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President's Address

As already stated in earlier Newsletters, the Council has introduced the new status of EUROMECH Fellow to acknowledge colleagues "who have contributed significantly to the advancement of mechanics and related fields". I would like to encourage you to reserve some of your time to prepare a nomination package on behalf of a particularly deserving fluid or solid mechanicist. The procedure is straightforward, as explained on page 26 of this Newsletter. Nomination packets must be received by January 15, 2006. Elections to Fellow status should be viewed as an important event in the life of our society, as they contribute to strengthening its collegiality. Please act now!

I am also pleased to announce our recent success in the submission of a proposal to the European Commission, within the Marie Curie Conference and Training Course program. The funds will provide very significant financial support in the organisation of four major events: the 6th European Fluid Mechanics Conference (2006) in Stockholm, the 6th European Solid Mechanics Conference (2006) in Budapest, the 10th European Mechanics of Materials Conference (2007) in Warsaw and the 11th European Turbulence Conference (2007) in Porto. May I take this opportunity to thank the organisers of these meetings for their assistance in the preparation of the dossiers.

Patrick Huerre

President, EUROMECH

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EUROMECH Council Members

Chairpersons of Conference Committees

Dietrich Küchemann

11 September 1911 – 23 February 1976

The photograph reproduced was taken by G. Argent in 1963 (1).

This article is written in grateful memory of one of the two most active founding members of the European Mechanics Committee, D. Küchemann and G.K. Batchelor. The role of Batchelor is well documented since he was Chairman for almost 25 years but that of the first secretary, D. Küchemann, is less known as he died as long ago as 1976.

Since Küchemann had been elected a Fellow of the Royal Society in 1963 he was honoured by an entry in the Biographical Memoirs (1) written by two of his colleagues and friends, P.R. Owen and E.C. Maskell (1980), who presented an excellent picture of this eminent European scientist.

Küchemann was educated at the universities of Göttingen and Munich, receiving his Dr. rer. nat. under the guidance of L. Prandtl at Göttingen in 1936. He then worked at the Aerodynamische Versuchsanstalt in Göttingen until 1946 when he moved to the Aerodynamics Department of the RAE at

Farnborough. This was partly achieved by the close links Peter Sutton (later in the Engineering Department of the University of Cambridge) had formed with Küchemann during the de-briefing of German aerodynamicists at Völkenrode in 1945 (personal communication of P. Sutton to the author). Küchemann was Head of the Department from 1966 to 1971, and thereafter Chief Scientific Officer on Special Merit and Visiting Professor at Imperial College. He was much honoured in his later years – he held three honorary doctorates and fellowships and was awarded several medals. Küchemann occupied – with great modesty – a special position within the entire international community of aerodynamicists. He was a citizen of the world (Sir Morien Morgan, 1976) but he saw himself, and wished to remain, a European. "I live in the 20th Century, in Europe, and I think I belong to the species of European Man", he once wrote.

This European Man had properties which were ideal to start a scientific enterprise like EUROMECH: "passion for communication, talent for stimulating and coordinating research combined with an incontrovertible soundness in his arguments, a freshness of concepts that were contained with consistent logic in a universal philosophical view", together with a personal modesty and humane warmth.

At the Symposium Transonicum in 1962, K. Oswatitsch (then at Aachen and TU Wien) remarked to Küchemann "that he would very much like to find a way to bring together more closely people working in fluid mechanics in Western Europe" (2). The purpose would be to get together informally to discuss the work that is going on, and to establish better contacts.

Küchemann was attracted to this idea and wrote to his colleague on the UK Fluid Motion Sub-Committee, B. Thwaites, for comments (3). On 30 October 1962 Oswatitsch (3) wrote a proposal for conferences on Fluid Mechanics in Western Europe. This resumé was translated into English and commented on by Küchemann in January 1963 (4). Replies to this resumé by M.J. Lighthill (5), P. Germain (France) and B. Thwaites were very favourable, emphasizing the need for smaller conferences on specialized parts of fluid mechanics.

After this promising start there is a gap in the correspondence (at least that available to the author) between January 1963 and March 1964. In the beginning of April 1964 a note by H.W. Thompson of the Royal Society (6) was published on "Research Conferences in Western Europe", in which he summarized previous experiences with smaller conferences of the "Gordon

type" and suggested the organisation of research conferences for chemists under the umbrella of the European Chemical Conference (EUCHEM). Regulations for these conferences, a possible course of action, and matters of finance were proposed and were largely transferred to the purposes of EUROMECH a year later.

In a letter to A.W. Quick (DVL Aachen) (7) Küchemann summarized the discussions of the British National Committee for Theoretical and Applied Mechanics, a committee of the Royal Society responsible for international relations. Here the idea of a European Mechanics Colloquium was apparently first formulated as a conference for people working on a specialized topic in Western Europe. This restriction to Western Europe avoided an involvement with IUTAM which was a strictly international organization. The proposition of European Mechanics Colloquia as a matter of European concern was fully endorsed by H. Görtler (8), the Secretary-General of the Bureau of IUTAM and former President of GAMM. Görtler encouraged "the establishment of EUROMECH Colloquia in support of European mechanics between the giants USA and USSR. This would strengthen European self-confidence which despite our great tradition is rather faint-hearted." This latter feature was certainly not intrinsic to Küchemann who prepared a one page note on the concept of European Mechanics Colloquia (9) which was sent to 28 European scientists (10), among others to Görtler in preparation of a meeting of the XIth ICTAM Congress in August/ September 1964 (11).

This note carried a motto handwritten by Küchemann (12):

Reading makes a full man;
conference a ready man;
and writing an exact man.

This initiative had by now also the support of the Royal Society which had authorized G.K. Batchelor and D. Küchemann (13) to arrange an informal meeting of representatives from various countries during the XIth ICTAM Congress in Munich with the aim of discussing the possibility of establishing a series of European Research Colloquia in the field of Applied Mechanics following the lines of EUCHEM. Küchemann and Batchelor were both fellows of the Royal Society which may have brought them into contact and led to subsequent conversations (see F. Alkemade).

Twelve representatives from six countries (13) met over lunch in Munich at the Künstlerhaus am Lehnbachplatz on 2 September 1964. All were very

favourable to the idea and an Interim Committee for European Mechanics Colloquia (EUROMECH) was established, comprising all those present at this first meeting, with Küchemann acting as Secretary of the Committee. The participants first discussed the pros and cons of large international congresses and symposia, devoted to more specialised subjects but with restricted participation, and then agreed on the need for EUROMECH Colloquia. The essentials are documented in a memorandum (13):

"There seems to be a case for a less formal gathering, which we may conveniently term a Colloquium, on a level intermediate between those of the formal Symposium and the private visit. The subject matter to be discussed would either be more specialised than that generally chosen for a formal symposium, or at a less developed stage; the scope would be such that the participants, invited because they have something to contribute, can all be expected to follow the discussion fully. The Colloquium should restore the immediacy and directness of personal contact in lively and spontaneous debate on current work by people personally engaged on it, from which considerations of prestige are absent. The Colloquium should help to reduce the isolation of the working scientist which tends to result from the continual and rapid ramification of subjects, and it should lead him to notice aspects of his problem which he would otherwise have ignored. It is in the nature of scientific work that such Colloquia should be organised on a partially international basis; but the region which supports them should be small enough to bring the meeting place within easy reach of every worker concerned. Europe is such a region. Special reasons for trying to further the European contribution to the body of scientific knowledge by means of research colloquia lie in our scientific tradition, the present level of scientific activity in Europe, and the need to counter the isolating effects of language differences."

With this general approach in mind, the discussion led to the development of some rules which could be adopted for the colloquia. It was thought that the first step should be, however, to gain experience of such colloquia.

The following rules were suggested for the first few colloquia:

(i) The subject chosen should be advanced and 'live', and (normally) sufficiently specialised to interest a definite group of people. It may be of fundamental or practical interest, but should not be too technical.

(ii) There should be a maximum of about 50 participants; the number might often be considerably less. Participants should be invited for their known active interest in the subject and not as representatives of organisations. Young people whose names are not yet known internationally should be given particular consideration. Only under special circumstances should 'observers' be admitted.

(iii) The meetings should last 2 to 5 days, according to the volume of work to be discussed. Much time should be left for discussions, especially for informal discussion during breaks and for opportunities for participants to get to know each other personally. 'Round-table' seating may sometimes be better than a lecture theatre.

(iv) Papers presented at a colloquium should not normally be published as a part of any record of 'proceedings'. In some cases, the organiser may wish to prepare a summarising report on the colloquium.

(v) A chairman should be appointed to organise each meeting with the help of a small committee of his own choosing. For the time being, the Interim Committee should choose the subject, the chairman, place and approximate date of each colloquium. Members of the Interim Committee should also help by suggesting the names of suitable participants to the chairman of a colloquium.

(vi) Colloquium committees should feel free to invite participants from any European country, east or west, although the USSR, being sufficiently large in itself to form a region suitable for colloquia, might be excluded.

(vii) For the time being, participants should be asked to obtain their travel and subsistence expenses from sources in their own countries.

The first Colloquium

"Since it would be difficult to exchange opinions by correspondence in the time available, we have taken the liberty of making tentative arrangements for the holding of some EUROMECH Colloquia next summer (14). A firm proposal for the first Colloquium is as follows:

EUROMECH 1. 'The Coanda effect'; March or April 1965; to be held at Technische Universität, Berlin; chairman of organising committee, Professor R. Wille.

Professor Wille (15) has agreed to act as chairman and to make available the facilities of his institute. He will be writing to you to ask for suggestions concerning participants."

The topic of this first EUROMECH Colloquium had been among the suggestions approved as suitable by the Interim Committee. This Committee was well aware that it did not represent the whole field of mechanics and the whole region from which participants to the European Mechanics Colloquia should be drawn. It felt free to co-opt members from other countries which by chance were not represented at the meeting.

It may be interesting to mention here the names of the members of the Interim *Committee who were involved with the foundation of EUROMECH in 1964/65:*

G.K. Batchelor (Cambridge University), J.R. Besseling (Technische Hoogeschool Delft), P. Carrière (ONERA, France), A. Craya (University Grenoble), K. Gersten (Technische Hochschule Braunschweig), D. Küchemann (RAE Farnborough, UK), R. Legendre (ONERA, France), F.K.G. Odquist (KTH Stockholm), K. Oswatitsch (TU Wien), J. Smolderen (Von Kármán Institute, Belgium), E. Truckenbrodt (TU München), K. Wieghardt (Universität Hamburg), R. Wille (TU Berlin).

Wille and Küchemann co-operated extremely successfully in the preparation of EUROMECH 1 as is documented in a series of letters. Wille finally sent out a letter of invitation for contributors to the colloquium on 29 January, with the date of EUROMECH 1 fixed for April 5 and 6, 1965. Küchemann wrote two important notes, one for participants (16) and another for organisers (17) of European Mechanics Colloquia, which were largely based on the memorandum (13) quoted above. These notes were also sent to the members of the Interim Committee for information, together with topics for three further EUROMECH Colloquia and suggestions for Chairmen of the Colloquia in 1965 and 1966 (18). Batchelor agreed with the activities initiated by Küchemann but regretted that he could not attend EUROMECH 1 since he would be away from Cambridge (19). Küchemann's last letter to Wille before the Colloquium, written on Küchemann's typewriter at home in Farnham, is a masterpiece on the arrangement of the proposals for the Colloquium and revolutionary on the method of representation (round table contributions to specific subjects and not a full presentation of contributions).

EUROMECH Colloquium 1 could not fail to be a success with Wille as Chairman and Küchemann as the moderator in the background. It was a success, as can be seen from the subsequent report written under the guidance of the Secretary. It should have been an example of reports on further Colloquia since it contains many elements which the EUROMECH Council

would even now like to read but too few Chairmen followed Küchemann's and Wille's pattern. For the benefit of future Colloquia the full text of the report on EUROMECH Colloquium 1 is given below. The scientific report was published in the Journal of Fluid Mechanics (20).

Report on the first European Mechanics Colloquium

Euromech 1.

The first in this new series of research conferences in Theoretical and Applied Mechanics was held at the Hermann-Föttinger-Institut für Strömungsforschung of the Technische Universität Berlin on April 5 and 6, 1965, under the chairmanship of Professor R. Wille. The subject of the discussion was "Boundary Layers and Jets along highly curved Walls - Coanda Effect". The following notes, prepared with the help of comments by participants, are mainly concerned with the organisational aspects of the meeting; a report on the discussion itself will be given in another note. There were 38 participants from 9 countries: Belgium (5), France (5), Germany (15), Holland (1), Norway (1), Rumania (1), Sweden (1), Switzerland (1) and United Kingdom (8). Thus some of the European countries were not represented. Colleagues from Hungary and Poland reported that no work on the Coanda effect is being carried out there, but no replies were received from Bulgaria, Italy, Spain and Yugoslavia. The aim of inviting all those working in the particular field under discussion to take part must have been very nearly achieved.

The experience of attending the colloquium and the most encouraging response and the positive comments and constructive criticisms of the participants showed the writer that a colloquium of this type answered a real need. There appears to be no doubt that the Euromech experiment of "workshop" meetings made an excellent start and deserves every support in its further development.

The subject chosen proved to be ideally suited for the purpose and the success of the meeting confirmed that the rules laid down for these colloquia are on the whole realistic. The subject was obviously "live" and also suitably restricted and definable. It became evident quite early on in the discussions that even such a restricted subject has many aspects and facets and that the individual worker finds it difficult to be aware of them all and to obtain a balanced view. Consequently, the participants particularly appreciated the opportunity to get acquainted with the whole spectrum of the work and to assess the present status of the subject and the scope of the various activities in Europe. The need was also felt for open and free discussions to enlighten investigators about the developments presently under way and about future projects, to stimulate

the emergence of fresh ideas, and to put the individual contributions and activities into perspective. It seems particularly important to bring different individuals or research teams face-to-face at an early and formative stage of the work.

The meeting was held in the Senate room of the University, which allowed a close approximation to round-table seating. This, the full projection facilities and easy access to a large black-board, combined with the pleasant atmosphere, led to lively discussions. The number of participants was about right and the experience showed very clearly that this should definitely be limited to about 50 for this kind of working meeting. It was also confirmed that it is very important to invite mainly people known for their active interest in the subject and especially to encourage the participation of young people: the latter enlivened the discussions considerably and contributed in a most effective manner throughout.

The time-table included a morning session (900 to 1300) and an afternoon session (1430 -1730), with half-hour tea or coffee breaks in each. This proved quite workable. It appeared useful to group papers under appropriate headings and to provide a thread through the whole meeting. It was found that a good survey paper at the beginning, which outlined existing knowledge under the same group headings, helped greatly in guiding the discussions. It was also very valuable to have the same chairman throughout the meeting, although this must have been quite a strain. The right climate of informal but incisive discussions was soon established.

22 of the participants made scheduled contributions, some of them several, so that there were altogether 29 items on the programme. In the event, the time available was rather short for all these, and the colloquium could well have been spread over 3 days. An extra day would have contributed towards a more relaxed atmosphere as well as to the clarification of a number of importan points which were raised but not adequately discussed. However, the time of preparation was too short in the present case to add an extra day so as to accommodate the unexpectedly large number of contributions more comfortably, but it would seem desirable for future colloquia to discover well in advance how many contributions there are likely to be and so to provide for sufficient time.

The colloquium proved again that it is quite possible in many cases to present the relevant points of an argument lucidly in a short time as 15 minutes. But this requires careful preparation and it would seem advisable before future colloquia to exhort contributors not to read out the usual formal paper but to remember the special purpose of these meetings, the particular points under discussion, and the special audience they are addressing and to prepare themselves accordingly with the greatest

care. Although it is in the nature of these colloquia that written papers or preprints will not, in general, be distributed to the participants, it may well be possible to bring along and to pass around the table copies of, say, figures giving the main results or other relevant information. This might be further encouraged.

The language difficulties were largely overcome simply by conducting most of the proceedings in English. It could not be ascertained, however, whether or not everybody was really able to follow the discussion fully and, at future meetings, people might be encouraged even more to interrupt when they are left in the dark and, if necessary, to ask for an on-the-spot translation.

Invaluable personal contacts and discussions were furthered immensely by the warm and most generous hospitality of Prof. Wille and his helpers. A meeting place had been arranged for the evening before the colloquium proper and another evening was spent in Prof. Wille's institute among well-prepared demonstrations of the interesting work carried out there and other apparently inexhaustible sources of invigorating refreshments. Full use was made of the breaks between sessions and it would seem useful if participants could lunch together at future meetings.

It may be mentioned that the meeting was accompanied by a copious and free demonstration of sonic bangs.

Finally, the desirability of requiring some funds for the Euromech colloquia became apparent. In the present case, Prof. Wille succeeded in organising the meeting so that no extra costs arose for the participants. But this may not always be possible and it would also seem desirable to be able to support some of the participants, especially young people.

It may justifiably be hoped that this first Euromech Colloquium at Berlin has initiated a series of working conferences which will benefit both the research scientist and the advancement of knowledge.

24. May 1965 *D. KÜCHEMANN*

On the occasion of a meeting of the General Assembly of I.U.T.A.M., the Interim Committee met at Vienna on 25 June 1966. "Here it was resolved (21) to make EUROMECH a permanent institution, with regional colloquia, within the framework of I.U.T.A.M.. A more permanent organisation should be set up by 1 January 1967 with members from various countries representing their respective National Committees. An executive committee with 4 members will be concerned with the running of the organisation. The members of this will be changed every 4 years."

For the first executive committee the following were elected: Professor G.K. Batchelor (President), Professor R. Wille, Professor J.F. Besseling, and Dr. D. Küchemann (Secretary). It is worth mentioning here that two participants, Professor W. Fiszdon (Warsaw) and Dr. J. Jerie (Institute of Thermodynamics (Prague) from East European countries attended the meeting. Professor J.F. Besseling retired on 31 December 1967 (22) and his place was taken by Professor F. Buckens (Heverlee, Belgium). Küchemann became Treasurer in addition to his duties as Secretary.

There is a gap in the flow of documents after (22) and the next information appeared as Notes on a Meeting of EUROMECH Correspondents at Stanford in August 1968 (23). Here it was reconfirmed that EUROMECH should not be regarded as a sub-organisation of IUTAM, obviously a change in policy compared with what had been decided earlier (21). At this informal meeting it was agreed that the EUROMECH Committee should be enlarged from four to six members with a term of office of six years. It was also regarded as desirable that a proper balance should be achieved between representatives on the committee of fluid mechanics and of solid mechanics. "There were no doubts that the EUROMECH colloquia performed a useful function and all those present agreed that efforts to organize future colloquia were worthwhile and that future prospects were bright."

As from 1 January 1969 the Committee has been enlarged to six members (24) in accordance with the resolution made at the meeting at Stanford.

To retire:

Professor G.K. Batchelor (Chairman) (F) 31 December 1970

Professor F. Buckens (S) 31 December 1971

Professor W. Fiszdon (F) 31 December 1973

Dr. D. Küchemann (Secretary) (F) 31 December 1972

Professor M. Landahl (F) 31 December 1974

Professor R. Wille (F) 31 December 1969

As of 1 January 1970, R. Wille retired and R. Legendre (ONERA, Paris) became a member of the Committee (25). The next changes in the composition of the EUROMECH Committee are given in the Notes of a Meeting of the EUROMECH Committee at Cambridge 21 April 1972 (26) which followed the meeting held at Rapperswil on 6 and 7 April 1971 (no information available). By then M. Landahl and F. Buckens had retired and H. Thomann and H.H. Fernholz (27) had become new members of the Committee. At this meeting it

was resolved to give up the original terms of rotation of members of the Committee and the replacement of one member by a new one every year. G.K. Batchelor was asked to remain Chairman until the end of 1974 and the Secretary was asked to carry on until the end of 1975. H.H. Fernholz agreed to take on some work from the Secretary if the need arises. There was considerable discussion about the need to strengthen the activities of EUROMECH on the side of solid mechanics and this was finally achieved by electing Professors S. Kaliszky (Budapest) and J. Carlsson (Stockholm) at the meeting of the EUROMECH Committee in Berlin on 6 April 1973. From 1975 onwards the EUROMECH Committee consisted of 10 members with a further increase of members from the solid mechanics side. It should be noted that three members, J. Brilla (Bratislava), W. Fiszdon and S. Kaliszky, came from Eastern Europe. They managed to attend EUROMECH Committee meetings in Western Europe which was not possible for colleagues from Romania or the former East Germany (DDR). Even a special visit of the Chairman G.K. Batchelor to the Academy of Sciences of the DDR in April 1973 did not improve the relationship between EUROMECH and the Academy of Sciences in East Berlin. It may be "that the fact that the USSR was not included among the countries from which participants of EUROMECH Colloquia were normally invited was noted with some concern" (28) and that this prevented closer contacts until 1989.

Between 1965 and the sudden death of Dietrich Küchemann on 23 February 1976 sixty eight EUROMECH Colloquia had been held, 51 in fluid mechanics and 17 in solid mechanics (29).

H.H. Fernholz

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Stokes and Kelvin, a century later: an essay

Keith Moffatt [1]

George Gabriel Stokes

William Thomson Kelvin

The year 2003 marked the centenary of the death of George Gabriel Stokes (1819-1903), and a meeting was held in Cambridge, where he was Lucasian Professor of Mathematics for more than half a century (1849-1903), to commemorate his life and work. I was asked to lecture on Stokes's contributions to fluid mechanics and I focussed particularly on his role as the pioneer of the dynamics of real (*i.e.* viscous) as opposed to 'ideal' fluids. It may be of interest to readers of this Newsletter if I reproduce parts of this lecture here, but I shall also intersperse this with reflections of a more personal nature.

Stokes's name will of course forever be coupled with that of Navier through the governing equations of fluid mechanics; but it is also permanently attached to the concept of Stokes flow (the viscous limit in which inertia forces may be neglected) initiated through his seminal study of the flow past spheres and cylinders.

Stokes's career was inextricably linked with that of William Thomson (Lord Kelvin) (1824-1907), his lifelong friend and correspondent; plans will no doubt soon be afoot to mark Kelvin's centenary also, both in Glasgow where he was Professor of Natural Philosophy (and this also for more than half a century 1846-1899), and in Cambridge where he was an undergraduate (1841-1845) and where he frequently sojourned as a Fellow of Peterhouse (1845-52 and 1872-1907) during his subsequent phenomenal career. His final visit was in

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February 1903 when he stood by the graveside of Stokes and is alleged to have uttered the words: "Stokes is dead; I shall visit Cambridge no more". G.I.Taylor told me once at lunch in Trinity back in the 60s that he had attended Kelvin's 1904 lecture to the British Association for the Advancement of Science; this is my slender personal connexion with these great pioneers of 19th century science!

In reflecting upon the lives of Stokes and Kelvin, I have been struck by certain parallels that can be drawn between them and two great figures of our own recent era, namely George Keith Batchelor (1920-2000) and Michael James Lighthill (1924-1998), whose careers resonate in numerous respects, albeit almost exactly one century later, with those of Stokes and Kelvin respectively. Like these two, Batchelor and Lighthill interacted for many years somewhat like sparring partners, enlivened by the tensions necessarily associated with their strongly divergent personalities. We were privileged in Cambridge to have these great scientific personalities in our midst, a presence that did so much to shape the development of fluid dynamics throughout the latter half of the 20th century, not only at the parochial Cambridge level, but also, through their widespread national and international influence, on the global stage.

The passage of time allows us to view great scientists of the past in their historical context and to better appreciate the scope and magnitude of their achievements. So it has been with Stokes and Kelvin, and particularly so for those who work in fluid mechanics, a subject that was influenced and shaped in so many ways by the brilliance of their investigations. David Wilson's (1987) comparative study *"Kelvin and Stokes"*, and his edition of *"The Correspondence between Sir George Gabriel Stokes and Sir William Thomson, Baron Kelvin of Largs"* (1990) have cast penetrating light on the interactions between these great men of science; I have drawn freely on these works in the following discussion. The papers of Stokes to which I refer may be found in his Collected *Mathematical and Physical Papers* (Stokes 1905).

Stokes was born in Co. Sligo in Ireland, son of the vicar of Screen, in which village a meeting is now held every three years or so, commemorating aspects of Stokes's life and work. I attended one of these meetings in 1998; it was held in the classroom of the primary school that Stokes had attended as a child; we used a blackboard mounted on its easel as our primary visual aid!

Stokes moved to England in 1835 and studied at Bristol College (precursor of Bristol University) for two years before coming to Cambridge as an undergraduate in 1837. He studied the Mathematical Tripos (so-named because of the medieval practice whereby students underwent the oral examination in mathematics while seated upon a three-legged stool). Students who attained first-class Honours in the Mathematical Tripos were (and indeed still are) known as Wranglers (to 'wrangle' being to engage in disputatious

argument), and the Wranglers were formerly placed each year in order of merit, the first on the list being accorded the coveted title of 'Senior Wrangler', a distinction that Stokes duly attained in 1841, the same year in which the younger William Thomson (at age 17) was admitted as an undergraduate of Peterhouse, the most ancient of Cambridge's many Colleges. On the basis of his success, Stokes was immediately elected to a Fellowship at Pembroke College.

It is interesting to note that, although the word Wrangler is used to this day in Cambridge, the listing is now alphabetical rather than by order of merit. The change was adopted in 1909 (G.I.Taylor who graduated 22nd Wrangler in 1907 was one of the last to suffer the slings and arrows of numerical listing!), on the grounds that the publication of an order-of-merit had an undesirable tendency to breed intense and potentially unhealthy competition. (I note that no such scruples are evident in that other great teaching establishment of which I had experience in the 1990s, the Ecole Polytechnique in Palaiseau, France, where the list of graduating students was still published each year in order-of-merit all the way from the first on the list to the four-hundredth!)

From the start, Stokes was conscious of the wide divergence between the predictions of the classical theory of irrotational flow and the results of common observational experience. In his 1843 paper *"On some cases of fluid motion"*, he sought to confront this divergence head-on: he wrote in the following terms:

"The only way by which to estimate the extent to which the imperfect fluidity [viscosity] of fluids may modify the laws of their motion, without making any hypothesis as to the molecular constitution of fluids, appears to be, to calculate according to the hypothesis of perfect fluidity some cases of fluid motion, which are of such a nature as to be capable of being accurately compared with experiment."

One of the cases studied in this paper was the flow of fluid (assumed irrotational) in a closed box whose interior is of the form of a rectangular parallelipiped, the box being subjected to an arbitrary rigid-body motion. Stokes solved this problem by adroit use of Fourier series. One may easily carry out an experiment (and Stokes probably did), by suspending a transparent box filled with water on a torsion wire and subjecting it to torsional oscillations; unless the amplitude of these oscillations is extremely small, the flow (which may be visualised using suspended particles – one may use tea-leaves, as Stokes might well have done – he was a great tea-drinker!) is different from the 'perfect-fluidity' potential flow, and most obviously so in the boundary layers (later to be called Stokes layers) that form on the interior surface of the box. I shall comment further on this flow below.

Stokes's great paper *"On the theories of the internal friction of fluids in motion, and of the equilibrium and motion of elastic solids"* was published in 1845. In the

course of his introduction he refers to a previous derivation of what we now refer to as the Navier-Stokes equations by Poisson, and he adds a footnote "The same equations have also been obtained by Navier (*Mém. de l'Académie*, t.vi. p.389), but his principles differ from mine still more than do Poisson's ". Navier had assumed a very specific model involving particles at the points of a lattice and subject to interactive forces linearly related to their instantaneous relative velocities – what we may now recognise as the first construction of a 'lattice gas dynamics'. Stokes, by contrast, sought to develop a theory based on the concept of a continuum, and freed from any assumption concerning the molecular structure of the fluid. He developed the concepts of stress and rate-of-strain and assumed these to be related in linear (Newtonian) manner, leading to the now familiar N-S equations. It is interesting to note that Stokes was aware of the problem of 'dilitational viscosity', and wrote "The equations at which I have thus arrived contain two arbitrary constants, whereas Poisson's equations contain but one". The power and generality of the approach pioneered by Stokes is evidenced by the fact that this same approach is almost invariably used nowadays in any treatment of the fundamentals of fluid dynamics.

Five years later came Stokes's paper *"On the effect of the internal friction of fluids on the motion of pendulums"*, and here it is interesting to note that it was indeed the practical problem of determining the effect of air friction on the damping of a pendulum that motivated this pioneering study. Stokes discusses first the neglect of the nonlinear $\mathbf{u}$.grad $\mathbf{u}$ term of the N-S equations, and second, what we would now describe as the dynamical-similarity properties of the resulting linearised equations; he then presents his solution for the oscillatory layer at a boundary oscillating parallel to itself (now called the Stokes layer), and only then turns his attention to the problem of the flow due to an oscillating sphere (like the bob of a pendulum undergoing small-amplitude oscillations). He solves this problem completely, then as a postscript passes to the steady (zero-frequency) limit, and obtains the famous 'Stokes drag' formula, $F = 6\pi\mu aV$, often described as the best-known result in all fluid mechanics. Not satisfied with this, he turns his attention to the problem of flow past an oscillating cylinder (modelling the flow past the wire supporting the bob of the pendulum), and notes a troubling divergence in this case in his series solution in the zero-frequency limit. He describes this as "a difficulty in the case of a cylinder", a difficulty that was in fact only resolved more than a century later with the development of matched asymptotic expansions (Lagerstrom & Cole 1955, Proudman & Pearson 1957). This 141-page paper of Stokes must surely be one of the greatest in fluid mechanics ever written.

What seems rather extraordinary to me is that (with only a handful of notable exceptions) so little further fundamental advance in the mechanics of viscous fluids was made over the next half-century (1850-1900). Was this because

Stokes himself became preoccupied with other areas (potential theory of surface waves, optics, the mathematics of infinite series, …) and with his exceptionally heavy responsibilities as Secretary of the Royal Society and Editor of its Philosophical Transactions over most of his subsequent active research life (1854-1885)? Or was it perhaps that the development of vortex dynamics pioneered by Helmholtz (1858), and much promoted by Kelvin (*"On vortex atoms"* 1867) as providing a model for the ultimate structure of matter, had an overpowering influence in swinging the pendulum of scientific investigation back towards the Eulerian domain of ideal fluids? For whatever reason, it is a fact that the next fundamental advance in 'real' fluid dynamics had to await Prandtl's (1905) introduction of the boundary-layer concept.

There was however an interesting precursor to Prantdl's boundary-layer theory in which Stokes played a part. This was provided by Hele-Shaw's (1898) experiments on the flow in a narrow gap between two parallel boundaries in which obstacles of various shapes may be placed (the Hele-Shaw cell). Stokes (now aged 79), with characteristic lucidity, wrote an Appendix to this paper entitled *"Mathematical proof of the identity of the streamlines obtained by means of a viscous film with those of a perfect fluid moving in two dimensions".* Again, Stokes's treatment is precisely that which finds its way into most modern textbooks of the subject. The two-scale treatment adopted by Stokes is just what Prandtl would need in his subsequent development of boundary-layer theory.

Stokes's remarkable correspondence with Kelvin extended from 1846 to 1901. Typical is an exchange that took place in the Spring of 1847. On 30th March, Kelvin, already installed in Glasgow, wrote:

"My dear Stokes,
It has just occurred to me this evening that you may possibly be able to give me some information that will help me out of a difficulty which has been puzzling me for a considerable time. …"

He goes on to pose in physical terms a problem concerning potential flow within a bounded domain. Stokes's reply from Pembroke College, Cambridge, is dated 1st April; the speed of communication using the recently established penny-post was remarkable -- every bit as efficient as modern e-mail! Stokes restates Kelvin's problem in more precise mathematical terms, and proceeds to give a preliminary solution. He follows this up with two further long letters dated 3rd and 5th April, in which he gives a wide-ranging discussion of the problem. Kelvin replies to all three letters on 7th April, where he says:

"Many thanks for your letters, which have given me plenty of matter for contemplation, in subjects with which I have long been interested. There is a great deal which I would like to say about them, but I do not know where to begin, especially as I am about to start for Ireland in a few hours, to take advantage of half a week's holiday …"

The exchange was typical of later correspondence also: Kelvin would throw out a plethora of physical ideas ranging over fluid dynamics, electromagnetism, thermodynamics, … ; and Stokes would endeavour to bring more disciplined thinking to bear on these ideas to the point at which they could be properly formulated in mathematical terms. This was truly a symbiotic relationship between two men of quite exceptional and yet complementary talents.

And why do I seek to draw the comparison between Stokes and, in our own era, the late Professor G.K.Batchelor? Like Stokes, Batchelor, having arrived in Cambridge from Australia in 1945, spent the rest of his life there. He was elected to a Fellowship of Trinity College in 1947, and, from 1948 to 2000, was successively Lecturer, Reader, Professor and Emeritus Professor of the University. In 1956, he founded the *Journal of Fluid Mechanics* (*JFM*), and, just as Stokes had devoted himself to *Phil Trans Roy Soc*, so Batchelor devoted himself to *JFM* for more than four decades. Both men were what could be described as 'supremely conscientious', with a strong personal commitment to the essential morality of science. Both made seminal contributions to fluid mechanics, in Batchelor's case, to the theory of homogeneous turbulence, and later to microhydrodynamics, appropriately the application of Stokes' theory to suspensions of particles, drops or bubbles in fluids. Batchelor was of course a Co-Founder of Euromech in 1966 (I have detailed his many achievements in his Biographical Memoir, Moffatt 2002).

And why do I similarly propose the late Sir James Lighthill as the fluid dynamicist of recent times who most closely mirrors the genius of Kelvin? Like Kelvin, Lighthill showed early signs of genius, qualifying in parallel with his close friend and classmate at Winchester, Freeman Dyson, for a major scholarship to Trinity College, Cambridge, at the exceptionally early age of 15. Like Kelvin, he graduated as a Wrangler in 1943 (the earliest date at which, according to the regulations he could do so). Kelvin had been disappointed to be second Wrangler in 1845; as indicated above, wranglers were not numerically ordered after 1909, but it was nevertheless common knowledge that Lighthill in fact came second to Dyson in the 1943 examination – no doubt a powerful stimulus to prove himself decisively in research in the years that followed! In fact, just as Kelvin had been elected to the Chair of Natural Philosophy at Glasgow at the spectacularly early age of 22, so Lighthill was elected to the Beyer Chair of Applied Mathematics at Manchester at the equally spectacular (for its time) age of 26. Lighthill's brilliant achievements in supersonic aerodynamics and aeroacoustics during the 1950s have been well described by Pedley (2001) and I shall not endeavour to summarise them here. Suffice it to say that they reveal hallmarks of genius that bear comparison with those attributed to Kelvin in relation to his work of the 1850s on the foundations of thermodynamics.

But the comparison does not end here: for just as Kelvin had subsequently devoted immense energy to problems associated with the laying of the first transatlantic telegraph cable, so Lighthill devoted himself during his years as Director of the Royal Aircraft Establishment at Farnborough (1959-1964) to problems associated with the first (and last?) commercial transatlantic supersonic aircraft, Concorde. Furthermore, just as Kelvin showed unbounded ambition and imagination in formulating his fundamental theory of matter – the vortex atom theory referred to above, so Lighthill showed comparably boundless intellectual energy and imagination in seeking to explain evolutionary biology in his later years of research both at Cambridge and at University College London, through a far-reaching investigation of the aerodynamics of flight and the hydrodynamics of swimming of insects, birds and fish, i.e. the greater part of the whole animal kingdom. The comparison is compelling, is it not?

I would like to end this essay on a personal note in relation to Stokes. In the course of my own career, I have worked on three problems within the field of Stokes flow that I would have dearly liked to discuss with him. We perhaps all have our individual favourites in this regard! Here are mine:

First, there is the problem of corner eddies that I described in 1964, and that were beautifully visualised experimentally by Taneda (1979): two-dimensional Stokes flow in a corner generally exhibits an infinite sequence of geometrically and dynamically self-similar eddies, a phenomenon that appears quite astonishing, bearing in mind that Stokes flows under prescribed boundary conditions are flows that minimise the rate of dissipation of kinetic energy. Of course, the eddies decay very rapidly as the corner is approached, and only the first two or three can be detected in experiments. Current work however (Branicki & Moffatt, in preparation) reveals that for time-periodic Stokes flow in a corner, these eddies 'come to life' one by one in a most intriguing way. Stokes's problem of the torsionally-oscillating parallelipiped, to which I have referred above, is well adapted to reveal this behaviour, far removed from that obtained by potential flow analysis!

Second, there is the problem of 'free-surface cusps' on which I worked with Jae-Tack Jeong some years ago (Jeong & Moffatt 1992). Theory based on the steady Stokes equations indicates a quite extraordinary formula for the minimum radius of curvature R on a free surface when viscous effects compete with surface tension effects in determining the free surface shape: if d is a characteristic geometric scale for the problem, then R/d is proportional to $\exp\{-32\pi\, Ca\}$ where Ca is the capillary number, essentially the ratio of the viscous force to the capillary force in the neighbourhood of the free surface. Under a 'level-playing-field' assumption $Ca = 1$, the formula gives a value of R/d of order 10^{-42}! This, so far as I know, is the smallest non-dimensional

number to emerge from any problem in continuum mechanics when the input parameters (here just the capillary number) are of order unity. This may certainly be described as a physical (though not a mathematical) singularity. One way to resolve the singularity (Eggers 2001) is to take account of the variable pressure distribution on the (no longer) 'free' surface due to the flow in the cusp region of the air above the surface.

My third choice is the phenomenon of chaos in steady Stokes flows (Bajer & Moffatt 1990). The fact that the streamlines of a steady Stokes flow inside a sphere, driven by a smooth tangential velocity distribution on the spherical surface, can be chaotic, came as quite a surprise! One might reasonably expect that steady Stokes flows, dominated as they are by strong smoothing viscous effects will exhibit maximum regularity. Not so! In three dimensions, they are generically chaotic, in the sense that initially adjacent fluid particles move apart exponentially with time (i.e.the Liapunov exponent is positive). The streamlines are not closed, neither do they lie on surfaces; they inhabit subdomains of the sphere of (no doubt) fractal character.

I like to think that Stokes would have been particularly intrigued by these three problems, all within the branch of the subject that bears his name. I have a similar group of problems that I would dearly like to discuss with Kelvin, but that is another story, that can perhaps best wait until 2007!

The support of the Leverhulme Trust is gratefully acknowledged.

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European Mechanics Society

EUROMECH Fellow

The EUROMECH - European Mechanics Society Council has the pleasure to announce the introduction of the category of **EUROMECH Fellow**, starting in 2005. The status of Fellow is awarded to members who have contributed significantly to the advancement of mechanics and related fields. This may be through their original research and publications, or their innovative contributions in the application of mechanics and technological developments, or through distinguished contribution to the discipline in other ways.
Election to the status of Fellow of EUROMECH - European Mechanics Society will take place in the year of the appropriate EUROMECH Conference, EFMC or ESMC respectively, and is limited in total (fluids and solids together) to no more than one-half of one percent of the then current membership of the Society.

Nomination conditions:

- The nomination is made by **two sponsors** who must be members of the Society;
- Successful nominees must be members of the Society;
- Each nomination packet must contain a **completed Nomination Form, signed by the two sponsors, and no more than four Supporting Letters** (including the two from the sponsors)

Nomination Process:

- The nomination packet (nomination form and supporting letters) must be submitted before 15 January in the year of election to Fellow (the year of the respective EFMC or ESMC);
- Nominations will be reviewed before the end of February by the **EUROMECH Fellow Committee**;
- Final approval will be given by the **EUROMECH – European Mechanics Society Council** during its meeting in the year of election to Fellow;
- Notification of newly elected Fellows will be made in May following the Council meeting;
- The Fellow award ceremony will take place during the EFMC or ESMC as appropriate.

Required documents and how to submit nominations: Nomination packets need to be sent before the deadline (before 15 January of the year of the respective EFMC or ESMC) to the President of the Society. Information can be obtained from the EUROMECH web page **www.euromech.org** and the Newsletter. Nomination Forms can also be obtained from the web page or can be requested from the Secretary-General.

NOMINATION FORM FOR FELLOW

NAME OF NOMINEE:……...…….…

OFFICE ADDRESS:……..……....

…….

…….

EMAIL ADDRESS:…….……..

FIELD OF RESEARCH: ……..

Fluids: ☐ Solids: ☐

NAME OF SPONSOR 1: ..……...……

OFFICE ADDRESS:……..……...…

…….

…….

EMAIL ADDRESS:……

SIGNATURE & DATE: ……

NAME OF SPONSOR 2: ..……...…….

OFFICE ADDRESS:……..…….…….……...….

……...…

……...…

EMAIL ADDRESS:…….

SIGNATURE & DATE: …….

SUPPORTING DATA

- SUGGESTED CITATION TO APPEAR ON THE FELLOWSHIP CERTIFICATE (30 words maximum)
- SUPPORTING PARAGRAPH ENLARGING ON THE CITATION, INDICATING THE ORIGINALITY AND SIGNIFICANCE OF THE CONTRIBUTIONS CITED (limit 250 words)
- NOMINEE'S MOST SIGNIFICANT PRINCIPAL PUBLICATIONS (list at most 8)
- NOMINEE'S OTHER CONTRIBUTIONS (invited talks, patents, professional service, teaching etc. List at most 10)
- NOMINEE'S ACADEMIC BACKGROUND (University Degrees, year awarded, major field)
- NOMINEE'S EMPLOYMENT BACKGROUND (position held, employed by, duties, dates)

SPONSORS DATA

Each sponsor (there are two sponsors) should sign the nomination form, attach a letter of recommendation and provide the following information:

• sponsor's name

• professional address

• email address

• sponsors signature/date

ADDITIONAL INFORMATION

Supporting letters (no more than four including the two of the sponsors).

Send whole nomination packet to:

Professor Patrick Huerre
President EUROMECH
Laboratoire d'Hydrodynamique, École Polytechnique
91128 Palaiseau Cedex, France
E-mail: huerre@ladhyx.polytechnique.fr

Regulations and Call for Nominations

EUROMECH Fluid Mechanics Prize

EUROMECH Solid Mechanics Prize

The *Fluid Mechanics Prize* and the *Solid Mechanics Prize* of EUROMECH, the European Mechanics Society, shall be awarded on the occasions of Fluid and Solid conferences for outstanding and fundamental research accomplishments in Mechanics.
Each prize consists of 5000 Euros. The recipient is invited to give a Prize Lecture at one of the European Fluid or Solid Mechanics Conferences.

Nomination Guidelines:
A nomination may be submitted by any member of the Mechanics community. Eligible candidates should have undertaken a significant proportion of their scientific career in Europe. Self-nominations cannot be accepted.
The nomination documents should include the following items:

- a presentation letter summarizing the contributions and achievements of the nominee in support of his/her nomination for the Prize,
- a curriculum vitae of the nominee,
- a list of the nominee's publications,
- at least two letters of recommendation.

Five copies of the complete nomination package should be sent to the Chair of the appropriate Prize Committee, as announced in the EUROMECH Newsletter and on the Society's Web site www.euromech.org Nominations will remain active for two selection campaigns.

Prize committees:
For each prize, a Prize Committee, with a Chair and four additional members shall be appointed by the EUROMECH Council for a period of three years. The Chair and the four additional members may be re-appointed once. The committee shall select a recipient from the nominations. The final decision is made by the EUROMECH Council.
Nomination Deadline for the Fluid Mechanics prize: **15 January 2006**.

The members of the *Fluid Mechanics Prize and Fellowship Committee* are:

- I.D. Abrahams
- H.H. Fernholz (Chair)
- P. Huerre
- D. Lohse
- W. Schröder

Nomination Deadline for the Solid Mechanics prize: **15 January 2006**.

The members of the *Solid Mechanics Prize and Fellowship Committee* are:

- A. Benallal
- I. Goryacheva
- H.M. Jensen
- F.G. Rammerstorfer (Chair)
- B. A. Schrefler

Chairmen's Addresses:

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Second Announcement
9th EUROMECH-MÉCAMAT Conference – EMMC9

Local approach to fracture
9–12 May 2006
Moret Sur Loing, France
http://www.mat.ensmp.fr/EMMC9

This conference is the ninth in a new series of European Mechanics of Materials Conferences to be held under the auspices of the European Mechanics Society and the French Society for Mechanics of Materials. These EUROMECH-MÉCAMAT Conferences continue the tradition of past MECAMAT International Seminars.

The purpose of the meeting is to bring together specialists in experimental, modeling and simulation techniques devoted to the analysis of macroscopic fracture based on the description of microscopic mechanisms. Various aspects such as the following are concerned:

* Ductile fracture of metals,
* Brittle fracture of metals,
* Ductile to brittle transition,
* Creep rupture,
* Fracture of polymers and elastomers,
* Experimental fracture mechanics,
* Constitutive models,
* Micromechanical modelling,
* Scale effects,
* Computational fracture mechanics.
* Load history effect (WPS, …).

The Conference will include presentation in oral or poster form. Abstracts of about 500 words are invited before September 1, 2005. They should contain the title of the communication, full names and addresses of the authors, objectives of the study, methods employed, and the most significant results. Submission of the abstract by e-mail (PDF format) is recommended. Notification of acceptance will be sent to authors by December 15, 2005. A six-page paper will be **due before March 15, 2006**. Copies of all these papers will be available in book-form as pre-prints of the proceedings, on the first day of the conference. Full size refereed papers will be published later as a special issue of Engineering Fracture Mechanics. These papers should be sent before December 31, 2006. Instructions concerning the format of the papers will be available on the conference web page.

Co-Chairmen : J. Besson, D. Steglich, D. Moinereau
Conference Secretariat: V Diamantino
E-mail**:** emmc9@mat.ensmp.fr

Announcement
6th European Fluid Mechanics Conference – EFMC6

26–30 June 2006
KTH, Stockholm, Sweden
http://www2.mech.kth.se/efmc6/

The 6th European Fluid Mechanics Conference, organized by EUROMECH (the European Mechanics Society), will take place at KTH, Royal Institute of Technology, Stockholm, 26–30 June 2006.

The conference aims to provide an international forum for the exchange of information on all aspects of fluid mechanics, including instability and transition, turbulence, multiphase and non-Newtonian flows, bio-fluid mechanics, reacting and compressible flows, numerical and experimental methods, geophysical flows etc., as well as all types of fluid mechanics applications.

Eight prominent scientists have already accepted the invitation to give keynote lectures in their respective fields of expertise. These are (in alphabetical order):
– Gustav Amberg (Sweden) - Fluid mechanics of phase change
– Stephan Fauve (France) - Generation of magnetic fields by turbulent flows of liquid metals
– Sascha Hilgenfeldt (USA) - The power of bubbles: Unconventional micro-fluidics
– Rich Kerswell (UK) - Progress in Reynolds' problem: transition to turbulence in pipe flow
– Hilary Ockendon (UK) - Continuum models in industrial applications
– Norbert Peters (Germany) - Combustion
– Jens Sørensen (Denmark) - Wind turbine wake structures
– Sandra M. Troian (USA) - Microfluidic actuation and sensing for open architecture systems: Fundamentals to applications.

In addition to these 8 invited lectures and one lecture by the EUROMECH Fluid Mechanics Prize winner (not yet selected), contributions are solicited from the worldwide fluid mechanics research community. The paper selection will be made by the EUROMECH Fluid Mechanics Conference Committee on the basis of the extended abstracts submitted at the end of 2005 (details on the submission process will be given on the conference home-page during Spring/Summer 2005). For further information please visit the above website.

Enquiries should be sent to **efmc6@mech.kth.se**

Announcement
6th European Solid Mechanics Conference – ESMC6

28 August - 1 September 2006
Budapest University of Technology and Economics
Budapest, Hungary
http://esmc2006.mm.bme.hu

The 6th European Solid Mechanics Conference (ESMC 2006) will be held at the Budapest University of Technology and Economics (BME), Hungary, 28 August -- 1 September, 2006 under the auspices of the European Mechanics Society (EUROMECH).

The conference aims to provide an international forum for the exchange of information on all aspects of solid mechanics, including Continuum Mechanics
(*General theories, Elasticity, Plasticity, Multi-field problems*), Materials Mechanics (*Damage and fracture, Viscoelastic materials and systems, Composites, Contact problems*), Structural Mechanics (*Beam structures, Plates and shells, Stability, Structural optimization*), Dynamics (*Kinematics, Multibody systems, Vibrations, Nonlinear dynamics*), Computational and experimental methods

The following scientists have already accepted the invitation to give keynote lectures in their respective fields of expertise:
– Werner Schielen (Universität Stuttgart, Germany) - Dynamics
– Gerhard A. Holzapfel (KTH Stockholm, Sweden) - Biomechanics
– Jean-Jacques Marigo (Université Paris 13, France) - Fatigue/Fracture
– Paul van Houtte (KU Leuven, Belgium) - Plasticity/Damage
– Alexander B. Movchan (University of Liverpool, UK) - Stability
– Nikita Morozov (St. Petersburg State University, Russia) - Micromechanics
– Dick van Campen (Eindhoven, The Netherlands) - Nonlinear Dynamics

In addition to these invited lectures and one lecture by the EUROMECH Solid Mechanics Prize winner (not yet selected), contributions are solicited from the worldwide solid mechanics research community. The paper selection will be made by the EUROMECH Solid Mechanics Conference Committee on the basis of the extended abstracts submitted before 15 November 2005 (details on the submission and registration process are given on the conference home-page). For further information please visit the above website.

Enquiries should be sent to **esmc2006@mm.bme.hu**

Announcement and Call for Papers
11th EUROMECH European Turbulence Conference
ETC11

25–28 June 2007

Faculty of Engineering of the University of Porto, Portugal

http://www.fe.up.pt/etc11

The 11th EUROMECH European Turbulence Conference (ETC11), organized by the EUROMECH - European Mechanics Society, will take place at the Faculty of Engineering of the University of Porto (FEUP) in Porto, Portugal.

The conference aims to provide an international forum for exchange of information on most fundamental aspects of turbulent flows, including instability and transition, intermittency and scaling, vortex dynamics and structure formation, transport and mixing, turbulence in multiphase and non-Newtonian flows, reacting and compressible turbulence, acoustics, control, geophysical and astrophysical turbulence, and large-eddy simulations and related techniques, MHD turbulence and atmospheric turbulence.

Following the established tradition, the conference programme will comprise 8 invited talks (two per day), selected papers and poster sessions.

Contributions are solicited from the worldwide turbulence research community.

The paper selection will be made by the EUROMECH Turbulence Conference Committee on the basis of two-page abstracts submitted via the conference webpage, at **www.fe.up.pt/etc11** by 6 October 2006.

All accepted papers and posters will appear in a conference proceedings to be distributed among the participants. A smaller set of papers may be published after the conference in a special issue of a scientific journal. For further information and updates please visit the conference website or contact the organizers at **etc11@fe.up.pt**.

EUROMECH Conferences in 2006 and 2007

The general purpose of EUROMECH conferences is to provide opportunities for scientists and engineers from all over Europe to meet and to discuss current research. Europe is a very compact region, well provided with conference facilities, and this makes it feasible to hold inexpensive meetings.
The fact that the EUROMECH Conferences are organized by Europeans primarily for the benefit of Europeans should be kept in mind. Qualified scientists from any country are of course welcome as participants, but the need to improve communications within Europe is relevant to the scientific programme and to the choice of leading speakers.

A EUROMECH Conference on a broad subject, such as the ESMC or the EFMC, is not a gathering of specialists all having the same research interests, and much of the communication which takes place is necessarily more in the nature of the imparting of information than the exchange of the latest ideas. A participant should leave a Conference knowing more and understanding more than on arrival, and much of that gain may not be directly related to the scientist's current research. It is very important therefore that the speakers at a Conference should have the ability to explain ideas in a clear and interesting manner, and should select and prepare their material with this expository purpose in mind.

EMMC9
9th EUROMECH-MÉCAMAT Conference
DATES: 9-12 May 2006
LOCATION: Moret Sur Loing, France
CONTACT: Jacques Besson, Ecole Nationale des Mines de Paris, France
E-MAIL: jacques.besson@ensmp.fr
WEBSITE: http://www.mat.ensmp.fr/EMMC9/

EFMC6
6th European Fluid Mechanics Conference
DATES: 26 – 30 June 2006
LOCATION: KTH, Stockholm, Sweden
CONTACT: efmc6@mech.kth.se
WEBSITE: http://www2.mech.kth.se/efmc6/

ESMC6
6th European Solid Mechanics Conference
DATES: 28 August - 1 September 2006
LOCATION: Budapest University of Technology and Economics (BUTE), Budapest, Hungary
CONTACT: Prof. Gábor Stépán – chairman; Dr. Ádám Kovács – secretary, BUTE Department of Applied Mechanics, 1521 Budapest, P.O. Box 91
Fax: +36 1 463 3471
E-MAIL: esmc2006@mm.bme.hu
WEBSITE: http://esmc2006.mm.bme.hu

EMMC10
10th EUROMECH-MÉCAMAT Conference
DATES: Autumn 2007
LOCATION: Warsaw, Poland
CONTACT: W.K.Nowacki, IPPT-Polish Academy of Sciences
E-MAIL: wnowacki@ippt.gov.pl
WEBSITE:

EETC11
11th EUROMECH European Turbulence Conference
DATES: 25 – 28 June 2007
LOCATION: Faculty of Engineering of the University of Porto
Porto, Portugal
CONTACT: etc11@fe.up.pt.
WEBSITE: http://www.fe.up.pt/etc11

Euromech colloquia in 2006 and 2007

EUROMECH Colloquia are informal meetings on specialized research topics. Participation is restricted to a small number of research workers actively engaged in the field of each Colloquium. The organization of each Colloquium, including the selection of participants for invitation, is entrusted to a Chairman. Proceedings are not normally published. Those who are interested in taking part in a Colloquium should write to the appropriate Chairman. Number, Title, Chairperson or Co-chairperson, Dates and Location for each Colloquium in 2006, and preliminary information for some Colloquia in 2007, are given below.

EUROMECH Colloquia in 2006

470. Recent Development in Magnetic Fluid Research
Chairman: Dr. Stefan Odenbach, ZARM, University of Bremen, Am Fallturm, D-28359, Bremen, Germany
Phone: +49-(0)421 2184 785, Fax: +49-(0)421 2182 521
E-mail: odenbach@zarm.uni-bremen.de
Co-chairman: Prof. Dr. Elmars Blums, Institute of Physics, University of Latvia, Salaspils, Latvia
Euromech contact person: Prof. Wolfgang Schröder
Date and location: 27 February-1 March 2006, Dresden, Germany
http://www.zarm.uni-bremen.de/2forschung/ferro/conferences/Euromech06/euromech_colloquium_470.htm

475. Fluid Dynamics in High Magnetic Fields
Chairman: Prof. A. Thess, Department of Mechanical Engineering, Ilmenau, University of Technology, P.O. Box 100 565, D-98684, Ilmenau, Germany
Phone: +49-(0)3677 69 2445, Fax: +49-(0)3677 69 1281
E-mail: thess@tu-ilmenau.de
Euromech contact person: Prof. Jorge Ambrosio
Date and location:1-3 March 2006, Ilmenau, University of Technology, Germany
http://www4.tu-ilmenau.de/mfd/euromech2006.html

476. Real-time Simulation and Virtual Reality Applications of Multibody Systems
Chairman: Prof. J. Cuadrado, Escuela Politecnica Superior, Universidad de La Coruña, Mendizabal s/n 15403 Ferrol, Spain
Phone: +34-9813 37400 ext. 3873, Fax: +34-9813 37410
E-mail: javicuad@cdf.udc.es
Co-chairman: Prof. W. Schiehlen, Institute B of Mechanics, University of Stuttgart, Germany
Euromech contact person: Prof. Jorge Ambrosio
Date and location: 13-16 March 2006, Ferrol, Spain
http://lim.ii.udc.es/events/euromech476/

477. Particle-laden Flow. From Geophysical to Kolmogorov Scales
Chairman: Prof. B.J. Geurts, Mathematical Sciences, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands
Phone: +31-(0)48 94125, Fax: +31-(0)48 94833
E-mail: b.j.geurts@utwente.nl
Co-chairman: Prof. Dr. H.J.H. Clercx, Eindhoven University of Technology, and Dr. W.S.J. Uijttewaal, Delft University of Technology, The Netherlands.
Euromech contact person: Prof. Detlef Lohse
Date and location: 21-23 June 2006, University of Twente, The Netherlands
http://wwwhome.math.utwente.nl/~geurtsbj/workshops/euromech_477/

478 Non-equilibrium Dynamical Phenomena in Inhomogeneous Solids
Chairman: Prof. Juri Engelbrecht, Centre for Nonlinear Studies, Institute of Cybernetics, Tallinn University of Technology, Akadeemia tee 21,
12618 Tallinn, Estonia
E-mail: je@ioc.ee
Co-chairman: Prof. Gerard A. Maugin
Euromech contact person: Prof. Ahmed Benallal
Date and location: 13-16 June 2006, Tallinn University of Technology, Estonia
http://greta.cs.ioc.ee/~berez/euromech478/

479. Numerical Simulation of Multiphase Flow with Deformable Interfaces
Chairman: Prof. Bendiks Jan Boersma, Laboratory for Aero and Hydrodynamics, Mekelweg 2, 2628 CD Delft, The Netherlands
E-mail: b.j.boersma@wbmt.tudelft.nl
Co-chairman:
Euromech contact person: Prof. Detlef Lohse
Date and location: 14-16 August 2006, "De Pier", Scheveningen, The Netherlands
http://www.ahd.tudelft.nl/~emil/euromech/

480. High Rayleigh Number Convection
Chairman: Prof. Detlef Lohse, University of Twente, The Netherlands
E-mail: lohse@tnw.utwente.nl
Co-chairman:
Euromech contact person: Prof. Hans H. Fernholz
Date and location: 4-8 September 2006, Trieste

482. Thermomechanics of Non-Homogeneous Structures
Chairman: Prof. Roman M Kushnir, Pidstryhach Institute for Applied Problems of Mechanics and Mathematics, 3-b Naukova Street, 79060 Lviv, Ukraine
Phone: +380 0322 63 83 77; Fax: +380 0322 63 72 70
E-mail: kushnir@iapmm.lviv.ua
Co-chairman: Prof. Georgij Sulym
Euromech contact person: Prof. Irina Goryacheva
Date and location: September 2006, National Akademy of Sciences, Lviv, Ukraine

484. Wave Mechanics and Stability of Long Flexible Structures Subjected to Moving Loads and Flows
Chairman: Prof. Andrei V. Metrikine, TU Delft, Faculty of Civil Engineering and Geosciences, PO Box 5048, 2600 GA, Delft, The Netherlands
E-mail: a.metrikine@citg.tudelft.nl
Co-chairman: Prof. L. Fryba and Prof. E. de Langre
Euromech contact person: Prof. Irina Goryacheva
Date and location: 19-22 September 2006, TU Delft, The Netherlands
http://www.euromech484.nl/

485. Durability of Composite Materials
Chairman: Prof. Antonio Torres Marques, Departamento de Engenharia Mecanica e Gestao Industrial, Faculdade de Engenharia de Universidade do Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal
E-mail: marques@fe.up.pt
Co-chairman: Prof. Albert Cardon
Euromech contact person: Prof. Jorge Ambrosio
Date and location: 18-21 July 2006, Hotel Santa Luzia, Viana do Castelo, Portugal

486. Deformation and Fracture Processes in Paper and Wood Materials
Chairman: Prof. Per A. Gradin, Department of Solid Mechanics,
Mid Sweden University, Sweden
E-mail: per.gradin@miun.se
Co-chairman: Prof. Tetsu Uesaka
Euromech contact person: Prof. Ahmed Benallal
Date and location: 12-15 June 2006, University of Sundsvall, Sweden
http://www.miun.se/fscn/euromech486

487. Structure Sensitive Mechanics of Polymer Materials-Physical and Mechanical Aspects
Chairman: Prof. Yves Remond, Institut de Mecanique des Fluides et de Solids
UMR 7507 ULP, 67000 Strasbourg, France
E-mail: remond@imsfs.u-strabg.fr
Co-chairman: Prof. Stanislav Patlazhan
Euromech contact person: Prof. Ahmed Benallal
Date and location: 10-13 October 2006, Strasbourg, France

EUROMECH Colloquia in 2007

483. Non-linear Vibrations of Structures
Chairman: Prof. P.L. Ribeiro, IDMEC/DEMEGI, Faculdade de Engenharia
Universidade do Porto, Rua Doutor Roberto Frias, 4200-465 Porto, Portugal
Phone: +351 22 508 1713; Fax: +351 22 508 1445
E-mail: pmleal@fe.up.pt
Co-chairman:
Euromech contact person: Prof. J. Ambrosio
Date and location: 5-7 September 2007, University of Porto, Portugal

EUROMECH CONFERENCE REPORTS

5th EUROMECH Nonlinear Dynamics Conference – ENOC-2005

7-12 August 2005, Eindhoven, the Netherlands

Chairperson: Prof. Dick van Campen

The fifth EUROMECH Nonlinear Dynamics Conference (ENOC-2005) was held on 7-12 August 2005 in the Auditorium Building of the Eindhoven University of Technology, Eindhoven, the Netherlands. ENOC-2005 covered the complete field of Nonlinear Dynamics, including multibody dynamics and couplings to control and optimization.

ENOC-2005 was attended by almost 400 participants from 42 countries from around the world, by far exceeding the number of participants of the previous ENOC conferences. Moreover, a substantial number of participants from East-European countries participated in ENOC-2005.

As regards the programme, seven plenary lectures were delivered by renowned scientists. In total 471 abstracts were submitted, of which 350 were accepted for oral presentation after review. The oral presentations were split into a succession of parallel sessions over 23 mini-symposia on a wide range of specific topics, including one miscellaneous group.

On the evening of 8 August an 'East-meets-West' Party was successfully organized in the Auditorium Building. On the afternoon of 10 August an excursion with guided tours was organized to the historical city of Maastricht, followed in the evening by the conference dinner in a historical cave.

The conference started with an exciting opening lecture delivered by Professor Philip Holmes from Princeton University (USA) and entitled 'Ninety plus thirty years of nonlinear dynamics: more is different and less is more.'

Tutorial papers associated with the plenary lectures have been published in the September 2005 special issue of the International Journal on Bifurcation and Chaos.

The topics of the ENOC-2005 Mini-Symposia included:

Dynamics and Bifurcations of Non-Smooth Systems, Impact Systems, Multibody Dynamics, Nonlinear Stochastic Systems, Optimization of Dynamical Systems, Reduced-Order Modeling, Synchronization of Oscillatory Systems, Systems with Time Delay, Time Series and Reconstruction, Control of Chaos, Fractional Derivatives and Their Applications, Oscillatory Motions in Hamiltonian Systems, Mechanisms for Diffusion in the Phase Space,

Computational Methods for Non-Smooth Systems, Dynamical Concepts in Computational Modelling, Numerical Bifurcation Techniques, Experiments in Nonlinear Dynamic Systems, Laser Dynamics, Micro- and Nano- Electro-Mechanical Systems, Nonlinear Dynamics and Control of Vehicle Systems, Asymptotic Methods in Nonlinear Dynamics, Nonlinear Dynamics of Distributed-Parameter Systems.

After review a total number of 310 papers presented at the mini-symposia were accepted for inclusion in the conference Proceedings on CD-Rom, which were handed to the conference participants upon their arrival.

Conference participants below 35 competed for two ENOC Young Scientist Prizes 2005. The prize committee awarded prizes to Christian Studer from ETH Zürich (Switzerland) for the paper 'Simulation of non-smooth mechanical systems with many unilateral constraints' and Alexei Mailybaev from Moscow State University (Russia) for the paper 'Optimal shapes of a beam under parametric excitation'.

As a novelty at ENOC-2005, and to value the activities of the organizers of the mini-symposia, the ENOC conference committee decided to establish a Mini-Symposium Organizers Award. The ENOC-2005 Mini-Symposium Organizers Award was assigned to the organizers of the mini-symposium on 'Experiments in Nonlinear Dynamic Systems': Walter Lacarbonara (Italy), Nathan van der Wouw (The Netherlands) and Hiroshi Yabuno (Japan).

ENOC-2005 turned out to be extremely positive in several aspects. First, it enabled the exchange of knowledge between the participants on a world-wide scale, including those from the East-European countries. Second, it enabled the exchange of and interaction between viewpoints from physics, mathematics and engineering in this field. Third, it has (again) put the European nonlinear dynamics community on the world map. Finally, owing to its size, this conference gave a good instantaneous picture of the major directions of research currently followed in nonlinear dynamics all over the world.

The Sixth EUROMECH Nonlinear Dynamics Conference will be held in St. Petersburg, Russia, in 2008.

EUROMECH Colloquium 454

"Large Eddy Simulation, Coherent Vortex Simulation and Vortex Methods to Study Turbulence"

14-16 April 2004, Marseille, France
Chairperson: Prof. Kai Schneider

The Euromech Colloquium 454 was organised at the Centre International de Rencontres Mathématiques (CIRM) in Luminy, Marseille (France) from 14 to 16 April 2004. There were 23 invited lecturers, 9 contributed talks and in total 60 participants from 17 countries from Europe, North and South-America and Japan.

The scope of the Colloquium was to discuss and exchange new trends for modelling and computing turbulent incompressible flows. For the majority of industrial applications (meteorology, oceanography, aeronautics, combustion, chemical engineering,…) the flows are in the fully developed turbulent regime and their modelling plays a crucial role for improving the prediction and the performance of the considered systems. The understanding of turbulence remains one of the big challenges yet to be resolved, either from a mathematical point of view (Navier-Stokes equations) or from a physical point of view (chaotic dynamics with many degrees of freedom). Numerical simulation is an essential tool to study turbulence as most analytical methods are unable to deal with the highly nonlinear behaviour encountered in turbulence. The Colloquium focused on the most recent methods for the numerical simulation of turbulent flows:

- Large Eddy Simulation (LES) which has been developed by Tony Leonard (CALTECH) and Joel Ferziger (Stanford)

- Vortex methods which have been developed by Alexander Chorin (Berkley) and Tony Leonard (CALTECH) since the 80ies

- Coherent Vortex Simulation (CVS) which has been developed since the 90ies by Marie Farge (ENS, Paris) and Kai Schneider (Marseille)

These three methods, which have been developed independently, starting from different principles but dealing with the same flows, are currently converging both from a conceptual point of view and also concerning their implementation on modern supercomputers. The principal objective of the conference was to highlight the similarities and differences of the three methods in order to study the possibilities of developing a joint approach. A secondary objective was to define typical turbulent flows, which could serve

as test cases and benchmarks to conduct a quantitative comparison of the different methods. The program comprised 23 invited lectures of 45 minutes, 9 oral presentations of 15 minutes and 7 poster presentations.

Additional information about the Colloquium can be found on the web-page: http://www.cmi.univ-mrs.fr/~kschneid/euromech454

EUROMECH Colloquium 455

"Semi-Active Vibration Suppression"

5-7 July 2004, Prague, Czech Republic
Chairperson: Prof. Michael Valasek and Prof. André Preumont

EUROMECH 455 was held in the Faculty of Mechanical Engineering of the Czech Technical University, Prague, from 5 to 7 July 2004. There were 22 participants from 9 countries and they presented 23 papers in 9 sessions during the Colloquium.

The topic of controlled vibration suppression has been investigated in many papers, and many scientific meetings have been devoted to it. However, the specialist sub-area of semi-active vibration suppression is dispersed among those papers and events dealing with active vibration suppression. This sub-topic has its own unique problems, methods, advantages/disadvantages and applications. Therefore, this Colloquium was organized in order to discuss the specific matters of semi-active vibration suppression and to provide a comprehensive coverage of the whole subject both in theory and applications.

The aim of the Colloquium was to bring together experts from the fields of mechanical vibration, control engineering, different application areas, and numerical modelling and simulation of vibration suppression in order to discuss the open questions about the potential, limitations, problems, synthesis methods and applications of semi-active control of vibration suppression. The concept of semi-active control is based on control where the actuator possesses many attributes of conventional (active) control but which requires very little control power. The semi-active actuator is usually only capable of dissipating energy, but not able to add energy into the system. The Colloquium focused on

- synthesis methods of semi-active vibration control,

- comparison of vibration suppression potential and limitations of semi-active and active systems,

- modelling techniques, numerical simulations and the experimental verification of semi-active vibration suppression,

- practical applications of semi-active vibration suppression.

The objectives of this Colloquium were:

- to bring together leading scientists and developers in the field of semi-active vibration suppression from universities, research institutes and industry,

- to create conditions for the exchange of ideas and development of collaborative applied projects,

- to offer possibilities for prospective young researchers to present their achievements and to establish professional contacts.

The Call for papers covered the following topics, but was not limited to them:

- semi-active vibration control,

- modelling of semi-active systems,

- vibration suppression potential of semi-active approaches,

- experimental verification of semi-active vibration suppression,

- application of semi-active vibration suppression.

The papers were sorted into 9 sessions dealing with Methods I and II, Applications in Vehicles I and II, Structures I and II, Bridges and Actuators in Devices I and II.

The opening lecture by Prof. André Preumont "Semi-active sky-hook, does it work?" raised two important questions describing the differences between active and semi-active vibration suppression. The questions are whether the damping introduced by sky-hook deteriorates the vibration attenuation for increasing frequences and whether the semi-active implementation of the sky-hook generates undesirable high-frequency excitations of the system; in other words, whether the semi-active vibration suppression works for practical wide-band vibration excitation of the system under investigation. The other opening lecture, by Zbynek Sika and Michael Valasek, entitled "Nonlinear versus Linear Control of Semi-active Vibration Isolation", raised the other important question as to whether the nonlinear switching of semi-active control requires that the semi-active control law has to be nonlinear in order to correspond to the nonlinear feature of semi-active switching, and whether the full potential of semi-active vibration suppression can be achieved only by nonlinear control. Both lectures offered many important arguments and examples in order to answer these questions but the final answer has not yet been reached.

The other main issues addressed in the papers, talks and discussions were:

Methods

It was discussed whether the methods from the synthesis of active control of vibration suppression can be used for the semi-active approach (LQG, NQR-SDRE, clipped-optimal).

Vehicles

The specific applications of vehicle vibration suppression using the energy efficiency of semi-active techniques were described (objectives of comfort, road-friendliness, soil-friendliness, load comfort, brake-friendliness).

Structures

Specific semi-active techniques suitable for different vibration suppression of structures were reported (vibro-isolation, vibro-absorption, vibro-damping).

Bridges

The application of semi-active vehicle suspension for the reduction of the vibration excitation of bridges by transport was described.

Devices

The number of currently known actuators for semi-active vibration suppression is rather limited. The known range of semi-active actuators was discussed (hydraulic damper with controlled orifice, magnetorheology, electrorheology, friction and switching of active actuators such as electromagnetics).

The talks were of a high scientific level and were actively discussed during the sessions. All authors were asked for their papers and these papers were published on a CD ROM that was made available to all participants.

EUROMECH Colloquium 456

"Experimental and Computational Biofluid Mechanics"

4-5 October 2004, Aachen, Germany
Chairperson: Prof. Dr. W. Schröder

In the Euromech Colloquium 456 "Experimental and Computational Biofluid Mechanics" held on October 4-5, 2004 at the RWTH, Aachen University, more than 50 people from all over Europe participated in eight sessions. To be more precise, 20 scientists from Germany, 31 scientists from Western European Countries, and another 6 scientists from Eastern Europe. This was the first Euromech Colloquium on such a subject, which is one of the fastest growing interdisciplinary research areas with a high impact on science and social trends.

In total 41 presentations were made including 3 invited talks in which overviews of flows in arteries and larger airways, micro-piv for cardio-vascular research and new approaches in interventional therapy were given. The first session focused on the flow in carotid bifurcation. The carotid bifurcation is one of the most critical flow bifurcations where plaques are often found in a person's old age. These plaques are mostly responsible for brain strokes. From the fluid mechanical point of view, most of the contributions dealt with the shear stress field and non-invasive flow measurement techniques to quantify the stresses. The high-shear regions are seen as the starting point of plaque growth initiated by the coagulation cascade. Two other sessions contributed to flow studies in the ventricle, the arteries and veins. Most of the results demonstrated the importance of wall compliance on the flow field. Therefore, it is one of the major tasks in CFD to incorporate fluid-structure interaction on a sound physical basis regarding biological tissue and compliances. In addition, there is still a lot of work to be done in the detailed rheological modeling of blood behavior. Most CFD codes use simplifying assumptions, e.g. Newtonian behavior, which is only valid for larger vessel diameters.

In another two sessions the flow in heart valves and pumps was considered. Here, the importance of pulsating or oscillating flow has been highlighted. It was concluded that the oscillation is one of the main sources of enhanced axial diffusion in biological flows. In addition, the presented work emphasized the trend to small devices due to recent progress in miniaturization, which requires the scaling down of the fluid mechanical properties.

Studies on the flow in human airways were subdivided into the nasal flow, the flow in the larynx and upper airways, and the lung flow. The presentations showed the experimental and numerical simulation of the nasal flow to be

possible with the same accuracy due to the availability of rapid prototyping, new mesh generation methods and improved numerical approaches such as Lattice Boltzmann and Level Set methods for complex geometries. Vocal fold flow is strongly influenced by the fluid-structure interaction resulting in self-induced vibration of the folds, which is the sound source of the human voice. The simultaneous calculation of the flow and sound field is far from being solved. Lung flow studies were presented, which demonstrate the complex mass-flow distribution in the branching network. In addition, the importance of defining the boundary conditions and their influence on the global solution were pointed out.

Furthermore, one session was devoted to heat transfer in biological flows. It was shown that sometimes biological systems other than embryonic vessels, for example, offer better experimental access to detailed flow studies, from which the results can be adapted to the human situation. The high reputation of the international speakers, the excellent quality of the presentations and the in-depth discussions made the Colloquium a success. The invited speakers were fully supported by the conference organisation. In addition, three grants were given to speakers from Eastern Europe. In conclusion, the informal and yet intensive exchange between the different scientific disciplines was the basis for the success of the Colloquium. After the conference numerous scientists from around the world requested more information on the presentations and the conference proceedings.

For the organisation of the Colloquium, two employees of the Institute of Aerodynamics worked fulltime and two technicians were in charge of the technical equipment. All contributions were collected, converted to PDF Files and stored on DVDs, which were mailed to all participants in December 2004.

EUROMECH Colloquium 459

"Mechanical Behaviour of cellular solids"

7-10 June, 2004, Nancy, France
Chairpersons: Prof. Jean-François Ganghoffer and Patrick Onck

The EUROMECH Colloquium 459 'Mechanical behaviour of cellular solids' took place on June 7-10, 2004, in Nancy, on the Campus of the Polytechnic University (INPL). It brought together 42 scientists from 9 European countries and from the USA, and aimed to represent the current state of the art in the growing field of cellular and fibrous materials in Europe.

The main focus of the Colloquium was to bring together researchers with interest in the areas of cellular solids and fibrous materials.

The topics of the Colloquium covered most of the mechanical and material aspects, grouped in the following four sessions:

- *Processing and experimental investigation*
- *Overall properties and homogenization*
- *Scale effects and generalised continuum models*
- *Woven and fibrous materials*

The high quality talks showed that cellular solids and fibrous materials involve similar modelling strategies, due to the fact that their overall behaviour depends on the properties of the constituting solid, the porosity, and 3D morphological information of the network architecture. The power of numerical simulations associated with refined constitutive laws increases the understanding of the deformation mechanisms of these materials, up to the post-buckling regime.

The duration of the 29 oral presentations (30 minutes) allowed an extensive presentation of the works, which in most cases stimulated many questions from the audience. A poster session took place (6 posters), introduced by a short oral presentation of the poster by their author.

The participants appreciated the informal and very pleasant atmosphere of the meeting during coffee breaks, meals, cocktails and the official dinner.

The articles from the Colloquium will be published in a special issue of the Journal of Materials Science.

EUROMECH Colloquium 463

"Size-dependent mechanics of materials"

13-15 June, 2005, Groningen, The Netherlands
Chairpersons: Prof. Patrick Onck

A key driving force in modern technology is to make microsystems of smaller dimensions. This poses enormous technological challenges on manufacturing procedures, both on the structural as well as microstructural level. Similarly, in design the engineer is faced with mechanical behavior that is inherently size dependent. Many examples have appeared in the literature showing pronounced size effects in shear, torsion, tension, indentation and fracture/cracking tests. Concepts from mechanics of materials that are based on a classical, size-independent, continuum description are not able to account for these. Thus, there is a need for new mechanics, able to address size-dependent deformation and fracture. The goal of this Colloquium was to provide a platform on which the above issues could be addressed.

The Colloquium took place on June 13-15, 2005, in Groningen, The Netherlands. It brought together 52 scientists from 13 different countries: The Netherlands (13), France (8), USA (7), Germany (6), Belgium (4), Canada (3), Switzerland (2) and Austria, Czech Republik, Denmark, Russia, Spain and Sweden (all 1). The topics of the Colloquium covered theoretical and experimental aspects of size-effects in the mechanical behaviour of materials and were grouped into a poster session and 6 oral sessions. Each oral session was moderated by an expert in the field, placing each topic in its proper context.

Session 1 – Grain-boundary/dislocation interactions (moderator: Yves Bréchet)

Session 2 – Advances in higher-order continuum theories (moderator: Samuel Forest)

Session 3 – Inclusion and precipitate size effects (moderator: Dave Embury)

Session 4 – Near crack tip plasticity and fracture (moderator: John Hutchinson)

Session 5 – Length scale dependent localization (moderator: Alan Needleman)

Session 6 – Size effects in thin films, interfaces and multilayers (moderator: Erik van der Giessen)

A subset of the papers presented at the Colloquium will appear in a special issue of the International Journal of Solids and Structures at the beginning of next year.

We are extremely happy with the outcome of the Colloquium, which gathered a critical mass of experts and probably most of the leaders in the field. The discussions were excellent, allowing younger researchers to get answers to their questions from the best possible sources and allowing technical in-depth debates between experts. We very much appreciated the presence of 10 North-American scientists making the meeting truly international and contributed to improving the mutual knowledge of the activities taking place on both sides of the Atlantic. Finally, the presence of both experimentalists and theoreticians played a key role in forcing the debates towards relevant questions for the future of the discipline.

EUROMECH Colloquium 465

"Hydrodynamics of bubbly flow"

6-8 June and 9-16 June, 2005, Leiden, The Netherlands
Chairpersons: Prof. Detlef Lohse and Prof. Leen van Wijngaarden

With their ubiquitous occurrence in a multitude of fluid systems, bubbles occupy a very important place in contemporary science and technology. One can readily cite a multitude of examples: the production and transport of oil (where bubbles are purposely injected to help lift heavy oil to the surface), energy generation (where boiling is the key process in producing the steam to drive turbines), the chemical industry (where gas-liquid reactors rely on bubbles to increase the contact area between the phases), the oceans (where breaking-wave generated bubbles are important sinks for atmospheric CO_2), piezo-electric ink-jet printing (where they are just disturbing), bubble chambers in high-energy physics (where they are used to signal the traces of energetic particles), and many others.

Due to the improved experimental and computational techniques there has been rapid progress in the field in the last decade. For example, simulating a few rising deformable bubbles in still water is now possible. Also, a great deal of theoretical insight has been gained. However, many questions remain open. This holds both for a single bubble, e.g. what is the lift force on a single bubble in shear or rotational flow, and for many bubbles, e.g. how do many bubbles in turbulent flow modify the spectrum? Various experimental and numerical results on these questions have been obtained, but they often seem to contradict each other, presumably as the exact conditions are different.

The goal of the Euromech Colloquium 465 and of the Workshop at the Lorentz-Center was to allow for an exchange of ideas on the recent developments in this field.

There were altogether around 50 participants and about 35 presentations, among them seven key-note lectures, namely John Blake (Birmingham), Christophe Clanet (Marseille), Alfonso Ganan-Calvo (Sevilla), Jacques Magnaudet (Toulouse), Yoichiro Matsumoto (Tokyo), Andrea Prosperetti (Johns Hopkins), and Gretar Tryggvason (Worcester). The reader is refered to the Programme for the full list of participants. Most importantly, there was a lot of time for informal discussion between participants who all had access to rooms equipped with computers and white-boards.

Recurring issues addressed in the talks and informal discussions were:

• *Bubble path instability of a rising bubble:*

Both optical and acoustical measurements and numerical calculations were presented. The latter allowed one to study 'artificial' cases such as rising bubbles of fixed nonspherical shape or bubbles with pure slip or pure no-slip boundary conditions. Quite some fraction of the parameter space of interest has thus far been explored. For a bubble with a Reynolds number around 800 the series of events is (i) straight path, (ii) zigzag, and (iii) spiralling. In the latter case the mean rise velocity is visibly smaller. Several models have been presented which explain the zigzagging due to the lift force on the bubble caused by its own wake. The ultimate aim would be to obtain expressions for the wake induced forces and torques to model the movements of freely moving bubbles through a set of ordinary differential equations.

• *Lift force on bubbles:*

Reliable effective force models for bubbles in flow are crucial for any numerical simulations of bubbly flow. Whereas drag and added mass are reasonably understood, this is not the case for the lift force. In several talks it was shown that even the sign of the lift force can change under certain conditions, e.g. for strongly deformed bubbles or for bubbles in vortical flow.

• *Interaction of two or more rising bubbles:*

Available analytical studies and numerical simulations predict that a homogeneously rising bubbly suspension is not possible because of the formation of clusters, essentially because of a lack of repulsive forces in existing models. Indeed, clustering was observed in experiments reported during the Colloquium, although to a much lesser extent than predicted by theory. A possible explanation, brought forward during the workshop, is that the trailing vortices, which accompany spiralling bubbles (see above), induce velocities in neighbouring bubbles, leading to effective repulsive forces. Statistical methods indeed indicate that artificially introduced fluctuating velocities prevent clustering.

• *Wake of a bubble swarm:*

Here the central question is: Is there a difference between the near-field – dominated by the wake of individual bubbles – and the far-field? There seem to be various indications for such a difference, namely, different probability distribution functions of the velocities and different rise velocities of individual bubbles in the far field as compared to the near field, but a final proof is missing. The scaling exponent of the energy spectrum in bubbly turbulence presumably is also connected with this question: In the far-field the

Kolmogorov 5/3-scaling would only be slightly flatter, whereas in the near-field the spectrum may be pronouncedly steeper.

• *Microbubble generation:*
Several nice methods to generate microbubbles in a controlled way were presented. This holds both for individual bubbles (flow focusing methods) and for microbubbles in large concentrations, where cavitation can be employed.

• *Bubble drag reduction:*
There is consensus in the community that in some regimes the injection of bubbles into turbulent flow can lead to drag reduction. Such a drag reduction has been seen both experimentally and in numerics. However, there is much less consensus on the mechanism: Is the drag reduction mainly due to the effective compressibility achieved through bubble accumulation in vortices, or is the bubble deformability responsible for the drag reduction. Moreover: Is bubble drag reduction a boundary layer effect or does it also occur in the bulk? How important is the statistical stationarity of the flow? Also, the method of addressing these questions was extensively discussed: Can we learn anything about drag reduction by flow visualizations of the boundary layer or will a statistical physics type approach, starting from averages of the relevant terms in the transport equations, be more successful? The analogy to drag reduction through polymers was also discussed and the recent progress on that question reviewed.

We thank the Lorentz-Center and Euromech for making the Meeting possible, and for all the financial and organizational support.

EUROMECH Colloquium 466

"Computational and Experimental Mechanics of Advanced Materials"

20 - 22 July 2005, Loughborough, UK
Chairperson: Prof. Vadim Silberschmidt

The EUROMECH Colloquium 466 "**C**omputational and Experimental Mechanics of Advanced Materials 2005" was held at Loughborough University, Loughborough, UK on 20-22 July 2005. This is the second EUROMECH Colloquium in this series, the first one was held at the Vienna University of Technology (TU Wien), Vienna, Austria, 19-20 September 2001.
39 participants from 13 countries, whose fields of research range from applied mathematics to experimental material sciences, took part in this Colloquium. A total of 35 lectures were presented in 9 sessions.
A considerable number of the presentations pertained to continuum and micromechanical modelling of the mechanical behaviour of inhomogeneous materials, such as composites, cellular materials, polycrystalline materials, and layered systems, under static and dynamic loading conditions. Among the fields of special interest in this context were an effect of microstructure on the global (effective) behaviour, damage and failure mechanisms, constitutive models and experimental parameter identification for advanced materials. Other focal points of the meeting were the modelling of material inhomogeneities such as inclusions, pores and defects, and wave propagation in non-linear composites.
Various types of materials such as particulate and layered composites, ceramics, nanocomposites, thermoplastic polymers, foams, lead-free solder materials, textile reinforced concrete and various alloys were specifically targeted in the presentations.
An obvious advantage of this Colloquium was a proper "mixture" of representatives from different subject fields: mechanics of solids, mechanical, civil and aerospace engineering, materials science and applied mathematics. Presentations covered the entire research chain within the chosen area: formulation of constitutive models of various materials → introduction of various length scales (nano and micro) into model descriptions → advanced analytical and numerical modelling schemes → experimental calibration/verification/validation of approaches → cases of engineering applications.
Another characteristic feature of this Colloquium was a high proportion of young participants that, together with participation of established and recognized experts in the field, stimulated an intensive exchange of ideas on the broad spectrum of topics. An additional impetus towards discussions was

made by multiple presentations of results of recent (and even unfinished) studies.

The publication of selected contributions to Euromech Colloquium 466 in the international journal *Materials Science and Engineering A* is planned.

The Colloquium confirmed that Computational and Experimental Mechanics of Advanced Materials is a highly dynamic and rapidly developing research field directly linked with numerous applications of challenging materials in modern industries, and that it can considerably benefit from multi-disciplinary scientific cooperation. The chairmen consider that another Colloquium, in 5 years time, on the same or related subject could be a useful continuation of this series.

EUROMECH Colloquium 467

"Turbulent Flow and Noise Generation"

18-20 July, 2005, Marseille, France
Chairperson: Prof. Claus-Dieter Munz,

The objectives of this Euromech Colloquium were to allow the exchange of advanced acoustic prediction techniques and on to discuss new active noise control strategies with applications to low noise design. This field of research is very active due to the requirements of stricter limits for noise radiation which prove to be one of the key challenges for the aircraft and engine industry. The numerical simulation of noise generated by a turbulent flow may be divided into four main topics. The first of these is the proper calculation of the turbulent flow field. The numerical prediction of acoustic wave propagation within the fluid domain up to the near far-field, i.e. over large distances, forms the second research topic. The coupling of fluid flow and acoustics is the third topic of research. The final research topic is related to active noise control mechanisms.

All of the above important topics of theoretical and numerical modelling in the computation of noise in turbulent flow were covered by different talks in the Colloquium. The number of participants was 65 with 39 presentations. The Colloquium itself took place at the CIRM (Centre International des Rencontres Mathématiques) which provided excellent facilities such as a conference room and library as well as housing for 75 participants and a restaurant. Keynote lectures were given by Fang Q. Hu, Philipe Spalart, and S.K. Lele. All of the four topics listed above were addressed in the talks with respect to different practical applications. A short overview is given in the following paragraphs:

Simulation of Turbulent Flow

Simulation concepts for turbulent flow were considered and discussed. Since the analysis of the acoustic field depends strongly on the quality of the resolution of the turbulent flow field, Large Eddy Simulations (LES) as a base to predict noise generation and propagation was an important issue during the Colloquium. Even with in-depth experience in LES over the last decade there are still a number of open questions that were addressed in several talks, such as the proper sub-grid scale modelling, the convergence to the direct numerical simulation, and especially, the interaction between the fluid flow and the acoustic wave propagation.

High Order Numerical Schemes for CAA

In Lighthill's classical acoustic analogy the noise propagation is mathematically modelled by the wave equation in a flow at rest which is valid

in the far field and with source terms concentrated in the relatively small flow region. Quite often the calculations are performed in the frequency domain. In the vicinity of the actual unsteady flow field this model has to be replaced by acoustic equations with a nonconstant background flow applied in the time domain. In acoustics, numerical schemes are designed to reproduce acoustic wave propagation over long distances with low dispersion and dissipation errors on coarse grids and are different from those used in CFD. Different numerical methods, i.e. finite difference, finite volume and finite element methods of high order of accuracy were proposed. It turned out that the Discontinuous Galerkin schemes seem to be good candidates for complex geometries. In order to reduce the computational effort of practical calculations heterogeneous domain decomposition techniques were presented. In one of the keynote lectures, non-reflecting boundary conditions for computational aeroacoustics were reviewed. In recent years, the progress in accurately simulating wave propagation over long distances has been remarkable.

The Coupling of Flow Simulation and Noise Propagation

The basic idea of acoustic analogies is to replace the real multi-scale problem by radiation in a medium at rest with equivalent acoustic sources. The extension of the acoustic analogy to the flow region may be based on perturbation methods. At low Mach numbers the perturbations are the compressible corrections of the incompressible base flow. Two talks addressed this flow regime. At moderate or higher Mach numbers the decomposition of the flow field into a hydrodynamic and an acoustic part becomes difficult. Acoustic waves are simultaneously transported by the CFD solver and the acoustic equations. An alternative to this volume-coupling, usually referred to as a "hybrid approach", is to perform highly accurate CFD calculations including the generation and propagation of sound waves in the compressible flow region without any analogy. The far field sound levels can then be deduced from surface coupling of the wave propagation model. Both approaches were considered in the Colloquium. Engineering flow computations for complex geometries are usually based on the Reynolds-averaged Navier-Stokes equations (RANS). Generally, relatively coarse grids can be used for calculations of this type since the influence of all turbulent scales is approximated via a statistical turbulence model. Because RANS calculations only provide local statistical properties and do not give direct information about the acoustic source term, one talk addressed the calculation of stochastic sound sources.

Applications

One important issue raised in a number of talks was the noise generated by jet flow at different subsonic and supersonic flow regimes. The prediction and

reduction of jet noise initiated the study of aeroacoustics over 50 years ago. The fact that turbulent jets are widespread among different industrial applications, e.g. in the field of commercial aviation, makes this application one of the basic problems in CAA. The talks indicated that the prediction of noise generated by a turbulent jet is still a very challenging problem for numerical simulation methods. Different components of jet noise of supersonic jets were simulated, e.g. the noise generated by shocks in an imperfectly-expanded jet due to the interaction of the large scale jet turbulence with the shock-cell structure, called jet-screech. In one of the key lectures the influence of bevelled nozzles was shown. The results indicated that the prediction of the overall sound pressure level was very susceptible to the size of the source region. Since there are still many open questions in the context of noise reduction for turbulent jets and since this is of general environmental interest, jet noise may still be considered as a core problem of aeroacoustics. Additionally, talks about the noise generation from a mixing layer and a turbulent boundary layer were given. Other important problems of practical applications like air frame noise, noise from cavities and wake vortex noise were considered.

Noise Control

The objective of noise simulation is to identify the noise sources and to use this knowledge in order to introduce an efficient noise reduction concept. A more sophisticated approach was proposed in one of the talks at the Colloquium. Here, the adjoint linearized Navier-Stokes equations were solved in order to perform a sensitivity analysis, which indicates in which regions of the flow field active or passive control devices have to be placed in order to be most efficient in decreasing the sound pressure level at a certain point or region. From the previous remarks, it is clear that many problems in computational aeroacoustics are still far from being resolved. In all topics listed above substantial improvement is necessary in order to simulate turbulent fluid flow together with the sound generation and propagation. This Euromech Colloquium has given a good overview of the state of current research. This meeting of international scientists has offered a possibility for a mutual transfer of knowledge and information exchange that may result in new ideas and progress for low noise design strategies. A special issue of "Computers and Fluids" will appear in near future with papers presented at the Colloquium. The participants very much enjoyed the stay at the CIRM, which provides excellent facilities for such a conference. The wonderful region of the Callanques and the vicinity to the city centre of Marseille provided good stimulation for scientific discussions.

EUROMECH Colloquium 468

"Multi-scale Modelling in the Mechanics of Solids"

June 29-July 1, 2005, St. Petersburg, Russia
Chairperson: Prof. N.F. Morozov

The Colloquium was held from 29 June to 1 July, 2005 in the suburb of St. Petersburg, Russia, in a beautiful seaside location in a modern congress hotel with all conference facilities. There were 35 participants from 10 countries (Russia 19; France 4; Italy 3; The Netherlands 3; Czech Republic 2; Japan 2; UK 1; Latvia 1; Spain 1). There were 7 keynote lectures, each of 40 minutes, and 27 session presentations, each of 20 minutes. The Colloquium concentrated mainly on the fundamental constitutive modelling of the mechanics of solids, in particular, on the area of multi-scale modelling in continuum and discrete mechanics. The topics included various approaches to the modelling of complex media (e.g. mechanics of granular materials and fine cohesive powders, damage and fracture processes, phase transitions, moving boundaries and inhomogeneities in solids), micro- and meso- models (molecular dynamics, micro-contact modelling) combined with macro-models (continuum mechanics of solids, granular dynamics). Of particular interest was the topic of multiscale modelling for composites including continuum to discrete linkage. In general, the description of multiscale mechanical behaviour of media with microstructure still remains a challenge for modern science, but we believe that significant progress was made during the Colloquium since it brought together a good mixture of theoreticians, engineers, and experimentalists, all of whom approach the problem by using different methods and techniques. The Colloquium initiated and stimulated relevant discussions between different scientific schools and so provided a platform for cross-fertilisation of ideas.

Finally, we can state that the Colloquium was very successful both from scientific and social perspectives, and many participants acknowledged the scientific content, the organization, and location of the meeting.

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EUROMECH Colloquium 472

"Microfluidics and Transfer"

6-8 September 2005, Grenoble, France
Chairperson: Prof. Michel Favre-Marinet

EUROMECH Colloquium 472 was held from 6-8 September 2005, at LEGI (Laboratory of Geophysical and Industrial Flows) in Grenoble. It was attended by 56 participants from 12 countries.

One aim of the Colloquium was to bring together researchers from Engineering Sciences and from Physics as it was thought that progress in the knowledge of Microfluidics is only possible by developing cooperations between scientists of these different fields. The Colloquium also intended to present up-to-date results of fundamental research in the various domains of Microfluidics and Transfer. Seven keynote invited lectures and 31 oral presentations were given during 7 technical sessions:

- Channel microflows 1
- Channel microflows 2
- Micro heat transfer (single phase flows)
- Micro heat transfer (two phase flows)
- Flows under electrical fields
- Physico-chemical properties of interfaces
- Isothermal two-phase flows. Interface phenomena

Each session was introduced by an invited lecture (40 mins), which reviewed the state-of-art and the open questions in the field. The time allowed for each oral presentation was 20 minutes including discussion. Papers were well organised into the various sessions. A booklet of abstracts (one to four pages for each paper) was given to the participants at the beginning of the meeting.

An introductory lecture was given by Dr. P. Tabeling (MMN-ESPCI, Paris, France), who was co-chairman of the Colloquium. He reviewed several important issues, namely the controversial topic of slip between liquid and solid at a wall, the difficulty of mixing in microsystems and he presented unexpected phenomena occurring in two-phase flow systems.

The first session was introduced by Prof. S. Colin (INSA Toulouse, France) and focused on the various approaches used in gas flows, both from theoretical and experimental points of view. Several studies on isothermal liquid flows in

microchannels were presented during the second session and microsize effects were discussed for these flows.

Dr. G-P. Celata (ENEA, Italy) reviewed the numerous experimental studies on single-phase heat transfer and fluid flow in micropipes. He showed that the discrepancies existing in the literature are mainly due to large experimental uncertainties and pointed out the microsize effects occurring in diabatic experiments (thermal entry, axial conduction…). Other papers focused on roughness effects on heat transfer in microchannels, Molecular Dynamics simulation of heat exchange in a nanochannel and a first attempt to produce carbon nanotubes in a microchannel for heat transfer applications.

The session on two-phase flows with heat transfer was introduced by J.R Thome (LTCM, EPFL, Lausanne, Switzerland). The model presented by Prof. Thome demonstrated that thin film evaporation explains observed experimental trends, not nucleate boiling. Investigations on a two-phase pulsating heat pipe and experimental procedures for studying boiling were presented during the session. Effects of confinement on pool boiling were also discussed.

Prof. A. Castellanos (Seville, Spain) presented the basic principles of electro-hydro-dynamics and their applications to electrically-driven motion of liquids and particles in microfluidics. He discussed the relative importance of the different effects due to electrical fields. This was illustrated by other papers where these effects were used for achieving stirring in biochips, or mixing in narrow passages.

Dr. M. Vignes-Adler reported experiments on fast spreading thin films of complex liquids and analyzed the role of the physical phenomena in the dynamics of droplets projected onto a solid surface. Several papers also presented experiments where the physico-chemical properties of interfaces play the main role in the flow dynamics.

The phenomenon of sonoluminescence associated with sound driven gas bubbles in water was described by Prof. D. Lohse (Twente, The Netherlands) in a keynote lecture. The last session was devoted to interface phenomena in isothermal two-phase flows. Presentations focused on experimental and numerical approaches used for investigating the formation of drops or bubbles.

A CD including most presentations has been sent to all participants after the meeting. Participants enjoyed the variety of topics presented during the Colloquium, the lively discussions after several talks and the friendly atmosphere of the Colloquium. The organizers wish to thank the institutions which financially supported the Colloquium making the meeting productive and comfortable.

Objectives of the EUROMECH Mechanics Society

The Society is an international, non-governmental, non-profit, scientific organisation, founded in 1993. The objective of the Society is to engage in all activities intended to promote in Europe the development of mechanics as a branch of science and engineering. Mechanics deals with motion, flow and deformation of matter, be it fluid or solid, under the action of applied forces, and with any associated phenomena. The Society is governed by a Council composed of elected and co-opted members.

Activities within the field of mechanics range from fundamental research on the behaviour of fluids and solids to applied research in engineering. The approaches used comprise theoretical, analytical, computational and experimental methods. The Society shall be guided by the tradition of free international scientific co-operation developed in EUROMECH Colloquia.

In particular, the Society will pursue this objective through

- The organisation of European meetings on subjects within the entire field of mechanics.
- The establishment of links between persons and organisations including industry engaged in scientific work in mechanics and in related sciences.
- The gathering and dissemination of information on all matters related to mechanics.
- The development of standards for education in mechanics and in related sciences throughout Europe.

These activities which transcend national boundaries are to complement national activities.

The Society welcomes to membership all those who are interested in the advancement and diffusion of mechanics. It also bestows honorary membership, prizes and awards to recognise scientists who have made exceptionally important and distinguished contributions. Members may take advantage of benefits such as reduced registration fees to our meetings, reduced subscription to the European Journal of Mechanics, information on meetings, job vacancies and other matters in mechanics. Less tangibly but perhaps even more importantly, membership provides an opportunity for professional identification; it also helps to shape the future of our science in Europe and to make mechanics attractive to young people.