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**ESA MISSION STATEMENT**

*Promoting systems, spaces and designs for People*

## Letters

### **ISABEL (IZZY) SHAW.**

Born 27.7.1908 Died 30.6. 1999

Izzy was a Physiotherapist who graduated from Adelaide University in 1929. In 1938 she moved to the UK while her husband was posted to the Royal Australian Navy. Izzy returned to Sydney, then worked in various Australian cities before settling in Melbourne with her family in 1956. She spent 19 years at the Queen Victoria Medical Centre with the chief physiotherapist, Gwen Huon. In 1969, she was appointed the Safety Officer there and there began her interest, and passion for ergonomics and occupational health. In the mid 1970's, Izzy moved to the Collingwood Community Health centre and worked in a multi disciplinary team involving a doctor and an ergonomist. She gave numerous lectures on back care, safe lifting, posture and relaxation. Who could forget Izzy at our Ergonomics Conferences in the 1970's and 80's out the front leading the pause gymnastics at the end of each of her addresses? Izzy was much loved and respected by the ESA members from this time.

### **CONGRATULATIONS GITTE LINDGAARD**

Congratulations to one of Australia's leading ergonomists and HCI specialists, Gitte Lindgaard who has just been appointed as Chair of this Centre at Carleton University, Ottawa, Canada. This is a new Chair which has been funded by Canadian industry initially for a 5 year term. The title is :

Chair  
User Centre Product Design  
Department of Psychology  
Carleton University  
Ottawa, Canada

Gitte will commence in January 2000 and will be moving at the end of this year.

Although not keen on the minus 400 winters, Gitte is excited about her new challenges.

On behalf of all her ESA friends, I wish Gitte every success.

David Caple  
ESA President

## President's Message

Dear Members,

It is gratifying to see the ESA thriving. The Board has introduced a credit card option for paying membership fees and, as of 1st July, we have received 21% increase in early subscriptions for this year. Over 42% of members have elected to utilise this new option. Thanks to Christine Stone in our Canberra office for her work and initiative in this area. During the last year we have approved:-

- 36 new members
- 25 new affiliates
- 5 new CPE's.

We are anticipating a total membership renewal of 550-600 members and affiliates.

As the new Executive and Board have completed our first 6 months, it is now more clear to identify a number of strategic directions taking shape. Underlying our strategy is a desire to underpin the professional standing of ESA and an outward focus in our strategies. Amongst the many examples of current initiatives, under our four agreed goals are:-

### **4 MEMBERSHIP**

4.1 The Board has voted to adopt the IEA model as the basis to a major review of our membership structures. Specifically, we have formed an Education Review Committee (ERC) to review the options currently utilised by IEA for defining certification of ergonomists. This committee will provide recommendations to the ESA Board on a range of issues with the objective of ensuring our membership processes are developed in line with international standards.

4.2 A range of changes have been occurring in Universities across Australia in relation to courses on offer to teach ergonomists (see article). The establishment of the ERC is planned to bridge a closer bond between the ESA and the main Universities in Australia who offer undergraduate and post graduate courses in ergonomics. Margaret Bullock will be assisting me in progressing the ERC discussions with the ERC members. We look forward

to some significant outcomes from this initiatives to be reported in Fremantle at the 1999 AGM, with possible constitutional motions for debate in Adelaide at the 2000 AGM. The members of this committee include:-

- QLD, Jim Carmichael, Margaret Bullock (IEA)
- NSW, Barbara McPhee, Roger Hall
- VIC, Wendy Macdonald, Owen Evans, David Caple (ESA President), Gitte Lindgaard and Bob Stacy (PAB)
- S.A., Verna Blewett
- W.A., Leon Straker

We thank these ESA members for accepting the invitation to join this Board sub committee.

## 5 PROMOTIONAL

- 2.1 Each Branch has been very active this year on a range of promotional activities. The ACT and Sth Australian Branches have developed a new range of brochures for the ESA. These are now available for circulating to prospective members. During 1999, the ESA has been developing a number of strategic alliances to promote ergonomics. These have included joint scientific programs with Industrial Engineers, Psychologists and Physiotherapist Associations. In June, I attended the Australian Physiotherapist Association's conference in Cairns on Occupational Injury – a very successful conference. It was agreed that their "Ergonomics and Occupational Health" group (with nearly as many members as ESA!) would work closely with ESA on joint projects of interest. The Victorian Branch recently hosted a series of workshops on "office ergonomics" (also very successful) which was well attended by members of this Physiotherapy group. In July/August the ESA and Physios are planning a joint workshop in Melbourne to discuss the new Victorian Manual Handling Regulations (1999) and Code of Practice.
- 2.2 The ESA has joined with Swinburne University to sponsor the CHISIG Awards for students involved in developing the new CHISIG website. A ceremony on August 3rd to present the Awards will be attended by all 350 students and employers from the HCI industries. Further, the ESA has established an agreement with Swinburne University to develop the ESA website as their 2nd semester major project for 1999. Many thanks to Gitte Lindgaard for her proactive role in these initiatives.
- 2.3 We continue to read and hear of ESA members receiving public exposure for their research. This is an initiative I support all of our members to explore to promote their findings into the community.
- 4.1 Our congratulations to Shirleyanne (Shann) Gibbs on being awarded the Liberty Mutual Prize for 1999. This is a prestigious award from the IEA and Shann's is the first Australian recipient. She will attend an IEA conference during the next year to receive her award.
- 4.2 Our IEA delegate, Margaret Bullock is planning to attend the next IEA meeting in Greece. Margaret will be providing details of ESA activities to the IEA and will be Chairing their committee on Certification. Whilst ESA make a contribution to her expenses, Margaret funds her IEA involvement for which we are very grateful.
- 4.3 The NSW Board member, Christine Aickin has chaired a sub committee to develop a Promotion's Strategic Plan. It is great to see her work being progressively implemented. Christine is also the ESA delegate on the OH & S Trust. We are currently exploring a grant application to lead on OHS "Umbrella" website. This would enable any of the relevant professional societies to be linked and facilitate exchange of expertise. It may also assist in developing "lobby group" positions on topic issues.
- 4.4 The Victorian Branch has completed their pilot promotional project with the RMIT marketing students. Thanks to Liz Pratt and her sub committee (Mark Dohrmann and Marg Juhasz) for their work.

4.5 We look forward to the promotional activities in Queensland during "Ergonomics Week" arranged by various members of the Queensland ESA Branch. This will be in early November 1999.

### 3 FINANCIAL

4.1 As indicated, the introduction of the credit card option, combined with early posting out of membership renewals have resulted in a significant inflow of our major income stream by 1st July 1999.

4.2 Through tight controls on spending, the Federal Office should have achieved a significant reduction in expenses for the first 6 months of 1999.

4.3 The consolidation of funds is progressing. As fixed term deposits are maturing, they are being reinvested in the ESA accounts to enable a better interest return.

4.4 The Branches are now finalising their programs and Budgets for 1999/2000. They will be reviewed at the next Board meeting (16th August). Payments of approved budgets should then be processed back to the Branches. These will replace the previous capitation payments based on a fixed percentage of income derived from each Branch.

4.5 The ESA Board is keen for all ESA Branches to maintain strict documentation and accountability for all funds expended. Issues such as receipts and committee approvals for expenditures must be closely controlled.

### 4 PROFESSIONAL DEVELOPMENT

4.1 Each ESA Branch has now finalised their scientific program outlined for 1999/2000. A wide range of ergonomics competency areas will be covered in these programs. We are hoping to explore a national overview of issues to be covered in these programs during the next year. This in no way is to stifle Branch initiative, but to promote expertise in Australia who can provide quality education in targeted areas of ergonomics. There may be options to link these into specific editions of "Ergonomics Australia" focussing on these topics.

4.2 It is important for us to recognise the depth and diversity of ergonomics in Australia and Internationally. Currently, focus in scientific programs indicates a strong involvement in OH & S related areas. Whilst promoting ergonomics in these areas is vital, we must recognise the many other application areas in Australia where ergonomics is being researched, taught and applied. It is my hope that we may identify and encourage professional understanding of the many ergonomic skills in Australia, apart from OH & S. My program from the last IEA Congress in Tampere, Finland (1997) details sessions in:-

- Organisational design and management (ODAM)
- Design – Standards, Tools, Useability, Products
- Environment – Vibration, thermal, healthy buildings, extremes
- Complex Systems – control rooms, human error, cognitive ergonomics
- Occupational Safety – safety management, slips and falls
- Musculo-skeletal disorders – risks, health and standards
- Manual Handling – packaging, materials handling, lifting
- Rehabilitation – rehabilitation ergonomics
- Human Computer Interaction (HCI)
- Mental load – physiological measures, stress
- Ageing – age and living environments, age and work
- Occupational Fields – building, dental agriculture
- Traffic and transportation – traffic safety, aviation, railways
- Education and training – competencies, certification
- Small Industries
- Countries in transition
- Theories and methodologies – measurement, interactive methods

- Special Issues / Economics – cost effective, ergonomics, women and work, forensic ergonomics, teleworking.

As you can see, ergonomics research internationally covers a wide range of areas. Most of these are also undertaken in Australia. We need ways to better appreciate and understand the depth of knowledge available in ergonomics and to provide opportunities to increase our professionalism in utilising these skills.

I look forward to the next quarter of activities within the ESA. It is great to be part of the action.

Best Wishes,

David C Caple  
ESA President

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*PS. The ESA has now established it's own Website based at the Canberra Office. Our Webmaster is Christine Stone, the ESA Administration Officer, and the address is "ergonomics.org.au". Our sincere thanks to MArk Dohrmann who has hosted the ESA site as part of his own series of sites since Oct. 1998. We have generously been offered the services of Swinburne University students to help design the website with us. Many thanks to Gitte Linaard and Steve Howard for their assistance. Any members who would like to assist with the site, or contribute materials for the site are most welcome to contact Christine. David Caple*

## FROM THE SECRETARIAT

Thank you to all members who have paid their renewal fees to-date. All those whose payments were received in this office by 5th July should have received a receipt with in the last day or so.

This year we are sending out receipts for all payments received. You will get one but from now it may be a little longer as We need to get a certain number to be able to Bulk post.

If you haven't paid yet here is a gentle reminder. If you have lost the form please contact me and I will send you a new one.

We are about to start the transfer process from our old database to Access so we need to ensure that all details are correct so **PLEASE** fill in and return the form even if there have been no changes it all helps for a smooth process.

Thank you  
Christine

## Liberty Mutual Prize

### **LIBERTY MUTUAL PRIZE AWARDED TO SHANN GIBBS**

Dr Shirleyann M Gibbs, Director of Gibbs + Associates Pty Ltd, Sydney, has won the International Ergonomics Association 1999 Liberty Mutual Prize in Ergonomics and Occupational Safety.

The chairman of the IEA Awards Committee is Professor Martin Helander, Linköping University, Sweden, and the current examining committee members are Professors T Singleton, and MM Ayoub and Dr K Kogi. The examining committee wrote:

*We, the assessment committee of three, have considered and debated eleven submissions. We recommend unanimously that the prize be awarded to SM Gibbs for her report on "Safety Services with particular reference to the handling of cytotoxic drugs." ... The report, based on work in Australia, also includes evidence from New Zealand, USA, Switzerland, France, England and Malaysia. It consistently emerges that there is a serious issue to do with regulations but more particularly with administration, attitudes and training, and that less attention is given to staff safety than to patient safety. The report is innovative in accepting that "safety is a multivalent condition" and attempting to cope by introducing fuzzy sets and fuzzy logic. The report is well written, well structured and well presented.*

The Liberty Mutual Prize (\$US5000) in Ergonomics and Occupational Safety is awarded annually by the International Ergonomics Association to "recognize original research leading to the reduction or mitigation of work related injuries and/or to the advancement of theory, understanding and development of occupational safety research". Each annual award must be received at an international conference supported by IEA. The best of every three years' winners is presented with a medal and \$US15000 at the triennial IEA Conference (next one will be USA in 2000).

Shirleyann Gibbs, a graduate of UNSW School of Safety Science, obtained her Masters from the Faculty of Engineering in 1988 and her Doctorate from the Faculty of Science and Technology in April 1999. Her supervisor for both awards was Dr Neil L Adams and her doctoral co-supervisor was Professor Jean Cross. She is known as 'Shann' to most UNSW colleagues and was a former

Secretary and President of the UNSW Postgraduate Representative Association in the early nineties. The paper presented to the examining committee was based on her doctoral thesis *Safety: a complex, interactive and adaptive systems model depicted by health industry workers handling cytotoxic drugs*.

Dr Shirleyann M Gibbs  
25 Melaleuca Drive, St Ives, NSW 2075  
Tel: + 612 9983 9855 F: + 612 9402 5295  
E-mail: shanng@gibbsplus.com.au

### **NEWS FLASH NEW WORKSHOP**

Shann Gibbs will be presenting a workshop at the 1999 ESA Conference on her award winning work!

"Chaos, complexity & fuzzy logic – new approaches to staff safety".

Register now to attend the workshop as part of the conference. Numbers will be limited so contact Keynote Conferences to reserve your place. If you have already registered for the conference, it's not too late to include this workshop as one of your choices – just contact Keynote Conferences.

Phone: + 61 8 9382 3799  
Fax: + 61 8 9380 4006  
Email: keynote@ca.com.au

## Branch News

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### CONSUMER PRODUCT SAFETY DATABASE

The Monash University Accident Research Centre has been commissioned by the Victorian Office of Fair Trading and Business Affairs and the Victorian Department of Human Services to establish a database of persons and organisations with expertise in consumer product safety and safe design of products.

The aim of this database is to provide government, industry, researchers and other potential users with access to high level expertise on issues of consumer product safety and safe product design. It is envisaged that this database will be a valuable resource for all those involved in: the design of consumer products; the setting of Standards; quality control; "accident" investigation; and injury research and prevention. The advantages to those listed will be networking, consultancies, and business and research opportunities.

The database coverage is Australasia-wide and is in electronic format.

Anyone wanting further information, or to be included on this database should contact Shauna Sherker by phone (03) 9905 1860, fax (03) 9905 1809 or by e-mail [shauna.sherker@general.monash.edu.au](mailto:shauna.sherker@general.monash.edu.au).

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### AGM DATES

NSW Branch 1 September, 1999. Contact Christine Aickin ph: (02)98102199 fax: (02)95554177 mobile: (0417)299893 email: [aickin@tpgi.com.au](mailto:aickin@tpgi.com.au)

QLD Branch 13 September Contact Jim Carmichael ph: 07 33605760 fax: 07 3831 6011 email: [carmichael.jim@comcare.gov.au](mailto:carmichael.jim@comcare.gov.au)

WA Branch 15 September, 1999 Contact Melanie Baker [mkbaker@acs.uwa.edu.au](mailto:mkbaker@acs.uwa.edu.au)



## Vic Branch News

### MEDICO-LEGAL WORKSHOP

Wednesday 4 August 1999  
1pm to 5:30pm

ROYAL MELBOURNE HOSPITAL - GROUND FLOOR  
LECTURE THEATRE

*What to know. How to protect yourself from litigation.*

*How to present reports and give evidence in court comfortably.*

**Michelle French**, Occupational Therapist

Parking on Grattan St, Royal Parade or Flemington Rd and the (pay as you exit) underground RMH carpark - access from the entrance off Royal Parade just past Melbourne Private Hospital.

Enter Royal Melbourne Hospital MAIN ENTRANCE - the steps up from Grattan Street. Walk straight ahead through the Outpatients' Block and East-West Block into the North Wing. Signs will direct you to the Ground Floor Lecture Theatre.

Michelle has ten years experience in the medico-legal area. She has represented both the plaintiff and defence, giving evidence in both the Supreme and County Courts.

This afternoon workshop will provide you with an overview of the Australian Court system, and give you

confidence when called to attend court or give evidence. If you are working in Ergonomics or a related area, it is quite likely that you will be summoned to attend court at some stage during your career. With an understanding of the system, the experience should be a little less intimidating.

The workshop is also aimed at those who may wish to become involved in medico-legal work, but are unsure how to get started.

Topics covered in the presentation include:

- Report writing - accepted formats for the legal system and what is expected
- Understanding the Court system
- Being a expert witness
- Understanding litigation - particularly in relation to your own position, i.e. how to avoid being sued.
- Giving evidence (*and surviving*)
- Costings if asked to prepare information for court or to attend as a witness

Detailed handouts will be provided on these and other topics. After the workshop, we have arranged for dinner in Lygon St.

- members - **\$10**
- non members - **\$40**
- dinner (6:30pm at University Cafe in Lygon Street) - **\$20**

To assure your place at this significant seminar, call Steve Isam (9890-2422 fax: 9890-4102 [stephen@pipeline.com.au](mailto:stephen@pipeline.com.au)), David Trembearth 0413 385 740 fax 9372-1542 [ergon@netspace.net.au](mailto:ergon@netspace.net.au) or Phil Clark (ph: 9844-3091 [psclark@rie.net.au](mailto:psclark@rie.net.au))

## **FACILITATING POSITIVE BEHAVIOUR CHANGES**

**Wed 15 September 6 for 6:30pm  
Royal Melbourne Hospital**

*Planning for success; how to facilitate positive change.*

Two speakers - **David Hainsworth** from DuPont and **Alex Jankiewicz** from Behavioural Safety Services P/L

The STOP system is credited for Dupont's world-leading safety performance achievement. **David Hainsworth** handles STOP system marketing and implementation in Victoria.

After initiating implementation of a behavioural safety process at Alcoa, Point Henry, **Alex Jankiewicz** modified the approach to enhance its effectiveness in the Australian environment. Behavioural Safety Services has provided employee-driven behavioural safety cultural change process implementation services in a number of workplaces since 1994.

Why behaviours are the key, what drives them, how to measure. Resistance to change, feedback, positive reinforcement. Suiting a behaviour-based safety process to workplace culture for long-term effectiveness.

**Tuesday 26 October: Injury Prevention**  
(a professional development presentation)

**Thur 2nd December Two for the price of one!**

**Vic Branch Annual General Meeting and  
Prof Devt Activity**

**Handling Special Needs - Vision and Hearing  
disabilities**



# Low Back Pain and Sailboarding Harness Design

## LOW BACK PAIN AND SAILBOARDING HARNESS DESIGN: PART 1. FIELD SURVEY

**Lisa Holley**, Ergonomics at Work, P.O. Box 231, Sawtell, New South Wales. Email: [ergowork@chamsoft.com.au](mailto:ergowork@chamsoft.com.au)

**Dr Clare Pollock**, Psychology Department, Curtin University, Bentley, Western Australia.

**Dr Leon Straker**, Physiotherapy Department, Curtin University, Shenton Park, Western Australia.

### ABSTRACT

Previous research has suggested a possible association between sailboarding harness design and back pain. The main aim of this project was to determine if there was an association between harness design and back pain. The project involved two aspects, biomechanical modelling (reported in a companion paper, Holley et al. 1999b) and a field survey.

The field survey study involved surveying 92 wave and slalom sailboarders at 3 different locations around Perth. The seat harness was the most popular harness currently being used by both wave and slalom sailboarders. The results indicated that the prevalence of low back pain, related to sailboarding was 40%. The majority of sailboarders with back pain believed that harness design was related to low back pain ( $Z = 1.648$ , upper tailed  $p < 0.05$ ).

### INTRODUCTION

Sailboarding is a popular recreational sport, particularly in Perth, Australia. It is a sport that combines surfing and sailing together. Although a relatively new sport, there have been rapid technological advances in the equipment available. The different designs of harnesses available are an example of this rapid change. Despite the widespread use of harnesses there has been little research published on their effects on the users.

Several studies have evaluated the physiological demands in sailboarding. Schölne and Reickert (1983) attributed the physical work demands in sailboarding to prolonged static muscle contraction, particularly in the upper limbs. Since the subjects in this study were not using a harness, the results are relatively obsolete as harnesses are now commonly used. A more recent study

by Allen and Locke (1990) compared the physiological responses of two groups of competitive sailboarders during longboard racing in different conditions. The results showed that sailboarders had higher heart rates and blood lactate levels in light wind conditions compared with strong wind conditions. In the strong wind conditions the sailors are able to spend more time using their harness. The use of a harness therefore appears advantageous as it reduces the physical work demands of the task resulting in less fatigue (Reilly, Brymer and Towend, 1993).

A number of epidemiological studies have attempted to document injuries in competitive elite and general sailboarding populations. Ullis and Anno (1984) surveyed racing competitors from longboard, slalom and wave sailing events in Hawaii and Allen and Locke (1989) surveyed Olympic and amateur longboard competitive sailboarders in Australia. Both studies reported that the most common acute injuries were cuts and contusions to the skin, shins and feet and muscle strain. The most common chronic injury was low back pain, which was evident in all age groups.

Rosen, Bauman, Knof and Steels (1991) conducted a survey of both professional and recreational sailboarders by postal questionnaire in Canada and interview in North America and Hawaii. They reported a higher prevalence of back pain in the windsurfing population compared to a control group. The results showed that at least one episode of back pain (in the last year) was reported by 93.3% of the windsurfers compared to 75.7% of the control group. There were a number of problems with this study which reduce its internal and external validity: subjects had difficulty following instructions regarding when to mark answers with crosses and circles, the response rate was relatively low, with only 285 out of the 400 questionnaires given to windsurfers being returned and filled out correctly; there was no matching of the control group attempted and only 152 controls were surveyed. However, the results do concur with earlier research (Allen and Locke, 1989; Ullis and Anno, 1984; McCormick and Davis, 1988) that back pain is the most common chronic injury both in the competitive elite and general sailboarding populations.

### LOW BACK PAIN: RISK FACTORS

The aetiology of back pain in sailboarding has been attributed to a combination of general factors including occupation, participation in other sports, age and physical activity level, and factors specific to sailboarding such as sailing posture and harness design (Allen and Locke, 1989; Ullis and Anno, 1984).

There is evidence to suggest that occupational workload is associated with the development of back pain. A survey by Frymoyer, Pope, Clements, Wilder, MacPherson, and Ashikaga (1983) indicated that jobs requiring heavy lifting, operating machine tools, jack hammers and motor vehicles were associated with low back pain. Svensson and Anderson (1983) found workers who were exposed to excessive manual lifting tasks were three times more susceptible to compensatable low back injuries than other workers. Therefore a sailboarder working in a job requiring heavy lifting may already have an underlying pathology related to work which could be aggravated by sailboarding.

Specific sports have been associated with a higher risk of low back pain. Stanish (1987) reviewed a number of studies and concluded that vertical loading, flexion-extension and rotational forces were associated with the specific sports which have high risks of associated back pain. Preliminary studies of sailboarding have shown a high incidence of low back pain (Allen and Locke, 1989; Ullis and Anno, 1984) in elite sailboarding athletes. Therefore sailboarding may be a high risk sport for back pain, possibly due to the nature of the spinal forces involved in sailboarding. As people often participate in more than one sport, a sailboarder may have had a back injury while participating in another sport. This may affect their performance or be aggravated when they are sailboarding

"Low back pain manifests itself in both the young competitive athlete as well as the older 'weekend warrior', but usually for profoundly different reasons" (Kraus and Shapario, 1989:59). Low back pain begins relatively early in life (Berquist-Ullemann and Larsson, 1977) with the peak frequency of appearance of symptoms being between 30 and 50 years of age (Brown, 1973; Rowe, 1969). Stanitski (1982) reports an increasing participation in sport by school aged children with a

corresponding increase in low back pain. Micheli (1979) and Stanitski (1982) attribute low back pain in the adolescent to rapid growth spurts which result in changes in the axial skeleton and soft tissue. This can cause structural imbalances between the ligaments and tendons and the bony elements resulting in postural changes and increased stress on the spinal column. The increased vulnerability of growth tissue has also been related to injury during adolescence (Micheli, 1979; Jackson, 1979). Allen and Locke (1989) found that low back pain was reported by sailboarders in all age groups (15 - 44 years), although particularly high in the young athletes (15 -19 years) studied. Therefore, although age has an influence on back pain, it is perhaps not in the way one would expect; that is more people report pain with increasing age.

There is conflicting evidence regarding the influence of activity level in low back pain. Svensson and Andersson (1983) found low back pain to be more common in men who were less physically active in their leisure time. Cady, Bischoff, O'Connell, Thomas and Allan (1979) studied the strength and fitness, and subsequent back injuries in fire fighters. They reported that individuals with a good state of general fitness appear to have a lower risk of chronic low back pain and recover more rapidly after low back pain. Cotta and Correll (1982) advocate frequency of activity as a way of maintaining general fitness and preventing injury in the older athlete. Conversely, Burton and Tillotson (1991), found no association between increased activity level through participation in sport for leisure and low back pain. Stanitski (1982), Jackson (1979) and Micheli (1979) all cite high frequency of physical activity as contributing to overuse, which may result in recurrent microtrauma and back pain. Therefore a high frequency of sailboarding may result in back pain from overuse. However there is no conclusive evidence to support this and the converse may also be true; sailboarding frequently may maintain strength and general fitness specific to the sport and therefore reduce the risk of low back pain.

Sailboarding harness design could also be associated with back pain due to influence on the way forces are distributed from the sailboard to the user. The harness reduces the strain on the arms by transferring the force from the wind in the sail, via harness ropes attached to the boom and thus to the sailboarder. The three main types of harnesses (chest, waist and seat) vary according to the attachment site on the body, and therefore, the point of application of force to the body. They may therefore have an important effect on the loads imposed on the low back during sailboarding. There has been little research into the effect of harness design and the amount of force incurred by the body, particularly the lower back. If the amount of stress on the back exceeds the body's stress-strain capacity, back pain can occur (Bogduk, 1987).

### **HARNESS DESIGN**

An evaluation of current harness designs was carried out by Reilly, Brymer and Towend (1993). They evaluated three harness designs (chest, waist and seat harness) in a laboratory setting using a 3.6m longboard. Harness force was measured using a strain gauge as well as estimated using biomechanical modelling. Muscle activity of Latissimus Dorsi, Rectus Abdominus and Vastus Lateralis muscles were evaluated using electromyography and spinal shrinkage was measured using a precision stadiometer.

The measured and estimated harness forces produced conflicting results. For example, the waist harness had the least measured harness force (273.6N) but had intermediate estimated harness force (408.1N). The seat was estimated (335.0N) and measured (441.7N) to result in the most harness force. The chest was estimated to be the least (366.7N) but measured in the middle (289.5N). The greatest loss of stature was measured with the waist harness. Use of the chest harness resulted in a small loss of stature and conversely, an increase in stature was reported for experienced sailors using the seat harness. The data on muscle activity was not reported, other than that sailing with a harness resulted in less muscular effort than sailing without a harness.

They concluded that the chest harness was better for less skilled and /or lighter (less than 70 kg) sailboarders and the seat harness was better for experienced sailors and those greater than 70 kg. It was not clearly outlined by the authors which variables they utilised to come to these conclusions and the study had some methodological limitations (small, gender biased sample of 7 males and 2 females, rig set up fidelity).

Given the limited amount and quality of biomechanical information relating harness design to back pain, and the limited epidemiological information on this association, further biomechanical and epidemiological investigations were required.

Therefore the main aim of this research was to determine if there was an association between harness design and back pain. Of the four main approaches to establishing a relationship between a risk factor and back pain, epidemiological, biomechanical, psychological and psychophysical (NIOSH, 1983), two were used in this research. This paper describes the collection of epidemiological data through a field survey aimed to build on the study by Rosen et al. (1991) in surveying sailboarders to determine if there is a relationship between low back pain and sailboarding harness design. The companion paper (Holley et al. 1999b) describes the biomechanical modelling study aimed to build on the work of Reilly et al. (1993) in estimating the harness forces and resulting stress on the back from different harness designs.

### **METHOD**

The field survey aimed to provide epidemiological data regarding harness use and back pain in a sailboarding population.

### **DESIGN**

A structured interview was used to gain evidence to test the hypothesis that there is an association between the type of harness used and back pain experienced. Data on a second hypothesis, that the majority of sailboarders would believe there is a relationship between type of harness and back pain experienced was also collected.

## **SUBJECTS**

A sample of 92 sailboarders were surveyed at three different sailboarding locations around the Perth area. The locations were: Lancelin (27 subjects), which is flat ocean water with a reef break mainly used by wave sailors; Cottesloe (24 subjects) which is a shore break where both wave and slalom sailors go sailboarding, and Pelican Point (41 subjects), which is flat water on a river and used by slalom sailboarders. Multiple sites were used to gain a diverse sample of the slalom and wave recreational sailboarding population. The subjects were volunteers of at least moderate competency. (Competency was assessed by self report of the ability to water start and ride a slalom or wave board.) Subjects were excluded if they had a previous back injury, not related to sailboarding, requiring medical attention or time off work.

## **MATERIALS AND EQUIPMENT**

A structured interview schedule was developed to collect information regarding age, sex, frequency of sailboarding, experience level, current and past harness use and back pain history. If the subjects reported back pain, they marked on a body chart the site of the back pain, estimated the severity of the pain using a Visual Analog Scale (VAS) and reported the frequency of the pain using an ordinal scale. The VAS was selected to measure pain intensity due to the short administration time required and considerable research support for its validity (for example, Jenson, Daroly and Braver, 1986; Chapman, Casey, Dubner, Foley, Gracely and Reading, 1985). The VAS was scored for pain intensity reported in the spinal area only. A separate back pain history (body chart, VAS and frequency rating) was obtained for each different harness used.

## **PROCEDURE**

The subjects were approached on the beach as they came out of the water for a break, or while setting up or packing up their sailboards. This may have increased the internal validity of the survey for current experiences of pain as the reliability of reports of past experiences of pain in retrospective studies has been questioned due to memory decay (Rosen et al. 1991). Subjects were interviewed according to the interview schedule, which took approximately 5 minutes. The data was collected during October 1993, the beginning of the main sailboarding season.

## **DATA ANALYSIS**

Descriptive statistics, means and standard deviations for continuous data and frequencies and percentages for categorical data, were utilised. A one sample Z-test was used to determine if the majority of sailboarders with back pain believed that harness design was related to back pain. A chi-square test was to be used to determine if there was an association between site, severity and frequency of back pain and harness design.

## **RESULTS**

Although ninety two sailboarders were interviewed, three were excluded from the study group because they rode longboards and 19 were excluded because they had a previous back injury that required medical attention or time off work. The rationale for the selection criteria was to exclude novices and longboard sailboarders, who may have reported back pain due to uphauling the sail, which may have confounded the results. The interest of the study was the effect of harness on back pain so subjects with previous back injuries unrelated to sailboarding were excluded.

The personal characteristics of the 70 subjects remaining in the study are summarised in Table 1. The sample consisted of nearly equal numbers of wave and slalom sailboarders. Wave sailboarders tended to be a little older and have more years of experience than slalom sailboarders. This may reflect the increased difficulty of wave sailboarding. There were only 2 female subjects compared to 68 males.

	Number of Subjects	Age (years)	Experience (years)
Total Sample	70	29.7 (SD ± 9.24)	6.4 (SD ± 4.7)
Slalom	34	29 (SD ± 10.58)	4.5 (SD ± 3.5)
Wave	36	30.3 (SD ± 7.87)	9.2 (SD ± 4.6)

**Table 1. Personal characteristics of the study sample**

The mean sailing frequency was 2.9 (SD ± 1.67) times per week. The estimate of frequency was based on a generalisation for all seasons that the subject sailed. All subjects reported that they sailed during summer, 73% in winter, 91% in spring and 90% in autumn. In Perth, the main sailing season is summer as there is a strong sea breeze compared to during the winter when the wind is associated with storms.

The seat harness was the most popular harness with 74% of the sample studied currently using this design (see Figure 1). Waist harnesses were used by 16% and chest harnesses by 10% of the sample. Some sailboarders reported that they had not previously used any other harness (22%). However, the majority had used either a waist or chest harness previously. There were only 9 subjects who had previously used a seat harness and were currently using a chest or waist harness. The extent of previous harness usage often related to years of experience and the evolution of harnesses from chest to seat harnesses over the last 10 years. This is reflected in the results that indicated a greater number of wave sailboarders, who on average were more experienced than the slalom sample, had tried other harnesses. Seven slalom sailboarders and 16 wave sailboarders had tried all three harness types.



*Figure 1. Harness usage of sample*

Slalom sailboarders mainly used the seat harness with only a few using the chest or waist (see Figure 2). More variation was seen with wave sailboarders, however the seat harness was still the most popular followed by the waist harness (see Figure 3). Some wave sailors commented that the seat harness restricted movement around their legs which reduced their wave riding performance.



*Figure 2. Harness usage for slalom sailors.*



Figure 3. Harness usage for wave sailors.

Forty percent of the sample (28 subjects) reported discomfort in the back which they associated with sailboarding. The group reporting discomfort comprised both slalom (54%) and wave (46%) sailboarders. Of the subjects who had used a seat harness (previously or currently), 13% reported discomfort in the back while using that harness. This was lower than the 29% who reported discomfort using the waist harness and 25% reporting discomfort with the chest harness.

Only those subjects who reported back pain associated with sailboarding were asked if they believed that the type of harness used was related to back pain. The results revealed that 17 of the 26 sailboarders who responded to the question (2 refused to answer the question) did believe or report that harness type was related to back pain (see Table 2). A one sample Z test indicated that the proportion of sailboarders believing that harness type and back pain are related was significantly more than those who did not ( $Z = 1.648$ , upper tailed  $p$  value  $< 0.05$ ).

Subjects were also asked if they had changed their harness type because it was associated with less back pain (see Table 2). The results indicated that more wave sailboarders believed that harness type was related to back pain and had changed their harness compared to the slalom sailboarders. This may be related to the previous results indicating that wave sailboarders had more experience and had tried more harness types than the slalom sailboarders or that wave sailboarding may be more stressful on the back.

	Believe harness is related to back pain		Change harness because of back pain	
	Yes	No	Yes	No
Total sample	17	9	15	11
Slalom sailboarders	5	8	5	8
Wave sailboarders	12	1	10	3

Table 2. Harness and back pain

There was insufficient data to conduct a chi square test to determine association between harness type and site, frequency and severity of back pain as the prevalence of back pain in subjects was lower than expected (see Discussion).

The reported site of back pain was predominantly the lumbar region. However, as had been anticipated, some (2) subjects reported pain in the thoracic area when using the chest harness. Fewer reported pain in the lumbar region when using the seat harness (8) than when using the chest (9) or waist (12) harness.

The reported frequency of back pain following a sailboarding session for each harness type is shown in Table 3. The rating scale had four levels, however the results are presented in two condensed categories: occasionally or rarely; and most or all of the time. The results indicated that the frequency of back pain was less with the seat harness than the waist or chest harness.

	Most or all of the time (no. of subjects)		Occasionally/ Rarely (no. of subjects)	
Chest Harness	4	(36%)	7	(64%)
Waist Harness	4	(34%)	8	(66%)
Seat Harness	2	(25%)	6	(75%)

Table 3. Harness type and frequency of back pain.

The rating of severity on the Visual Analogue Scale is shown in Table 4. The scores were divided into two categories, scores from 0-5 were considered less severe and scores from 6-10 more severe. Although there are fewer subjects using the seat harness a larger percentage of these, when they do experience back pain, report greater severity of pain.

	Pain VAS 6-10 (no. of subjects)		Pain VAS 1-5 (no. of subjects)	
Chest Harness	4	(36%)	7	(64%)
Waist Harness	4	(34%)	8	(66%)
Seat Harness	2	(25%)	6	(75%)

**Table 4. Harness type and severity of back pain.**

In summary, the hypothesis that the majority of sailboarders with back pain did believe that harness type was related to back pain was supported. Although the hypotheses of an association between harness used and back pain experienced could not be tested, the descriptive evidence appears to support the hypotheses.

**DISCUSSION**

**LIMITATIONS AND RESULTS OF THE FIELD SURVEY**

The method of data collection, interviewing sailboarders at different locations randomly, ensured a sample group that was representative of the recreational population. However, this resulted in a sample group that was gender biased as there were very few females sailboarding at the time of the survey and of the 4 females interviewed 2 were excluded. This has been a problem with other surveys of the sailboarding population (Ullis and Anno, 1984, Allen and Locke, 1989). Therefore the results of the study can only be generalised to the male population. Perhaps in order to collect data regarding female sailboarders, a study may need to be gender exclusive due to the apparent male domination of the sport.

The exclusion of subjects who had a previous back injury requiring time off work or medical attention may have also biased the results. Initially the interest of the authors was whether a particular harness type caused back pain. However, on reflection, the inclusion of those

with a pre-existing back injury would have provided complimentary data on whether the harness type aggravated pre-existing back pain or perhaps even relieved back pain.

The site, frequency and severity of low back pain in Perth wave and slalom sailboarders was identified for the sample group. Subjects appeared to have no difficulty with completing the body chart, VAS or frequency rating scale. Being unable to use pain measurement data to perform the chi-square analysis to test if there was an association between back pain and harness design was an unexpected limitation of the study. This was due to insufficient numbers of participants with back pain related to sailboarding.

One aspect of the study was to determine what type of harnesses were used in Perth and their relative popularity. The results indicated overwhelmingly that the seat harness was the most popular harness design. However the objective to establish if there was a relationship between harness type and back pain was not achieved. Although statistical testing did not allow an association between harness type and back pain to be determined, it could be suggested that there is self selection by subjects to a harness that is more comfortable. The subjects that reported back pain using a chest or waist harness had all changed to a seat harness, except one who changed from a chest to waist harness and has not used a seat harness. There were also subjects who had only used a seat harness who did not report any back pain when sailboarding. Therefore the current use of the seat harness by subjects may indicate that it results in the least discomfort in the back.

However, there may be other possible reasons for the popularity of the seat harness. As this harness is a more recent development, keeping up with the latest fashion may be a possible reason for the subject's preference to use the seat harness. Reduced stress and load transfer via the arms may be more strongly associated with the preference for the seat harness than association with back pain. Sailing performance may also be affected by the type of harness used. Subjects may feel that they perform better aerial manoeuvres, go faster or experience reduced fatigue when using the seat harness.

## COMPARISON OF CURRENT STUDY TO THE LITERATURE

The results of Rosen et al. (1991) indicated that the number of episodes of back pain were not significantly related to the type of harness used. This result is difficult to interpret as there were 5 categories of harness, chest, waist, seat, chest/seat, waist/seat. The latter two may cater for sailboarders who used different harnesses for different tasks (eg waist/chest for wave sailboarding and seat for slalom). In the current study this was overcome by identifying the task that the subject was doing at the time of interview. This avoided combinations of harness types, as the aim of the current study was to differentiate between the harness types.

In both the current study and Rosen et al.'s (1991) study it was difficult to draw conclusions from pain frequency data in isolation from the other pain measurements.

The frequency of back pain may relate to the number of accidents resulting from aerial manoeuvres when wave sailboarding rather than the harness design. In the case of Rosen et al.'s (1991) study, the inclusion of subjects with a pre-existing back injury may have resulted in high pain frequency being reported due to the nature of the injury. The need to include a question regarding what the subject thought caused the back pain would assist in establishing the role of harness design in back pain. This was a methodological weakness in both the current study and that of Rosen et al. (1991).

The identification of the extent of low back pain in the recreational wave and slalom sailboarding population was another aspect of the study. This was achieved, however the reported prevalence rate of back pain in the study was biased due to the exclusion of subjects with pre-existing back injuries. If this group is included, the prevalence rate increases from 40% to 51%. With this bias taken into account, the results of back pain prevalence in this group of sailboarders is lower than reported by previous studies. Rosen et al (1991) reported an extremely high rate of 93.3% compared to Ullis and Anno (1984) who reported 71.4% and Allen and Locke (1989) reporting 56%. However all these prior studies included professional sailboarders in their sample. There is no other study reporting back pain prevalence in the recreational population to compare with the results of this current study.

## CONCLUSION

The prevalence of back pain appeared to be lower in the recreational population in the field survey study than professional populations surveyed in other studies (Allen and Locke, 1989; Ullis and Anno, 1984). Although an association between harness type and back pain was not established (due to a small sample size), descriptive statistics provided support for an association. The majority of sailboarders interviewed with back pain believed there was a relationship.

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## REFERENCES

- ALLEN, G. and LOCKE, S. (1989) "Training activities, competitive histories and injury profiles of elite boardsailing athletes". *The Australian Journal of Science and Medicine in Sport*, 21(2):12-14.
- ALLEN, G. and LOCKE, S. (1990) "Physiological responses of highly competent boardsailors during competition". *Australian Sports Medicine Federation National Scientific Conference Proceedings*, 27:365-370.
- BERQUIST-ULLEMAN, M. and LARSSON, U. (1977) "Acute low back pain in industry" *Acta Orthopaedica Scandinavia (Supplementary)*, 170:18-23.
- BOGDUK, N. (1987) "The pathology of low back injuries" *Australian Sports Medicine Federation National Scientific Conference Proceedings*, 295-302.
- BROWN, J.R. (1973) "Lifting as an industrial hazard" *American Industrial Hygiene Association Journal*, 34:292-297.
- BURTON, A.K. and TILLOTSON, K.M. (1991) "Does leisure sports activity influence lumbar mobility or the risk of low back trouble?" *Journal of Spinal Disorders*, 4(3):329-336.
- CADY, D.B., BISCHOFF D.P., O'CONNELL, E.R., THOMAS, P.C., & ALLAN, J.H. (1979) *Strength and fitness and subsequent back injuries in firefighters. Journal of Occupational Medicine*, 21, 269-272.



- CHAPMAN, C.R., CASEY, K.L., DUBNER, R., FOLEY, GRACEY, R.H. and READING, A.E. (1985) "Pain measurement: an overview" *Pain*, 22:1-31.
- COTTA, H. and CORRELL, J. (1982) "The risk of injury and damage due to overstraining in the older athlete" *Proceedings of World Conference of Sports Medicine, Vienna*, A.12.:116-123.
- FRYMOYER, J.W., POPE, M.H., CLEMENTS, J.H., WILDER, D.G., MacPHERSON, B., ASHIKAGA, T. (1983) "Risk factors in low-back pain" *The Journal of Bone and Joint Surgery*, 65-A(2):213-218.
- HOLLEY, L., POLLOCK, C. & STRAKER, L. (in press) Low Back Pain and Sailboarding Harness Design: Part 2. Biomechanical Modelling of Lumbar Stresses. *Ergonomics Australia*
- JACKSON, D. (1979) "Low back pain in young athletes: evaluation of stress reaction and discogenic problems" *American Journal of Sports Medicine*, 7(6):364-366.
- JENSON, M., KAROLY, P. and BRAVER, S. (1986) "The measurement of clinical pain intensity: a comparison of six methods". *Pain*, 27:117-126.
- KRAUS, D. and SHAPIRO, D. (1989) "The symptomatic lumbar spine in the athlete" *Clinics in Sports Medicine*, 8(1):59-69.
- McCORMICK, D.P. and DAVIS, A.L. (1988) "Injuries in sailboard enthusiasts". *British Journal of Sports Medicine*, 22(3):95-97.
- MICHELI, L. (1979) "Low back pain in the adolescent: differential diagnosis" *American Journal of Sports Medicine*, 7(6):362-364.
- NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (1983) *Work practices guide for manual lifting*. Ohio, American Industrial Hygiene Association.
- REILLY, T., BRYMER, E. and TOWEND, M. S. (1993) "An ergonomic evaluation of boardsailing harnesses" *Proceedings of Ergonomic Society Annual Conference*, Edinburgh, Scotland, 13-16 April 1993: 445-450.
- ROSEN, G., BAUMAN, C., KNOF, J. and STEELS, B. (1991) "Low back pain and harness use in windsurfing: a controlled comparative survey" *Chiropractic Sports Medicine*, 5(2): 34-37
- ROWE, M.L. (1969) "Low back pain in industry. A position paper" *Journal of Occupational Medicine*, 11:161-169.
- SCHÖNLE, CH and RIECKERT (1983) "Cardiovascular Reactions during Exhausting Isometric exercise while windsurfing on a simulator or at sea" *International Journal of Sports Medicine* 4, 260-264.
- STANISH, W. (1987) "Low back pain in athletes: an overuse syndrome" *Clinics in Sports Medicine*, 6(2): 1987
- STANITSKI, C. (1982) "Low back pain in young athletes" *The Physician and Sports Medicine* 10(10):77-91.
- SVENSSON, H.O. and ANDERSSON, G.B.J. (1983) " Low back pain in 40-47 year old men: Work history and work environment factors" *Spine*, 8:272-276.
- ULLIS, K.C. and ANNO, K. (1984) "Injuries of competitive boardsailors" *Physician and Sports Medicine*, 12(6):86-93.

# Ergonomics in Australia

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## INTRODUCTION

The need to consider worker capacities and limitations in the design of work and working environments was recognised in Australia quite early in this century and research studies in a range of areas relevant to ergonomics were undertaken in separate institutions or under the auspices of various government bodies. As members of separate disciplines came together to share their interests in ergonomics, the value of utilising expertise from a variety of professional backgrounds to contribute to the design of work and work environments was recognised. The fundamental belief of the founders of the Ergonomics Society of Australia was that in dealing with specific problems, the skills of the most relevant combinations of disciplines should be applied. It was believed that as long as these experts had a common primary interest in considering the needs of the worker and an understanding of how that could be achieved, they would, collectively, provide an ergonomics solution to a work design problem and would add to the knowledge base of the new discipline. The emphasis in this early application of ergonomics was on design in its broadest sense.

With the changes in the workplace during the latter half of the century have come new needs for the worker. The importance of applying the knowledge and skills of a broader range of disciplines to deal with these needs has been acknowledged. The idea that one person, an "ergonomist" might solve many of the problems requiring application of ergonomics principles has developed. The broadened scope of ergonomics in today's world, uncertainties as to the nature of core competencies required by any person working within the field and the importance of quality practice have led to concerns to define the professional ergonomist. As a result, the issues of professional certification of ergonomists, the specification of optimal educational requirements for an ergonomist and accreditation procedures have generated considerable discussion in Australia.

This paper offers an overview of the development and growth of ergonomics in Australia and traces the changes in approach to its practice which have led to its current status and to the deliberations on its future.

## EARLY HISTORY OF ERGONOMICS IN AUSTRALIA

One of the first papers written in Australia about ergonomics was by Dr J.C. Lane, then the Superintendent of Aviation Medicine, in the Department of Civil Aviation. Although Lane's (1953) paper was entitled "Human Engineering: A New Technology", his discussion described the practice of ergonomics. His definition of human engineering was that it relied on a multidisciplinary input and that it was a blend of various biological sciences, physiology, anatomy, physical anthropology and especially applied experimental psychology, together with various branches of engineering. He explained that human engineering aimed to determine human capacities, to provide principles governing the design of machines for efficient human use, and to ensure an effective integration of man and machines for the accomplishment of an overall task. Lane (1953) outlined the details of equipment used for air traffic control systems, navigational aids to assist aircraft in their final approach to landing and the importance of appropriate design of visual displays to eliminate irrelevant information and assist the operator to organise incoming data. Lane's interest in ergonomics led to important research and development in the area of operator performance and safety within the aviation industry and, as the Director of Aviation Medicine, Lane was the catalyst for many of these developments.

Reference to a history of the medical services of the Royal Australian Navy and Royal Australian Air Force by Walker (1961) reveals that from the 1930s, aircraft pilots were seeking to determine whether personal characteristics such as reaction times, concentration and coordination could be used as predictors of a pilot's ability to learn to fly. Indeed, considerable effort was directed at determining appropriate selection procedures for flying training, interest being directed at such features as the influence of neurosis and neuromuscular coordination, particularly in relation to reaction times

for tracking and manipulation of aircraft controls. Following the formation of the Flying Personnel Research Committee in 1940, research was expanded beyond selection methods and flying performance to operational efficiency, comfort and safety, clothing, orthoptics, vision and lighting, acoustics, motion sickness, decompression, hypoxia, antigravity effects and fatigue. According to Walker (1961), flying personnel research units were established in cooperation with departments of physiology at the Universities of Sydney and Melbourne. Working in association with these units were government instrumentalities such as the National Standards Laboratories, the Council for Scientific and Industrial Research, the Acoustic Laboratory, the National Health and Medical Research Council and the Fatigue and Tropical Unit of the University of Queensland, demonstrating an early concern in human performance by a range of scientific disciplines.

Factors relating to visual standards, changes in atmospheric pressure with altitude, the problems of blackout in air crew and the problems of noise in air craft were areas for particular attention in this early ergonomics related research. With a considerable proportion of Australia being located within the sub tropics and tropics, it is not unexpected to find that the Tropical and Fatigue Laboratory within the Department of Physiology at The University of Queensland carried out major studies into the physical and psychological effects of tropical service, as well as investigations into the design of clothing for flying in the tropics and at low temperatures. Studies in the School of Public Health and Tropical Medicine at the University of Sydney investigated the effects of climatic extremes on comfort and performance of people of all ages, whether healthy or sick. These and later studies had application to the mining industry in northern Australia and in Australia's station at Mawson, in Antarctica. Ferguson (1969) has pointed out that this early research was the first example of organised interdisciplinary collaboration and the first application of scientific method and knowledge from the human biological sciences into the study of man and work in Australia. To the extent that it concerned the man-machine relationship in flying and fighting, it represented ergonomics. A Human Engineering

Research Group was set up within the Aeronautical Research Laboratories of the Australian Defence Scientific Service in the Department of Supply, in about 1957. Nominated as a human engineering group, this represented the first formally constituted research group in ergonomics as such in Australia (Ferguson, 1969). Three of the principal researchers associated with this group, Cameron, Cummings and Lane, were to become instrumental in the later formation of the Ergonomics Society.

Outside of the aviation industry, other work of an ergonomics nature was being undertaken. For example, Oxford (1967), one of the pioneers in Australia for furniture design, undertook surveys of school children to collect data relevant to furniture design for schools. The influence of seating design, posture and work place layout on the production of musculoskeletal injuries during process work was recognised by Peres who instituted a study of these relationships during the 1950s, while working within a human engineer group of the Division of Occupational Health in New South Wales. In 1963, the name of this group was changed to Ergonomics Group. Thus, an interest in the prevention of musculoskeletal injuries in industry was an important component of ergonomics in Australia from its earliest days. Early work of psychologists, principally by Provins in South Australia, was concerned with studying the relationship between environmental conditions, body temperature and the performance of skilled tasks (Ferguson, 1969).

Important studies within engineering departments were also relevant to ergonomics. For example, in an early demonstration of interest in rehabilitation ergonomics, Tichauer collaborated with Wing at the Royal South Sydney Hospital to examine upper limb stresses in process work and the design of prostheses which would enable disabled persons to become productive workers. At The University of Queensland, major studies in tractor design for safe use were initiated in the Department of Mechanical Engineering. This work was later extended to safety features and temperature control in the design of load haul dump vehicles (LHD) for mining operations. Collaborative studies by the Departments of Mechanical Engineering and Physiotherapy at the

University of Queensland investigated the skills demanded of LHD drivers to cope with vibration.

The implications for back injury in operators using pedals both in agriculture and in industry were recognised by Bullock in the Department of Physiotherapy at The University of Queensland and extensive studies were carried out using stereophotogrammetry to determine the optimal worker-pedal relationship to minimise spinal movements (Bullock 1969, 1974a, Bullock and Harley, 1972). This research within a Department of Physiotherapy in the 1960s reflected a concern by physiotherapists to apply their understanding of body mechanics to ergonomics-related research so contributing to the design of work situations which would prevent many of the conditions they were called upon to treat. At the request of Dr Lane and the Department of Civil Aviation, that Physiotherapy Ergonomics Research Laboratory went on to study accommodation problems in light aircraft and to provide structural and functional anthropometric data which would improve accessibility to controls (Bullock, 1973, 1974b). This work was later extended to a study of space requirements within Australian automobiles. Also for the Department of Civil Aviation, physiotherapist Bullock investigated the pull force capabilities of women parachutists (Bullock, 1978a, 1978b).

Major research was undertaken by Patkin, a practising surgeon in South Australia, who applied his interests in ergonomic design to the development of more effective surgical instruments, compatible with surgeons' needs and work demands.

This early history of ergonomics in Australia shows that on the whole, people from a number of different disciplines - medicine, physiology, psychology, engineering, physiotherapy, were working on individual or collaborative research projects relating to the enhancement of operator comfort, safety and performance.

## **ESTABLISHMENT OF A SOCIETY**

Interested people from a number of disciplines gathered together in 1964 for the first Australian Ergonomics Conference. At this meeting, prompted by the visit to the University of Adelaide of Welford, who had been so active in the development of ergonomics within the United Kingdom, it was decided that an Ergonomics Society of Australia and New Zealand (ESANZ) should be established and that it should represent all relevant disciplines. The first two conferences were held within Departments of Psychology (Adelaide and Monash). The third was organised by the Occupational Health Section of the School of Health and Tropical Medicine in the University of Sydney, reflecting an early interest in occupational health and safety factors in ergonomics research and practice. By this time, rules for an Ergonomics Society had been developed and were formally adopted by the conference. The first chairman and secretary of the Ergonomics Society were R.W. Cumming and K.A. Provins respectively and these were succeeded by J.C. Lane and J. Bryant, respectively. In recognition of the concern of engineers for ergonomics at that time in Australia, the fourth conference was held within the Mechanical Engineering Department at the University of Queensland in 1967. At that Conference, the decision was taken to form State branches of the Society. New South Wales members announced their intention to form the first State branch of the Society incorporating Queensland members within their group. A Victorian branch was established soon after.

By the end of the 1960s, membership of the Society showed strong representation from engineering, medicine and psychology, some from science, architecture and education, and small representations from management and physiotherapy. This major involvement of engineering and medicine, both larger in membership numbers than psychology, differed from the structures of some other Ergonomics Societies around the world at that time. Many Society members were drawn from tertiary institutions, probably indicating the interest in research in this field by academics. This was often pursued in topics which were directly related to the contribution of that discipline to ergonomics, but topics combining expertise from different disciplines were also

the subject of important research. With succeeding years, the number of disciplines represented within the Society has grown and membership now includes those with professional education in design, safety and other fields of allied health. Early leaders within the ESANZ asserted that the range of interests and membership of the Society should be wide rather than narrow. The importance of a multidisciplinary doctrine was proclaimed often and indeed, it was asserted that there was no such thing as an ergonomics expert, but rather, that there were many experts in many disciplines who could offer parts of the whole (Cameron 1985). These views were embodied within the original aims of the Society, which were to promote research into the relationship between man, his occupation and his environment and to promote the use of the human sciences and engineering knowledge to solve problems arising from this relationship.

Reflecting the interest in research by the Universities, the principal employers of the society members were the educational institutions. However, increasingly, members employed within private industry as well as by the Commonwealth and State Government and their research organisations were represented. With the growth of ergonomics practice in Australia, self employed consultants became more frequent. Members were also drawn from employment within medical institutions and other public organisations.

Following queries from a New Zealand member, the ESANZ recognised in late 1984 that a reduced membership service was being presented to New Zealand members and the President of ESANZ suggested a number of options including the formation of an independent New Zealand Society. At the time, there were only two New Zealand members of ESANZ and they and their colleagues believed that there was scope for the creation for a vibrant society organisation within New Zealand. Following the decision to separate, the New Zealand Ergonomics Society was formed in early 1986. Within its first year, the new Society attracted 73 members and the number has grown steadily since that time.

Several approaches to communication amongst ergonomics society members were developed. These included the annual conference, a bi-monthly newsletter, branch newsletters, symposia and workshops on topical area. It was thought that carefully planned conference programs could provide the delegate with a comprehensive overview of new findings and developments in specific fields. For those working in a multidisciplinary field like ergonomics, such exposure was deemed to be important to help keep members in touch with the broader aspect of practice. The presentation of new research findings, novel solutions and innovative ideas would be stimulating for both the contributor and the delegate.

The programs of the Society's Conferences have reflected the early emphasis on a multidisciplinary approach, for papers have covered a wide range of topics. However, although some papers have reported the results of major research projects of interest to those in the ergonomics field, the majority have offered quasi educational, descriptive or overview papers which, although they heighten awareness of particular aspects of the practice of ergonomics, do not make a marked effect on the advancement of knowledge in ergonomics.

Special interest groups (SIGs) in the areas of computer human interaction, manual handling, repetition strain injuries, education and product design were established in the mid 1980s as a means of communication between members with a particular interest in the field. Of these, the Computer Human Interaction Special Interest Group (CHISIG) became the most active and has attracted many members. It has become a network group of researchers and other interested parties combining their skills and efforts to generate worthwhile projects in both fundamental and applied research and development. Ideas are exchanged and work exposed to peers for constructive criticism and comments, in an effort to produce user interfaces of a world standard and quality. The second most active SIG at that time was concerned with product ergonomics (PRODSIG). The objectives of this group included exploring the common ground between ergonomics and industrial design (and by definition, between ergonomists and designers), and providing first hand experience of the benefits of a multidisciplinary approach to product design and product ergonomics.

## ERGONOMICS PRACTICE IN AUSTRALIA

A review of developments in ergonomics can be made by reference to the conference topics presented within the ESAZA Conferences and to the commentaries within the Society's newsletter. The focus of attention at conferences has reflected the changes in community needs for application of ergonomics. Nevertheless, some concerns demonstrated in the early days of ergonomics practice within Australia have continued to the present. For example, the early interest in problems relating to aviation has continued as demands on the pilot have continued in new forms. The importance of designing vehicles or the environment to cater for vehicles has been a continuing interest.

While early conferences demonstrated a consuming interest in workstation design, improvement of posture during work or design of instruments, tools or machines, this interest has not waned. This latter day concern has undoubtedly related to the recognised importance of design in relation to use of visual display units. This topic alone has attracted an increasing number of papers at national conferences. Interestingly, the early preponderance of presentations in such topics as physical perception, mental stress, noise and work physiology has not continued. While such topics are still addressed, they have fallen to a minority grouping within recent years. On the other hand, reflecting the growing interest within the community of musculoskeletal injuries to the upper extremity, neck and shoulder girdle, and to the lower back, papers relating to the effect of repetitive work or prolonged sustained posture have increased in number. Also more evident today are topics related to technological change, information technology and the importance of information systems within the ergonomics approach. The need for application of organisational design and management within ergonomics practice has been a recent interest within the Society, papers on this topic appearing only since the 1990s. Despite the considerable interest in technological change, the number of papers on problems associated with manual handling and lifting has not diminished. It is obvious that while mechanisation and automation have modified many work practices in Australia, the demand for

manual work at home, in recreation and in work environments still exists and poses a problem for those concerned with control of injury.

The development of ergonomics in Australia has been closely associated with interests in occupational health and safety. Ferguson, one of the early leaders in ergonomics in Australia, himself a physician, considered that there was scarcely any aspect of ergonomics that was not connected directly or indirectly with the health and safety of workers (including students, homeworkers, the self employed and the unemployed), as well as those affected by the operations of an enterprise and the consumers of products from that enterprise. Such views were not shared by all later members of the Society, when their principal interests lay in other areas of ergonomics practice. For example, Howie (1980) contended that Australia would seriously undersell ergonomics if it only identified ergonomics with occupational health issues. He pointed out that large areas of ergonomics were not relevant to occupational health and that it was important for an organisation to employ an ergonomist who could advise on all ergonomics issues and especially systems ergonomics. Howie asserted that occupational health was an identifiably different discipline with its own body of knowledge and methodology. Holding different views from some of the founders of the ESANZ, he claimed that the links of occupational health and safety with ergonomics needed to be more clearly established, defined and exploited. By the early 1980s Ferguson (1983) acknowledged that there were some members of the ESA and NZ who felt that ergonomics was becoming too much a part of occupational health and safety and that ergonomics could well lose its own identity. As Ferguson (1985) observed, while skills in ergonomics are not necessarily a part of the repertoire of the medical practitioner, the clinician must cope with the consequences of conditions where ergonomics principles have not been applied. He argued that where medical practitioners and other allied health workers were providing advice to patients and employers about prevention of recurrence of injury, they were involved in ergonomics.

While there are many aspects of occupational health and safety which relate to ergonomics, one of the major concerns in Australia has been in the control of musculoskeletal injuries. Research in this area was well established from an early stage of ergonomics practice in Australia, and a considerable amount of research in relation to different types of work and complaints of musculoskeletal discomfort and occupational cramp was carried out in Australia from at least the 1960s. For example, Ferguson (1971 a, b, 1976) and Duncan, a physiotherapist (Ferguson & Duncan 1974, 1976; Duncan and Ferguson 1974) undertook some important collaborative studies. Following a study of upper limb injuries in women within a factory, Ferguson (1971b) found that the injuries fell into two broad groups: well defined clinical syndromes such as supraspinatus tendonitis and tennis elbow and ill defined symptom complexes, with the latter group in the majority. For this reason, Ferguson broadened the description of work-related musculoskeletal disorders of the upper extremities from simple tenosynovitis and periodontitis crepitans to a wider and more complex set of conditions. Ferguson coined the term "repetition injuries" to indicate his understanding of the cause - repetitive manual work. This term, subsequently enlarged to "repetition strain injuries" (RSI) was used increasingly in Australia to describe pain and discomfort in the hands, arms, shoulders and necks of workers involved in repetitive, unvaried work, who were forced by their work and the work place design to maintain awkward, fixed postures for long periods during the working day (McPhee 1991). The term, used to denote any one of a number of disorders, was discarded at a later date in favour of the term occupational overuse syndrome, as well as others. For approximately ten years in Australia, a wide variety of physical symptoms and signs was attributed to repetition strain injury. The peak of incidence occurred about the end of 1984. The excessive amount of lost time from work because of musculoskeletal injury and the subsequent costs forced employers to introduce measures of control. Although the initial emphasis tended to be placed on physical measures to prevent the occurrence of repetition strain injury, other suggestions as to the cause of RSI included an appreciation for the psychological and emotional factors influencing motor performance (Bullock 1989).

Partly as a result of the growing interest in and concern about problems of occupational health within Australia, most States of Australia introduced new legislation to govern aspects of occupational health and safety at work. In 1974, the Federal Government introduced a code of general principles for occupational safety and health in Australian Government employment. Within that code was the direction that "responsibility for safety coordination throughout the department or instrumentality shall be included in the functions of a senior management position having direct access to the head or his deputy". In 1982, the National Health and Medical Research Council issued a document entitled "Recommended Practice for Occupational Health Services in Australia". Howie (1982) felt that the appearance of this document was a timely reminder that not everyone's view of occupational health ownership was the same. He asserted that members of different professional backgrounds would have a different viewpoint as to their own perspective of occupational health. Importantly, Howie considered that these differences were impeding progress towards the attainment of the common goal of safety and health at work. Howie contended that emphasis had been shifted from a design based approach for occupational health services to an approach marked by professional divisions and an over emphasis on disease and injury. Howie shared Ferguson's concern that controlling risk, which was often the approach taken within the occupational health and safety arena was negative in comparison to the advocacy of work design principles which are based on ergonomics. Howie argued that because technology was having profound effects on people and their jobs, it could be regarded as a direct cause of ill health at work. He believed that a concern about the effects of technology on people and jobs should be reflected in a renewed focus on the systems design process.

To put the upsurge of repetition strain injury into its proper perspective, the increasing incidence of this condition during the 1980s was basically related to technology and the way it was introduced. Howie (1982) highlighted the fact that there were many dimensions to this problem including medical or physiological, social, economic, engineering, ergonomic and organisational. Howie emphasised the importance of recognising that repetition injury was a complex problem wherein the solution concerned many of the dimensions listed above.

In advocating the application of systems ergonomics which takes a holistic view of the repetition strain injury problem, Howie pointed out that a complex problem of this nature demanded the cooperative effort of a team of professionals acting together with the user group. As Howie pointed out, it was the process of design which had led to the introduction of the technology which should be used as the focal point for remedial action. Howie (1982) touched on an important point in relation to multidisciplinary teams. As he noted, members of the various professions and disciplines in occupational health see problems from their own disciplinary viewpoints. To be successful he averred, a multidisciplinary team must determine how each member of the team will relate to each other and how each may contribute individually and collectively to the solution of problems. This did not appear to be happening sufficiently often in Australia. Indeed, by this time, many practitioners of the ergonomics discipline worked alone rather than as part of a team.

The impact of new technology on jobs, automation, quality of work life and industrial democracy was soon recognised. However, the introduction of technology in the workplace has not always met with cooperation from workers and has often led to disputes. In 1980, the government set up a committee of inquiry into technological change in Australia, paving the way for a number of developments in employee relations and legislative areas. These offered employees the possibility of influencing outcome in terms of technological change in the work place. In 1985, the Report of the Australian Educational Council Task Force on Education and Technology established a link between education and technological change and highlighted the challenges facing the education system in preparing the community for the effects of technological change and indeed how that community could participate in those changes (Howie 1989). Positive changes in occupational health and safety practices and also in management style were introduced into many work places in Australia during this period. These included not only changes in occupational health and safety practices, but also in management style.

Howie (1980) suggested that ergonomists held the key to many of the problems by virtue of their involvement in systems ergonomics. However, Howie (1980) insisted, the grounds for ergonomics intervention (for example, a better quality of working life or higher productivity) must first be defined. Otherwise, workers would tend to avoid becoming involved with job satisfaction measurements. The absence of any significant amount of quantitative data which could be used to support the need for improvement in work systems had become one of the difficulties of the ergonomist's practice.

Reflecting the need to adapt to technological change, in 1983, Rawling made a plea for ergonomics practitioners in Australia to not only concentrate on people - machine mismatches (micro-ergonomics), but to appreciate also the need to plan a strategy of change. Rawling (1990) asserted that a strategic approach to ergonomics embodied the elements of micro-ergonomic applications geared to organisational needs, performance evaluation systems and a macro-ergonomic approach. Rawling highlighted the need for ergonomists to understand the context in which they were operating, including elements such as a sense of long term organisational directional mission, an understanding of organisational strengths and weaknesses, an appreciation for the strategies to cope with such challenges and a set of objectives for evaluating progress against defined goals. Consideration of this approach could help the Society to clarify some of the issues for ergonomics in Australia today. However, responses by those working in ergonomics to these calls for a re-look at direction, context and approach to ergonomics have been slow. Only gradually have the majority of Society members come to an appreciation of the need for a broader view of ergonomics.

The most important way in which ergonomics principles can be applied practically is through design. The founders of the Ergonomics Society of Australia certainly saw design as an outcome of the ergonomist's work. Collaboration of medical, allied health workers and psychologists with engineers ensured a constructive outcome for early ergonomics research and practice. Such collaboration is still necessary.



The need for anthropometric data as a basis for ergonomics design and which are applicable to Australia has long been voiced. Although a number of studies have been undertaken, no large scale anthropometric survey of the Australian population, other than of the armed forces has been carried out. Unfortunately, the unavailability of sufficient resources has been an impediment to the wide ranging study required. It is contended that the research efforts in ergonomics should be more directed to the design needs of the community. Priorities for research in Australia may differ from those elsewhere and they could well be established by the Society. Support for particular projects may encourage developments which could have an impact on the growth and application of ergonomics within Australia.

One of the modes of transportation in Australia which has been most influenced by the application of ergonomics design is road transport. Partly as a result of the Australian design rules for motor vehicle safety, the driver's work-space has been considerably improved. Ergonomics has influenced the geometric design and the traffic engineering, particularly in relation to signs and signals which provide information to the road user (Lane 1978). The Australian Road Research Board has been influential in supporting the collection of relevant data for these applications. Wigglesworth's research on many aspects of safety in design and placement of road signs received international acclaim.

The role of ergonomics and the ergonomist in systems design was first introduced to the members of the Ergonomics Society by Howie in 1978. He explained that while during the 1950s and early 1960s, systems design had been almost exclusively a technical process, during the 1960s and the 1970s, emphasis was placed on the human, social and behavioural aspects of systems design. It was unfortunate, Howie explained, that during the earlier period, systems and computers had become almost synonymous to many people and that during the 1960s some disenchantment and suspicion had grown in relation to use of computers. It was not until the 1970s that the idea was voiced that the systems design process could involve others than technically oriented designers. It was in the 1970s that the role of the trained social scientist in a team concerned with the implementation

of the management information system was recognised (Howie 1980). Howie described how the behavioural scientist could exert an influence in two separate areas associated with systems design: the area of task allocation, where functions best performed by man and machine are allocated accordingly and the occupational psychology area of job satisfaction and motivation. Howie suggested that one of the functions of the ergonomist in work design is to ensure that the job has a challenge and that this challenge is satisfying for the operator. This could be difficult for the designer of the computer-aided system where the nature of the interaction placed special demands on people interfacing with the computer. Howie (1978, 1980) also argued that one of the important issues concerning ergonomists involved in systems design was the relative merits of the interdisciplinary and multidisciplinary approaches. In his view, in the multidisciplinary or team approach, agreement is reached by consensus and the strongest viewpoints tend to predominate. He noted also that the interdisciplinary approach tended to eliminate some of the participants although not their interests. Howie (1980) considered that if those whose major tasks was to design work, work systems and work places (that is the engineers, operations researchers, systems designers, architects and others) were themselves familiar with ergonomic principles and could apply them to their design, then the application of ergonomics was likely to be more widespread. As Howie saw it, the role of the ergonomist would continue to be that of a catalyst in a multidisciplinary team, but that it would be difficult to establish such a team. To make a move more towards the interdisciplinary approach would require education of consumers and the providers of the systems. In noting that the application of relevant ergonomics design data from the biological and behavioural sciences would most probably be the responsibility of engineers, Howie (1980) warned that for members of these disciplines to make a substantial contribution, it was essential that their requisite knowledge of matters relating to ergonomics be sufficient.

Interest in product design within the ESA reached such a level in the late 1980s that the annual conference for 1990 had as its theme: ergonomic design, products for the consumer and, as the keynote speaker, Bullock (1990) highlighted the importance of this endeavour. Such was the interest in this field generally, that the Industry Commission in Australia commissioned a study of product-caused injuries in Australia. It was found that of the 0.94-1.86 million product-involved injury episodes estimated annually by the Australian Consumers' Association, about 10% were attributable to unsafe products (Somers 1990). Safety experts involved with appraisal of accidents considered that any increase in the likelihood of product-liability litigation would stimulate producers to design safer products and that such safety in design could have a large impact on injury prevention in Australia.

This focus of interest on product design raised questions about the relationship between designers and ergonomists. Ward (1990) questioned the basis of the designers' claim to be competent practitioners of ergonomics, even if this claim were limited to its application within the context of product design. Further, Ward challenged the proposal that courses of industrial design necessarily prepared designers to apply ergonomics effectively in the design of consumer products. The need for a clearer definition of needs in ergonomics education is now being recognised. Wood (1990) asserted that if ergonomists were to be sought as integral contributors in the product design process, there was a need for ergonomists and designers to recognise each other's strengths and to appreciate that while ergonomists focussed solely on safety, ease of use and ease of learning, industrial designers sought a balance between form, function and useability, relying heavily on experience, intuition and creativity to achieve their end.

Another area of continuing concern was related to manual handling and lifting. Recognition of the high incidence of manual handling lost time injuries led to the development of a strategy to reduce the incidence and cost of injuries in high risk industries in some areas in Australia. For example, the development of a joint data base between the Department of Occupational Health, Safety and Welfare of Western Australia and the

Workers Compensation and Rehabilitation Commission provided accurate and timely information on which to base prevention services and policy development (Lawson 1992). The information allowed the identification of those industries for targeted inspections. Strategies to raise awareness of manual handling problems through the use of promotional material aimed at reducing injuries and to provide solutions in high risk industries are implemented.

Over the years, the number of people working in the occupational rehabilitation field has expanded markedly in Australia. In responding to the need for rehabilitation practitioners to have skills in ergonomics which would enable them to carry out work place assessments and introduce modifications on behalf of injured workers and their employers, a course was developed jointly by the Victorian Accident Rehabilitation Council and La Trobe University in 1986 (Stuckey, Pratt and Meyer 1992). This course was designed to teach participants how to apply basic ergonomics principles in rehabilitation work rather than general ergonomics practice, recognising that the participants would be non expert users of ergonomics and not seen primarily as ergonomics practitioners (Stuckey, Pratt, Meyer 1992). The preparation of practitioners with rehabilitation specific ergonomics skills and the knowledge of how and when to use generalist ergonomics practitioners was seen as one method of catering to a growing need for industry based rehabilitation and injury management practitioners.

#### **PROMOTION OF ERGONOMICS**

Despite the significant research undertaken in fields relevant to ergonomics, concern began to be expressed in the 1980s about the lack of application of ergonomics principles generally within industry and the community. Those in the field sought answers to questions relating to slow introduction of safety principles and the reliance on old methods. Suggestions were made that too little consultations with the user had occurred, that designers were not sufficiently informed about the application of ergonomics, and that the costs of introducing ergonomics principles had not been calculated or advertised. Absence of legislative standards in Australia at that time

was also seen as a contributing factor. Ferguson (1985) predicted that for ergonomics to be introduced more widely within the community, legislative standards, improved technology, product liability and compensation costs would contribute to the application of ergonomics, but that the process would demand that ergonomists supply relevant data, offer practical methods and undertake cost analyses. He noted that too few ergonomists, or properly trained multidisciplinary teams were available to provide the information. Education of professionals at a higher level would be required.

By the late 1980s, it was realised that membership numbers within the ESA were not growing at the rate initially anticipated. It was also realised that although the community was aware of the word "ergonomics", through exposure during the repetitive strain injury pandemic, their appreciation of the full extent and contribution of ergonomics practice was not complete. The Society determined, therefore, to embark upon a marketing exercise designed to develop community awareness of ergonomics and ultimately to ensure that ergonomic factors were taken into account in a professional manner in appropriate activities or areas. Short term promotional objectives included increasing the awareness of ergonomics in legislation and standard setting bodies, increasing the ESA members' motivation and capability in ergonomics and assisting ESA members to promote ergonomics in the community. Relevant strategies were developed progressively to meet these objectives and are in the process of implementation.

#### **EDUCATION IN ERGONOMICS**

In the early days of ergonomics practice in Australia, no undergraduate or postgraduate programs specifically leading to the practice of ergonomics were available. However, components of ergonomics were contained within individual educational programs for a number of professions. For example, during the 1960s, ergonomics was incorporated into undergraduate programs in engineering, psychology, physiology, architectural science, physiotherapy, occupational health and applied arts and in a postgraduate degree in industrial engineering. In each case, the programs provided an introduction to the concept of ergonomics and led students to an understanding of their role in a

multidisciplinary science and the way in which they could contribute to cooperative and collaborative ventures with professional people from other disciplines working in the ergonomics field.

In 1976, the president of the ESANZ at the time, Colin Cameron, found ergonomics in Australia as being distinctly under threat. In debating the way in which ergonomics would need to develop in Australia if it were to flourish, he considered the possibilities of specialisation or diversification. He argued that rather than move towards a discrete professional speciality of ergonomics, it was more important to develop the sub specialists in architectural, engineering, psychological, medical or other "ergonome" by a process of symbiosis rather than of parasitism (Ferguson 1983). In Ferguson's (1983) view, the future of the professional development of ergonomics lay in incorporating the subject within the education of various disciplines. He advocated three levels of education in ergonomics: the level appropriate for all professionals to provide background knowledge; the level relevant to the professional planning to apply ergonomics within their professional activity; and the level needed by the professional in any one of several possible disciplines, who was working substantially full time in ergonomics. However, he warned, people would not take on additional ergonomics education unless there was a demand for their services. This relied upon employers recognising the benefits of incorporating ergonomics within their industries.

Ferguson (1987) acknowledged that the advent of legislation on occupational and environmental health and safety, whereby standards and codes of practice would need to be met, could be the catalyst for the adoption of ergonomics principles by employers. The development of standards and codes of practices backed by legislation would require interpretive support from government advisers particularly in divisions of occupational health and consumer affairs, as well as in departments of labour, environment and housing. It was argued that cost benefit and cost effectiveness analyses could also enhance acceptance of ergonomics application. The skills required for these consultative services would demand education of ergonomists at postgraduate level.

An important step in the development of ergonomics in Australia came with the establishment of the National Institute of Occupational Health and Safety, in 1988. Its initial objectives included to promote, assist, initiate and evaluate research; to develop and facilitate specialist training; and to develop and implement systems for collecting, recording, processing, evaluating and disseminating statistics. The Institute also aimed to provide a national focus for Australian occupational health and safety research, responsive to industry needs and new knowledge, and to raise and harmonise the standard of occupational health and safety education and training in Australia to improve health and safety in the workplace. A great deal of important research was undertaken within the Institute and it is a loss to the discipline that this Institute no longer exists.

No undergraduate program totally devoted to the preparation of an ergonomist is offered within Australia. Some have argued that because of the diverse areas for application of ergonomics principles, it is more important for the practitioner to hold a qualification in one of the contributing disciplines. Undoubtedly because of the concern in occupational health and safety issues, the development of ergonomics courses at post-graduate level has been in the form of components of occupational health and safety post-graduate educational programs, of which there are several available. Only in a small number of institutions in Australia are post-graduate qualifications (at Post Graduate Diploma or Masters Degree level) offered in ergonomics. These courses are designed to prepare competent practitioners in ergonomics, capable of working within a multidisciplinary team, assessing functional effectiveness of equipment, environments and systems, contributing to design modifications to optimise human performance, undertaking or interpreting research in ergonomics and communicating ergonomic theory and practice to others.

## PROFESSIONAL CERTIFICATION

With the community's preoccupation with repetition strain injury, came a general interest in ergonomics as a form of injury control. Whereas previously, the community did not understand the term ergonomics, frequently confusing it with economics, with the advent of the repetition strain injury pandemic meant that the term was used frequently within the media. Thus the community in general became more informed about some of the aspects of ergonomics practice. While on the one hand, the profile of ergonomics was raised within the community through this exposure, on the other hand, the appreciation of the wide role which an ergonomist could play within society was not gained. Too many people developed the idea that ergonomics represented the design of tables and chairs and that it was particularly related to the physical aspects of computer use.

During that pandemic, those consultants who had been working in the ergonomics field for many years were called upon to offer advice and guidance in many workplaces. At the same time, others who had previously shown little interest in ergonomics, became overnight "experts" and exploited the opportunity to consult in an apparently burgeoning field. Those with insufficient education in the ergonomics field were unable to carry out effective job analyses and no doubt failed to determine the range of problems leading to injury. This created a serious problem for the practice of ergonomics and for the Society itself. Although mention had previously been made within the Society that a professional register of ergonomists would be desirable, the growth in the number of inexperienced practitioners in the field to satisfy the repetition strain injury pandemic acted as a catalyst to establish a standard of practice for the professional ergonomist.

The criteria which could be used for a program of certification of professionally qualified ergonomists in Australia aroused much debate within the Society. While some saw such a move as strengthening the ergonomics discipline and the Society itself and of improving the quality of practice, others saw the proposal as a threat to their own participation in ergonomics work programs. Initial concerns and queries raised about certification

of ergonomists related to the definition of a professional ergonomist, the acceptability of courses of education, the recognition of formal postgraduate education in ergonomics, the mechanism of evaluation of the courses, the recertification process, the mechanism for resolving such issues, the marketing and communication required to encourage participation in the professional certification program and the level of membership.

Nevertheless, consultations with members continued and in 1985, a proposal from Rawling to proceed with developing the professional certification scheme was adopted by the Society. The certification process was formally accepted in Australia in 1990. An Interim Professional Affairs Board, to administer the certification process was established and the first 21 Society members awarded professional certification status in 1990. The first chairman was Richard Rawling, who was the originator of the scheme and who had successfully steered the concept through to its inception. Professional certification as an ergonomist within Australia, as outlined in 1985, required that the applicant hold tertiary qualifications in a relevant field and have completed a total of at least three years (or its part time equivalent) in ergonomics practice and/or in teaching of and/or research in ergonomics. Support from three referees who could testify to the nature of the applicant's experience, competence and professional conduct was also required. It was also recognised that should the requirement for an academic qualification in ergonomics become mandatory for certification in the future, it would be necessary to establish a system of accreditation of ergonomics courses. A code of ethics was established to guide professional behaviour. By 1992, 28 practising ergonomists in Australia had become registered as certified members. Although pleasing in itself, the number was seen as a disappointing proportion of the 500 strong ESA and was perceived as a poor reflection of the scheme's acceptance by the membership at large, prompting a promotional exercise to the membership and to employers. Bullock (1996a, 1996b) highlighted the need to review and update approaches to certification and to reach international standards in quality control.

Once listed as a professional member of the ESA, implying competence in the field, the continuing ability to operate at the required standard needs to be ascertained. It is because of this need that appropriate criteria for recertification process are currently being investigated. Perhaps it is only through reference to competencies as defined by the IEA and the ESA, that initial and continuing ability in the field may be evaluated.

### COMPETENCIES IN ERGONOMICS

In 1990, the Australian Government moved to introduce competency based assessment in all occupations and professions. Competencies were required to be outlined in a way which would demonstrate a person's performance in practice. It was realised that definition of competencies relating to the practice of ergonomics was of vital importance for the comprehensive review of the certification procedure and as a basis for recertification of ergonomists. Such an outline could also form a valuable resource in planning new education curricula and, in the long term, in accrediting ergonomics education programs. A competencies framework could also be used to establish personal development needs (Rawling 1993) and help those working in ergonomics to advance their own knowledge, skills and abilities. Applications of the competencies was also seen as a constructive part of the future review of the applications for various categories of membership (Rawling 1992a).

A combined ESA and NZEA working party ably chaired by Carmichael consulted widely within the membership in both Australia and New Zealand to develop an outline of competency standards for ergonomists (ESA/NZES 1998). The important document representing the outcome of this work is available to members and provides a major resource on which further developments in the ergonomics discipline may be based. The IEA Competency Standards for the practising ergonomist were released at much the same time and offer another avenue for development and evaluation of standards of practice (Bullock 1998).

## CONCLUSIONS

Interest in ergonomics in Australia has a relatively long history and major advances in design have been made in a number of important areas influencing human performance. The concern of those with an early interest in ergonomics in Australia related to research determining design characteristics to match the capacities and limitations of workers in a variety of situations. The development of ergonomics practice has been closely associated with occupational health and safety, partly because of the high incidence of musculo-skeletal injuries in the workplace. Although many demands are still placed upon human performance, the challenges to ergonomists have altered with changing technology and the need for an holistic approach to work systems to counter the increasing impact of rapid technological change has been emphasised.

As the scope of ergonomics has become more diverse, mechanisms for controlling quality of practice have been contemplated. Issues before the Ergonomics Society of Australia relate to ensuring continued high quality practice in the workplace, targeting and supporting research, developing an optimal ergonomics education approach, applying the competency standards expected of ergonomists and refining the appropriate method of certifying those who satisfy professional standards. In this way, the Society and the discipline itself should remain vigorous, viable and of value to the community.

## REFERENCES

Bullock, M.I. (1969). The use of photogrammetry in measuring body movements. *6th Annual Conference of Ergonomics Society Aust. and N.Z.* Canberra

Bullock, M.I. and Harley, I.A. (1972). The measurement of three-dimensional body movement by the use of photogrammetry. *Ergonomics*, 15:3:309-322.

Bullock, M.I. (1973). Cockpit design - pilot accommodation and accessibility to controls. *Aerospace Medicine*. Nov.1295-1299.

Bullock, M.I. (1974a). The determination of an optimal pedal-operator relationship by the use of photogrammetry. *Biostereometrics*. 290-317. *Proceedings of the Symposium of Commission and*

*International Society for Photogrammetry*, Washington, USA.

Bullock, M.I. (1974b). The determination of functional arm reach boundaries for operation of manual controls. *Ergonomics*, 17,3,375-388.

Bullock, M.I. (1978a). Ripcord release capability of female parachutists. *Aviation Space Environ. Med.*, 49:117-118.

Bullock, M.I. (1978b). Pull force capabilities. 15th Annual *Conf. Ergonomics Soc. Aust. and N.Z.*, Melbourne.

Bullock, M.I. (1989). Occupational health and safety: challenges for the ergonomist. *Proceedings of the Annual Conference of Ergonomics Society of Australia*, Canberra.

Bullock, M.I. (1990). Product design - a need for ergonomics. *Proceedings of the Annual Conference of Ergonomics Society of Australia*. Adelaide

Bullock, M.I. (1996a) Ergonomics in Australia: meeting the challenges. *Proceedings of the Annual Conference of the Ergonomics Society of Australia*. Canberra.

BULLOCK, M.I. (1996b) Ensuring quality in ergonomics practice. *Proceedings of the Annual Conference of Ergonomics Society of Australia*. Canberra.

Bullock, M.I. (1998) International developments in certification, accreditation and competency standards. *Proceedings of the Annual Conference of Ergonomics Society of Australia*. Melbourne.

Cameron, C. (1985). Tribute to David Ferguson. *Ergonomics Australia*. 2, 3,1-2.

Duncan, J., Ferguson, D. (1974). Keyboard operating posture and symptoms in operating. *Ergonomics*. 17:651-662.

ESA and NZES (1998). Competency Based Standards for Ergonomists. ESA, Canberra.

Ferguson, D. (1969) Ergonomics in Australia. *The Medical Journal of Australia* 1(30),30-33.

Ferguson, D.A. (1971a) Repetition injuries in process workers. *Medical Journal of Australia*. 2:408-412.

- Ferguson, D.A. (1971b). An Australian study of telegraphists' cramp. *British Journal of Industrial Medicine*. 28:280-285.
- Ferguson, D.A. (1976). Posture, aching and body build in telephonists. *Journal of Human Ergology*. 5:183-186.
- Ferguson, D. (1983) Ergonomics in Australia - past and future. *Proceedings of the 20th Annual Conference of the Ergonomics Society of Australia*. Adelaide. (1 - 13).
- Ferguson, D. (1985) Reflections on ergonomics. *Ergonomics Australia* 2(3),3-6.
- Ferguson, D. (1987). Training in ergonomics in relation to work, health and safety. *Ergonomics Australia*. 1:7-20.
- Ferguson, D.A., Duncan, J. (1974). Keyboard design and operating posture. *Ergonomics*. 17:731-744.
- Ferguson, D.A., Duncan, J. (1976). A trial of physiotherapy for symptoms in keyboard operating. *Australian Journal of Physiotherapy*. 22:61-72.
- Howie, A. (1978). Ergonomics and systems design: what price user involvement? *Proceedings of the 15th Annual Conference of the Ergonomics Society of Australia and New Zealand, Melbourne*. (pp107-113).
- Howie, A. (1980). Ergonomics in practice. *Proceedings of the 17th Annual Conference of the Ergonomics Society of Australia and New Zealand* (pp1-14).
- Howie, A. (1982). The occupational health debate: an ergonomist's viewpoint. *Proceedings of the 19th Annual Conference of the Ergonomics Society of Australia and New Zealand, Melbourne*. (pp8-16).
- Howie, A. (1989). Managing technology and technological change. *Proceedings of the 25th Annual Conference of the Ergonomics Society of Australia, Canberra*. (pp26-34).
- Lane, J.C. (1953) *The Medical Journal of Australia* 2(7).
- Lane, J.C. (1978). Introductory address. *Proceedings of the 15th Annual Conference of the Ergonomics Society of Australia and New Zealand, Melbourne*. (pp1-2).
- Lawson, S. (1992). Reduction of manual handling injuries in high risk industries. *Proceedings of the 28th Annual Conference of the Ergonomics Society of Australia, Melbourne*. (pp84-91).
- McPhee, B. (1990). Musculoskeletal complaints in workers engaged in repetitive work in fixed postures. In Bullock, M.I.(Ed) *Ergonomics: The physiotherapist in the workplace*. Edinburgh. Churchill Livingstone. (pp101-132).
- Oxford, H.W. (1967). The problem of misfit furniture. *Medical Journal of Australia*. 2:415.
- Rawling, R. (1990). Strategic approaches to ergonomics in organization. *Proceedings of the 26th Annual Conference of the Ergonomics Society of Australia* (pp 37-38).
- Rawling, R. (1992a) Society Membership - a restructuring proposal. Ergonomics Australia.
- Rawling, R. (1992b) Professional development in ergonomics. *Professional development workshop, Annual Conference of the Ergonomics Society of Australia, 1992*.
- Rawling, R. (1993). Professional development workshops outcome. *Ergonomics Australia* 1 (22).
- Somers, R. (1990) Product - caused injuries. *Proceedings of the 26th Annual Conference of the Ergonomics Society of Australia* (pp19-22).
- Stuckey, R., Pratt, E., Meyer, P. (1992). The ergonomics in rehabilitation course and its relevance to occupational rehabilitation in industry. *Proceedings of the 28th Annual Conference of the Ergonomics Society of Australia, Melbourne*. (pp197-203).
- Walker, A.S. (1961). Australia in the war of 1939 - 1945. Series 5, Vol. 4, *Medical Services of the RAN and RAAF* Australian War Memorial, Canberra.
- Ward, S.J. (1990) The Designer as Ergonomist. *Proceedings of the 26th Annual Conference of the Ergonomics Society of Australia* (pp101-106).
- Wood, D. (1990) Ergonomists in the Design Process. *Proceedings of the 26th Annual Conference of the Ergonomics Society of Australia* (pp125-132).

## Electronic Resources

The **Victorian Manual Handling Regulations** 1999 came into effect on 1 July, 1999. The 1988 regs are rescinded.  
<http://www.dms.dpc.vic.gov.au/12d/O/STAT00625/index.html>

**Biomechanics classes** homepage for Biomechanics World Wide (BWW) has been moved to ...  
<http://dunx1.ocs.drexel.edu/faculty/ak46/biomechanics>

There are now links to over 50 classes on the web in the following areas:

- Biomedical Engineering
- Kinesiology
- Physical Therapy
- Animal Biomechanics
- Ergonomics

**Kinesiology and Biomechanics** Teaching Resources  
<http://www.usfca.edu/ess/resourcepage.htm>

**Computers and Your Health: Preventing Eye Strain**  
Thomas May, Essential Facts, Inc.  
<http://www.e-facts.com/miningco3.html>

**Visual Ergonomics** in the Office  
Guidelines for monitor placement and lighting)  
Dennis R. Ankrum CIE, Nova Solutions, Inc.  
<http://www.ur-net.com/office-ergo/setting.htm>

Rx: **Good Humor**, Good Health  
David S. Sobel, MD, and Robert Ornstein, PhD  
<http://www.healthy.net/library/columns/MindBody/archive/10goodhumor.htm>

June 8, 1999

### **N.I.H. PLAN FOR JOURNAL ON THE WEB DRAWS FIRE**

By ROBERT PEAR

WASHINGTON -- The director of the National Institutes of Health has touched off a passionate debate by proposing that scientists disclose and disseminate the results of biomedical research on the Internet, making the full text of their reports available at no cost to anyone with a computer anywhere in the world.

The director, Dr. Harold E. Varmus, said his proposal for an electronic publishing operation, called E-biomed, would speed the progress of science by accelerating the exchange of information among researchers and by vastly increasing access to it.

Moreover, he said, the Web site could be "a democratizing force" because any legitimate researchers, "however remotely located or poorly known," could enter reports on it.

The New England Journal is owned and published by the Massachusetts Medical Society. It has for years had a strict policy against publishing manuscripts whose "essential substance" has been published elsewhere.

Web Sites for Organizations Mentioned in New York Times Article:

The New England Journal of Medicine.  
<http://www.nejm.org/content/index.asp>

Association of American Medical Colleges.  
<http://www.aamc.org/>

National Institutes of Health.  
<http://www.nih.gov/>

Oregon Health Sciences University.  
<http://www.ohsu.edu/>

National Center for Biotechnology Information.  
<http://www.ncbi.nlm.nih.gov/>

Full Story May Be Found At:

<http://www.nytimes.com/library/national/science/060899sci-research-journal.html>



It might be of interest to some EGONoz members that a **discussion group** has been set up for people who have a special interest in **manual handling**.

To subscribe send an email to:  
listcaster@worksafe.gov.au  
with the message:  
subscribe mhcare  
and then messages can be posted to  
mhcare@worksafe.gov.au

As I discovered in the Occupational Health Newsletter, this discussion group has been set up by the National Occupational Health and Safety Commission (NOHSC).

Regards,  
Rebecca Mitchell

Senior Officer  
Epidemiology Unit  
National Occupational Health and Safety Commission  
Tel: 61 02 9577 9302  
Fax: 61 02 9577 9300  
email: mitchelr@worksafe.gov.au

#### AUSTRALIAN DIGITAL THESES PROJECT

<http://www.library.unsw.edu.au/thesis/thesis.html>  
The aim of the project is to establish a database of digital versions of theses produced by postgraduate students at participating Australian institutions. The theses will be available via the web.

#### COGNITIVE SCIENCES EPRINT ARCHIVE

<http://cogprints.soton.ac.uk/>  
CogPrints is an electronic archive for papers on the study of cognition in subjects such as psychology, neuroscience, linguistics, computer science, philosophy, medicine, and anthropology.

#### EDUCATION-LINE

<http://www.leeds.ac.uk/educol/>  
An archive of education and training papers, which now includes over 1,000 full-text documents, conference programs and a conference listing service. The collection, which consists mainly of conference texts, can be searched by keyword.

#### WORLD CONFERENCE ON SCIENCE

<http://helix.nature.com/wcs/index.html>

The first global conference on science and society in nearly 20 years will take place in Budapest from June 26 to July 1, 1999. Organised jointly by UNESCO and the International Council for Science, it covers a range of topics within a global context, from the role of fundamental research, to the sharing of scientific information and knowledge, to science and technology.



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CybErg 1999, the second international cyberspace conference on ergonomics, will run from 15th September- 15th October 1999 at website <http://cyberg.curtin.edu.au/>.

Registration cost \$AUD110

### PRIZES FOR BEST PAPERS

CybErg 1999 will be awarding Gold, Silver and Bronze prizes for the best papers. The best paper prizes are sponsored by Elsevier Science publications. The Gold award winner will get a one year subscription to the International Journal of Industrial Ergonomics, a refund of registration costs and a certificate. Silver and Bronze award winners will also get a subscription to the International Journal of Industrial Ergonomics and a certificate.

### PRIZES FOR BEST PARTICIPATION

We will also be awarding Gold, Silver and Bronze prizes for the best contributors to the discussions. The best contribution prizes are sponsored by Liberty Mutual. The Gold award winner will also get a one year subscription to the International Journal of Industrial Ergonomics, a refund of registration costs and a certificate. Silver and Bronze award winners will also receive a refund of registration costs and a certificate.

### LIVE CHAT ON FRIDAYS

There will be 3 periods each Friday where we will encourage people to participate in live discussion at the conference. The three periods will be set to allow business hours discussion in the Asia, Africa/Europe and Americas time zones. People from other time zones could also join in 'after hours'. As each period will probably be 2 hours duration, Gymbreak is sponsoring this feature to remind you about not staying at the computer too long.

Please register now via our world wide web site <http://cyberg.curtin.edu.au>

### 1999

September 15-17, European Symposium on Safety in the Modern Society Helsinki FINLAND. Contact Ms Kristiina Kulha, FIOH, Topeliuksenkatu 41 a A, FIN-00250, Helsinki FINLAND; [Kristiina.Kulha@occuphealth.fi](mailto:Kristiina.Kulha@occuphealth.fi)

September 27- October 1, 43rd Annual meeting of Human Factors and Ergonomics Society, Houston. [Hfes@compuserve.com](mailto:Hfes@compuserve.com) <http://hfes.org>

**October 11-13th, 35th Annual *ESA* Conference.** Freemantle, WA. Contact Keynote Conference, PO Box 1126, West Leederville, WA 6901. Ph +61 8 9382 3799 Fx +61 8 9380 4006. Email: [keynote@ca.com.au](mailto:keynote@ca.com.au).

### 2000

March 19 - 22 Fatigue Management Alternatives to Prescriptive Hours of Service "Strategies for Programme and Promotion Evaluation", Fremantle.

Tel 618 9322 6906 Fax 618 9322 1734

Email [conwes@congresswest.com.au](mailto:conwes@congresswest.com.au)

July 23-28, Stockholm, XXVII International congress of psychology. <http://www.icp2000.se>

**IEA 2000** 29 July-4 August 2000 in San Diego, California, USA. Contact IEA/HFES 2000, HFES, PO Box 1369, Santa Monica, CA 90406-1369, USA; Email: [HFES@compuserve.com](mailto:HFES@compuserve.com) <http://iea2000.hfes.org>

August 22nd-25th, Asia Pacific conference of computer human interaction, S.E. Asian Ergonomics Society conference, Singapore. Email [myklim@ntu.edu.sg](mailto:myklim@ntu.edu.sg).

27 August - 1 September 26th ICOH International Conference, Singapore.

Contact Secretariat ICOH2000, c/o Dept of Community, Occupational and Family medicine Faculty of Medicine MD3, Lower Kent Ridge Road, Singapore 119260.

Oct 9 - 11, 2000, **ESA 2000** Conference, Adelaide

### 2001

July 8-13, 2001, Zurich, Switzerland, XVIIIth Congress of the International Society of Biomechanics [www.isb2001.ethz.ch](http://www.isb2001.ethz.ch) email: [isb2001@biomech.mat.ethz.ch](mailto:isb2001@biomech.mat.ethz.ch)

### 2002

August 3-8, 4th World Congress on Biomechanics, University of Calgary, Canada.

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**IEA 2000** 29 July-4 August 2000 in San Diego, California, USA. Contact IEA/HFES 2000, HFES, PO Box 1369, Santa Monica, CA 90406-1369, USA; Email: HFES@compuserve.com <http://iea2000.hfes.org>

August 22nd-25th, Asia Pacific conference of computer human interaction, S.E. Asian Ergonomics Society conference, Singapore. Email [myklim@ntu.edu.sg](mailto:myklim@ntu.edu.sg).

27 August - 1 September 26th ICOH International Conference, Singapore.

Contact Secretariat ICOH2000, c/o Dept of Community, Occupational and Family medicine Faculty of Medicine MD3, Lower Kent Ridge Road, Singapore 119260.

Oct 9 - 11, 2000, **ESA 2000** Conference, Adelaide

## **2002**

August 3-8, 4th World Congress on Biomechanics, University of Calgary, Canada.

## Information to Contributors

### SUBMISSION DEADLINES

The deadline for each issue is the 15th of the previous month etc... the deadline for the **October issue is September 15**

### CONTRIBUTIONS

Contributions to Ergonomics Australia are always welcomed and encouraged.

The activities, achievements, experiences, views and opinions of Members are always of interest.

These can take the form of letters, notices, notes, commentaries and articles.

Graphics (photos, illustrations, drawings, computer graphics etc) are particularly welcome and should be camera ready. Photos need not be black and white and negatives are not required.

The preferred form of submission is via email, either in the body of a message, or as an attachment. Files may also be mailed on floppy, (or Zip disc if very large). Virtually any format of files can be accommodated. Otherwise contributions should be printed in a large (14 pt preferred) non-serif font (such as Helvetica) and faxed to 07 3365 6877. Printed pages of similar specification may also be sent by post. Handwritten submissions will only be accepted in exceptional circumstances.

Any enquires about contributions should be directed in the first instance to the Editor.

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