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INTERNATIONAL CONFERENCE ON PRESSURE SURGES

This International Conference on Pressure Surges was sponsored and organised by BHRA Fluid Engineering, in conjunction with The City University London, and was held at Rutherford College, University of Kent at Canterbury, England 6-8th September, 1972.

These proceedings contain the papers presented at the Conference together with a record of the Oral Discussion and Written Contributions, Name and Subject Indexes and a List of Delegates.

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J. A. Fox, University of Leeds,
Dr. J. A. Swaffield, Polytechnic of the South Bank, London
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OPENING ADDRESS

It is a great honour to be asked by the BHRA to welcome you to this Meeting and to declare the Conference open. An undeserved honour - I was never (to use a hydrodynamic simile) on the glistening crest of the wave of progress, and am now an almost stationary particle in the dim region behind and below it.

When the Queen of Sheba heard of the fame of Solomon, she came to prove him with hard questions. Solomon told her all her questions - there was not anything hid from the King which he told her not. And when the Queen had seen all Solomon's wisdom, there was no more spirit in her.

I felt a bit like the Queen when I had tried to read - and here and there to understand - the wealth of papers submitted to this meeting. But I have enough spirit left in me to make me very grateful to the Authors, and to look forward with much interest to the elucidations and the discussions of the next two or three days.

One thing that struck me on reading the papers was that in so many of them space was devoted to the "peptinisation" of the information to be fed to a computer to make it digestible by the monster - and digestible, moreover in a minimum of computer-time. Could the Conference perhaps do something to reduce the resulting repetition?

Having recently been concerned in the study of the intermittent pumping of undigested gassy sewage sludge along long mains, I was specially interested in papers dealing with the analysis of the effects of varying bulk-elasticity (mainly resulting from varying pressures). Incidentally, the "softness" of sludge has, of course, the merit of cushioning surge or collision pressures, also of facilitating the starting-up of an idle column in a long pipe - the near end of which will often be up to speed before the outlet knows anything of what is coming. On the other hand, a measure of surge is, at starting, actually advantageous in breaking down, in the Bingham plastic, or pseudo-plastic, fluid, any initial shear-strength. But an impeller pump will usually impose sufficient surge, and the frequent preference for positive pumps is probably not justified, at any rate on this account.

Your time can be spent far more profitably than in listening to me. So, having congratulated the BHRA on having attracted such a galaxy of Hydrodynamicians and presented - so beautifully produced - such a range of Papers, I will sit down and allow your serious proceedings to start.



Hugh R. Lupton

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Proceedings of the 1st International Conference on Pressure Surges

CONTENTS

OPENING ADDRESS

by Hugh R. Lupton

v

SESSION A: COMPUTING METHODS

- A1 **Numerical methods for calculation of transient flow.**
V. L. Streeter, University of Michigan, U. S. A. A1-1
- A2 **Analysis on simulating pipeline transient flow by computer.**
J. Zaoui and J. P. Recoura, S.O.G.R.E.A.H., France A2-13
- A3 **Determination of pump characteristics for a computerised pump transient analysis.**
G.O. Thomas, U. S. Bureau of Reclamation A3-21
- A4 **Economic methods for modeling hydraulic transient simulation.**
M. Kaplan, C. Belonogoff and R. C. Wentworth, Pacific International Computing Corporation, U. S. A. A4-33
- A5 **Non-wave, approximate analysis of pressure surges.**
M. Macagno and E. O. Macagno, Iowa Institute of Hydraulic Research, U. S. A. A5-39
- A6 **The accuracy of certain numerical procedures where applied to the solution of ordinary differential equations of the type used in the digital computer prediction of mass oscillation in closed conduits.**
J. B. B. Bullough and J. F. Robbie, University of Aberdeen, U. K. A6-53
- A7 **What to hope from analytical methods for solving pressure surge problems.**
C. Thirriot, Institut National Polytechnic de Toulouse, France. A7-77
- Discussion and contributions A-105

SESSION B: ANALYSIS OF PIPE SYSTEMS

- B1 **Pressure transients in pipe networks - a computer solution.**
J. A. Fox, University of Leeds, U. K. B1-1
- B2 **Analysis of water hammer in complex pipe systems.**
C. J. Apelt, University of Queensland, Australia. B2-11
- B3 **The build-up from rest of some non-Newtonian flows.**
R. K. Duggins, University of Nottingham, U. K. B3-21
- B4 **Oil hammer and transient response in oil pipeline.**
T. Ichikawa, Shizuoka University, Japan and K. Yamaguchi, Toyota Technical College, Japan. B4-29
- B5 **An analagous treatment of wave propagation in liquid filled elastic tubes and gas-filled rigid tubes.**
J. Lorenz and H. Zeller, Aerodynamisches Institut der Rheinisch-Westfälischen Technischen Hochschule, Aachen, German Federal Republic. B5-45
- B6 **Surge analysis of a water transmission system.**
H. Eriksen, Camp, Dresser & McKee, Inc., U. S. A. B6-61
- B7 **Water hammer protection of low-head conduits and networks by air chambers with natural air content.**
K. Haindl, Water Research Institute, Czechoslovakia. B7-77
- Discussion and contributions B-89

SESSION C: TWO PHASE FLOW AND SEPARATION

C1	Surge pressures in a gas-liquid mixture with a low gas content. K. J. Enever, The City University, U.K.	C1-1
C2	Column separation in an aircraft fuel system. J. A. Swaffield, Polytechnic of the South Bank, London, U.K.	C2-13
C3	Two phase flow in long vertical pipes. P. P. Vaidyaraman, Central Water and Power Research Station, Poona, India and A. G. Anderson, St. Anthony Falls Hydraulic Laboratory, University of Minnesota, U.S.A.	C3-29
C4	The effect of free gas on cavitation in pipelines induced by water hammer. C. Kranenburg, Delft University of Technology, The Netherlands.	C4-41
C5	Digital computations for water hammer-column separation. H. Safwat and J. P. de Kluyver, Delft University of Technology, The Netherlands.	C5-53
	Discussion and contributions	C-69

SESSION D: COOLING WATER SYSTEMS

D1	Computer analysis of waterhammer in power station cooling water systems. T. J. Sheer, Electricity Supply Commission of South Africa.	D1-1
D2	Experimental study of pressure surges in condenser cooling water systems. H. Safwat, Delft University of Technology, The Netherlands.	D2-17
D3	Transient with column separation in cooling water systems for steam-power plants. A. Atzeni, C. Cao and E. Piga, Universita di Cagliari, Italy.	D3-33
	Discussion and contributions	D-53

SESSION E: HYDROELECTRIC SCHEMES AND OTHER SURGE TANK PROBLEMS

E1	Method of characteristics applied to calculation of surge tank oscillations. C. S. Martin, Georgia Institute of Technology, U.S.A.	E1-1
E2	Computer aided design of surge chambers in pumped storage conduit systems. J. F. Robbie and F. M. Robson, University of Aberdeen, U.K.	E2-13
E3	The analysis and computation of steam surge tank pressure transients. D. J. Gorman and R. K. Gupta, University of Ottawa, Canada.	E3-37
E4	Analysis and prototype verification of hydraulic transients in Jordan River Power Plant. E. A. Portfors and M. H. Chaudhry, International Power and Engineering Consultants, Canada.	E4-57
E5	Surge problems of the Hydro-Electric Commission of Tasmania. P. T. A. Griffiths, Hydro-Electric Commission of Tasmania.	E5-73
E6	Some aspects of the multiple surge tank problems on the Southern Tunnel Main. J. V. Levy, Metropolitan Water Board, U.K.	E6-83
	Discussion and contributions	E-93

CLOSING SPEECH

Professor V. L. Streeter, University of Michigan, U. S. A.

The basic tools of transient analysis are now quite widely understood; although graphical analysis is in use in many engineering offices, the thrust of research papers is toward better mathematical simulations using the digital computer. Six years ago, in an international research conference on surge in England, more than half of the papers dealt with graphical analysis. The math model has developed rapidly and has replaced the physical model in many one-dimensional applications. The two- and three-dimensional problems remain almost completely in the physical simulation field as they are too difficult for analytical models.

Acoustic velocity prediction is our greatest problem in math models of transient flow. The reduction of pressure in a system by a transient, even when vapour pressure is not encountered, causes a large reduction in wave speed. Both maximum and minimum pressures are affected. To complicate the situation the wave speed is a function of both pressure and time. Air and other gases come out of solution and reduce wave speed when pressure is lowered, but the bubbles return back into solution at a lower rate. When vapour pressures are encountered a greater reduction in wave speeds takes place.

One must conclude from this conference that the trend in transient analysis is toward the use of the method of characteristics. An important problem arises in its use with systems having more than one pipe, and that is the satisfying of the Courant condition. It can be very serious for large interpolations. Other methods available include use of implicit reaches, which complicate programming, adjustment of wave speeds, or use of small incompressible reaches, referred to as "lumping". Some adjustment of wave speed seems reasonable, as it is not accurately known in most situations. When this is not adequate, lumping in such a way that the expression appears similar to a characteristic equation may also be used; these methods provide no complications in programming.

In this conference the paper by Kaplan, Belonogoff and Wentworth suggests a novel method they call "zooming", which has not been adequately tested at this time.

Of the thirty-seven papers presented, eleven dealt with special project simulations covering a wide range of applications. Each one cannot be discussed, but the work of P. T. A. Griffiths was especially interesting in that the study was very thorough and comprehensive, including electrical transients, governor characteristics, relief valves to control resonance conditions, air effects and open channel flow. The two papers by R. Svee and H. Brekke on compressed air surge chambers were also very significant.

Five papers were presented which used the impedance, or linear analysis, for steady-oscillatory flow cases. The paper by T. Ichikawa and K. Yamaguchi also dealt with a transient problem. Much can be learned from these methods, and with a computer program which is less costly to execute than with the characteristics method. This method is also subject to error if improper wave speeds are used.

Five papers were devoted to two-phase flow resulting from column separation. This is an important field that needs this research concentration. Prototype measurements of acoustic speeds during severe transients are required before this problem can be adequately handled in a math model.

Four papers dealt with incompressible analysis. In some cases they are more complicated than the compressible analysis and require use of the digital computer for results. The paper by M. Macagno and E. O. Macagno may provide help in the "lumping" of small reaches for the characteristics method.

Three papers were concerned with the method of characteristics. This small number of papers indicates that it is generally accepted and interest has turned to its applications.

There were also three papers describing "general" programs, i. e. programs which endeavour to solve any and all transient flow cases by properly imputing of the data. Large companies strongly endorse this approach, in part so that non-programmers may use the programs with limited transient understanding and so that the program is still easily used with changes in personnel. Compromises have to be made with these programs, with the actual case being adjusted to fit the program. The general approach, with its sorting and indexing is also more expensive to load and execute. Both special simulations and general programs will be used in the future.

Six papers dealt with a separate topic: numerical accuracy, non-Newtonian flow, visco-elastic flow, valve stroking, physical modelling, and pump characteristics interpolation.

To sum up the three basic problems requiring more attention are:

1. Acoustic speed determinations and predictions of acoustic speed during a transient.
2. Understanding of the basic physics of column separation, and
3. The handling of short reaches of pipe that do not satisfy the Courant condition $\Delta x = a \Delta t$

On behalf of the conference attendees I would like to thank Mr. Young, Mr. Stephens, Mr. Rowat and the other staff members of BHRA for the great efforts they expended in preparing for and carrying out this excellent conference.

SUBJECT INDEX

- AIR CHAMBERS
 - air behaviour in F2-15
 - air cushions, in B7-80
 - attenuation, in F2-13
 - frequency modulators
 - model tests G5-67
 - latent heat effects F2-17
 - natural air content B7-79
 - pressure losses B7-82
 - rational heat transfer F2-15
 - semipneumatic tanks B7-79
 - temperature effects F2-16
- AIRCRAFT FUEL SYSTEMS
 - column separation in C2-16
 - Concorde main transfer system C2-17
 - Concorde refuelling system C2-17
- AIR CUSHIONS
 - air chambers, in B7-80
 - surge tanks, in G2-17
 - G3-30
- AITKEN-NEVILLE INTERPOLATION TECHNIQUE E2-19
- APALACHIA DIFFERENTIAL SURGE TANK
 - field test results E1-7
- BALL VALVES
 - closure effect F1-7
- BANGKOK WATER SUPPLY FACILITIES
 - transmission system
 - power failures B6-71
 - pumping station B6-65
 - receiving structures B6-65
- BERGERON METHOD A5-44
- BLOOD VESSELS *see* Pipes, elastic
- BUBBLE FLOW C4-43
- BUBBLE FORMATION A1-4
- C4-44
- CAVITATION
 - bubble collapse D2-22
 - cooling water systems D3-37
 - evolution D3-35
 - experimental work C3-35
 - gas-liquid flow, in C3-33
 - inception D3-35
 - macroavity formation B7-79
 - regions D2-21
 - shock waves C4-43
 - vertical conduits, in C3-33
- BUTTERFLY VALVES
 - closure effect F1-7
- CENTERED IMPLICIT METHOD
 - A1-3
 - E1-8
- CIRCULAR GATE VALVES
 - closure effect F1-7
- COLUMN SEPARATION
 - acoustic wave speed estimation A1-4
 - aircraft fuel systems, in C2-18
 - condensers, in D1-3
 - D2-21
- digital computation C5-55
- mathematical model D3-35
- tank discharge, in F3-25
- test rig C2-18
- transient analysis C2-15
- C4-43
- valve boundary conditions C2-18
- COMPRESSIBILITY
 - liquid C1-4
- COMPUTER AIDED DESIGN
 - see also* Computer Programs
 - Computer Techniques
 - Poatina hydroelectric system E5-74
 - real pipe systems B2-16
 - surge tanks E2-21
- COMPUTER PROGRAMS
 - See also* Computer Techniques
 - Computer Aided Design
 - complex pipe systems, for B2-15
 - global A2-13
 - B1-7
 - heavy water sub-program E3-45
 - insurge/outsurge computation E3-43
 - light water sub-program E3-45
 - method of characteristics A4-33
 - B2-13
 - B5-47
 - B6-68
 - C5-55
 - D1-3
 - E1-3
 - E4-61
 - E6-86
 - A2-16
 - network simulation
 - surge tank oscillations E1-3
 - transient condition, prediction D3-40
 - zooming feature A4-33
- COMPUTER TECHNIQUES
 - see also* Computer Programs
 - Computer Aided Design
 - C1-5
 - C2-21
 - C5-55
- CONCORDE FUEL SYSTEM
 - column separation C2-18
 - pressure variations C2-18
 - test rig C2-16
 - valve boundary conditions C2-18
- CONDENSERS
 - column separation
 - D1-3
 - D2-21
 - cooling water systems D2-18
 - experimental work D2-22
 - position, effect of D3-39
- COOLING WATER SYSTEMS
 - cavitation D3-37
 - circulating systems D1-5
 - condensers
 - D1-3
 - D3-35
 - pumping systems D1-5
 - steam power plants
 - D1-3
 - D3-35
 - C5-55
 - D2-18
 - thermal power stations
 - D2-18
 - transient simulation D2-18
 - valve closure D1-5

DISCHARGE TANKS		METHOD OF CHARACTERISTICS	
design	F3-26	complex pipe networks	B2-13
maximum over pressure	F3-26	laminar flow	A1-5
operation	F3-25	steady oscillatory flow	A1-5
siting	F3-27	surge analysis	B6-68
size determination	F3-26		C5-55
DRIVA POWER STATION (NORWAY)	G3-37		D1-4
			E6-86
EMOSSON HYDROELECTRIC PROJECT	A2-18	surge tank oscillations	E1-3
		theoretical basis	A7-84
FOURIER TRANSFORMATION		unsteady flow	E4-61
frequency response analysis	G1-3	wave propagation	B5-47
GAS-LIQUID FLOW		NATURAL GAS SYSTEMS	A1-3
cavitation region	C3-33	NEEDLE VALVES	
enthalpy calculations	C3-32	closure effect	F1-7
shock waves	C1-3	NON-NEWTONIAN FLUIDS	
sudden valve closure	C1-3	pseudoplastic materials	B3-23
		yield stress materials	B3-23
GLOBAL COMPUTER PROGRAMS		NON-WAVE ANALYSIS	A5-39
see Computer Programs		NUCLEAR REACTORS	
GLOBE VALVES		primary heat exchanger circuits	A2-19
closure effect	F1-7	NUMERICAL METHODS	
		Generally; for specific methods see under	
HEADRACE TUNNEL SYSTEM	G2-17	their own names, e. g. Method of	
HENDRINA POWER PLANT (S. AFRICA)		Characteristics	
	D1-3	global transfer matrix	G6-81
HORNBERGSTUFE-HOTZENWALDWERK		mass oscillation calculation,	
PUMPED STORAGE SYSTEM	G1-6	comparison of methods	A6-53
HYDROELECTRIC POWER STATIONS			E2-19
computer aided design	E5-74	Heun-Romberg method	A6-59
Driva power station (Norway)		predictor-corrector methods	A6-59
frequency response tests	G3-37	Runge-Kutta	A6-59
Jorundland power station (Norway)		NYQUIST STABILITY CRITERION	
frequency response tests	G3-35	valve and pipeline stability	G4-51
IMPEDANCE METHOD OF HYDRAULIC		OIL PIPELINES	
TRANSIENTS		oil hammer	
fluid column interaction	G4-48	experimental work	B4-33
		pressure response	B4-35
JORDAN RIVER POWER PLANT	E4-59	straight pipes, in	B4-32
JORUNDLAND POWER STATION		transfer matrix	B4-31
(NORWAY)	G3-35	experimental work	B4-35
		straight pipe	B4-33
LEITZACH II SURGE TANK		volume tank position, effect of	B4-35
field test results	E1-7	OSCILLATION STABILITY	
		general	G3-30
MARCHING INTEGRATION METHOD		mathematical description	G2-18
flow build-up		method of small oscillations	G2-20
non-Newtonian fluids	B3-25	OSCILLATORY FLOW	
MASS OSCILLATIONS		LaPlace Transformations	G3-27
air cushion surge chamber stability	G2-20	PARAMETRIC INTEGRAL METHOD	
mathematical analysis	E2-19	flow build up	
method of characteristics	E1-3	non-Newtonian fluids	B3-25
surge tanks, in	A6-56	PENSTOCKS	E4-59
	E1-3		E5-74
	E2-17	PIPES see also Oil Pipelines	
MATHEMATICAL MODELS		branched	
column separation	D3-35	mathematical description	B6-70
conduit simulation	E4-61	model tests	G5-65
conservation laws	C4-44	periodic surges	G5-68
method of characteristics	E4-61	conical	
three-phase flow	C4-43	transfer matrices	G6-84
		elastic	
		experimental work	B5-53
		liquid filled	B5-47

wave propagation in	B5-47	SAECKINGEN PUMPED STORAGE SCHEME	
hydraulic impedance	G4-50	model tests	
low head conduits	B7-79	air chambers	G5-67
networks		elastic deformation, water of	G5-65
low head	B7-79	Mach similarity	G5-65
computer analysis	B1-7	surge tanks	G5-68
	B2-15	viscous energy dissipation	G5-67
frequency response analysis	G1-3	SCHNYDER-BERGERON METHOD	E1-8
natural mode analysis	G1-5		E6-86
steady state behaviour	B1-7	SHOCK ABSORBERS	A5-45
transient behaviour	B1-8	SHOCK WAVES	
parallel		bubble effects	C4-47
wave-propagation in	A7-87	cavitation region	C4-47
stability		pseudoviscosity, effect of	C1-7
Nyquist stability criterion	G4-51	sudden valve closure, result of	C1-3
transfer matrices		SIPHONS	C5-56
conical pipe	G6-86		D2-19
conical lossless pipe	G6-84	SOUTHERN TUNNEL MAIN	
constant characteristics pipe	G6-83	friction considerations	E6-87
cylindrical lossless pipe	G6-85	model tests	E6-86
variable wave celerity/		surge prediction	E6-85
diameter pipe	G6-86	SQUARE GATE VALVES	
varying cross-section		closure effect	F1-7
wave-propagation in	A7-90	STEAM POWER PLANTS	
viscoelastic		cooling water systems	D1-3
experimental work	B5-53		D3-35
gas-filled	B5-49	ST. ETIENNE WATER DELIVERY	
wave propagation	B5-49	SYSTEM	A2-18
PIPE JUNCTIONS		STORM WATER DROPSHAFTS	
boundary conditions	B1-5	cavitation region	C3-33
branched	G3-31	outlet flow	C3-31
mathematical description	B6-70	SURGE TANKS	
transient analysis	A7-85	Apalachia differential tank	E1-7
POATINA DEVELOPMENT (TASMANIA)	E5-74	boundary conditions	G3-30
PRESSURISERS see Surge Tanks; steam		computer aided design	E2-16
surge tanks		Gordon tank (Tasmania)	
PSEODOVISCOSITY		air admission	E5-76
shock waves, effect on	C1-7	air release	E5-75
PUMPED STORAGE SYSTEMS		operating conditions	E5-76
advantages	E2-15	system analysis	E5-76
design implications	E2-16	Leitzach II tank	E1-7
Hornbergstufe-Hotzenwaldwerk	G1-6	mass oscillations, in	A6-56
Saeckingen (West Germany)	G5-65		E1-3
surge tanks			G2-17
computer aided design	E2-21	load changes, causing	E2-16
PUMPS		mathematical description	B6-70
centrifugal	D3-38	model tests	G5-68
characteristics	A3-21	multiple shafts	E6-88
cooling water systems, in	D1-5	power failures	B6-71
failure		steam surge tanks	
macrocavity formation	B7-79	experimental work	E3-45
overpressures	B7-79	insurge problems	E3-40
head-discharge curve	B1-3	outsurge problems	E3-42
rarefaction waves, in	D2-18	weir crest levels	E6-89
rundown speeds	D1-6	THERMAL POWER STATIONS	
startup	B6-72	cooling water systems	C5-55
stoppage	D2-18		D2-18
	F3-25	THREE PHASE FLOW	
transient prediction	A3-23	mathematical model	C4-43
RAREFACTION WAVES		TURBINES	
pump stoppage, caused by	D2-18	guide vane effect	G3-33
RATIONAL HEAT TRANSFER		head variation	G3-33
air chambers, in	F2-15	TWO-PHASE FLOW	
temperature measurements	F2-18	cavitation	C3-33
		gas-liquid	C1-3
			C3-31

VALVES

ball valves	
closure	F1-7
boundary conditions	
Concorde fule systems	C2-18
numerical solution	C2-21
butterfly valves	
closure	F1-7
circular gate valves	
closure	F1-7
closing	A5-43
	B6-72
air-pocket volume, changes	C1-6
complex systems, in	C1-4
cooling water systems, in	D1-5
	D2-19
experimental work	D2-20
gas-liquid systems, in	C1-3
optimum closure	F1-8
pseudoviscosity	C1-7
shock waves	C1-3
surge prediction/control	F1-6
time	D2-23
globe valves	
closure	F1-7
mid-pipe vent	B1-6
needle valves	
closure	F1-7
opening	A5-44
pressure reducing	
characteristics	E4-61
upstream/downstream head r'ship	B1-5
spring loaded relief type	

chatter	G4-48
dynamics	G4-48
experimental work	G4-53
fluid column interaction	G4-48
model tests	E5-75
prototype tests	E5-75
stability	G4-49
square gate valves	
closure	F1-7
VALVE STROKING	A1-5
	F1-6
VERTICAL CONDUITS	
cavitation region	C3-33
head-discharge r'ship	C3-32
shock front	C3-34
test rig	C3-35
WAVE PROPAGATION	
elastic pipes, in	B5-49
mathematical analysis	
linear system	B5-51
non-linear system	B5-52
piston problem	B5-53
one-dimensional	B5-45
parallel pipes, in	A7-87
pipes with varying cross-	
sectional area	A7-90
viscoelastic pipes, in	B5-49
WAVE SPEED	
variability	B1-7
WEIRS	
crest level	E6-89
dimensional effects	E6-89
spillage	E6-89

NAME INDEX

TO PAPERS, CONTRIBUTIONS AND DISCUSSION

In this index, papers presented at the Conference are denoted by bold print.

Anderson, A. G.	C3; C79
Apelt, C. J.	B2; B94; B95
Atzeni, A.	D3
Belonogoff, G.	A4; A129
Boldy, A. P.	A123
Brekke, H.	A122; G3; G89;
	G104; G105; G107
Buchanan, R. W.	E96; G106
Bullough, J. B. B.	A6; A130; A131
Cao, C.	D3
Chaudhry, M. H.	A122; A131; C75;
	E4; E96; E101;
	G99; G101
Collins, T. M.	C74; C76
de Kluyver, J. P.	C5; C81; C84
Donsky, B.	A124
Driels, M. R.	C77
Duggins, R. K.	B3; B95; C75;
	C78; G102

Enever, K. J.	A123; C1; C73;
	C74; C75; D56;
	F35
Eriksen, H. A.	B6, B98, E101
Erskine, J. B.	B93; D56; D58
Famili, J.	A131, C80
Fanelli, M. A.	A131; E95; G6;
	G93; G100; G104
Fox, J. A.	B1; B91; B92;
	B93; B98; C73;
	C75; C80; C81;
	C82; D56; E99
Franke, P.	G5; G106; G107
Gorman, D. J.	E3; E100; E101;
	F37
Graze, H. R.	B98; C74; C76;
	C78; D57; E100;
	F2; F35; F36;
	F37; G101; G105
Green, W. L.	G4
Griffiths, P. T. A.	A130; D57; D58;
	E5; E99; E102;
	E103; G100
Gupta, R. K.	E3; E100; E101

Hack, H. P. Haindl, K.	G1; G99; G100 B7; B99; B100; G102	Schreck, C. W. Schroder, R. Sheer, T. J.	A130; E99 G5; G106; G107 B92; D1; D55; D56; D57 D56; F36 G5; G106; G107 A128; F3 A122 A1; A121; A122; B92; D55; F34 G2; G100; G101; G102; G104 C2; B92; B93; C76; C77; C78; C80; C82
Ichikawa, T.	B4	Smith, B. Stefan, H. Stephenson, D. Strawson, H. Streeter, V. L.	
Jones, S. E.	F1; F34	Svee, R.	
Kaplan, M. Kranenburg, C.	A4; A129 C4; C70; C80; C81	Swaffield, J. A.	
Levy, J. V. Logan, T. H. Longman, A. D. Lorenz, J.	E6 A125 E95; E100 B5; B96; B97; C78 B95	Tekle, T. Thirriot, C. Thomas, G. O.	F36 A7 A3; A123; A124; A127; A128 B96
Lupton, H. R.		Thorley, A. R. D.	
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Macagno, M. Martin, C. S.			
Novak, P.	A121; E96; E101; G106	Wentworth, R. C. Wood, D. J. Wood, G. D.	A4; A129 F1; F34 A129; G4
Piga, E. Portfors, E. A.	D3 E4; E101	Yamaguchi, K. Young, G. A. J.	B4 C73; C77; C81
Recoura, J. Robbie, J. F.	A2; A122; A123 A6; A130; A131; E2; E99; E100 E2; E99; E100	Zaoui, J. Zeller, H. Zielke, W.	A2; A122; A123; A129 B5; B96; B97 B94; G1; G99; G100; G107
Robson, F. M.			
Safwat, H. H.	A121; A129; B93; B97; C5; C77; C81; C84; D2; D58; E100; F34; G107		

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