plate, and concentric cylinder; normal stresses; Weissenberg effects. Application to extrusion and die-swell. Non-Newtonian polymer suspensions: thixotropy, dilatancy, pseudoplasticity. Application to latices, blood and wood pulp. Theories for polymer solutions and suspensions. Elongational

flow: Trouton viscosity and spinnability. Viscoelasticity of solid polymers in creep, stress-relaxation and oscillation. The complex modulus and compliance; the time-temperature superposition principle.

This course is one of the Materials group in the Department of Chemical Engineering and Applied Chemistry; it is also relevant to students in chemistry or the Centre for the Study of Materials. Qualified fourth year undergraduates may be given permission to take this course. Interested students should telephone C. E. Chaffey (978-3067) or visit him in room 340, Wallberg Building, where they may examine the detailed notes for the course.

LETTERS TO THE EDITOR

Dear Sir,

I hope that you will allow me the opportunity, through the Bulletin, to thank the British Society of Rheology for honouring me with its first Annual Award. I was very surprised, but very pleased, to learn that my various contributions to the Society and to rheology generally were so highly regarded.

In his article in the September Bulletin, Tom Davenport mentioned the courses in Rheological Techniques which I began giving at Battersea about 20 years ago. These lectures took place weekly, from 6.30 p.m. to 8.30 p.m., and I hoped that there would be enough interest in rheology in Central and South-West London to justify running the course. I was astonished to find that people were prepared to travel to Battersea on November evenings, crossing London in the rush hour, from as far afield as Maidstone, Welwyn and even Manningtree. Rheologists are a dedicated lot!

The purpose of the early courses (as of my forthcoming book) was to discuss the physical and mathematical basis of rheological measuring techniques at a level between simple empiricism and sophisticated mathematics. Rheologists with backgrounds in chemistry, engineering, physics or biology were anxious to make meaningful measurements without being confused by more mathematics than was essential. I differ from some members of the Society in my opinion of the level of mathematics which is to be regarded as "essential" to an introductory course. My belief is that most people like to cope with difficulties one at a time. By restricting consideration to the few types of deformation used in the vast majority of rheological measurements, it is possible to use essentially two-dimensional mathematical analyses, which are easily understood, when dealing with the unfamiliar non-linear and time-dependent properties of materials which are encountered in industry. Later, if the major effort involved is justified, the world of three-dimensional continuum mechanics can be entered. Twenty years ago much less

of this world had been explored but even today rather few real materials are sufficiently well behaved to obey tractable general rheological equations of state.

In the sixties the scope of the courses was extended to give both a broader mathematical basis and an account of the rheology of particular materials. Satisfactory completion of the full course led to the award of an M.Sc. While run in London, the course was viable as audiences for lectures comprised not only full-time and part-time M.Sc. students but also visitors from a very wide area who were interested in one or other of the various parts of the course. Unfortunately the number of full-time students was never greater than *one* and when I moved to Guildford with the University of Surrey it was not possible to continue the course. It is sad that so many new graduates are likely to take courses in what, to them, seem to be glamorous subjects rather than in what we know to be a fascinating subject with far better career prospects.

In conclusion, I should like to repeat my thanks to the Council of the Society for making the Award. In particular I thank Dr. and Mrs. Benbow for the care with which they provided and mounted such a fine scroll and Mr. Davenport for his generous comments at the Annual Dinner and in the Bulletin.

Yours faithfully,

R. W. WHORLOW

"Greenhedges"
The Ridgeway
Cranleigh
Surrey GU6 7HR

Dear Sir,

At the recent Annual General Meeting of this Society, the two signatories of this letter expressed opposing views with some force concerning a motion introduced by one of them asking Council to minimize contact with the Soviet Union. As will be seen from the formal report of the Annual General Meeting the question of whether such a motion is a permissible part of the business of the meeting has been referred to Council.

We feel that it is important to make quite clear which are the points of agreement and disagreement between us since these were, we believe, representative of strong feelings held by most of those present.

We are in no doubt at all that those present at the meeting, and the overwhelming majority of members of the Society, would condemn any and every violation of the Helsinki Agreement on

Human Rights. There is also no doubt that many of us would, as individuals, wish to keep official cultural exchanges with representatives of the Soviet Union to a minimum, lest any partaking in such exchanges be taken to indicate ignorance of, or indifference to, the sufferings of the victims of a tyrannical regime. The reported abuses of psychiatry are particularly repugnant to us and, no doubt, to all readers of this Bulletin. We would, therefore, urge our Government to take whatever steps it can to express these strong feelings in a way which will be of the greatest help to any who suffer under oppressive regimes.

However we do disagree as to whether the British Society of Rheology, as a scientific body and a registered charity, should seek to involve itself, as a corporate body, in questions such as these. There are powerful and strongly held arguments on both sides. We shall not present these here since our primary concern is to express, as clearly as possible, the message contained in the preceding paragraph. Our secondary aim is to express the hope that this disagreement will not lead to the appearance of factions or any divisive action within the Society.

Yours sincerely,

R. S. LENK, C. J. S. PETRIE

JOB VACANCY

Warren Spring Laboratory, Stevenage

CHEMICAL ENGINEER/RHEOLOGIST

This post in the Industrial Rheology and Fluid Mechanics section provides an opportunity for an experienced chemical engineer/rheologist to join a team working on a Government/Industry co-operative project in applied rheology.

The work is experimental as well as theoretical, involving mathematical modelling and numerical computation. Current topics of research include development of measurement techniques on non-Newtonian and viscoelastic properties, investigation of physical and chemical factors governing rheological properties, and applied rheology in process engineering (initially, investigation into roller coating/transfer processes).

Candidates, normally aged under 32, should have a good degree or equivalent in chemical engineering/applied physics/applied mathematics, or be Chartered Chemical Engineers or have attained an equivalent standard of knowledge and experience. At least four years' relevant postgraduate experience essential, preferably covering rheology.

Appointment as Senior Scientific Officer (£5,150-£6,900), with starting salary according to qualifications and experience. Promotion prospects. Non-contributory pension scheme.

For further details and an application form (to be returned by 2nd February, 1979) write to Department of Industry, Warren Spring Laboratory, Gunnels Wood Road, Stevenage, Herts. *Please quote ref: SA/52/MF.*

NOTICES

ANNUAL AWARD 1979

Nominations for this year's annual award are requested from members. Please notify Secretary of the Society by 31st March, 1979.

TRAVEL GRANTS FOR STUDENTS

Would those students wishing to receive a travel grant from the Society to attend the meeting in Amsterdam please notify the Secretary.

APPLICATIONS FOR MEMBERSHIP—SEPTEMBER 1978

Dr. Masao, D.O.I., Ph.D.
f,t,sa,C,D,G,M,N.

Dept. Physics,
Faculty of Science,
Tokyo Metropolitan University,
Setagoya,
Tokyo, Japan.

Professor Dr. Habil Zdzislaw
Kemplowski, D.Sc., Ph.D.,
M.Sc., B.Sc.
f,et,sa,D,E,G,L.

Institut of Chemical Engineering,
Lodz Technical University,
ul. Wolczanska 175,
90-924 Lodz,
Poland.

RESIGNATIONS

Dr. David Griffiths.

DIARY

1979

January 5. "Measurement and Control of Rheological Processes." London.

April 2-5. "Deformation, Yield and Fracture in Polymers." Cambridge.

April 18-20. "Rheology of Associating, Structured and Biological Systems." Amsterdam.

May 28-30. First National Conference of Australian Branch. Monash University. Melbourne, Australia.

September 11-14. "Applied Rheology." Aberstwyth.