

**Proceedings
of the 2nd International
CONFERENCE ON PRESSURE SURGES**

London England

1976



bhbra
fluid engineering

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A.L. King,
Christine A. Stapleton

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When citing papers from these proceedings, the following bibliographic details should be used:

Title, Author(s), Paper No., Pages, Proc. 2nd International Symposium on Pressure Surges (London: Sep. 22-24, 1976). BHRA Fluid Engineering, Cranfield, U.K. (1977).



British Library Cataloguing in Publication Data

International Conference on Pressure Surges, 2nd,
London, 1976
Proceedings of the 2nd International
Conference on Pressure Surges.
1. Hydrodynamics - Congresses 2. Pressure -
Congresses
I. Stephens, Herbert Simon II. King, Alan
Leslie
III. Stapleton, Christine A IV. British
Hydromechanics Research Association. Fluid
Engineering
532'.56 QC150

ISBN 0-900983-65-5

Printed and Published by:

BHRA Fluid Engineering,
Cranfield, Bedford MK43 OAJ, England

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ISBN 0 900983 65 5

2nd INTERNATIONAL CONFERENCE ON PRESSURE SURGES

The 2nd International Conference on Pressure Surges was held at the City University, London, on September 22nd-24th, 1976 and was organised and sponsored by BHRA Fluid Engineering and the City University. This volume contains the 29 papers presented at the Conference, together with a record of the oral discussion, subject index, authors and contributors index and delegates list.

ACKNOWLEDGEMENTS

The invaluable assistance of the Organising Committee and Referees in the successful organisation of this Conference is gratefully acknowledged.

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OPENING ADDRESS

Hugh R. Lupton, OBE, MC, MA, CEng.
Vice-President, BHRA Fluid Engineering.

Mr. Stephens, Ladies and Gentlemen:-

My first, very pleasant, duty is to welcome you to this Conference, especially those of you who come from overseas - and I congratulate the Organisers on their success doubtless largely the result of the success of the Canterbury meeting four years ago, in attracting such a numerous and distinguished attendance.

Having been honoured on that occasion by BHRA in being invited to open the Conference, it occurred to me to wonder what can be the value, to those in the forefront of the Art concerned, of an opening address by an ancient like myself.

Because, probably, more than half of the world's scientists since Tubal-Cain are now living, the increase in the rate of growth of Knowledge - I don't say of Wisdom - and of the instruments of its increase - its d^2/dt^2 - is nowadays so explosively great, that the stage of knowledge attained at the period of my main activities must have been, I suppose, about half-way back to that of Pithecanthropos, the Ape-man, in his forest - or perhaps that of Anthropopithecus, his predecessor. Still, not all the hard-learned 'know-how' of Pithecanthropos is obsolete, and not all the ideas of so-called Homo Sapiens so very clever.

And, of course, as compared with Pithecanthropos, in whose day the increase of knowledge in one lifetime was negligible, I have the great advantage of access to recent advances - e.g. these papers.

BHRA, who have organised this gathering, designate it a Conference. The word implies that participators bring something. They might have called it a Symposium - literally a Drinking Party - at which friends meet and ideas flow freely. They might, again, have called it a Seminar, at which Seed - ideas and experiences - is broadcast on receptive ground, which, however, demands cultivation, including, in most cases (certainly in my own) the study of what is commonly called the Literature. What they could not properly call it is a Conclave - a secret meeting which would inhibit the broadcast of seed - now, happily, mainly a thing of the past. And this time it is a Panoramic conference, embracing many aspects, from the elasticity of Arteries to the behaviour of Bubbly Mixtures. So, please, Spread Knowledge and Experience; Meet and make Friends; Do any necessary Homework, and sow the Seed - and the Conference will have the success it deserves.

But there is one component of most fluid-manipulating installations which could benefit from further research which, however, does not seem to find a place in any of the Papers, yet which probably causes more than half the objectionable waterhammer to which Man is heir. I refer to the ordinary humble Non-return Valve in which the motion of the obturator (the blanking agent, usually a rigid plate) is derived from the fluid itself. In such valves the mean velocity of the fluid is backward at the instant when the valve shuts. Over part of the surface of the obturator the component of the fluid velocity perpendicular to that surface is suddenly killed, giving rise to pressure-surges, and over most of the rest separation usually occurs. The disturbances are

quickly damped down provided the liquid column between the valve and, say, an air-cushion, or a reasonably large pipe-manifold - which column must be traversed by the remedial pressure-waves - is short. The shock may be tempered by elasticity of the obturator or of its seating, or, in a pump circuit, by increasing the MI of the rotating parts. In some designs of valve the obturator is loaded so as to decrease the closing time, but possibly at the cost of increased head-loss.

Now the obturators of reciprocating-pump valves, which have, of course, to operate repeatedly, with minimum displacement back-flow and shock, minimum leakage and minimum head-loss, are usually light and their travel small, the flow-passages carefully streamlined and, often, obturators and seatings slightly elastic. But the preponderance of ordinary check-valves are of flap or disc type, which often close with considerable shock, such as, with better design following informed research, could be greatly reduced.

But let the prope-Pithecanthropoid prattler sit down, and enjoy with you the Conference which it is now my priviledge to declare open.

Hugh R. Kapton

CLOSING ADDRESS

by

Professor C.S. Martin,

Georgia Institute of Technology, U.S.A.

As evident by the written contributions and the attendance at this Second International Conference on Pressure Surges there remains an intense interest in the area of pressure transients. The design of systems of more complexity and the stipulation of more stringent modes of operation requires analyses of greater sophistication than previously. The concern for public safety has introduced new transient problems, either postulated or real, in the field of nuclear energy. Changing technology probably holds even more challenging transient problems for this body of engineers and researchers.

Of the 29 papers presented at this conference, nearly one-half (14) were on some aspect of two-phase flow, compared to eight of 37 at the First International Conference on Pressure Surges four years ago. Clearly, transient two-phase flow problems are with us for at least the near future. The phenomenon of vapour explosion and the attendant pressure wave propagation is definitely in a primitive stage of understanding. Although the purpose of studying the loss-of-coolant-accident problem (LOCA) is not because of pressure surges, the phenomenon clearly is one for which the tools of pressure transient analysis are applicable.

Column separation and the release of dissolved gases is still not completely understood. It is refreshing, however, to witness fundamental efforts into the understanding of the effect of nuclei on gas bubble formation. It is obvious that the gas release problem will not be understood without considering the physical chemistry of the process. It is still not obvious, however, that column separation is a serious problem in cooling water systems. The inclusion of dissipative mechanisms in analytical models of column separation, as proposed by De Bernardinis and Siccardi, is a welcome innovation. It should be stressed that no-two-phase flow model be developed without some awareness of the various regime that may occur.

The paper by Vardy on an improved method of characteristics will hopefully allow for the development of interpolation techniques that are an improvement over the currently employed ones. Much can be learned from this method as well as from the techniques proposed by Song and by Safwat.

Worthwhile design information in the field of hydroelectric power was furnished by Anderson et al. and Mawer et al. The paper by Brekke on the effect of turbine characteristics on turbine governing is certainly outstanding. Compared to the normal representation of turbine machine characteristics, e.g., as proposed by Streeter and Wylie and by Marchal and Suter, the interpolation procedure proposed by Boldy is encouraging, especially near the region of zero gate.

The paper by Thorley and Twyman on the effect of plastic deformation on wave propagation and the one by Larsen on pipe buckling are original contributions to this area of pressure surge.

It was illuminating to listen to the opening address of Mr. Hugh Lupton, especially his comment about our lack of understanding of an age-old cause of pressure surge, the non-return valve. Frequently, we dismiss the effects of these valves without a clear view of their operation and influence. Perhaps the comments of Mr. Lupton will motivate renewed activity in this subject.

Papers F2, H1 and H3 stressed the application of incompressible or rigid-column theory to pressure surge problems. Everyone should recognise that there are numerous engineering situations for which the liquid need not be considered elastic. In fact, there should not be proponents of one school (say, incompressible) opposing those of the other school (compressible) inasmuch as the technique employed should depend upon the problem at hand.

The presentation of field data on air chamber performance by Graze et al. is worth-

while in that earlier laboratory experience has now been confirmed. The confirmation should lead to a better design of air vessels.

Although there were several papers on the subject of field measurement and prototype performance, future conferences would certainly be enhanced if there were more substantial input from users or operators. Designers can definitely improve their product if past deficiencies in design are pointed out. I would like to encourage the staff of BHRA to solicit a greater participation and response from individuals and institutions who can relate important field experiences.

Papers that are likely to prove to be significant in the future are:-

1. Variation of free gas content in water during pressure fluctuations by Keller and Zielke.
2. The influence of turbine characteristics on turbine governing by Brekke.
3. Field measurements of air chamber installations by Graze, Schubert and Forrest.
4. Details on the use of the method of characteristics by Vardy.

Regarding the future one should anticipate an increased activity of transient phenomena associated with nuclear power plants, especially vapour explosions, plastic deformation, depressurization, and collapse of steam pockets. Attention should be given to the development of better constitutive equations for describing gas release. There is, of course, a dire need for measured field data for many transient phenomena. Although the analytical modelling is probably ahead of our understanding of the physics, especially our formulation of constitutive relationships, we still need refinements to numerical modelling, in particular numerical interpolation.

I would in closing like to thank the BHRA staff, especially Mr. Stephens, Mr. King and Mr. Hanson for their superb organisation. In my opinion, the 1976 Conference is just as much a success as its predecessor in 1972.



C.S. Martin
Professor

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