EUROMECH
European Mechanics Society

President's Introduction

This is the first EUROMECH Newsletter in a new format, under the Editorship of Dr John Finley. I welcome Dr Finley to the EUROMECH team and thank him for the work he is prepared to put in on behalf of EUROMECH. Readers will see, on p.2 that Dr Finley will be glad to receive comments on the format and content of the Newsletter. He will also be glad to receive contributions, in the form of brief articles, letters or announcements on topics in mechanics, for possible publication in future Newsletters.

Readers will also see that in this issue we are publishing the first of a regular series of articles, by distinguished scientists, on important developments or major unsolved problems in mechanics. We are, further, publishing synopses of the reports on Colloquia submitted by Chairs. Hence these had, after consideration by the Council, usually simply languished in the archives of the Secretary-General! Once the backlog of reports from 1995 and 1996 has been cleared, we shall publish reports from Colloquia in 1997 and onwards as they are received, to give an up-to-date picture to EUROMECH members.

A particularly important issue FOR ACTION NOW by members of EUROMECH is that of the election in September 1997 of five new members of the EUROMECH Council. The Advisory Board (membership list on the Internet at http://www.euromech.maths.org.uk/) will prepare a list of candidates on whom members will vote in June/July 1997, with papers issued with the next Newsletter No. 9 May/June. Suggestions for candidates can be made to any member of the Advisory Board. If you suggest a candidate, please make sure he/she is willing to serve on the Council for six years, and please supply a one-page curriculum vitae.

Please do not simply suggest the most prominent scientists; such people are usually already very busy, and may not have the time needed. EUROMECH has much to do, and the Council needs new blood, younger members and men and women with the ideas, energy, time and resources to really work for mechanics through EUROMECH!

D.G. Crighton
President EUROMECH
OTHER CONFERENCES

1. Wind Energy Conference, Germany
2. 13th European Conference on Energy from Wind
3. 12th International Conference on Renewable Energies and Sustainable Development

NOTICES

1. Euronorma Conference
2. Euronorma Conference
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THE NEWSLETTER

1. Euronorma Newsletter
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Membership Fee for 1997 – Deadline 30/06/97

Please send your membership fee for 1997 to Prof. E.-A. Müller, Treasurer of EUROMECH, Max-Planck-Institut für Strömungsforschung, Bunsenstr.10, D-37073 Göttingen, Germany.

Methods of payment:

1. Give your EUROCARD, MASTERCARD or VISA credit card number and the expiry date to the treasurer.

2. Send a Eurocheque. The lowest charges are incurred if (i) a German town e.g. Göttingen) is the place of signature, (ii) the Deutsche Mark is chosen as currency and (iii) your card number is written on the back of the cheque.

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NOTICES

EUROMECH COLLOQUIUM 358
CHANGE OF DATE

"Mechanical behaviour of adhesive joints: analysis, testing and design"
Nevers, France

To avoid a clash with AUM, this meeting has been put back one day, the revised date being 4-6 September 1997.

Prof. S. Aivazovzadeh, Institut Supérieur de l'Automobile et des Transports.
49, rue Mademoiselle Bourgeois, BP 31, F-58027 Nevers, France.

EXTENDING THE FLUID MECHANICS OF AIR-SEA INTERACTION TO EVER HIGHER WIND SPEEDS

Sir James Lighthill, FRS. (University College London)

ABSTRACT

The past three decades of hard-won progress in understanding air-sea interaction have made a most valuable beginning. Yet the big challenges, of extension to still higher wind speeds (around 50m/s) relevant to the energetics of Tropical Cyclones, will need perhaps two more decades of dedicated observation and analysis.

1. An early campaign to promote air-sea interaction mechanics

In 1964, having devoted the first twenty-one years of my working life mainly to aerodynamics, culminating in five years as Director of the Royal Aircraft Establishment (Farnborough), I chose to branch out into new fields that would include not only biomechanics, but also ocean dynamics. Into this latter field I had been skilfully drawn by the late George Deacon who showed me the exciting work he directed at the then National Institute of Oceanography (Wormley) – one of the distinguished laboratories about to be placed under the control of Britain's new Natural Environment Research Council (NERC); of which, early in 1965, I became one of the fifteen founder members. Very soon, NERC appointed an Oceanography and Fisheries Research Committee and I accepted its chairmanship, with special responsibility for fostering research in both physical and biological aspects of ocean science; although here I write only about the physical aspects.

With fellow members of that committee, including Henry Charnock, I was conscious that air-sea interactions generate most ocean waves and currents and, reciprocally, are major influences on weather and climate. Yet, as an aerodynamic specialist moving into oceanography, I found far too much separation between the sciences of the atmosphere and the ocean. For example, meteorologists engaged in ever more refined studies of atmospheric motions seemed content to parameterise, in only the simplest possible way, such key influences on those motions as transfers of water vapour, heat and momentum between the ocean and the atmosphere. Against this unpromising background for a programme of interaction studies that would need intimate involvement of meteorologists with physical oceanographers, a campaign to set up such a programme was nevertheless launched, with strong support from the Royal Society (of which I was then Physical Secretary).

The Royal Society project became known as JASIN (Joint Air-Sea Interaction Project) and, after a purely UK trial in 1970, was progressively expanded to involve five other countries from Western Europe, along with Russia, USA, Canada and Australia. by the summer of 1978 (3 July to 17 September) when the
The objective of EUROMECH 341, held on September 26th – 28th, 1995 at Giens, was first to encourage the connection of the disciplines concerned in the development of this new sector of activity and then to summarize the advances in knowledge and technique for the concept of smart materials. Sixty-five participants were present at Giens to hear thirty-nine presentations from twelve countries, and all the main European teams working on this subject were represented.

The connection between disciplines concerned various aspects of mechanics, mathematics and to a lesser degree, automation. Many participants appreciated this range of subjects, but it seems desirable, in the future, to place more emphasis on automation (activators), electronics and the science of materials.

Many significant theoretical results were revealed, the major parts of which related to methods for stabilization of elastic, air-elastic and acoustic structures. New mathematical results on problems of stabilization showed that there are important advances in this subject by the European mathematical and mechanical communities. It seems that this aspect is rather better developed in Europe than in the USA. The description of experimental results and industrial applications made a really big impact. At the end of this Colloquium many participants thought that the smart materials concept had become a reality in Europe, since it had already given birth to the first industrial applications.

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observed Pierson-Moskowitz spectrum. Wave-packet propagation along great-circle paths (combined with dispersion and diffusion) is well described by the deep-water mode; while the extension to shallow water is based on data from the Joint North Sea Wave Project (JONSWAP). Good agreement between hindcast and observed waves was achieved even for hurricanes in the Gulf of Mexico, as well as for storms in the Atlantic and North Sea; while many further verifications come from Seasat data. The WAM model is now used satisfactorily for operational wave forecasting.

Besides this programme with modelling aims, another large programme entitled Humidity Exchange Over the Sea (HEXOS), pursued by five countries in Western Europe (Netherlands, Germany, France, UK and Denmark) with Canada and USA, has been directed primarily towards winning new data on transfer of water vapour and sensible heat – and secondarily to systematizing the results. After a pilot experiment in 1984, the HEXOS main experiment took place near the Dutch coast from 6 October to 28 November 1986 with the use of (i) the Dutch research platform Meetpost Noordwijk, (ii) a tripod-based mast operated by Kiel University, and (iii) a British aircraft and research ship. Fluxes of each quantity were directly measured from its covariance with vertical velocity. Because special interest attached to the water vapour transfer coefficient, the fact that for wind speeds up to 18m/s it took an essentially constant value 0.0011 (the same as the heat transfer coefficient) is viewed as a particularly important conclusion of these researches.

3. Needs related to the thermodynamics of Tropical Cyclones

Tropical Cyclones (TC) are those huge cyclones (often called hurricanes or typhoons) in which the inward component of cyclonically spiral winds vanishes at the "eyewall": a circular wall of very dense convective cloud surrounding an essentially clear "eye of the storm". The eyewall is where water vapour transfer from the ocean to inwardly spiralling surface winds has raised their humidity to 100%; the thermodynamics of such saturated air allows it moreover to be lifted by buoyancy forces right up to the top (around 15 km altitude) of a not too stably stratified troposphere. A heat-engine analysis of the TC views it as following a Carnot cycle, with (i) surface winds gaining energy – mainly as evaporative latent heat – at approximately the sea surface temperature (around 300K); with (ii) the working phase as a nearly adiabatic process for rising saturated air subject to buoyancy forces in the eyewall; and with (iii) heat being lost at approximately the stratospheric temperature (around 200K). The mechanical energy gain (Carnot efficiency times energy input) is balanced by losses due to frictional dissipation at the sea surface.

This balance between latent-heat input and frictional dissipation indicates why TCs are tropical phenomena. For each unit mass of air, possible latent-heat input is proportional to the saturated water-vapour concentration (by mass) which is a steeply increasing function of temperature; yet dissipation rates in the atmospheric boundary layer depend little on temperature. Furthermore, to a first
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The equation is:

\[ E = MC^2 \]
passive scalar in connection with windtunnel data for wake flow over a two-dimensional hill, and the solution of the boundary layer equations with dust simulated by changes in the thermodynamic properties of the flow. A second order numerical model, appropriate to flow computation over terrain, was presented, capable of ranging from time-averaged flow descriptions to sub-grid averaging such as Large Eddy Simulations.

Turbulent boundary layer flow across a regular array of roughness elements was studied, both experimentally and by numerical models, which are suitable for application to situations of geophysical interest such as canopy flow. From the analysis it appears that the large shear produced at the roughness element height is the mechanism limiting the scale length of the eddies, a quite general mechanism which is everywhere present in shear-driven turbulence.

The last day of the meeting was devoted to a consideration of the needs of data bases and to presentations describing selected cases. These included the ERCOFTEC base for dispersion behind buildings, the RUSHIL and RUSVAL data sets for turbulence and dispersion in two-dimensional windtunnel flow and the TRACT database describing field measurements in the valleys of the Rhine and the upper Ticino.

The meeting was closed by a round table discussion concerning suggestions for future development of the data bases for improving our knowledge on the boundary-layer turbulence and dispersion in complex terrain and for model evaluation. The main points raised during the discussion concerned the need to account for the time variability intrinsic in a time-averaged steady process (the task being to describe and model the concentration fluctuations, starting from simple conditions) and for the unsteadiness of the real world, where the concept of ensemble averaging, for instance, has in practical terms a quite different outcome from the laboratory case.

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EUROMECH Colloquium 339

Internal Waves, Turbulence and Mixing in Stratified Flows

Chairmen: C. Staquet and J. Sommeria, Lyon, France

EUROMECH colloquium 339 was organized by C. Staquet in Lyon (France) from September 6th to 9th, 1995. It involved seventy-six participants from fourteen countries. Papers were presented on various aspects of stably stratified flows: (1) internal waves, their generation mechanisms, propagation and reflection properties, their instabilities leading to breaking; (2) vortex structures in stably stratified fluids, which can be slow layerwise structures, or small intense vortices, appearing for instance in shear flow instabilities; (3) statistical properties of random wave fields or stratified turbulence; (4) mixing properties resulting

I eagerly proceeded, on being invited to use this article to identify the problem within fluid dynamics which I would most like to see solved during my lifetime, to single out "the mechanics of air-sea interaction at speeds of 40 to 60 m/s typical of Tropical Cyclones". Perhaps there may already be some hopes of promising new methods for moving towards this goal – whether from satellite sensors, from new types of instrumentation on oil and gas installations in TC-affected regions, or from new approaches to fluid-dynamical analysis. Happily all possible methods are due to be reviewed in detail at yet another WMO/ICSU meeting (Hainan, China, January 1998). Yet hopes of success in this latest stage of development of air-sea interaction mechanics might be better justified if a few readers of this EUROMECH Newsletter were to respond by bringing their great talents to bear on the problem.

References


Reminder
1997 Membership fee
See page 22
The colloquium was held at the University of Metz on July 10th-13th, 1995. The colloquium venue was the 14th century cloister "Cloître des Récollets" in downtown Metz. It focused on phenomena such as adiabatic shear banding and dynamic ductile fracture, and on their applications to penetration and perforation of plates, dynamic fragmentation of plates and shells, shaped charges, metal cutting, machining and metal forming at high velocities. Not only conventional metallic alloys have been covered, but also more "modern" materials, such as metal matrix composites. The contributions were allocated to six themes, each theme providing the basis for one of the six working sessions:

- Material behaviour
- Instabilities
- Adiabatic localization
- Experimental techniques and observations
- Forming processes
- Shaped charge jets, penetration.

The basic theme of the colloquium (as stated in its title) was covered from various complementary points of view. Experiments and theoretical models (analytical and numerical) were reported. The microstructural as well as the macro-mechanical continuum aspects were reviewed. Fundamental as well as applied investigations were presented, although the fundamental ones were the more numerous. Due to that variety, it is believed that the Colloquium could be of interest for any expert working in the field; 40 scientists, many of them young, participated in the Colloquium.

The discussions brought to the attention of the participants the need for two offshoots of this colloquium, which could possibly be proposed to EUROMECH in the near future. One of these proposals could be concerned with terminal ballistics in multi-layered composite materials (DODD), the second one with explosive material elaboration and forming processes (FRUEMMER).

The problem of the onset and development of laminar/turbulent transition in boundary layers under a free-stream with disturbances of various kinds has received wide interest in the fluid-dynamics communities engaged in fundamental and applied research. Most of the major European research groups participated in this Colloquium, held on April 10th-13th, 1995 in Prague. Most of the participants stayed until April 14th to attend the Workshop of ERCOFIT SIG on Transition. The Colloquium was attended by 43 scientists, of which 5 were from Eastern Europe and 7 from the Czech Republic. Thirty contributions were presented by authors from 13 countries.

The main aim of the colloquium was to stimulate the exchange of ideas and results describing the physics of the phenomena, the mathematical aspects and experimental observations of transition in 2D and 3D-boundary layers.

The contributions can be grouped as follows, according to the methods used:

Analytical Studies (4 papers) based on the NS-equations, linear stability theory and the analogy between electromagnetic waves and waves in fluid flow.

Numerical Studies (8 papers) demonstrated a large range of approaches to the problem: e.g., large eddy simulation, linearized unsteady boundary layer equations, linearized NS-equations, parabolized stability equations, direct numerical simulation of NS-equations and the use of conditional averaging. The receptivity of boundary layers to disturbances of various kinds and intensities was studied.

Modelling of transitional boundary layers (6 papers) showed quite good computational prediction of some (but, as usual, not all) important boundary layer characteristics by means of various models including an algebraic model for the transition region, one-equation turbulence models (k-ε) and γ models, (k-ε) or (k-ε) and RST models.

Experimental investigations of by-pass transition (16 papers) covered a wide range of boundary conditions, as well as of processes and phenomena. For example: boundary conditions: smooth flat plates, a curved turbine blade, a stagnation region on a cylindrical surface, a stratification of the fluid density near the surface, external disturbances coming from homogeneous grid-turbulence or from the wake of a body upstream of the boundary layer onset, disturbances generated by oscillating surfaces, etc. Phenomena such as the flow stability, the internal structure of transitional boundary layers, the occurrence of turbulent spots, longitudinal streaks, bursts and other coherent motions were investigated.
An extended account is found in my book "Prize Pumps," 1996.

The steam-driven engines were the forerunners of the vacuum cleaner. The first practical model was invented by James Henry Great Britain. It was a simple device consisting of a cylinder containing a piston and a pump. The pump was operated by a hand crank, and the cylinder was connected to a vacuum chamber. The vacuum chamber was sealed and the air was抽出. The vacuum was then drawn off and the air was polluted.

Chairman: C. A. Meyer, Gilgenau, Germany

A short session followed the discussion. The next session was devoted to the development of the steam engine. The first three sessions were attended by a large number of participants from many countries. The final session was devoted to the future of the steam engine. The last of the session's papers was presented by Mr. Paul Johnson from the United States. He discussed the development of the steam engine in the United States and its impact on transportation. His presentation was well received, and many attendees expressed interest in further discussions.

Some presentations gave rise to arguments and discussion. The session was adjourned at 5:00 PM, and the participants were invited to attend a reception at the hotel where the conference was held. The reception was well attended, and many attendees stayed late to continue their discussions.

The conference was a success, and many attendees expressed interest in attending future conferences on the subject. The organizers were pleased with the interest shown in the conference and expressed hope that it would continue to be successful in the future.
EUROMECH Colloquium 332
Drag Reduction
Chairmen: P. Luchini, Naples, Italy; D.W. Bechert, Berlin, Germany

Following the eight European Drag Reduction Meetings held at Lausanne, London, Chatillon Lausanne, Teddington, Eindhoven, Berlin and Lausanne, a EUROMECH colloquium devoted to Drag Reduction and ERCOFTAC Workshop on Active Control for Turbulent Drag Reduction (Chairman K.S. Choi) was organized by the University of Naples Federico II in the village of Ravello, near Naples in Italy, from 19th. to 21st. April 1995. There were 50 participants.

The scope of the meeting encompassed a wide range of mechanisms and devices through which the structure of turbulence can be manipulated to the end of reducing the drag caused by internal or external turbulent flow, e.g. riblets, compliant walls, moving walls and the modification of the rheological properties of the fluid through chemical additives or particles. Three invited and 35 contributed papers were presented on the theoretical and experimental understanding of drag reduction phenomena, including in-flight experiments, as well as on ways of overcoming practical difficulties and on emerging new methods and combinations. Separation control and active versus passive techniques of drag reduction were also given space in both general lectures and contributed papers. The lively final discussion concentrated upon the basic similarities and differences of the physical mechanisms involved in different kinds of active and passive drag reduction and on the potentialities for future development.

EUROMECH Colloquium 336
Flows dominated by centrifugal and Coriolis forces
Chairman: H.I. Andersson, Trondheim, Norway

The 336th Euromech colloquium, on flows dominated by centrifugal and Coriolis forces, was held in Trondheim from June 21st. to 23rd., 1995 with the author acting as chairman. An objective of the colloquium was to display the similarities and differences between flow phenomena induced by streamline curvature and system rotation. The forty-eight papers which were presented covered a wide range of flow problems with emphasis on geophysical as well as engineering applications. The purpose of this survey is to give an overview of the major topics addressed at the colloquium, anticipating that these reflect current trends in research on flows exposed to centrifugal and/or Coriolis forces.

EUROMECH Colloquium 333
Ground Freezing: Mathematical Models and Applications
Chairman: A. Fasano, Firenze, Italy

The Euromech colloquium 333 devoted to "Ground Freezing: Mathematical Models and Applications" was held in Montecatini Terme, near Florence, June 2nd.-4th., 1995. The organization of the colloquium was affected to some extent by the fact that the Organizer, Prof. Mario Primicerio, was elected Mayor of the City of Florence shortly before the conference and had to discontinue all his academic engagements. Professor A. Fasano took over all organizational matters at very short notice.

Freezing of fluids in porous media is a phenomenon of great complexity and with relevant implications in civil engineering and environmental sciences, particularly because it is accompanied by a migration of the fluid towards the cold region.
In the field of nanotechnology, the development of new materials and their applications is a rapidly growing area of research. The use of nanomaterials has led to significant advancements in various fields, including electronics, energy, and medicine. One of the most promising areas of research is the development of nanocomposites, which combine the properties of two or more materials at the nanoscale. These materials have unique properties that make them ideal for a wide range of applications, from drug delivery systems to advanced structural materials.

"In the field of nanotechnology, the development of new materials and their applications is a rapidly growing area of research. The use of nanomaterials has led to significant advancements in various fields, including electronics, energy, and medicine. One of the most promising areas of research is the development of nanocomposites, which combine the properties of two or more materials at the nanoscale. These materials have unique properties that make them ideal for a wide range of applications, from drug delivery systems to advanced structural materials.