

## PRELIMINARY OBSERVATIONS AND CONCLUSIONS

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### INTENTION

It is virtually impossible to highlight all the new facts, the progress and the discussions emerging from this conference, in view of the large number of papers and the briefness of the papers. The oral discussions may add considerably to the written text and has not yet taken place. However, we feel that we should at least attempt to analyze the trends and developments. We are aware of the fact that such an analysis may show a bias, depending on our personal knowledge and interest.

### CONTENTS

About one hundred qualified and interesting papers have been accepted from all over the world. The East-European scientists showed their interest in participation, which is currently frustrated by insufficient financial support. The traditional dominance of West-European and North-American countries is being counteracted by participants from many other places. The contributions have been grouped in 15 topics, dealing with all aspects of the thermal environment, but also with non-thermal aspects of work. The main topics proved to be heat strain control, thermoregulation, work in the cold, and clothing and materials.

### TRENDS

A general trend is that few papers have been submitted dealing with coarse observations, as happened often in the past. Instead, many papers deal with a deeper analysis of physiology and heat transfer, showing that progress is being made.

The interest in heat strain has shifted from general heat strain to the breakdown of individual variance in heat strain. Relatively many papers deal with the influence of age, mainly from Japanese who are studying socially determined activities, but fitness seems to be the predominant factor. Systematical separation of the factors (fitness, age, gender, fatness, acclimatization, body size) is not yet common.

Progress is being made in the generalization process of clothing insulation and vapour resistance values. Tools are becoming available to estimate insulation in a reference condition and the effects of motion and wind on insulation. The mechanisms of wet and dry heat transport inside clothing are analyzed in a physical way, studying condensation and absorption.

Mathematical modelling is becoming a powerful tool for the study of heat transfer processes. Many applications include so many variables that experimental approach is too expensive and the problem too complex to oversee. By means of model studies the heat balance in the extremities is studied, the heat and moisture transfer in clothing, and the human heat balance in outdoor conditions. Models have become accepted as a database compilation and are no longer restricted to specialists publishing in not application oriented journals.

As a spin off of the Gif conflict many heat control protocols and devices are being developed. Prominent are the cooling garments. Effectivity and feasibility have been shown, but there is a power requirement problem, restraining their use. Heat strain control by protocol is still widely investigated.

### TOPICAL DEVELOPMENTS

- The production technology of semipermeable materials has so advanced that the porosity can be controlled and within limits be adjusted to the desired value.
- Functional design of clothing continues; next to comfort safety plays an increasing role.

- Inspired by European standardization activities the safety aspects of touching hot and cold surfaces are studied.
  - Finger temperature or finger blood flow is gaining in interest as an indicator of the thermal state of the body, both with regard to thermal control and **CIVD**, and also to study age differences.
  - Very elegant equipment for active noise reduction and tympanic contactless temperature measurement has been developed.
  - The effects of wearing protective clothing on the wellbeing of workers is **becoming** subject of study.
- A shift in approach of fire-fighting heat strain is observed, more studies being done in (simulated) field conditions compared to laboratory studies.

#### TOPICAL LACK OF DEVELOPMENT

- There is a drive for integration of protection against various threats into single materials, in view of the bulk and weight of the clothing. Integrated materials are shown, but relatively few.
- Thermal sensation for clothed persons is more complicated than for nude. The use of psychological methods is indicated, but better progress is waiting for implementation of these methods on a larger scale. One good example is shown.
- Few papers deal with heat acclimatization. However, some papers deal with the still debatable effects of cold acclimatization.

#### DISCUSSIONS

- The discussion of the importance of counter-current heat exchange for heat conservation keeps going on. Effectivity of CC heat exchange seems difficult to define.
  - Stroke volume is proposed as a criterion value for heat and exercise tolerance, superior to heart rate or core temperature.
  - There is a renewed interest in the calculation of body heat content in cold conditions. The usual weighing between core and skin temp may deviate largely.
  - The influence of body composition on cold tolerance is being confirmed.
- A strong belief in the existence and relevancy of selective brain cooling is expressed. It is not sure if this ends the discussion.

#### OTHER REMARKS

It has been shown increasingly difficult to obtain industrial sponsorship for conferences. We thank W.L. Gore and Associates for their generous support.

The number of participants tends to drop to the the number of speakers. This is due to the general policy not to provide travel funds if not a presentation is given. This sure enough is good for the active participation of all, but increases budgetary problems.