International Society of Biomechanics Newsletter

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AFFILIATE SOCIETIES OF ISB:
American Society of Biomechanics; British Association of Sports Science; Canadian Society of Biomechanics; China Sports Biomechanics Association; Czechoslovak Committee on Biomechanics; French Société de Biomécanique; Korean Society of Biomechanics; Polish Society of Biomechanics; Sports Commission of the Soviet Union.

ISB News

COUNCIL ELECTIONS

Election materials including some general comments, biographical sketches of the candidates and a ballot are found in this issue of the Newsletter. Under the election procedure adopted in 1981, the election of the President Elect and the Executive Council takes place every two years and is coordinated by the Past President and the ten members of the Executive Council. The position of the President is automatically assumed by the current President-Elect. This means that Professor Ronald Zernicke, current President-Elect, will become President at the XIVth Congress in Paris in July. At the same time, our current President Dr. Aurelio Cappozzo will assume the position of Past-President. The person elected to the position of President-Elect in this election will automatically become President in 1995.

The term of office for members of the Council is two years with the possibility of being re-elected twice. I include a list of candidates who are currently members of the Council, indicating the year in which they were first elected. Those who were elected in 1989 are eligible for one more term; those elected in 1991 for two more terms.

The following guidelines have been developed with a view to ensuring that these elections produce a Council that is both well-qualified for the tasks to be performed and well-representative of the Society's activities. I would therefore urge all members to give serious consideration to these guidelines before casting their votes.

1. Internationality: The Council should represent many different countries and not have too many members from the same country.

2. Fields of Interest: The Council should have members representing the various fields of biomechanics interest of our Society. Such fields include, but are not limited to, and in alphabetical order: computer simulation, locomotion, motor control, muscle modelling, occupational, orthopaedic, tissue, rehabilitation, and sports biomechanics. It would not be wise if one field was excessively represented on the Council.

3. Scientific Quality: The Council should be made up of members who are acknowledged leaders n their field of research.

4. Administrative Ability: The Council should be made up of members with strong administrative ability. Most of the work of the Council is connected with leading the Society by organising and guiding various projects. The administrative ability of each Council member is therefore of great importance

Voting Instructions: Complete the ballot, which is on the opposit side of this sheet, by placing an X in the blank provided opposite the name of each candidate for whom you wish to vote. Be sure to vote for only 1 candidate for President-Elect and only 10 candidates for Council Members. Place your ballot in the small white envelope provided. Enclose this envelope in a second envelope and send it by AIR MAIL to:

Professor Robert W. Norman, PhD
Dean, Faculty of Applied Health Sciences
University of Waterloo
Waterloo, Ontario
CANADA, N2L 3G1

The deadline for receipt of the ballots by Norman is June 18, 1993. Ballots will be counted by two members of the Society appointed by the current Council at the XIVth Congress in Paris. Results will be announced at the General Assembly meeting in Paris and included in the ISB Newsletter following the Paris Congress.

OBITUARY

HOWARD A. PAYNE

Members of the University of Birmingham were saddened to learn that Howard Payne died suddenly of a heart attack on Sunday, March 1, 1992, aged 61 years.

Howard was a graduate of the University and a member of the teaching staff since 1964. He enjoyed a long and distinguished career as a widely respected athlete who represented Great Britain on 61 occasions; took part in three Olympic Games (1964, 1968 and 1972); won three Commonwealth Hammer Throwing titles in 1962, 1966 and 1970 and broke the British record when aged 43.

Howard will be long remembered for his contribution to the University and to athletics, as a competitor, as a coach, and as a sport scientist. He was a foundation member of the International Society of Biomechanics and at one time chairman of the Force Platform Group of the ISB. His interests in sports biomechanics focussed on the development of a strain gauge based force platform and the measurement of ground reaction forces during a variety of sporting activities.

We express our own sense of loss over the passing of an esteemed colleague and extend our deepest sympathy to Howard's family.

Charles Jenkins
Head, School of Sport & Exercise Science
The University of Birmingham

Biographical Sketches of the Candidates (alphabetic order)

Barry T. Bates

Ph.D., Professor and Head, Department of Exercise and Movement Science, University of Oregon, Eugene, Oregon, USA.

Principle research interests:
- lower extremity function
    * injury and performance mechanisms
    * mechanisms of impact attenuation
    * foot function during running
    * footwear evaluation
- Methodology in biomechanics research

Activities:
Charter member of ISB and American Society of Biomechanics. Participated in nearly all ISB Congresses. Fellow of American Academy of Kinesiology and Physical Education and Human Factors Society. Director, Biomechanics/Sports Medicine Laboratory and Chair, Department of Exercise and Movement Science, University of Oregon.

Simon L. Bouisset

Ph.D.. Professor of Biomechanics and Physiology of Movement. Department of Work Physiology and Ergonomics, University Paris-Sud, Orsay/Paris, France.

Principle research interests:
- mechanical properties of in situ muscles
- electromyographic analysis of muscular patterns
- development of biomechanical methods of assessing sitting posture
- programming and posture-kinetic organization of simple and complex movements
- occupational and clinical biomechanics

Activities:
Participant in nearly all ISB Congresses. A Founding member and past President of the French Society of Biomechanics. A past ISB Council Member. A past ISEK Council Member. An ISB Member since 1973. A past General Secretary of the French Society of Ergonomics. Active researcher and teacher of Biomechanics. Member of the Scientific Board of various journals (J. of Electromyography and Kinesiology, J. Clin Biomechanics, Human Movement Sciences, Acta Biomechanica, J. of Rehabilitation Science, etc.)

Peter Cavanagh

Ph.D. Professor and Director, Centre for Locomotion Studies, Penn State University, University Park. PA USA.

Principal research interests:
- biomechanics of running
- economy of locomotion
- the diabetic foot
- locomotion in hypogravity

Activities:
Past president of the American Society of Biomechanics. Member of the board of trustees of the American College of Sorts Medicine. ACSM Wolffe lecturer, 1987. Muybridge Medal - ISB, 1987. ISB member since 1973. ISB Council since 1985. Secretary General 1991-1993.

Bruce Elliott

Ph.D. Associate Professor and Head of Department. Department of Human Movement. The University of Western Australia, Australia.

Principal research interests
- sport biomechanics
- development of biomechanical methods of assessing injury risk

Activities:
Participant in nearly all ISB Congresses since Waterloo, 1983. Founding editor of the Australian Journal of Science and Medicine in Sport and Vice President, Sport Science of the Australian Association of Exercise and Sport Science. Program committee chairman, XIIIth ISB Congress (Perth. 1991). Active teacher and researcher of biomechanics.

Micheline Gagnon

Ph.D. Professor Biomechanics, Department of Physical Education, University of Montreal. Montreal, Canada.

Principal research interests:
- occupational biomechanics
- joint loadings and work-energy processes
- optimization procedures in material handling
- published over 30 papers

Activities:
Co-chair of the North American Congress on Biomechanics in Montreal in 1986. Executive member of the Canadian Society of Biomechanics from 1978-1981. 1985-1987, and President from 1987-1989. ISB member for over 10 years. ISB Council since 1989.

Frances Goubel

Docteur es Sciences (University of Lille. France). Professor of Physiology and Director of Doctorate degree programme in Biomedical Engineering at the University of Technology, Compiegne. France.

Principle research interests:
- muscle mechanics
- neuromuscular physiology
- effect of microgravity on muscle function
- over 150 publications (43 in peer reviewed journals)

Activities:
Participant in nearly all ISB Congresses since 1977. Co-organizer of 3rd ICCMB Conference and 7th Congress de Biomechanique (Compiegne, 1982). Founding member and Vice-President of the French Society of Research in Physical Activities and Sport from 1985. ISB member since 1979.

A. Peter Hollander

Ph.D. Associated Professor of Exercise Physiology, Department of Exercise Physiology and Biophysics. Faculty of Human Movement Sciences, Vrije Universiteit, Amsterdam, The Netherlands.

Principle research interests:
- the relation between metabolic and external power in different sport activities as swimming, speed skating wheelchair riding and arm cranking
- the anaerobic contribution in human performance

Activities:
ISB member since 1985. Participant of several ISB Congresses, Secretary-General and Treasurer of the Organising Committee of the XIth ISB Congress (1987, Amsterdam); Secretary-General of the Scientific Committee of the XIth ISB Congress (1987 Amsterdam); Treasurer of the Organising Committee of the Second World Congress of Biomechanics to be held in 1994 in Amsterdam.

Mont Hubbard

Ph.D. Professor, Department of Mechanical Engineering University of California, Davis USA.

Principal research interests:
- applications of modelling, estimation and control in mechanical and biomechanical systems
- sport mechanics and optimization
- author of more than 65 papers, including 25 in the area of biomechanics

Activities:
Organizer of the 2nd International Symposium of Computer Simulation in Biomechanics (Davis, 1989). ISB Council since 1991.

Minayori Kumamoto

Ph.D. Professor and Director, Disabled Student Bureau, Kyoto University, Kyoto, Japan.

Principal research interests:
- particular function of antagonistic biarticular muscles
- gait analysis, sport biomechanics
- motor control of human movement as a multi-articular system
- EMG biofeedback for rehabilitation

Activities:
Organizer of the Kyoto Satellite Symposium of VIII ISB Congress in 1981, and the International Symposium of Biofeedback in Neuromuscular Re-education in Kyoto in 1981. Council member of the World Commission of Sport Biomechanics. ISB member since 1975. ISB Council since 1989.

Timo Leskinen

M.Sc. (Biomed. Eng.); (Ph.D. thesis will be publicly defended on April 2nd, 1993 at Tampere University of Technology).

Research Engineer, Biomechanics Laboratory, Department of Physiology, Finnish Institute of Occupational Health, Helsinki, Finland.

Principal research interests:
- development of dynamic biomechanical models for assessing loads especially on the spine
- electromyographic activity in occupational work load studies
- body height changes in relation to spinal load
- strength measurements

Activities:
Participant in ISB congresses since 1985. Member of Industrial Ergonomics Technical Group of the International Ergonomics Association. Member of the European Standardization Committee. CEN's Working Group TC 122/WG 4 (Biomechanics), and the International Standardization Organization ISO's TC159/SC3/WG 2-4 (Working postures, Human physical strength, Manual handling). Member of ISB since 1985, Member of ESB since 1986.

Toshio Moritani

Ph.D. Associate Professor of Applied Physiology, The Graduate School of Human and Environmental Studies, Kyoto University, Kyoto, Japan.

Principal research interests:
- EMG and its application
- muscle physiology
- ergonomics

Activities:
Participant in all ISB Congresses since 1981. Delivered two keynote lectures (1985, 1991) at ISB Congresses. Fellow of the American College of Sports Medicine (FACSM). Active members of the Editorial Boards of European Journal of Applied Physiology. Journal of Electromyography and Kinesiology, Journal of Biomechanics (Consultant), and Japan Journal of Physical Education.

Kurt Öberg

Ph.D. Associate Professor and Director of Ergonomics Research. Department of Agricultural Engineering, Swedish University of Agricultural Sciences, Sweden.

Principal research interests:
- orthopaedic biomechanics (gait disorders, development of CAD/CAM system)
- occupational biomechanics (flooring and cleaning ergonomics)
- agricultural ergonomics

Activities:
Fellow of the International Society of Prosthetics and Orthotics. Short-term consultant for the World Health Organization. ISB Council since 1991.

Sandra J. Olney

Ph.D. Professor of School of Rehabilitation Therapy, Queen's University, Kingston, Ontario, Canada.

Principal research interests:
- biomechanics of gait in stroke and cerebral palsy, other pathologies
- biomechanically-based biofeedback in rehabilitation
- EMG and muscle mechanics
- mechanical factors in joint replacements

Activities:
Editorial board, Physiotherapy, Canada, chair-elect. Board of directors and grant review committee of Easter Seal Research

Institute, Ontario. Research advisory board, Canadian Cerebral Palsy Association. ISB Council since 1991.

Alf Thorstensson

Ph.D. Lecturer in Biomechanics, Stockholm University College of Physical Education and Sports; Associate Professor in Physiology, Department of Physiology III, Karolinska Institute, Stockholm, Sweden.

Principal research interests:
- neuromuscular and mechanical bases of movement control
- lumbar spine biomechanics, injury mechanisms and prevention
- muscle strength development and trainability

Activities:
Participant in all ISB Congresses since 1975. Member of the Advisory Committee for the 1985 and 1993 ISB Congresses. Member of the Editorial Board for Journal of Applied Biomechanics, European Journal of Experimental Musculoskeletal Research and Scandinavian Journal of Medicine and Science in Sports. Author of about 90 scientific papers.

Kit Vaughan

Ph.D. Associate Professor, Department of Bioengineering. Clemson University, South Carolina, USA.

Principal research interests:
- mechanics of human gait
- computer simulation of human motion
- orthopaedic and sport biomechanics
- over 40 books, chapters and refereed journal articles

Activities:
Founding member of ISB's Working Group on Computer Simulation. Active at all ISB conferences since 1979. Scientific program chair for American Society of Biomechanics, 1989-91. ISB Council since 1991.

Savio Woo

Ph.D. Professor of Surgery and Bioengineering at University of California, San Diego, USA. Executive Director of M & D Coutts Research Institute.

Principal research interests:
- biomechanics of tendons and ligaments. homeostasis and healing
- repair of articular cartilage
- effect of exercise on critical bone remodelling
- about 100 papers in referred journals, 40 book chapters and edited two books

Activities:
Past president of the Orthopaedic Research Society. Past president of American Society of Biomechanics. Chair of bioengineering division of American Society of Mechanical Engineers. ISB Wartenweiler Lecturer, 1987. ISB Council since 1991.

M.R. (Fred) Yeadon

Ph.D. Senior Lecturer in Sport Biomechanics, Department of Sports Science, Loughborough University. Loughborough, United Kingdom.

Principal research interests:
- computer simulation of human movement
- technique in testing somersaults
- sports biomechanics

Activities:
Regular participant in ISB Congresses since obtaining Young Investigator's Award at ISB IX in Waterloo (1983}. Chair of ISB Technical Group on Computer Simulation in Biomechanics, Chair of Sports Biomechanics Section of the British Association of Sports Sciences (affiliated to ISB).

XIVth CONGRESS UPDATE

Instructional Courses at Congress

Your attention is drawn to the instructional tutorials that will be offered in conjunction with the XIVth ISB Congress in Paris this summer. There will be a total of four tutorials, each lasting three hours. They have been arranged for Sunday 4 July 1993 in the following format:

9H00 to 12H00:
- (1) Three-dimensional analysis of human movement
- (2) Biology and biomechanics of tendons and ligaments

13H00 to 16H00:
- (3) Clinical gait analysis
- (4) Biomechanical assessment of worksite tasks

There will be a 15 minute break for coffee during each of these tutorials. The lecturers will hand out an extensive set of notes to all those who register and attend. A detailed listing of the courses and instructors follows.

Three-Dimensional Analysis of Human Movement

Dr. Paul Allard, Professor Joannes Dimnet and
Dr. Zvi Ladin

This tutorial provides an overview of the existing technologies and current practices for capturing, processing, analyzing and representing three-dimensional data related to human movement description. The first part addresses general issues concerning a motion assessment laboratory. Among these are the need for standardization, instrumentation, body marker configuration and global, local and anatomical coordinate systems. The second part of the tutorial deals with 3-D reconstruction techniques, error estimation, image processing, smoothing displacement data as well as 3-D representation of the moving body. The third and final section details standard and hybrid biomechanical models and optimization and simulation techniques. Applications will be given throughout the tutorial to illustrate the various aspects of three-dimensional analysis of human movement.

Biology and Biomechanics of Ligaments and Tendons

Dr. Savio L.Y. Woo

This tutorial will serve as an introduction to the basic biology and biomechanics of ligaments and tendons. Particular attention will be paid to ligaments around the knee, that is, the medial collateral ligament, anterior and posterior cruciate ligaments. Discussion will be on the basic mechanical and structural properties of ligaments, age-related changes, strain rate and temperature effects, determination of in-situ strains and forces in the tissue. The effect of stress and motion dependent homeostasis will also be discussed, particularly as this relates to exercise and immobilization. The course will also cover simple visco-elastic theory that describes the properties of ligaments and tendons. Finally, the healing and repair of ligaments and tendons will be presented.

Clinical Gait Analysis

Dr. Christopher L. Vaughan, Ms. Diane Damiano and Dr. Brian L. Davis

In this tutorial we will represent the walking human as a series of interconnected systems -- neural, muscular, skeletal, mechanical, and anthropometric -- that form the framework for detailed gait analysis. The 3D and cyclical nature of human gait will be emphasized, and we will also utilize the inverse dynamics approach to integrate anthropometric, 3D kinematic and 3D force plate data. Although conceptually rigorous, the mathematical details to calculate joint moments and powers will be kept to a minimum to make the material accessible to all students of human motion. We will describe the basics of electromyography (EMG) and how EMG reveals the actions of various muscle groups during the gait cycle. In the second part of the tutorial we will focus on two different clinical case studies, looking at (1) the effect of an orthopaedic procedure on a patient with a congenital anomaly; and (2) the application of ankle foot orthoses (AFOs) in the treatment of a child with cerebral palsy.

Biomechanical Assessment of Worksite Tasks

Dr. Robert W. Norman, Dr. Stuart M. McGill and Dr. Richard P. Wells

Occupationally-acquired acute and over-use injuries to backs, shoulders, elbows, wrists, and other parts of the body present an enormous social and monetary cost to all industrialized nations. The problem appears to be increasing rather than decreasing despite of many years of concern and attention. If risk of injury is to be reduced, methods for quantifying the magnitudes of acute and accumulating loads on tissue before and after intervention, understanding injury mechanisms, and a comprehensive approach to addressing the issue of loading in the work place are needed. This tutorial will review current and emerging methods for quantifying the physical demands of occupational tasks, present current thinking on occupational injury mechanisms, and discuss conflicting opinions regarding the relative roles of biomechanical and other approaches to the problem. The workshop will assume familiarity with biomechanical instrumentation, modelling approaches and the application of some of these to the worksite.

The registration fees (per course) are as follows:

ISB Member	200 French Francs
Non-ISB Member	250 French Francs
Student (full-time)	150 French Francs

You may register for the course by writing directly to:

Laboratoire de Physiologie de la Mortricite
XIVth ISB Congress, C.H.U. Pitie-Salpetriere
91, Boulevard de l'Hopital
F. 75634 PARIS Cedex 13, FRANCE

Payment will be on-site (in French Francs). If you have any questions or concerns, please contact me at:

Kit Vaughan
University of Virginia
2270 Ivy Road, Charlottesville, VA 22903
Tel: (804) 982 0893; Fax: (804) 982 1727
E-Mail: kvaughan@virginia.edu

BIOMECHANICS

XIVth I.S.B. Congress

Paris - France
4 - 8 July 1993

CONGRESS TOPICS

Biomechanics of Human Movement
Sport Biomechanics
Occupational Biomechanics
Assessment of Muscle Function and Rehabilitation
Clinical Orthopaedics Biomechanics
Biomechanics and Neurology

Musculo-Skeletal Biomechanics
Neuromuscular Control of Posture and Movement
Muscle Mechanics and Energetics
Biomechanics of Joints and Spine
Electromyographic Analysis

Environmental Biomechanics in Humans and Animals
Impact and Vibration Biomechanics
Micro and Hypergravity Biomechanics
Terrestrian, Water, and Air Locomotion

Biomechanical Methodology
Methods and Instrumentation
Measurement and Data Processing
Computer Modeling
Simulation and Optimization in Biomechanics

Biomechanics of Tissues and Biomaterials
Soft and Hard Tissue Biomechanics
Biomaterials
Prostheses, Orthoses and External Fixations

Cardio-Respiratory Biomechanics
Cardiac and Vascular Biomechanics
Respiratory Biomechanics
Biorheology

SCIENTIFIC PROGRAM

Highlights

Wartenweiler Memorial Lecture - *Carlo A. De Luca*
• Limits on the use of electromyography in Biomechanics

Muybridge Lecture - *Malcolm H. Pope*
• Biomechanics of low back pain

Keynote Lectures
• Interaction between central programs and efferent inputs in control of posture and locomotion - *Volker Dietz*
• Remodeling of tendons and ligaments - *Kosaburo Hayashi*
• Dynamics of blood circulatory systems under exercise or extreme environment - *Christian Oddou*
• Mechanics of bird flight - *Colin J. Pennycuick*
• New principles in Dynamics of multi-arm robot manipulators: Application to the control of multi-joints human movements - *Eugeniy S. Pyatnitskiy*
• Infant motor development: facts and theories - *Esther Thelen*

Round Tables
• Optimization of Sports Performance - *Coordinator: Wolfgang Baumann*
• Sensory motor adaptation to microgravity - *Coordinator: Alain Berthoz*
• Biomechanical Assessment of Motor Impairments - *Coordinator: Richard A. Brand*
• Paraplegics locomotion - *Coordinator: John P. Paul*

Tutorials - July 4, 1993
• Three-dimensional analysis of human movement - *Coordinator: Paul Allard*
• Biology and biomechanics of ligaments and tendons - *Coordinator: Savio J. Woo*
• Clinical gait analysis - *Coordinator: Christopher L. Vaughan*
• Biomechanical assessment of worksite tasks - *Coordinator: Robert W. Norman*

Satellite Events to the XIVth International Congress on Biomechanics
• Second International Symposium on 3-D Analysis of Human Movement - June 30 - July 3, 1993 - Poitiers - France
• Fourth International Symposium on Computer Simulation in Biomechanics- June 30 - July 2, 1993 - Montlignon - France

EXECUTIVE COMMITTEE

Simon BOUISSET
Stephane METRAL
Hugues MONOD

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Fax: (33-1)40.31.01.65

Special feature article

The following article is based on a lecture delivered by Professor Jan Oderfeld of the University of Technology in Warszawa on the occasion of the Xth School on Biomechanics, held on September 24-26, 1992 in Wrocław, Poland.

On Jonathan Swift's Biomechanics (1726)

Abstract: This paper is meant as an informal talk on Jonathan Swift's Gulliver's Travels (1726). It concentrates on Parts One and Two where the fantastic aspect is rigorously controlled by assumptions on geometrical similitude and on invariance of physical properties of the matter. It shows that in nearly all cases Swift's inference based upon the above assumptions was correct and only in a few others was fallacious.

INTRODUCTION

Gulliver's Travels, the famous work of Swift, first published in 1726, is so well known that it is sufficient to say that it possesses at least three aspects: it is a merciless satire upon human nature, it is a political pamphlet and a masterpiece of controlled fantasy. In this paper the last aspect only will be considered. Moreover, I will limit myself to Parts One and Two which have much to do with biomechanics. It is assumed that the Lilliput Empire is geometrically similar to the real world (i.e. to England A.D. 1726) but reduced by a factor of 12. This applies to all beings (men, animals and plants) and to their natural environment (e.g. to the sea depth). The Brobdingnac Kingdom is Lilliput in reverse, i.e everything is increased by a factor of 12. In both cases all the properties of the matter (organic and unorganic) are identical with those in the real world. This applies for instance to the unit force of muscles, to density of water, etc. These assumptions are not formulated explicitly but introduced as obvious. Just this pedantry of Swift creates situations which are worthy to be analysed from the point of view of biomechanics. Out of about fifty cases, I have chosen a few characteristic ones, and grouped them according to standard branches of modern science.

GEOMETRY AND STATICS

Swift tells that Gulliver *was found sleeping on the ground of the Lilliput Empire, and that the Emperor has determined that he should be tied and a machine*† *should be prepared to carry him to the capital city.*

The main dimensions of the machine were (in metric units) as follows: height 8 cm, width 120 cm and length 210 cm. The width may seem excessive but a closer analysis proves that Gulliver had to be laid into the vehicle with hands spread out.

Assuming that Gulliver's real weight was 80 kg, and taking into account Swift's assumptions it may be clearly observed that the machine would correspond in the real world to a transporter of dimensions in meters 1x14x25, having the load capacity of $80 \times 12^3 = 140{,}000$ kg. This calculation fully justifies the statement that for Lilliputians this machine was *the greatest engine they had and that a principal difficulty was to raise and place Gulliver in this vehicle.* To solve this problem *nine hundred of strongest men were employed* who by means of poles (3.7m high in the real world), hooks, cords and pulleys *raised and slung Gulliver into the engine in less than three hours.* Assuming for pulleys a popular ratio 1:4 one can evaluate that the required net force of one workman in the real world would amount to

$$\frac{140{,}000 \times 9.81}{900 \times 4} = 400N$$

which is a quite reasonable figure.

KINETOSTATICS

Now, I propose to concentrate on the famous story of seizing the entire fleet of the enemy Empire Blefuscu and bringing it to the Emperor of Lilliput. First of all, let us examine the data given by Swift in dead earnest. The hostile Empires were separated by a channel 2,000 meters wide (in real world's units) and from 1.3 to 1.8 meters deep. The Blefuscu fleet consisted of about fifty men-of-war.

Next, Swift describes in detail Gulliver's preparations which among the others included *ordering of strongest cables and bars of iron* which in Gulliver's eyes were but *pack-thread with hooks of size of knitting needle.* Equipped with all these devices Gulliver walked into the sea and, partly wading and partly swimming, arrived at the Blefuseu fleet. Then *he fastened a hook to each ship, tied the cords together and with great ease drew fifty of ereroy's largest men-of-war after him.*

Let us put the question whether this heroic exploit was compatible with Swift's general assumptions. To solve this problem I propose to use a modern branch of mathematics, the dimensional analysis.

Denote (for a real ship): L - length, V - velocity, G - gravity acceleration, D - density of sea water, T - resistance. Dimension analysis gives the formula:

$$T = \phi(\pi) \times D \times L^2 \times V^2 \tag{1}$$

where $\pi = V^2/DL$ is known in fluid mechanics as the Froude number, and $\phi(\ldots)$ denotes a dimensionless function which can be found by experiment only.

For a Blefuscu ship an analogical formula holds:

$$T' = \phi(\pi') \times D' \times (L')^2 \times (V')^2 \tag{2}$$

By dividing (2) by (1) one gets:

$$\frac{T'}{T} = \frac{\phi(\pi')}{\phi(\pi)} \times \left[\frac{L'}{L}\right]^2 \times \left[\frac{V'}{V}\right]^2 \tag{3}$$

Now, from assumption on identic physical propertieswe have $D'/D=1$, and on account of geometrical similarity $L'/L=1/12$. Moreover, fluid mechanics indicates that for such numerical values of the Froude numbers that are considered in our case the quotient $\phi(\pi')/\phi(\pi)$ is approximately equal to 1. Then, formula (3) reduces to:

† Machine, engine and vehicle are used by Swift as synonyms.

$$T' \cong \left[\frac{1}{12}\right]^2 \times T \times \left[\frac{V'}{V}\right]^2 \qquad (4)$$

In the Encyclopedia Britannica it can be found that for an English man-of-war in Swift's times the following figures† were valid (in metric units)

$$T = 110 \text{ kN} \quad \text{for} \quad V = 16 \text{ km/hour} \qquad (5)$$

It only remains to select a reasonable value for the velocity V' with which Gulliver pulled the fleet of 50 Blefuscu men-of-war in water. A careful study of a respective text in Gulliver's Travels suggests that:

$$V' = 1.5 \text{ km/hour} \qquad (6)$$

Putting (5) and (6) into formula (4) one gets $T'=3$ N (for one ship), and 150 N for pulling the entire Blefuscu fleet. This figure does not exceed a normal performance of an adult man.

Clearly, Swift was not able to perform a similar calculation because the dimensional analysis had been not yet invented in his times. However, I hope to have proved that the relation on seizing fleet was not in contradiction with general assumptions in Part One of Gulliver's Travels.

DYNAMICS

Analysis of motion involving rapid changes of velocity often presents a trap. Swift was not the first, and certainly will not be the last one, who had fallen into it. But, let us see what Gulliver has to say about one of his adventures in Lilliput:

The riders would leap horses over my hand as I held it on the ground, and one of the Emperors huntsmen, upon a large courser, took my foot, shoe and all; which was indeed a prodigious leap.

The last words of praise have to be interpreted as follows: since the Lilliput huntsman took an obstacle high some 15 centimeters, then his counterpart in the real world would take 15x12=180 cm, which indeed would be a remarkable achievement. Unfortunately, this conjecture is false and the following statement is true: the huntsman in the real world would be able to take 15 cm only, exactly as high as his colleague in Lilliput. Thus, the praise was undeserved.

Formally speaking, under Swift's general assumptions the height of a jump does not depend on the similitude scale. To prove this paradox let us denote:

- M - mass of the system horse-huntsman,
- L - a characteristic dimension, e.g. length of horse's leg,
- H - maximum height of the trajectory of the center of mass of the system,
- G - gravity acceleration,
- E - muscular energy applied to the jump,
- E_k - kinetic energy just afterthe loss of contact with the ground,
- E_p - potential energy of the system when the trajectory attains its peak.

† I am indebted to Professor Stefan Drobot, Santa Clara, USA for this formulation.

For the sake of simplicity let us neglect losses of energy. Then:

$$E = E_k = E_p \qquad (7)$$

From general assumptions on similitude:

$$E = \text{muscular force x displacement} = (c_1L^2) \text{ x } L = c_1L^3 \qquad (8)$$

where c_1 is a constant coefficient.

$$E_p = GM \text{ x } H = c_2 L^3 \text{ x } H \qquad (9)$$

where c_2 is a constant coefficient.

From formulas (7), (8) and (9) it follows:

$$c_1L^3 = c_2 L^3 * H, \quad \text{whence} \quad H = \frac{c_1}{c_2} \text{ constans.}$$

Thus, H is identical for both the fictitious Lilliput land and the real world. This result remains valid if we put into formula (8) instead of a product an integral, which is more correct. This completes the proof.

Moreover, the paradox applies also to cases, when both geometrically similar objects belong to the real world. And if so, it is highly probable that this paradox was discovered and will be rediscovered many times and independently. For that reason, I was not surprised when just before the X School on Biomechanics I came across the recently published book by C.J.Pennyquick, **Newton Rules Biology**, Oxford University Press, 1992. The author mentions Hill's First Law of Locomotion discovered in 1950 which reads as follows: *geometrically similar animals are all be able to reach the same height in a standing jump*. My first contact with this paradox was both remote and funny. About 1933 I happened to notice that the maximum height attained by jumping cats was practically independent of their size. To explain this fact it was sufficient to assume that the muscle force was proportional to its cross-section. After having this idea, I forgot all about it. Many years later (1945-1948) I was lecturing on mechanics at the Higher School of Engineering in Warsaw, and for rendering my lectures more attractive I included the paradox into them. My students enjoyed this relaxation. Quite a contrary happened in the early seventies. When I mentioned the paradox during a Seminar at the Warsaw University of Technology some of my listeners remained so skeptic that I promised them to perform an empirical demonstration. A few months later I was able to show them a purely mechanical model which still exists.

The model consists of two devices geometrically similar and mounted on a common base. One of them is shown in Fig. 1. Here No.3 denotes a slider which can move along the vertical guide bar No.2 fastened to the base No.1. The slider is pressed upwards by the spring No.4 which rests on the washer No.5. When the click No.6 is pulled out all the moving parts (Nos.3, 4, 5) are flung up. The jump height is registered by means of a simple marker not shown on the sketch. Corresponding elements of both devices are made of identical materials and their dimensions are proportional with a coefficient of proportionally 1.6. This means that masses are proportional with a coefficient $1.6^3 \cong 4.1$. Nonetheless, the jump heights of both devices are practically equal.

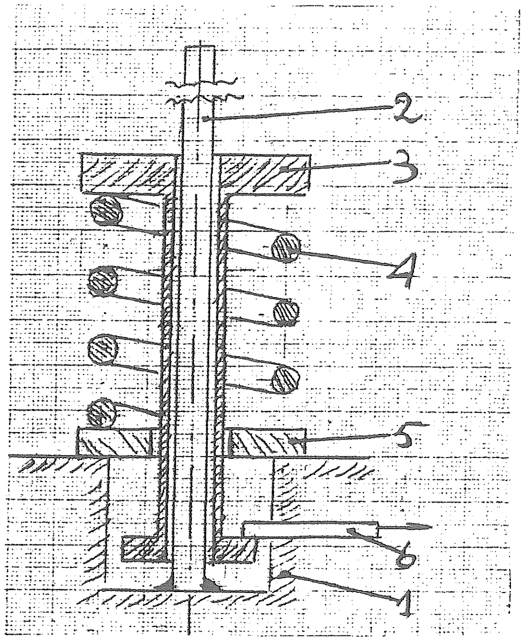


Figure 2: Model of Hill's first law of locomotion.

ACOUSTICS

Since linear dimensions of lungs and vocal cords of beings in Brobdingnac (Part Two of Travels) were 12 times greater than in the real world, it is easy to prove that frequences of emitted sounds must have been decreased by a factor of 12 which means lowering the pitch approximately by three and a half octaves. It would be much more difficult to evaluate in decibels the increase in volume of sounds. However, it is clear that all sounds emitted by the giants in Brobdingnac must have been much deeper and louder than in the real world.

An excellent illustration of these remarks is given by a short passage which accounts for Gulliver's first meeting with a farmer: *The farmer spoke often to me but his voice pierced my ears like that of a watermitt.*

Correspondence to: Prof. Jan Oderfeld, Ph.D. Politechnika Warszawska, ITLiMS, ul.Nowowiejska 24, 00-665 Warszawa, Polska.

Laboratory feature

Biomedical Engineering Center
The Cleveland Clinic Foundation

INTRODUCTION

The Cleveland Clinic Foundation (CCF) has been in existence since 1921 and is currently rated as one of the top five hospitals in the United States (according to a 1992 survey conducted by U.S. News and World Report). It is a non-profit organization that has four divisions: clinical, hospital, educational and research. The last of these divisions is composed of eight departments, 104 faculty members, 150 research associates and fellows, and nearly 300 support personnel. The annual budget of the Research Institute is approximately 37 million dollars, more than 66 percent of which comes from extramurally funded grants and contracts.

One of the departments in the Research Institute is Biomedical Engineering (BME). The department is chaired by J.F. Cornhill, D.Phil. who is also the director of the Biomedical Engineering Center at the Ohio State University, an institution with which the Cleveland Clinic Foundation has an academic affiliation. The department is composed of approximately 70 individuals, including 20 researchers with either a Ph.D. or M.D. degree or both, research engineers, research technicians, secretaries, a manuscript/grant editorial assistant, a quality control engineer, and others.

BME research is by nature, interdisciplinary. At the CCF, the BME department conducts research in areas as diverse as tissue spectroscopy, blood pumps, growth factors in cartilage, gait analysis, pressure sores and orthopedic implants, to name just a few topics. Although these areas may appear to have little in common, the philosophy is that by having people with different backgrounds working in close proximity, novel solutions to problems may be obtained. As a means of illustrating the diversity of biomechanics-related research, specific projects have been grouped into two general areas: musculoskeletal and cardiovascular research. The projects listed below do not necessarily reflect the researcher's major interest, but lack of space prohibits a comprehensive description of all of BME's activities. The guiding principle in this article is the quote from Virchow;

"Brevity in writing is the best insurance for its perusal"

MUSCULOSKELETAL RESEARCH

"But like a man walking alone in the darkness, I resolved to proceed so slowly and carefully that, even if I did not get very far, I was certain not to fall"--Descartes.

Mark Grabiner, Ph.D. has research interests that include determining the mechanisms underlying the predisposition of the elderly to falling. He has focussed upon (i) falls that occur in the forward direction as a result of tripping or stumbling during locomotion and (ii) identifying those factors that limit, or constrain, an elderly individual's ability to recover. The approach to this multifaceted problem has been one of integrating experimental work with mathematical modeling and

ISB

simulation using optimal control theory. Research to date has revealed three areas in which age-related functional deficits may limit the ability to recover from a stumble; (i) reduced capability to detect the stimuli associated with postural stability, (ii) requiring too long to select the motor sequence, and (iii) the inability to generate the appropriate motor sequence.

"The point of the spear...severed the ligaments and wrenched the bone right out"--Homer

Enhancement of rigid graft fixation for ACL reconstructions has been studied in the Biomaterial Lab, headed by Helen Kambic, M.S. She has evaluated the mechanical strength of bone-patellar-bone ACL grafts using interference screw fixation and suture/post techniques. Other recent biomaterials research has included (i) studying biodegradable materials for fixation, and (ii) the development of a Video MicroScaler technique to quantify micromotion. Coupled with microscopy the technique compares designs and articular surfaces and provides a direct measurement of relative motion at the bone prosthesis interface.

"...if the pressure exceeds the stimulus of thickening, then the pressure becomes an irritation..."--J. Hunter, 1841

An example of research being conducted by Steve Reger, Ph.D. in the area of rehabilitation engineering is the development of a method for designing wheelchair seats. His group has developed and patented a computer sensor that enables seat and back shapes to be stored in a digital manner. Software, including a 3-D graphic display, allows on-screen shape modification. Data can then be transferred via a modem to a central fabrication site which has a numerically controlled milling machine that shapes foam blocks according to the code it receives. The finished custom contoured cushions are then fitted on to a wheelchair frame.

"My knee made hard with kneeling"--Shakespeare (King John, Act IV)

Research into connective tissue development and repair is conducted by Raymond Miller, Ph.D. One of the tissues he is involved with is the meniscus. The response of this tissue to physiological stimuli and injury is critical in the maintenance of long term structural and functional properties of the knee. The natural history of meniscal tears is that those in the vascular peripheral region heal while those in the avascular central region do not heal. This suggests that the meniscal cells of these regions differ in their intrinsic capacities to mount a repair response. This view was strengthened when he recently demonstrated that explants from the peripheral region of the meniscus have a higher rate of cellular proliferation and matrix synthesis than explants from the central region of the meniscus. Continuing efforts on this project are targeted at further characterization of the two cell populations with the aim of understanding the differences in the healing responses of these regions.

"...he hath the joints of everything; but everything is so out of joint..." --Shakespeare, Troilus and Cressida, Act 1.

Cahir McDevit, Ph.D. has interests in tissue engineering that include studying matrix organization. In early osteoarthritis, the cells (chondrocytes) of articular cartilage begin to detach themselves from their surrounding matrix, and the fibrillar meshwork of that matrix becomes looser and disorganized. He proposed the hypothesis that a pivotal event in the early degeneration of cartilage is a compromise in the function of an adhesion protein that attached cells to their extracellular matrices, or that organized extracellular macromolecules into higher ordered structures. His group has identified type VI collagen as an important adhesion protein in cartilage that changes in early osteoarthritis.

"For the bones...to get fixed, around thirty days are needed, but nothing is achieved with exactitude..."--Hippocrates

The focus of the bone biology laboratory, headed by George Muschler, M.D. is in bone cell differentiation and applications of bone grafting and bone regeneration. The laboratory integrates three related areas of musculoskeletal research: the cellular and molecular biology of osteoblastic stem cells; the biomechanics of bone regeneration; and the development and testing of composite synthetic bone grafting materials. An example of a project being conducted in this area is the development of a segmental canine posterior spinal fusion model which allows efficient and sensitive evaluation of composite graft materials for spinal fusion application. This model has been used successfully to document the failure of some composite materials which had previously been considered strong candidates for clinical application.

"...the right and left, are linked to one another by the same common original (by which I mean that which controls their movement)..."--Aristotle

It is widely recognized that amputees demonstrate an asymmetrical gait pattern. This type of gait pattern could conceivably result in any or of the following; (i) overloading of parts of the musculoskeletal system, (ii) decrease control of balance and (iii) an increase in the energy demands of locomotion. Research being conducted by Brian Davis, Ph.D is aimed at analyzing the vertical loads under each limb during multiple, successive, gait cycles while a person walks at a constant speed on a treadmill. Other interests include the development of transducers that simultaneously measure shear and pressure and analyzing EMG data collected on cerebral palsy patients.

CARDIOVASCULAR RESEARCH

"Some say that the arteries do pulsate, for their walls dilate and contract just like the heart, but they do this not by any innate power of their own, but receive it from the heart"--Herophilus

Leonard Golding, M.D. and William Smith, D.Ed. have for the past decade performed a series of studies in the area of nonpulsatile blood pumps. Research has included (i) physiological effects when blood is pumped in a continuous non-pulsatile manner, (ii) engineering aspects of pump design and (iii) studies of hemolysis induced by a blood-lubricated pump. The present design produces 5 liters/min flow against 100 mm pressure rise at 7 watts. Future research will involve biomaterials (particularly ceramics), fluid dynamics and computer modelling.

"Erasistratos has told us that the heart's valves ensure a one-way course of the blood" James Young, 1930

An NIH grant awarded to Hiroaki Hirosaki, Ph.D., M.D., is aimed at elucidating the mechanisms of initial calcification in bioprosthetic heart valves. Part of the investigation involves implanting a composite valve made from three different materials in the mitral position. In addition, subcutaneous implants of the valve materials were implanted in the same experimental animals. The data obtained suggest differences in calcificability relative to both location and material. This finding questions the validity of the subcutaneous model since it was unable to predict the results obtained from the cardiovascular system. Other work being conducted by Dr. Harasaki entails mammary implants, artificial finger joints and chronic effects of heating on tissue.

"When any mechanical contrivance fails, it will do so at the most inconvenient time" Johnson's First Law as stated by Bloch, 1977

Dr. J. Fredrick Cornhill's research interests include biomedical image processing. As an example, automated radiographic techniques are being developed for the identification of failures in the outlet struts of heart valves. Clinical studies of valves implanted in sheep suggest that one leg of an outlet strut may separate from the valve flange some time prior to the second leg breaking. Preliminary analysis of digitized 35 mm cineangiographic data of mitral valves in sixty patients indicates that the analysis of differential pixel intensity along the long axis of the leg of the outlet strut is a sensitive measure of outlet strut integrity of these valves. At present image processing software is being developed to process multi-frame cine data in an automated manner.

"Maid of Athens, ere we part,
Give, oh, give me back my heart!"--Byron, Maid of Athens

The Total Artificial Heart Development is a joint project with Nimbus, Inc., initiated in 1988. A key person in the project is Ray Kiraly, M.S. who oversees the development of an electrically driven system to permanently replace the cardiac function in a patient after removal of a diseased natural heart. The present intention is for the blood pump, electrohydraulic drive system and ancillary components to be implanted in a patient without the need for chronic percutaneous connections. This allows the recipient to return to a productive and near-normal lifestyle.

"Blood is a truly remarkable juice"--Goethe, Mephistopheles to Faust

At present, the separation of proteins focuses on cryo-proteins detectable in patients with immunological diseases, such as rheumatoid arthritis and in certain patients with idiopathic cryoglobulinemia. In acute cases, the clinical treatment of cryoglobulinemia requires periodic replacement of patient's plasma by a substitute such as albumin solution. Maciej Zborowski, Ph.D. has been developing a technique of selectively filtering cryoglobulins from plasma. In clinical applications, this technique requires a two stage separation in which (i) plasma is separated from blood cells, and (ii) cryoglobulins are separated from plasma which, in turn, is recombined with blood cells and reinfused to the patient.

COMMON FACILITIES

There are two core facilities housed within the Department of Biomedical Engineering that service the electronics and mechanical prototyping needs of the department. The Electronics Core facility is managed by an M.S.E.E. who directs the work of three electronics technicians. The mechanical prototype facility is managed by a Master machinist who directs the work of three others. These two facilities approximate 2500 square feet of space.

The department has a local area network (LAN) running Ethernet (10Mbits/s). The LAN connects eight Sun computer workstations (Unix), four NCD-X terminals (X Windows/Unix), and fifty IBM compatible personal computers with Ethernet cards. The LAN is linked to the rest of the CCF campus through a broadband network, and gatewayed to the Ohio Academic Research Network (OARNet) through a T1 network link (1.5 Mbits/s) which provides access to the Internet and BITNET international computer networks.

GAIT ANALYSIS FACILITY

Gait analysis data collection is performed using a multicamera (6) video-based system manufactured by Motion Analysis Corporation (Santa Rosa, Ca.) The commercial software that drives this instrumentation was originally developed in the Department of Biomedical Engineering. Collection instrumentation is centered around a Sun 4 microsystems computer that serves as a master to an IBM PC/AT. The IBM serves as a collection node for eight channels of telemetered EMG data (Noraxon) as well as force and moment data. The department has five AMTI force plates.

Other major instrumentation in the laboratory includes a Balance System (Chattecx Corp). This instrument has been refined in our laboratory to allow simultaneous collection of electromyographic (EMG) signals and angular/ linear position data of the platform during perturbations. Isolated joint function is measured during static and isokinetic conditions using a Kin-Com isokinetic dynamometer (Chattecx Corp). This instrument has also been modified from its commercial state to allow the simultaneous collection of isokinetic and EMG data.

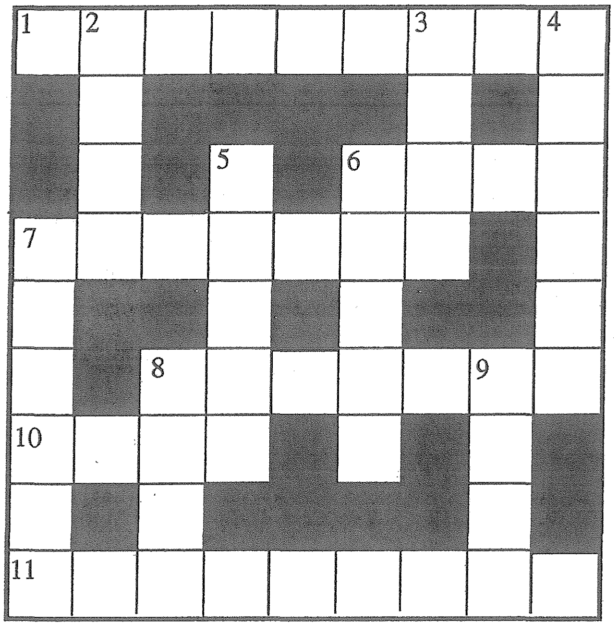
SUMMARY

The topics that have been listed above reflect the diversity of BME research at the Cleveland Clinic Foundation. We are always keen to have visitors--last year we were honored to have Drs. Roger Enoka, Al Schultz and Graeme Wood deliver invited presentations to our department. If anybody would like additional information, please contact:

Brian L. Davis, Ph.D.
Dept. Biomedical Engineering (Wb3)
Cleveland Clinic Foundation
9500 Euclid Ave, Cleveland, OH 44195, USA
Tel: 216-444-1055; Fax: 216-444-9198
Email: davis@bme.ri.ccf.org

CROSSWORD PUZZLE

(Submitted by Brian Davis. Solution on page 16)



Across:

1. When tensile forces are applied to ligaments, they become like this.
6. Surgeons often need to do this to a femur before implanting the femoral component of a Total Hip Replacement.
7. Associated with a change in the median frequency of an EMG signal.
8. A forceplatform manufacturer and major sponsor of ISB.
10. The olecranon process is associated with this bone.
11. He was given the Muybridge Award at the 1991 ISB meeting held in Perth.

Down:

2. Tensor Fascia .... (e).
3. This structure has many bifurcations.
4. Used in developing rheological models of viscoelastic materials.
5. Flexor Digitorum Longus has its origin on this bone.
6. Biocompatible implants should not become this way *in vivo*.
7. This bone has been reported to carry about 16% of the body weight during stance.
8. The largest joint in the human body.
9. .... detection is an important part of image processing.

Announcements

BIOMECHANICS POSITIONS AVAILABLE

HUMAN PERFORMANCE BIOMECHANIST

KRUG Life Sciences

The successful candidate will possess at least a masters degree in biomechanics with a solid educational background in statistics and research methods. The selected candidate will work in the Motor Performance Laboratory at NASA's Johnson Space Center in Houston, Texas and be responsible for collection and analysis of a variety of biomechanical measures. Current laboratory projects include the impact of space flight on postural control and eye-hand coordination. Preference will be given to individuals with demonstrable experience with force plates and video analysis systems. Successful candidates will possess strong communication and technical writing skills. Interested applicants should submit a current resume, list of references, and salary history to:

June E. Richmond
Human Resources Manager
KRUG Life Sciences
P.O. Box 58827
Houston, TX 77258-8827
USA

Employment eligibility verification required.
E. O. E. M/F/H/V
Smoke-free workplace provided.

For more information or details, feel free to contact Dr. Chuck Layne (713) 483-6357.

RESEARCH ASSOCIATE

The Seattle VA Medical Center, Human Motion Analysis Laboratory is looking for a research associate to conduct both clinical gait analysis and biomechanical research studies on lower extremity amputees. This work involves biomechanical data collection using ground reaction force plates and a video based motion analysis system, metabolic data collection using the Douglas bag technique, as well as some hardware interface development and software generation/modification. We are looking for an individual who is a US citizen and has either a bachelors or masters degree in clinical bioengineering or kinesiology. Please contact:

Joseph M. Czerniecki, MD
Tel: (206) 764-2222.

POSTDOCTORAL POSITION : CARTILAGE BIOMECHANICS and MICROSCOPY

Available starting September 1993. A background in bioengineering and a strong interest in connective tissue structure and function is desired. Projects involve studying the effect of tissue loading on cell behaviour, and the relationship between extracellular matrix ultrastructure and mechanical properties, in cartilage. Advanced microscopic techniques will be utilised. Please send curriculum vitae and names of three references to:

Ernst B Hunziker, Director
ME Mueller Institute of Biomechanics
Postfach 30, 3010 Berne
Switzerland

ORTHOPAEDIC ENGINEER

The Department of Orthopaedics and Rehabilitation at the University of Virginia School of Medicine is seeking candidates for a tenure track position at the Assistant Professor level. Suitable candidates will have the opportunity for a joint appointment in the School's Department of Biomedical Engineering. Laboratory space, with appropriate equipment, will be provided in the Orthopaedic Research Laboratory. The position requires a strong, independent research program with some teaching responsibilities. Collaborations with the department's clinical and research staff will be encouraged. Candidates with a Ph.D. degree in Engineering should submit an application and three letters of recommendation sent separately to:

Dr. G.J Wang
Chairman, Department of Orthopaedics and Rehabilitation
University of Virginia Health Sciences Center,
Box 159, Charlottesville, VA 22908, USA

Candidates who are still conducting research for their dissertation should indicate when they expect to graduate. The University of Virginia is an equal opportunity/affirmative action employer.

RESEARCH DIRECTOR

A position is available for a full-time Research Director in the St. Joseph's Health Centre Musculoskeletal Research Laboratory. Affiliated with the University of Western Ontario, this multidisciplinary laboratory will primarily focus on disorders of the upper extremity. The candidate must be a Ph.D with demonstrated excekkence in biomechanics research.

The Research Director will help develop a basic research program and serve as a consultant to the clinical faculty of the Hand and Upper Limb Centre. The successful candidate will be appointed in both the Departments of Surgery and Engineering at The University of Western Ontario. A commitment to graduate and under-graduate teaching in both of these Departments is essential.

Salary and rank will be commensurate with experience and proven record of excellence. Applications will be accepted until April 30, 1993. Applications, including curriculum vitae, statement of research objectives and the names of three referees should be addressed to:

Dr Graham J.W. King
Hand & Upper Limb Centre
St. Joseph's Health Centre
268 Grosvenor Street
London, Ontario
CANADA N6A 4L6

Positions are subject to budget approval. The University of Western Ontario is committed to employment equity, welcomes diversity in the workplace, and encourages applications from all qualified individuals including women, members of visible minorities, aboriginal persons, and persons with disabilities.

POST-DOCTORAL POSITION

A post-doc position may shortly become available for the period of one or two years to work with me in the Department of Biomed. Eng., Technion, Haifa, Israel. The candidate should have training and experience in Orthopardic Biomechanics, System Analysis and FES.

Please write to:

Prof. J. Mizrahi
Department of Biomedical Engineering
Technion, Israel Institute of Technology
Haifa 32000, ISRAEL
Phone: 972-4 294218
Fax: 972-4 234131
E-mail: jm@techmax.bitnet or
jm@maxc.technion.ac.il

NEW FACULTY POSITION

Department of Exercise Science
University of Massachusetts-Amherst

Position: Full-time Faculty, tenure track, 9 month appointment
Rank: Assistant Professor
Salary: Dependent on experience and qualifications
Effective Date: September, 1993

Position Requirements:

1) Ph.D. or equivalent terminal degree with specialization in (a) biomechanics/motor control or (b) either exercise biochemistry, exercise physiology, therapeutics, or wellness.
2) Ability to teach undergraduate human anatomy/ applied human anatomy.
3) A strong commitment to research.

Priority deadline: April 1, 1993 or until suitable candidate is obtained. Applicants should forward curriculum vitae, statement of current and planned research activities, names, addresses, and telephone numbers of five people who have agreed to write letters of recommendation, and reprints or copies of pertinent publications or other scholarly achievements to:

Dr. Walter Kroll, Chair
Dept. of Exercise Science, Boyden Building
University of Massachusetts
Amherst, MA 01003, USA

The Department of Exercise Science offers degrees at the B.S., M.S., and Ph.D. levels. The Department of Exercise Science has established research laboratories in Biomechanics, Exercise Biochemistry, Exercise Physiology, Motor Integration, Biofeedback, and Wellness. For further information, contact Joe Hamill at (413) 545-2245 or JHamill@ExcSci.UMass.EDU

FACULTY POSITION

Department of Kinesiology
University of Illinois at Urbana-Champaign

Position: Full-time, tenure track, 9 month appointment.
Salary: Commensurate with experience.
Description:

The focus is on the biomechanical study of physical activity. Physical activity is broadly defined, and includes a variety of movement contexts such as exercise, dance, locomotion, play, sport and work. Instruction involves teaching at both the undergraduate and graduate level, and graduate student advising. The research function includes independent research, directing student research, and seeking grant support.

Effective date: August 21, 1993.
Application Procedures: Applicants should send a letter of application, vitae, and three letters of recommendation by March 1, 1993 to:

Les G. Carlton
Chair of Search Committee
Department of Kinesiology
University of Illinois at Urbana-Champaign
Louise Freer Hall
906 S. Goodwin Avenue
Urbana, IL 61801, USA
Phone: (217) 244-3986

DIRECTOR OF SPORTS BIOMECHANICS RESEARCH

Minneapolis Sports Medicine Center

The Minneapolis Sports Medicine Center is seeking an outstanding individual to head its newly constructed, 3000 square foot sports biomechanics research laboratory. The Minneapolis Sports Medicine Center serves the central Minnesota area including professional sports teams. The successful applicant will work with the physicians and therapists associated with the Minneapolis Sports Medicine Center to specify, develop, supervise, and participate in research in the areas of: 1) Mechanisms of sports-related injuries, 2) Prevention of injury, 3) Injury treatment, 4) Injury rehabilitation, 5) Functional outcome evaluation. The director will oversee the initiation of operations and the hiring of a research staff. Funding will be provided through foundation support as well as private and public grants for which the director must successfully compete at the national level. Qualifications include a Ph.D. in engineering (preferably mechanical or biomedical with extensive course work in biomechanics) as well as demonstrated technical, managerial, and entrepreneurial skills. The applicant must also have biomechanics research skills proven through experience, publications in peer reviewed journals, and conference participation. Salary commensurate with qualifications and experience.

Interested applicants should forward cirriculum vitae to:

Bob Finke, Executive Director
Minneapolis Sports Medicine Center
701 25th Ave. South
Minneapolis, MN 55454

ASSISTANT/ASSOCIATE PROFESSOR

GEO-CENTERS, INC., a high-technology, growth-oriented research and development firm has an opening for a Lead Biomechanist to work at our Natick, MA location. This position will be filled at the asst/assoc professor level. Qualified applicants will have a Ph.D. in Biomechanics, Exercise Science, or a related Human Movement Science discipline. The successful applicant will have demonstrated research and scientific communication skills in one or more of the following specialities: video or cine-based motion analysis; ground reaction force plate studies; and/or human movement analysis-software development. Responsibilities will include conception and implementation of innovative research designs; and serving as principle investigator on collaborative research projects. The Biomechanics Program conducts basic and applied human movement research to support the ergonomic design and sizing of personal protective clothing, equipment, and workstation/crewstation geometries. Interested applicants should submit a Curriculum Vitae, names of three references, and salary requirements to:

Robert J. Woods
GEO-CENTERS, INC.
190 N. Main St.
Natick, MA 01760-2057

For more information or details, contact Ms. Susan Dewey (508) 651-8147.

An Equal Opportunity/Affirmative Action Employer. U.S. Citizenship required.

RESEARCHER IN BIOMECHANICS

The National Institutes of Neurological Disorders and Stroke (NINDS), National Institutes of Health (NIH) is sponsoring a two year tenure track appointment to advance the clinical/research assessment of normal and pathological subjects in the areas of gait and balance. The incumbent will be working with the Clinical Director, NINDS and staff of the Biomechanics Laboratory, Rehabilitation Medicine Department. Patient populations may include, but are not limited to, Parkinson's disease, Cerebellar Ataxia, Autism, and Myoclonus.

The Biomechanics Laboratory is equipped with a passive infrared, three-dimensional target tracking system, two position adjustable force plates, EMG instrumentation, and software for complete six degree-of-freedom analysis of segmental and full body movements.

Candidates must have post doctoral status and should have a background in Biomechanics, Engineering or the Physical Sciences. Prior applied research experience is desirable, but not mandatory. We anticipate a starting date of July 1993.

Send Curriculum vitae, three letters of reference, and a letter explaining your interest to:

Steven J. Stanhope, Ph.D.
Biomechanics Laboratory, Building 10 Room 6s235
National Institutes of Health
Bethesda, MD. 20892, USA
Tel: (301) 496-4733 ext 11

NIH is an Equal Opportunity Employer

LECTURERS AND SENIOR LECTURERS

School of Human Movement Studies
Queensland University of Technology, Brisbane, Queensland, Australia.

In line with expansion of its teaching and research profile the School of Human Movement Studies at the Kelvin Grove campus is seeking to fill a number of tenurable positions at the Lecturer and Senior Lecturer levels in the following sub-disciplines of human movement studies: exercise physiology; exercise and sports psychology; biomechanics and functional anatomy; and motor control and learning. The appointees will contribute to the undergraduate and postgraduate teaching programs in areas related to their expertise and research interest.

Qualifications/Skills:
Applicants should be active scientists with a commitment to research and postgraduate teaching and a demonstrated ability to establish an independent research program capable of attracting external funding. To be appointed as a Senior Lecturer, applicants should possess a doctoral qualification in a relevant field, or equivalent accreditation or standing. To be appointed as a Lecturer, applicants should have a doctoral or master qualification in a relevant field, or equivalent accreditation or standing.

Salary: Lecturer A$41 000 to A$48 688 pa: Senior Lecturer: A$50 225 to A$57 913 pa.

Further Information:
Duty statements and selection criteria are available from the Personnel Department telephone +61 7 864 3200. For further information, telephone Professor Tony Parker on +61 7 864 3512; Fax: +61 7 8643980.

Applications: Applications and envelopes should quote ref 118/93 and include evidence of academic qualifications, experience and teaching evaluations plus the names, addresses and telephone numbers of three referees. Applications should address the selection criteria and reach the Personnel Director Queensland University of Technology Locked Bag No 2 Red Hill 4059 by 9 April 1993. Smoking is not permitted in QUT buildings or vehicles. QUT is an equal opportunity employer.

Solutions to Crossword Puzzle

ACROSS	DOWN
1. elongated	2. Lata(e)
6. ream	3. tree
7. fatigue	4. damper
8. Kistler	5. tibia
10. ulna	6. rusty
11. Alexander	7. fibula
	8. knee
	9. edge

Thesis abstracts

THE EFFECTS OF LOAD AND UNEXPECTED DELAY, ON BRAKING-AND-ACCELERATING VOLUNTARY FOREARM MOVEMENTS

by

Nikitas Tsaousidis*

Dept. of Physical Education and Sport Studies
University of Alberta, Edmonton, Alberta, Canada T6G 2H9
Degree: Master of Science
Advisor: Pierre Gervais, Ph.D.

The purpose of this study was to examine the role of load and unexpected delays of the stretch stimulus onset during braking-and-accelerating forearm movements. The investigation focused on the effects of these factors on mechanical performance and the reflex responses of the biceps brachii and triceps brachii.

A stretch stimulus, caused by the free fall of a weight, was applied to the elbow flexors of the dominant arm of thirty male subjects. The subjects were warned of the imminent fall of the weight and were instructed to brake the movement of the load and try to move it backward as fast as possible. No visual or auditory cues were provided. To test the effect of unexpected delay, the weights in the last two trials performed by each subject were released four seconds after the warning instead of the usual two seconds expected in the previous forty trials. Each subject was tested with one of three load intensities (11, 19 or 27% of his maximum isometric strength).

The angular displacement, joint power and rectified EMG data were averaged for five 'regular' and two 'delayed' trials of each subject. Subsequently, split-plot factorial ANOVAs were conducted. The findings suggested that mechanical performance (reflected in the maximum angular displacement during the braking phase of the movement) deteriorated when the load increased and when the stretch stimulus was delayed. The reflex EMG response of the biceps was enhanced by increased loads and was reduced by unexpected delays. The data provided support for the notion of a preparatory set of limited duration in the flexors. The reflex EMG responses of the triceps were not affected by the type (expected or unexpectedly delayed) of stimulus, and light and medium loads, but increased sharply when heavy loads were applied. The observed reflex coactivation patterns suggest the existence of two different preparatory sets, one for the flexors and a second, not affected by delays, for the extensors. Negative joint muscle power increased proportionally to the increases in the load and remained unaffected by delays but was shown to be a poor indicator of performance in this particular experimental task.

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HYDRAULIC WATER FORCE AND FLOW AT THE OARBLADE IN ROWING

(Wasserkraft und Strömung am Ruderblatt beim Rennrudern)

by

Hans Gerber

Biomechanics Laboratory and Institute of Hydromechanics
Swiss Federal Institute of Technology, ETH, Zurich

Degree: Doctor of Technical Science
Supervisors: Prof. Dr. T. Dracos, Dr. A. Gyr, Dr.E. Stüssi

The goal of this research project was to find a method, (i) to measure the resulting three-dimensional force at the oar-blade and to detect its center ofpressure, (ii) to visualize the water flow around the oar-blade produced during water contact, (iii) to test theoretically and experimentally the hypothesis concerning the hydrodynamic lift with reference to the aerofoil-theory.

The measuring system on the rowing boat was composed of installed transducers and a data-logger. The measurements on the boat were made during 2 to 4 test-runs with 15 oarsmen from Switzerland and New Zealand. The oarsmen ranged from international top-class down to the Swiss middle-class. Each run took about two minutes rowing and measuring time.

In the rowing boat the three components of force and the torque were measured by a specially equipped oar (trade-mark "Dreissigaker" with a "Mâcon-blade") with strain-gauges arranged in a particular set-up on the loom of the oar. In order to record the horizontal and vertical angles of the oar a rubber band goniometer was installed on the pivot of the swivel. The horizontal and vertical accelerafion of the boat was measured by accelerometers. The analog signals were sampled and stored by a digital data-logger. The only difference to the usual boat was the use of a special pair of oars with the equipped oar on back-board and about 1.5kg of extra mass in the boat.

On land the data was transferred from the data-logger to the computer. A comper evaluation of the collected data was made by an efficient, menu-controlled program at the laboratory. This program allows an automatic stroke-detection and calculates the vector of the flow as well as the hydraulic force by a mathematical model.

The water flow around the oar-blade was made visible by introducing different colored dye at the blade's edges into the water by attaching dark filaments on the white surface of the blade, and by surveying floating particles on the surface of the water. The "water flow" experiments were made with 3 oarsmen. After running-in for about five strokes, one stroke was filmed within a defined field under and above the water level with a high-speed camera and with video-camcorders. The films and videos were analysed by means of the analysing software of the laboratory.

With the results (i) of the measurements it was possible to compute the angle and velocity of the water flow at the oar-blade during water contact. Furthermore, the force vector acting upon the oar-blade and the point of application on the blade was determined. It could be shown that the highest efficiency in respect to propulsion of the oar is in the area of the orthogonal position to the boat. It was also found that the efficiency within the first quarter of the stroke drops beyond 0.5. (ii) From the films and videos it became possible to describe the water-flow around the oar. (iii) The findings showed, that due to turbulent and unsteady water flow the application of the two-dimensional aerofoil-theory is not adequate to explain the hydrodynamic propulsion. In addition, the resuls of this research project show that the eddies, resulting from the oar being moved through the water, produce the principal energy of propulsan which is transferred to the water.

Conference news

One Day Symposium on
OPTICAL METHODS IN BIOMECHANICS
To be held at Queen Mary & Westfield College University of London, Thursday, 16th September 1993.

This one day symposium is being organised by the Bioengineering Measurements Technical Group of the British Society for Strain Measurement in association with the Italian Association for Experimental Stress Analysis (AIAS) and the European Society of Biomechanics (ESB). It will comprise a series of keynote lectures on special topics along with scientific research papers. There will be time for questioning and discussion and sessions for poster presentations will be included.

The aim of the day's presentations is to inform delegates of the different aspects of optical techniques with a view to their use in new areas. The presentations will be focused on the variety of techniques available and their applications, rather than on interpretation of the results.

The meeting will be of interest to people with varied backgrounds, from engineers in industry and research establishments, to those with a medical training. It will be of relevance to senior personnel to provide an overview of techniques and equally to research students wishing to use optical techniques in their work.

The day will include presentations on: Photoelasticity; Holographic interferometry; Electronic speckle pattern; interferometry; Moire fringe methods; Displacement measurements.

Contributions are invited for the topics outlined and other relevant topics within the theme of the day. Abstracts not exceeding 450 words should be submitted to the meeting secretariat at the address below by 30 June 1993.

For further details contact:

Dr John Orr,
Department of Mechanical & Manufacturing Engineering,
The Queen's University of Belfast,
Ashby Building,
Stranmillis Road,
Belfast, BT9 5AH

Tel: 0232 245133; Fax: 0232 661729

Calendar of scientific events

April 22-23, 1993
International Biomechanics Seminar, Centre for Biomechanics, Göteborg, Sweden. Contact: Gunilla Ekman, Center for Biomechanics, Chalmers University of Technology, S-412 96, Göteborg, Sweden. Tel: +46-31-7721515; Fax: +46-31-7723477.

June 14-18, 1993
IEA World Conference on Ergonomics of Materials Handling, Warsaw, Poland. Contact: EMH '93 Secretariat, Center for Industrial Ergonomics, University of Louisville, Louisville, KY 40292, USA. Tel: +1 (614) 292-6670; Fax: +1 (614) 292-7852; E-Mail: marras@CCL2.Ohio-state.edu

June 30 - July 3, 1993
Second International Symposium on 3-D Analysis of Human Movement, Poitiers, France. Contact: Paul Allard, PhD, International Symposium on 3-D Analysis of Human Movement, Centre de recherche Hôpital Sainte-Justine, 3175 Côte Ste-Catherine, Montréal, PQ, H3T 1C5, Canada. Tel: +1(514)345-4740; Fax: +1(514)345-4801; E-mail: aissaoui@ere.umontreal.ca

June 30 - July 2, 1993
IVth International Symposium on Computer Simulation in Biomechanics, Paris France. Contact: B. Landjerit, Laboratoire de Bioméchaniique, E.N.S.A.M., 151 Boulevard de l'Hôpital, 75013 Paris, France. Tel & Fax: 33.1.44.24.63.65.

July 4-8, 1993
XIVth Congress of the International Society of Biomechanics (ISB), Faculté de Médicine Pitié-Salpêtriè, Boulevard de l'Hôpital, Paris 13e, France. Congress Office: Convergences - I.S.B. '93, 120, avenue Gambetta, 75020 Paris, France. Fax: (33-1) 40.31.01.65; Telex: 216911 F.

July 9-13, 1993
First World Congress of Science and Racket Sports, Merseyside, England. Contact: Dr Mike Hughes, Centre for Sport and Exercise Sciences, Liverpool Polytechnic, Liverpool L3 3AF, England. Tel: +051 207 3581 ext. 2157.

October 21-23, 1993
17th Annual Meeting of the American Society of Biomechanics, University of Iowa, Iowa City, USA. Contact: Vijay K. Goel, PhD, Professor and Chair, Department of Biomedical Engineering, University of Iowa, 1202 Engineering Building, Iowa City, IA 52242-1527, USA. Tel: 319/335-5638; Fax: 319/335-3533.

April 7-9, 1994
International Conference on Biomedical Engineering (BME'94), Hong Kong. Contact: BME'94 Conference Secretariat, c/o Rehabilitation Engineering Centre, Hong Kong Polytechnic, Hunghom, Kowloon, Hong Kong. Tel: 852-766-7683; Fax: 852-362-4365; E-Mail: PCRIS@HKPCC.HKP.HK.

July 10-15, 1994
Second World Congress of Biomechanics, Amsterdam, The Netherlands. Congress Office: Biomechanics Section, Institute of Orthopaedics, University of Nijmegen, PO Box 9101, 6500 HB Nijmegen, The Netherlands. Tel: +31-80-613366; Fax: +31-80-540555.

ISB membership news

Unfortunately space did not allow for the publication of the names and addresses of all 40 new members who have recently joined our Society. This will be done in the next issue, due out just before the Paris Congress, where, hopefully you will have the opportunity to meet some of these new members.

EDITOR'S NOTE

This Newsletter is published quarterly: February-March (Spring); May-June (Summer); August-September (Autumn), and November-December (Winter). Deadlines for material and articles are the first day of each first named month, and the Newsletter is mailed to members early in the second named month.

Members can submit *Letters*, *Special Articles*, *Affiliate Society News*, *Laboratory Features*, *Reports*, or *Announcements* of *Meetings*, *Conferences*, and *Jobs Available*. Also, *Short Abstracts* from biomechanics society meetings and *Thesis Abstracts* can be published. In special circumstances a complete edition of the Newsletter can be devoted to the publishing of a Society's "Proceedings".

Submitted material must be in letter-quality print and computer scannable, or on a computer disk as a text-only file, and in English. Graphics or complex equations must be in camera-ready art form, and photgraphs must be black and white

Society abstracts should not be more than 250 words in length. They should be submitted with full details of the conference, and accompanied by any conference or society logos which could be printed as well.

Thesis abstracts should be submitted with full details of:

> Title, Student's Name, Department, Name of Degree and Conferring Institution, together with Supervisor's Name.

Thesis abstracts should not be more than one Newsletter page in length.

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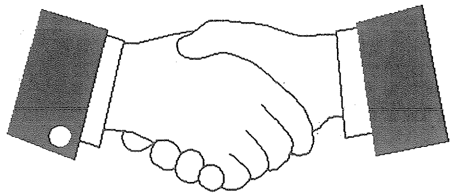

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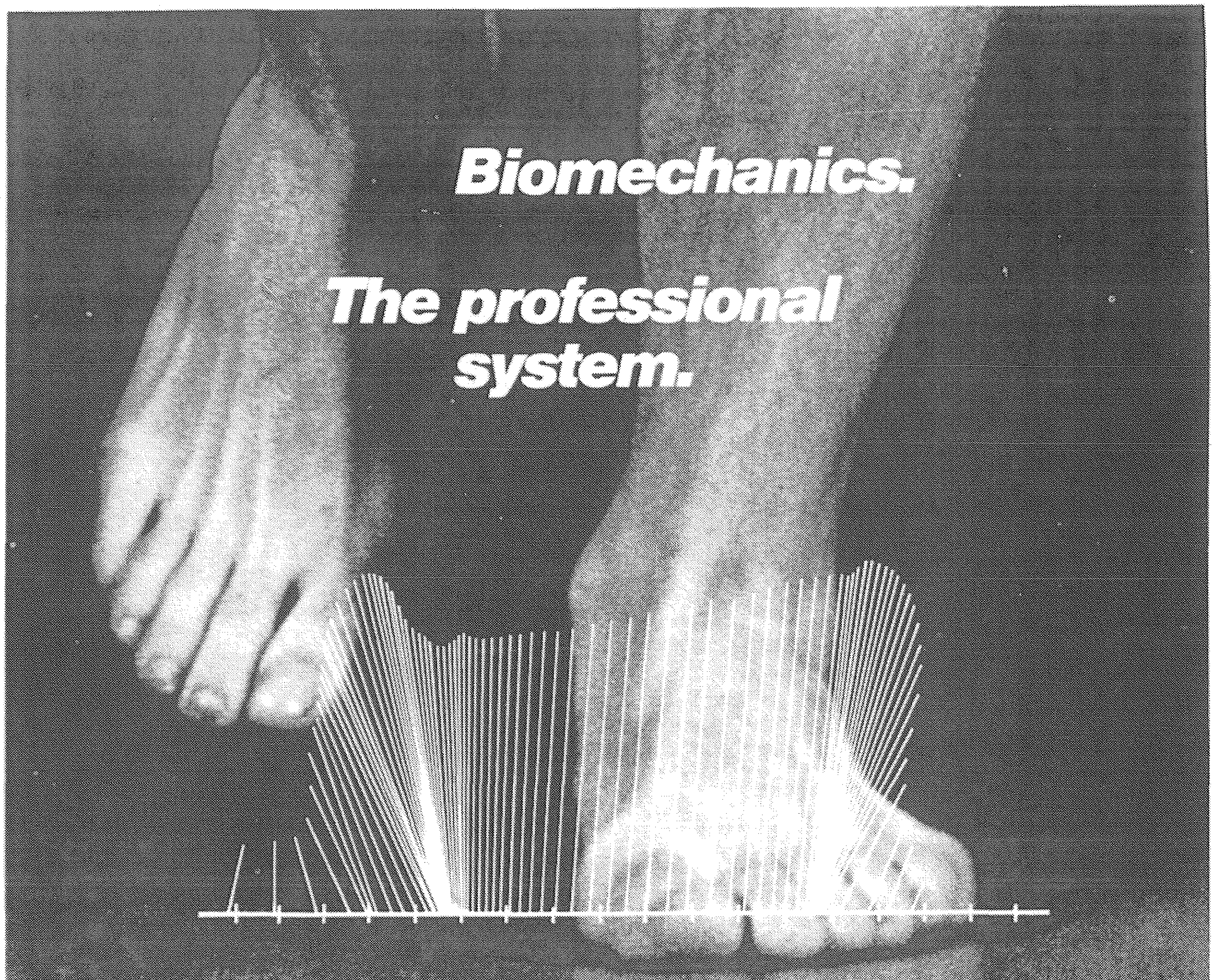

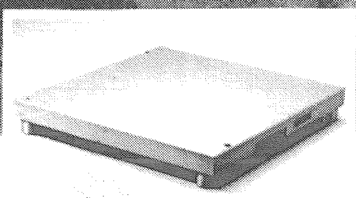

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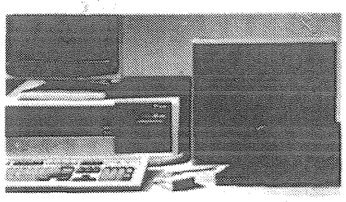

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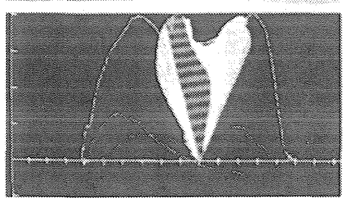

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