

Environmental Physiology – What's It All About?

....how animals function in and respond to their environment (**i.e., how do animals cope**)

....an outgrowth of comparative physiology – need to study animals where they live...real conditions

....hence, **eco-physiology, physiological ecology, adaptational biology**

Beginnings of “Environmental Physiology”

Difficult to pinpoint a specific time or individual

A 20th Century development

Factors that stimulated interest:

- 1) Armed forces operating in inhospitable climates**
- 2) Construction projects in stressful environments**
- 3) Observations of plants/animals in these areas**
- 4) Expansion of traditional “comparative physiology”**

Some early pioneers

- E.F. Adolph
- Knut Schmidt-Nielsen
- P.F. Scholander
- C. Ladd Prosser
- George Bartholomew



Behavioral and Morphological Adaptations

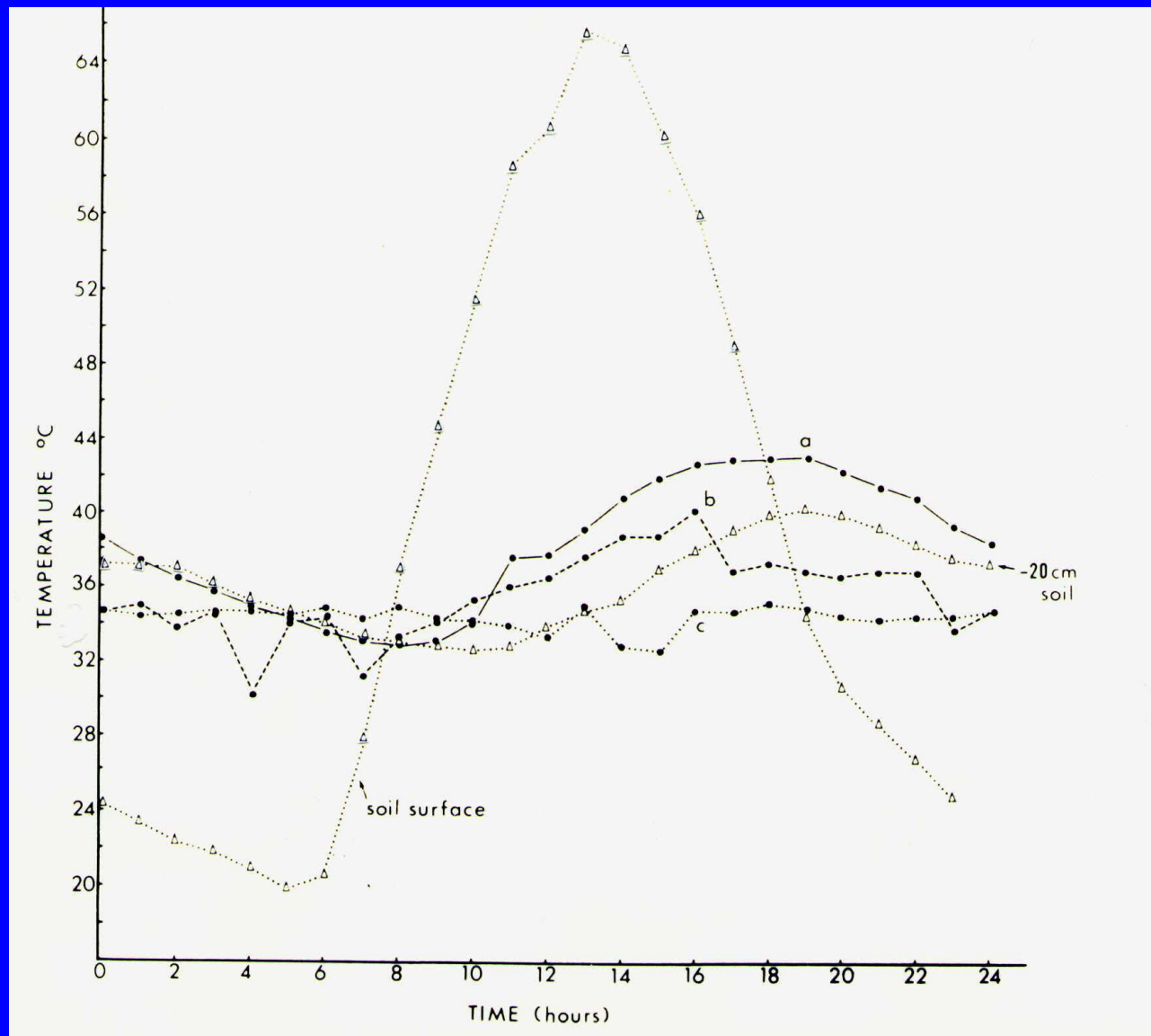
Most important adaptive characteristic – ability to burrow or seek cover

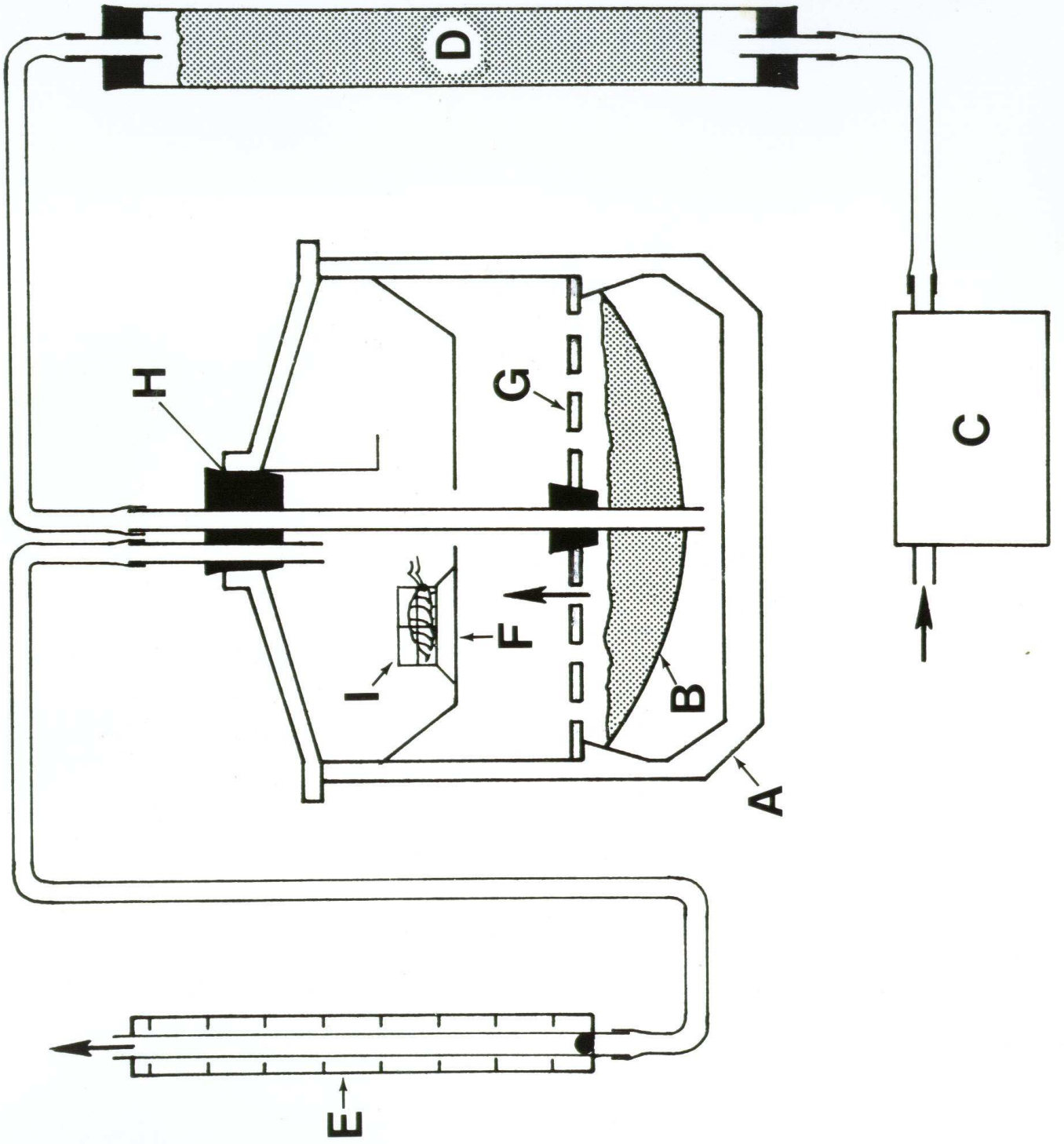


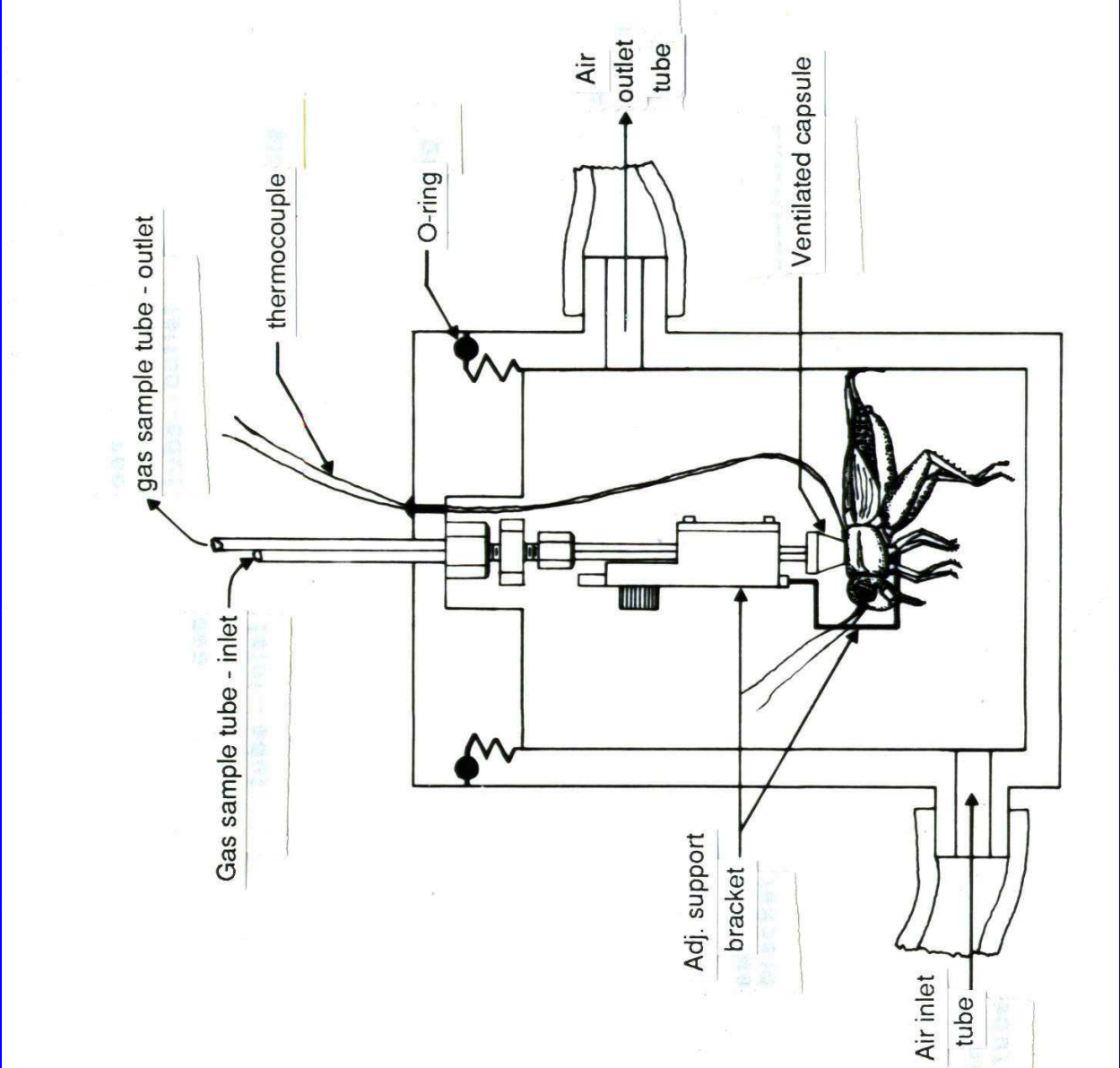
Excavation of tiger beetle burrow

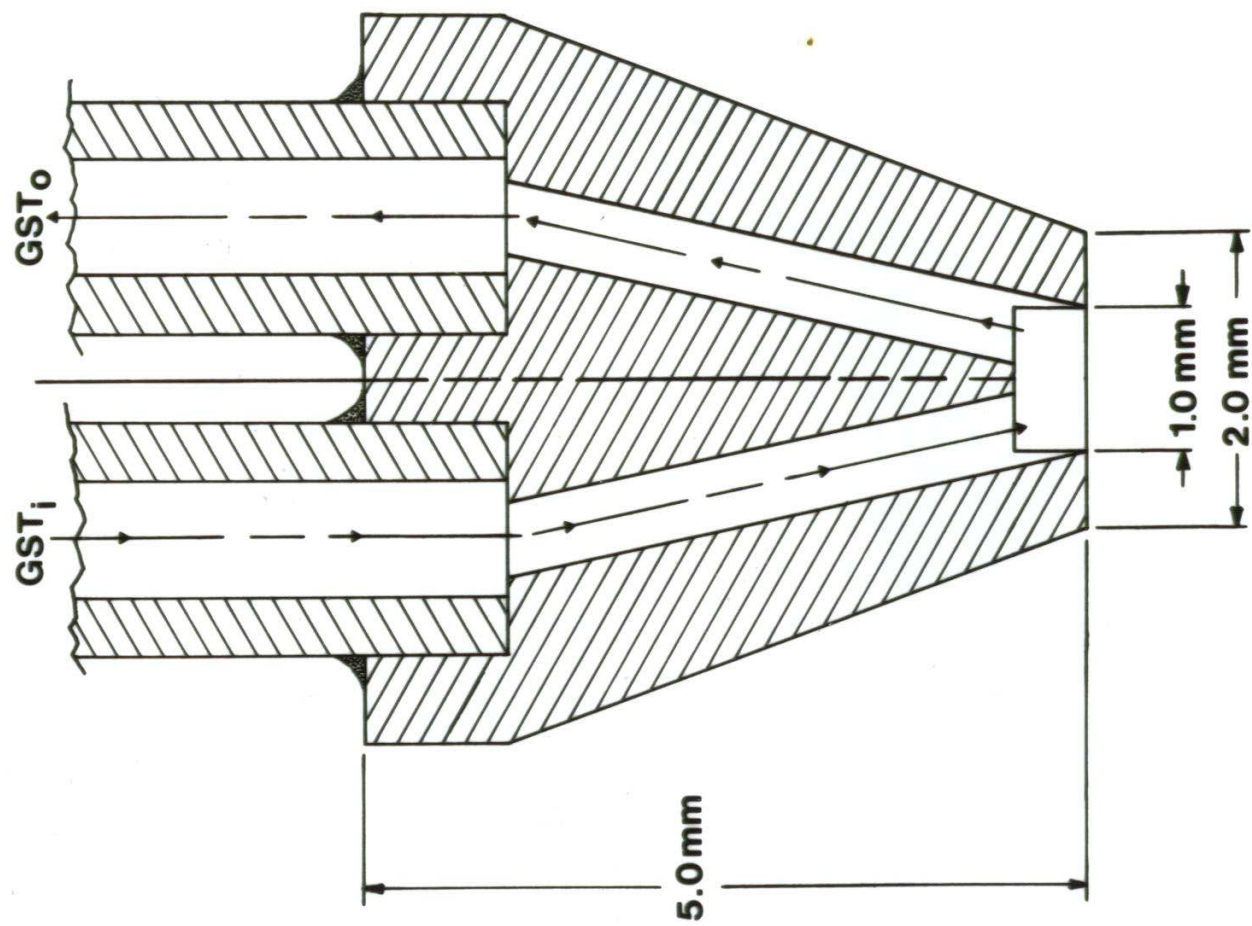


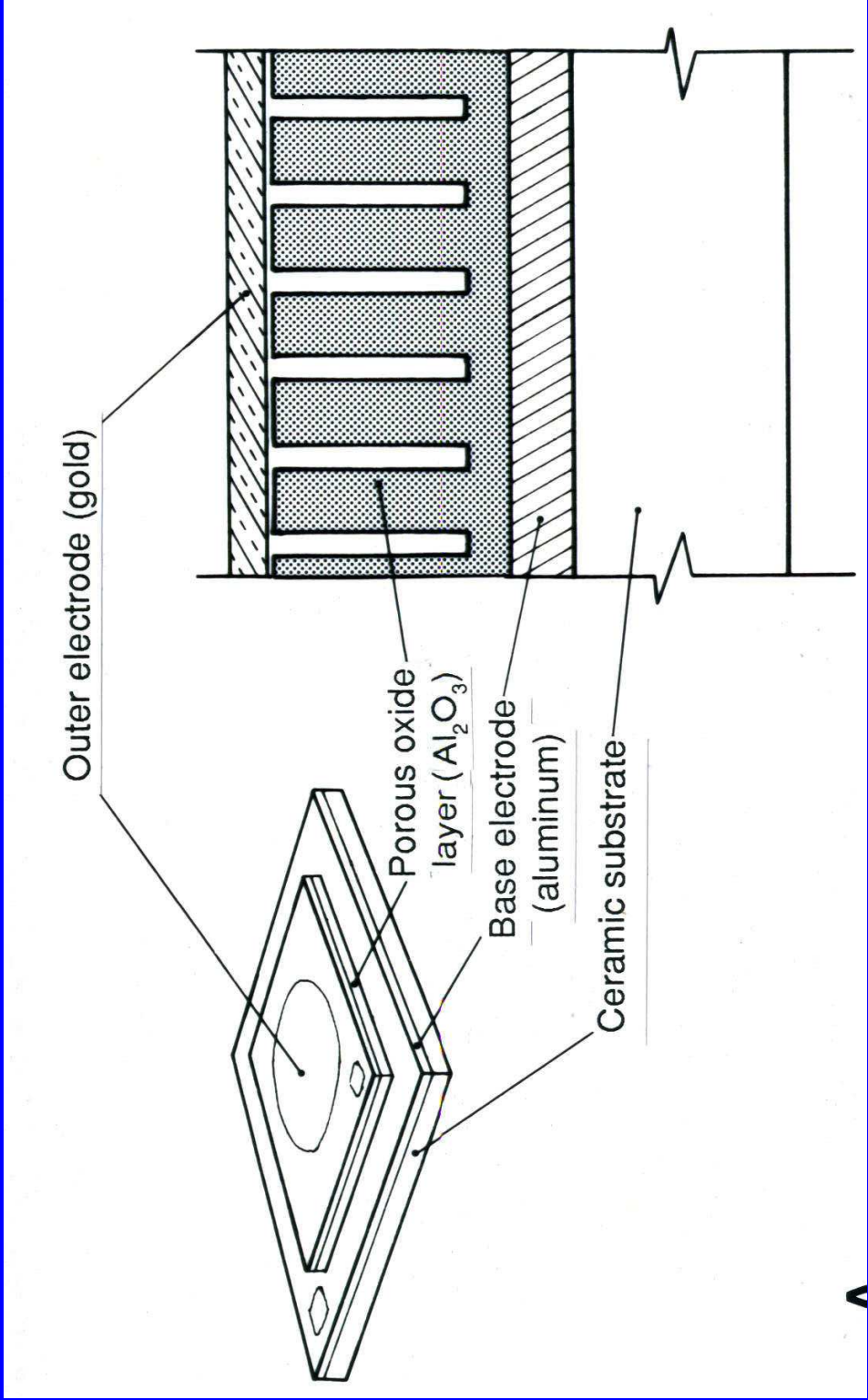
Burrow temperatures experienced by 3 scorpions

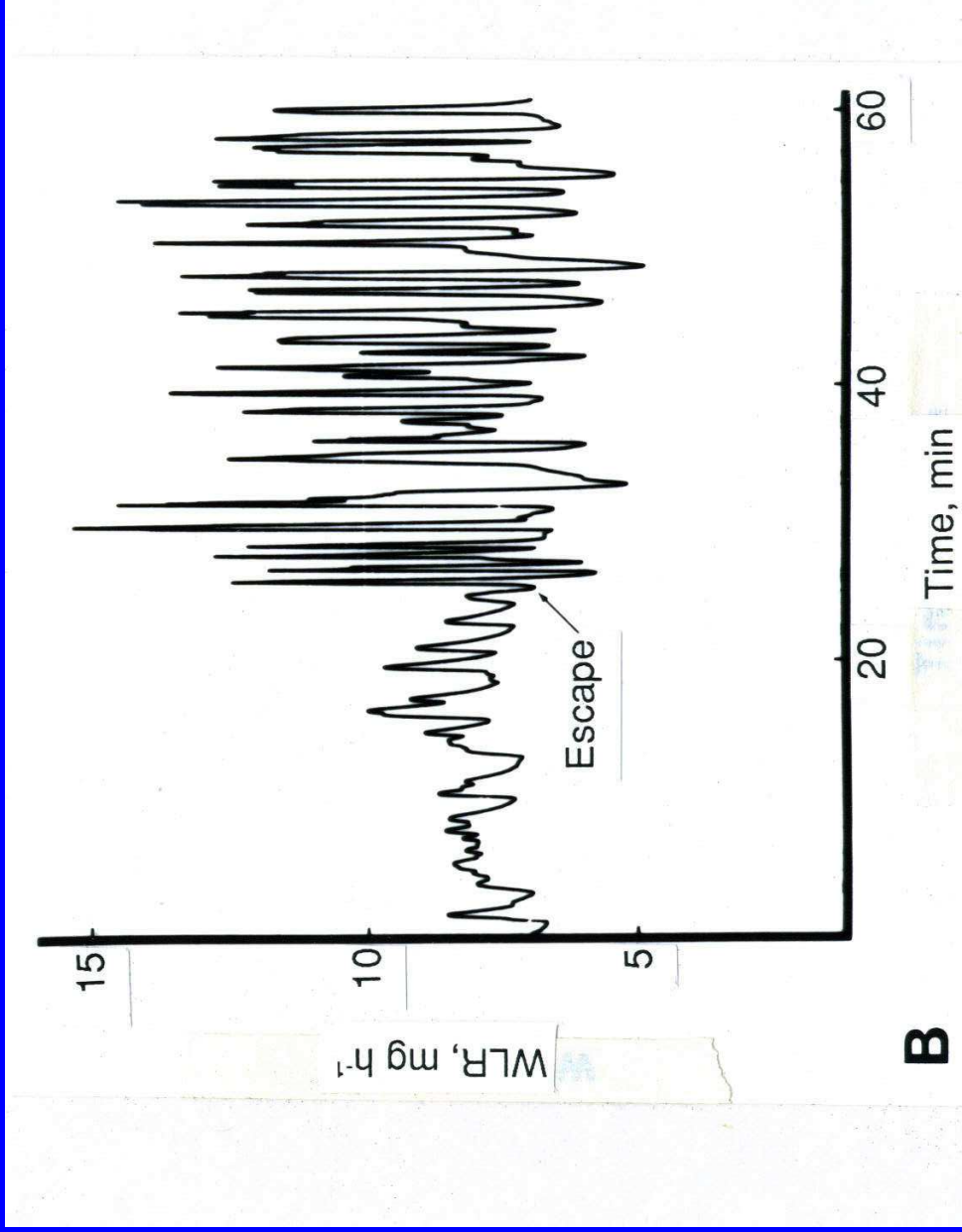


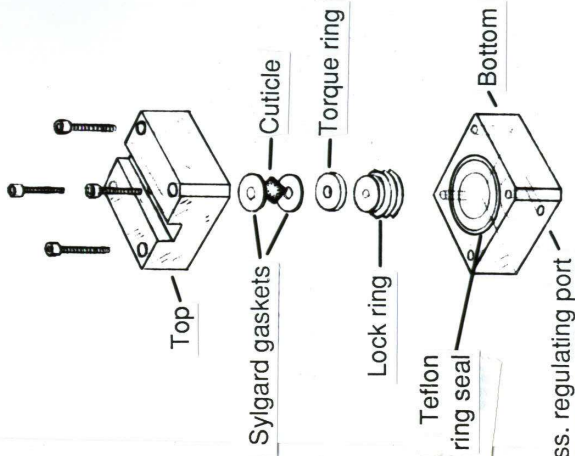
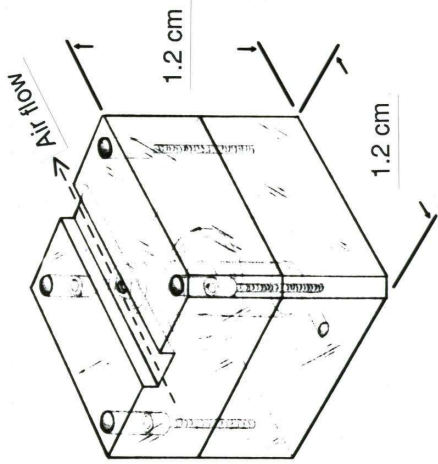




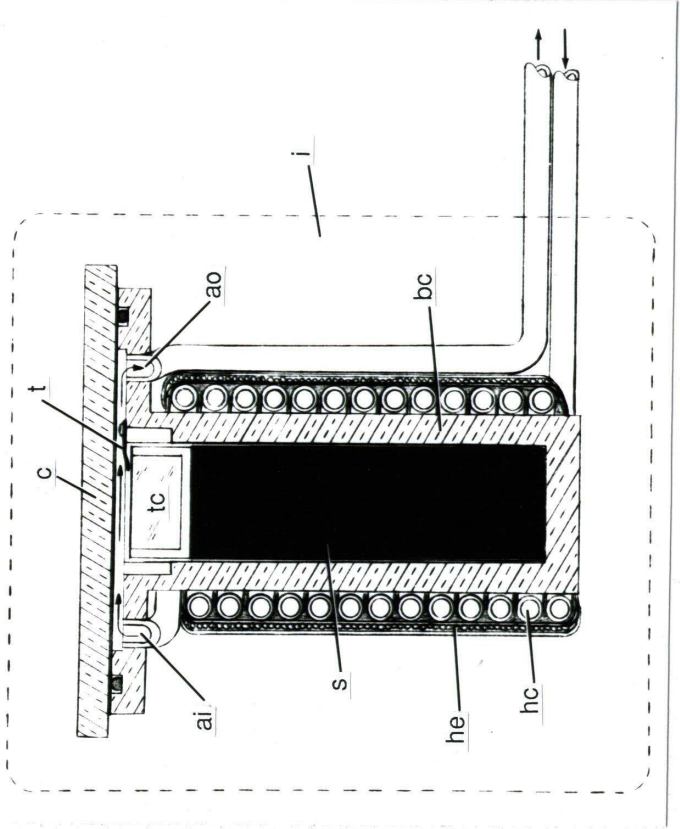


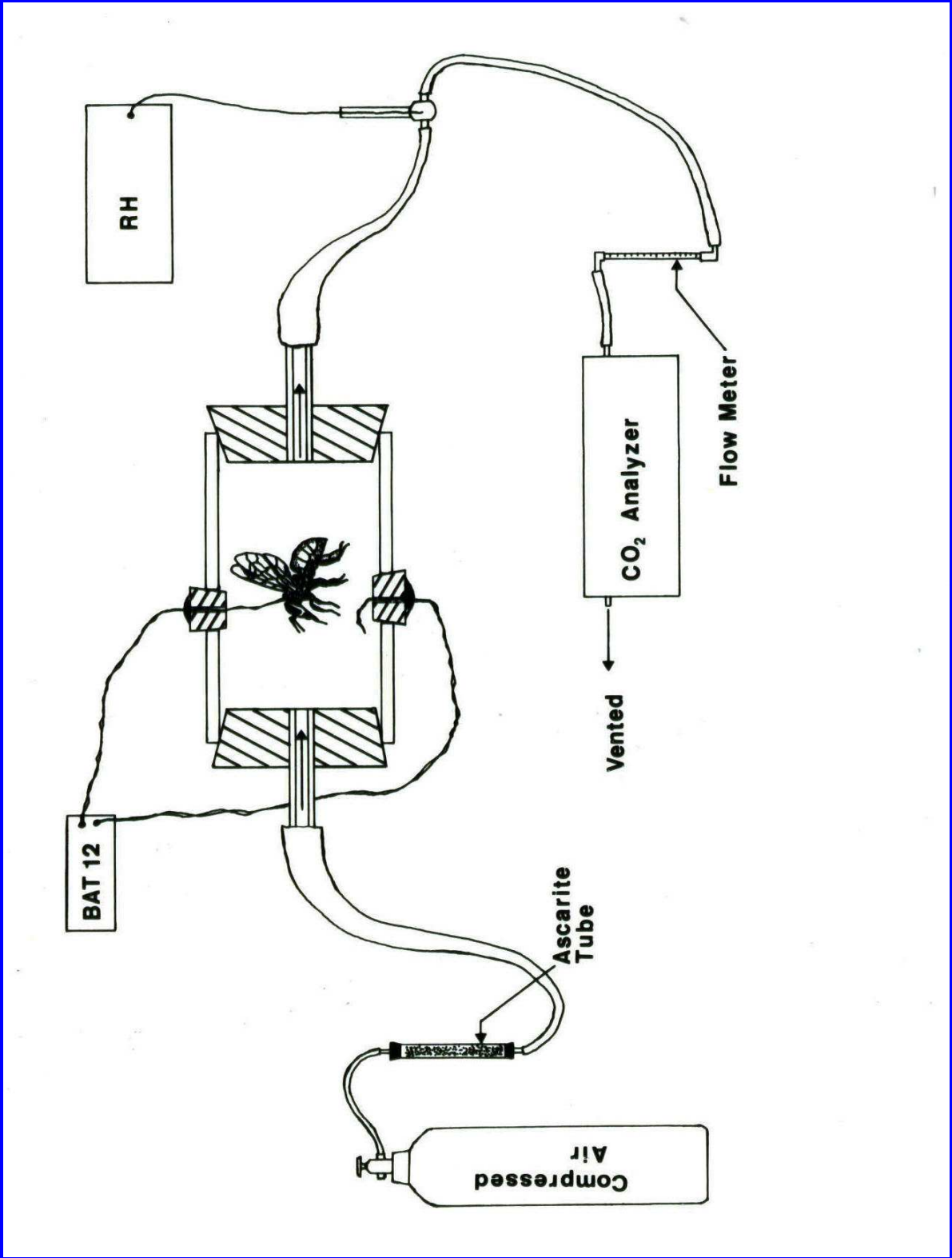


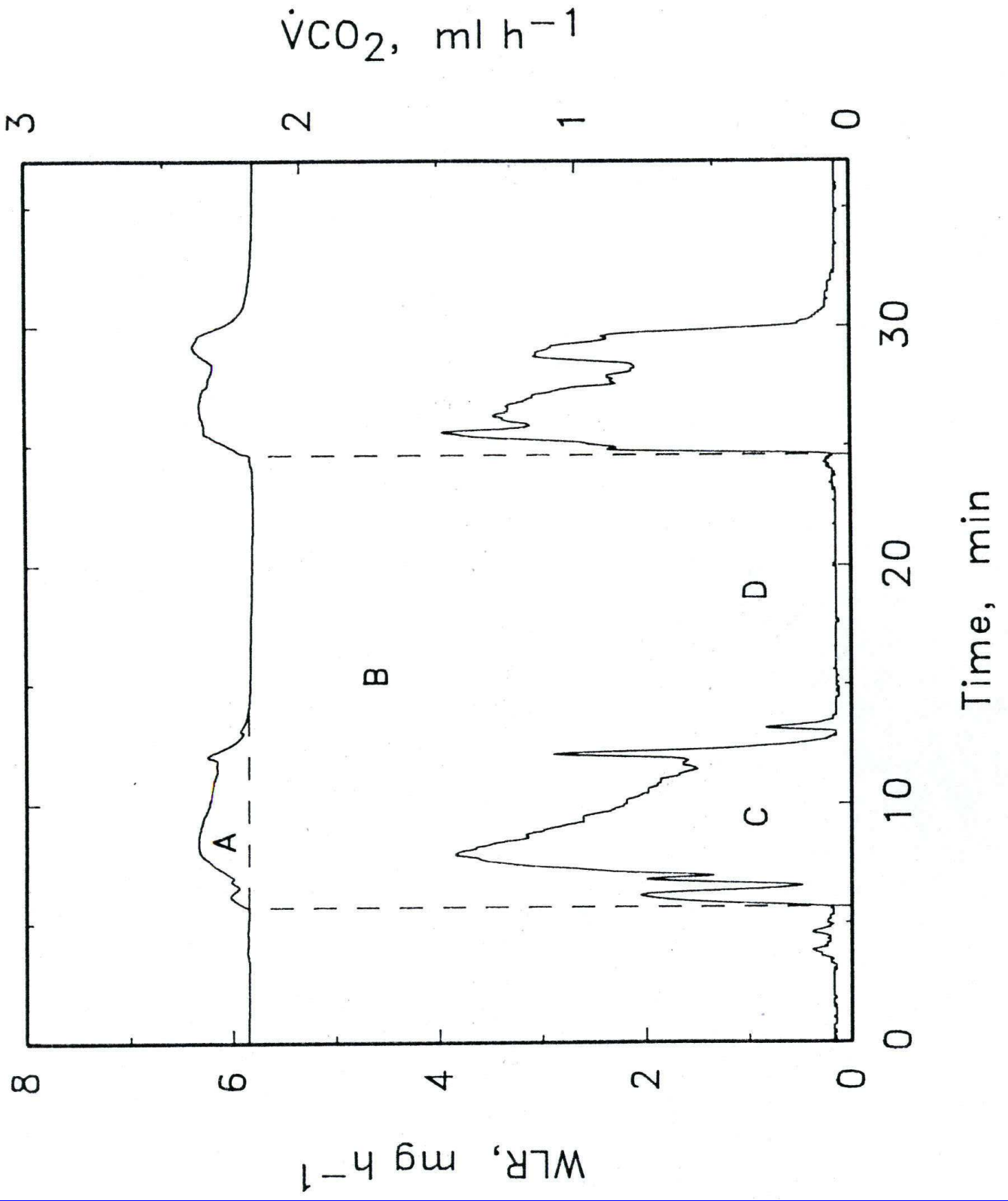


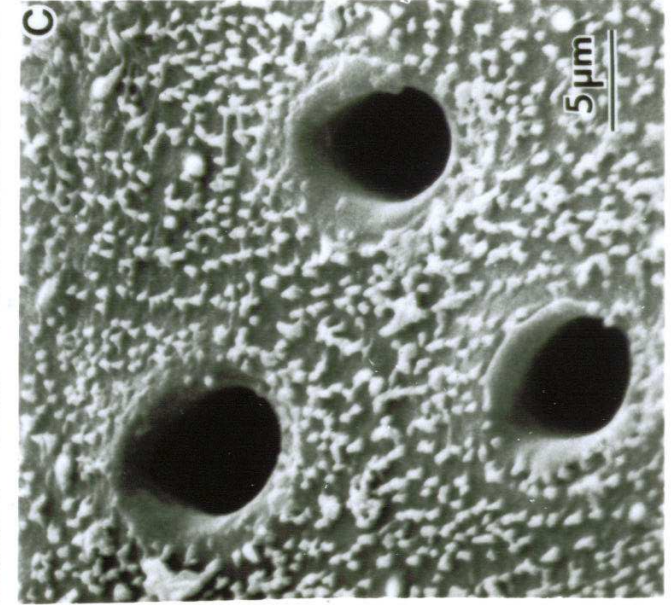
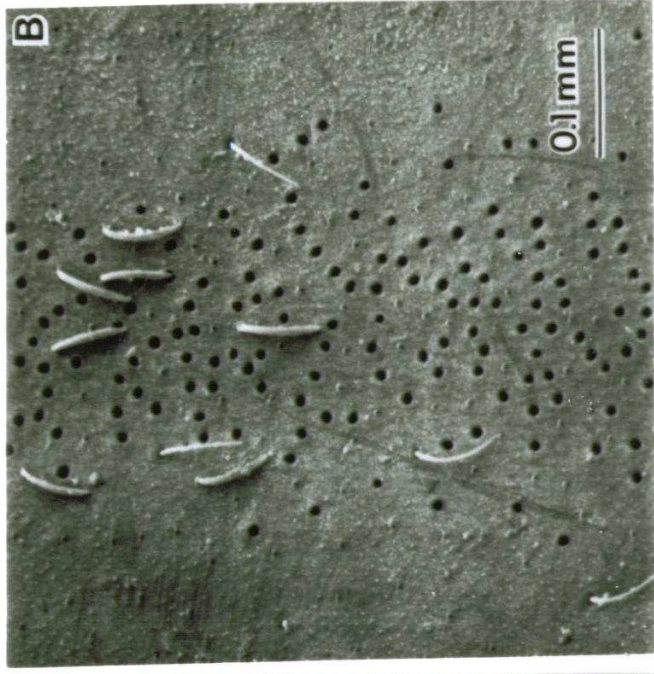
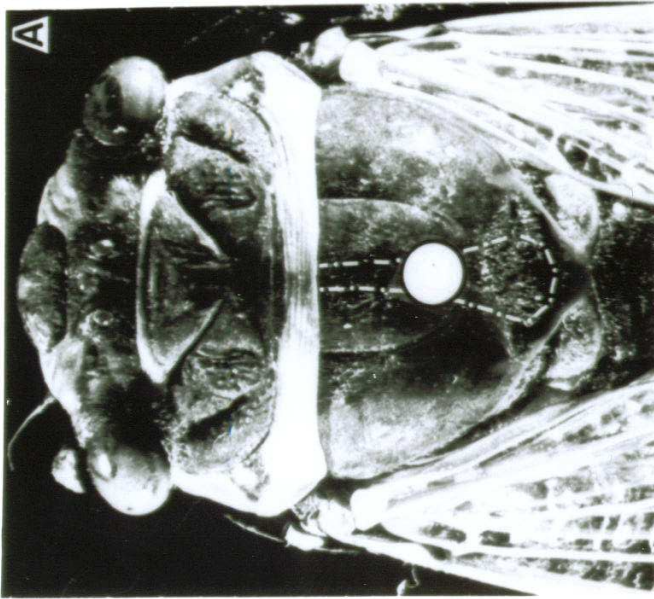


Press. regulating port

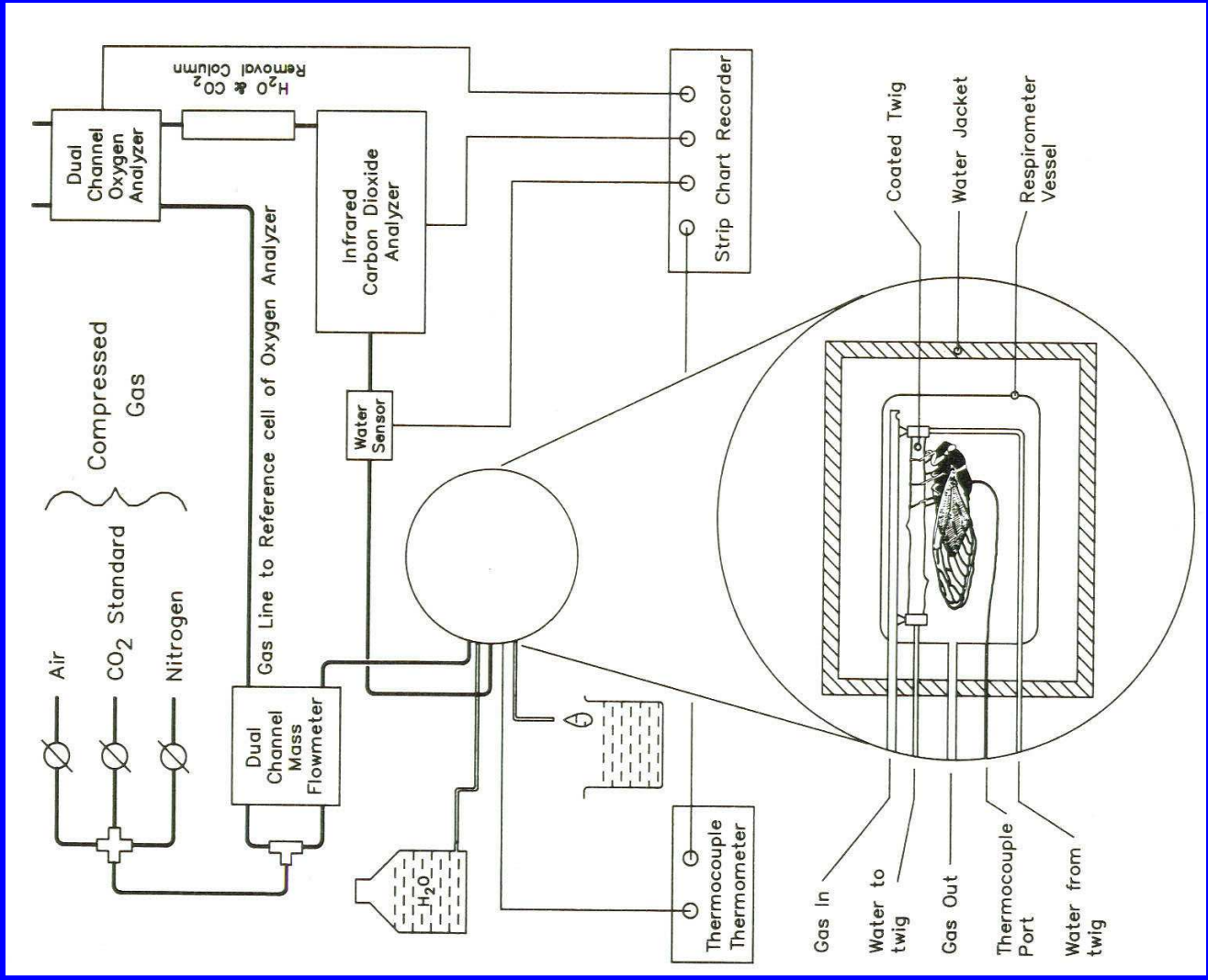


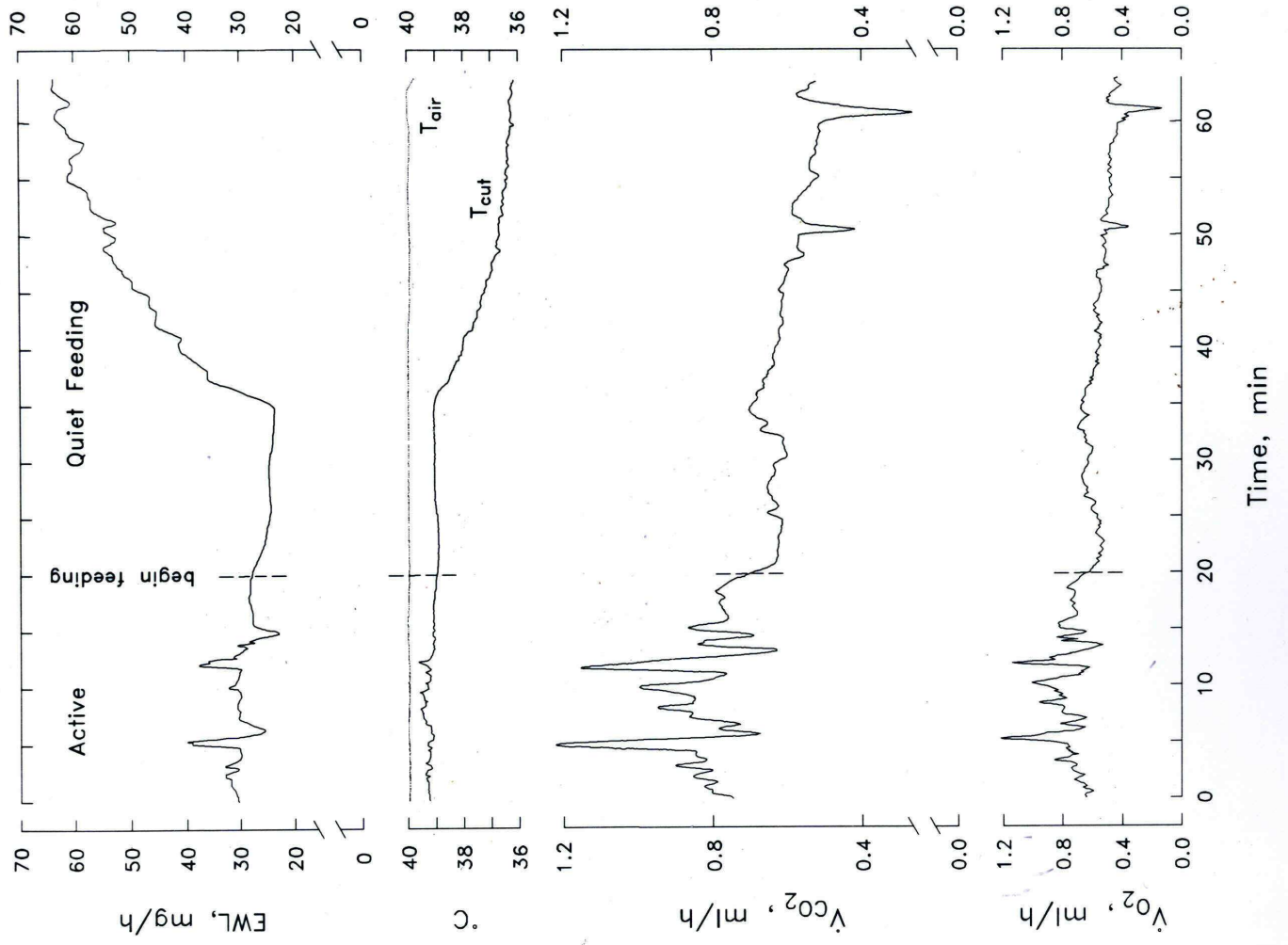






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What is an “extreme” environment?

Habitat or region not conducive to life because of
abiotic and/or **biotic** factors present

- Excessive heat or cold
- Lack of water or moisture
- Extreme radiation or wind
- Inhabitable substrate
- Inadequate cover
- Inadequate food (vegetation
or prey)

Deserts – Hot



Deserts - Cold



Polar Regions



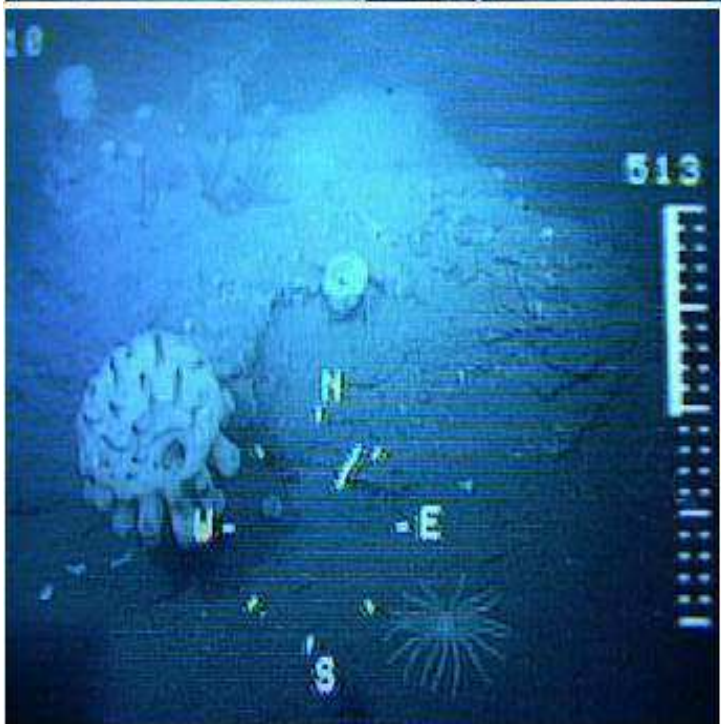
Ocean Depths



BATHYAL, 510-520m, off Eureka, Calif. Above left: octopus. Above: catshark and searobin. Above right: seastar



Above: seapen with brittle star--very common site. Left: carbonate rock with a sea cucumber nearby.



Far left: carbonate rock with sponges, and nearby seastar. Middle left: mushroom corals withdrawn into central body, on a carbonate rock. Left: sea urchin and clams that live off bacteria in a seep area.

Caves



High Elevations



Adaptational Biology

Fundamental characteristic of living tissues

Adaptive mechanisms can involve:

- 1) behavior
- 2) morphology
- 3) physiology
- 4) biochemistry
- 5) any combination of the above

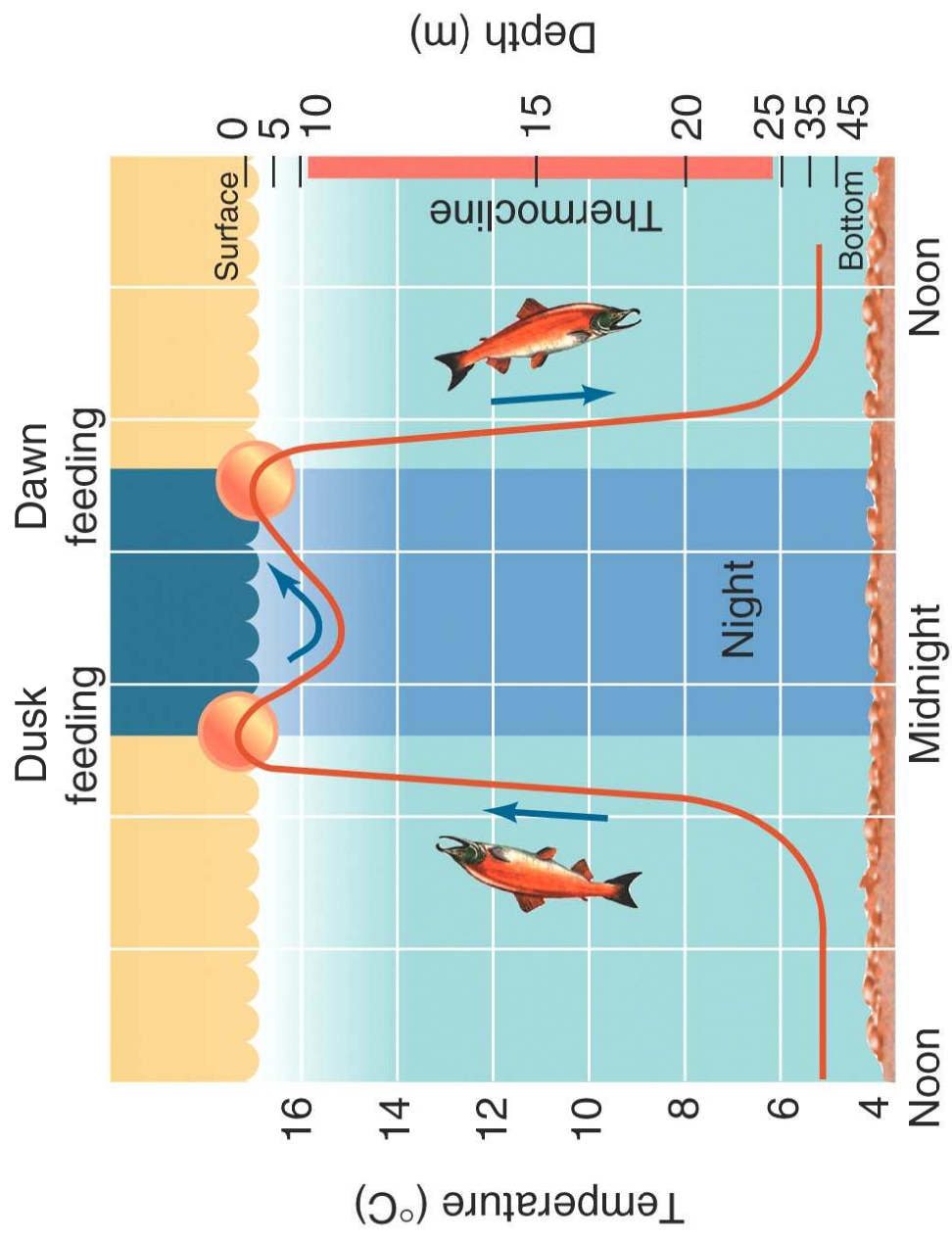
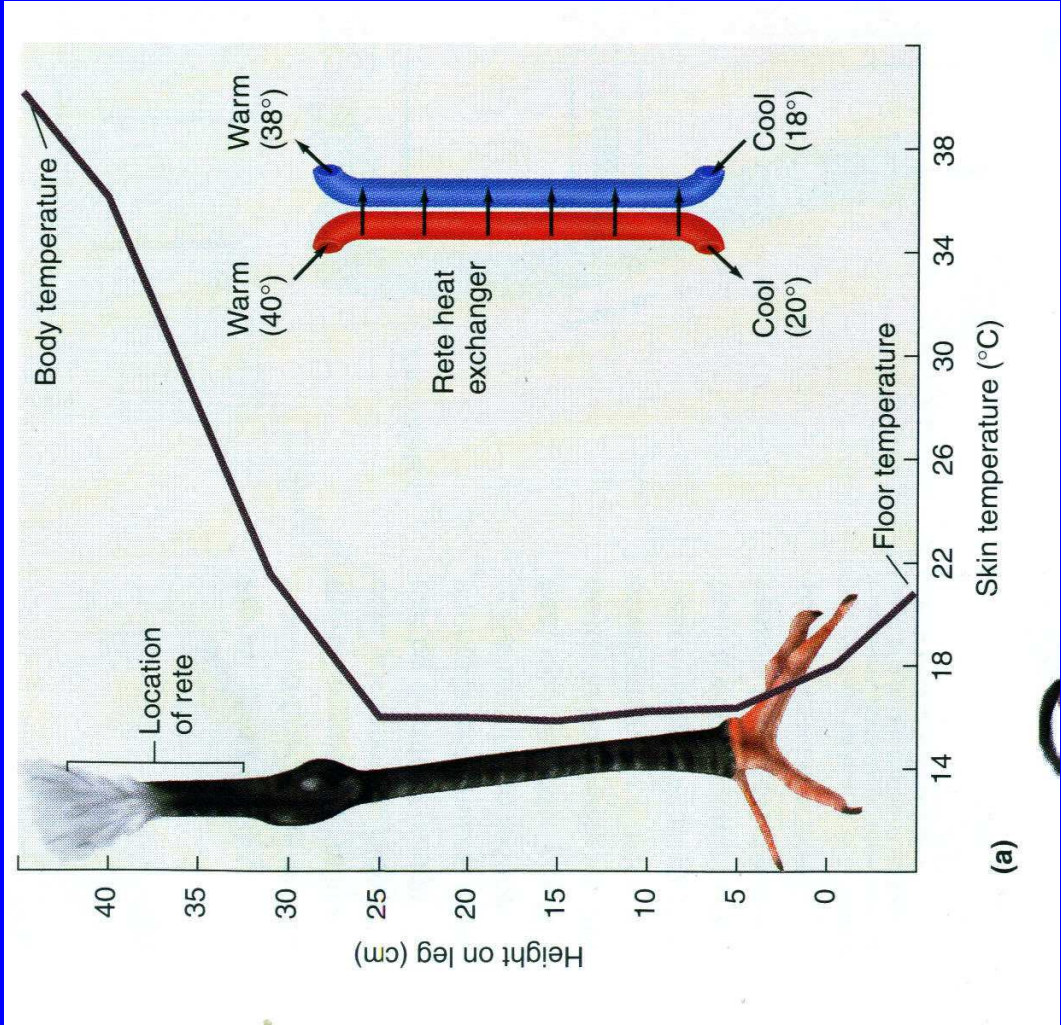




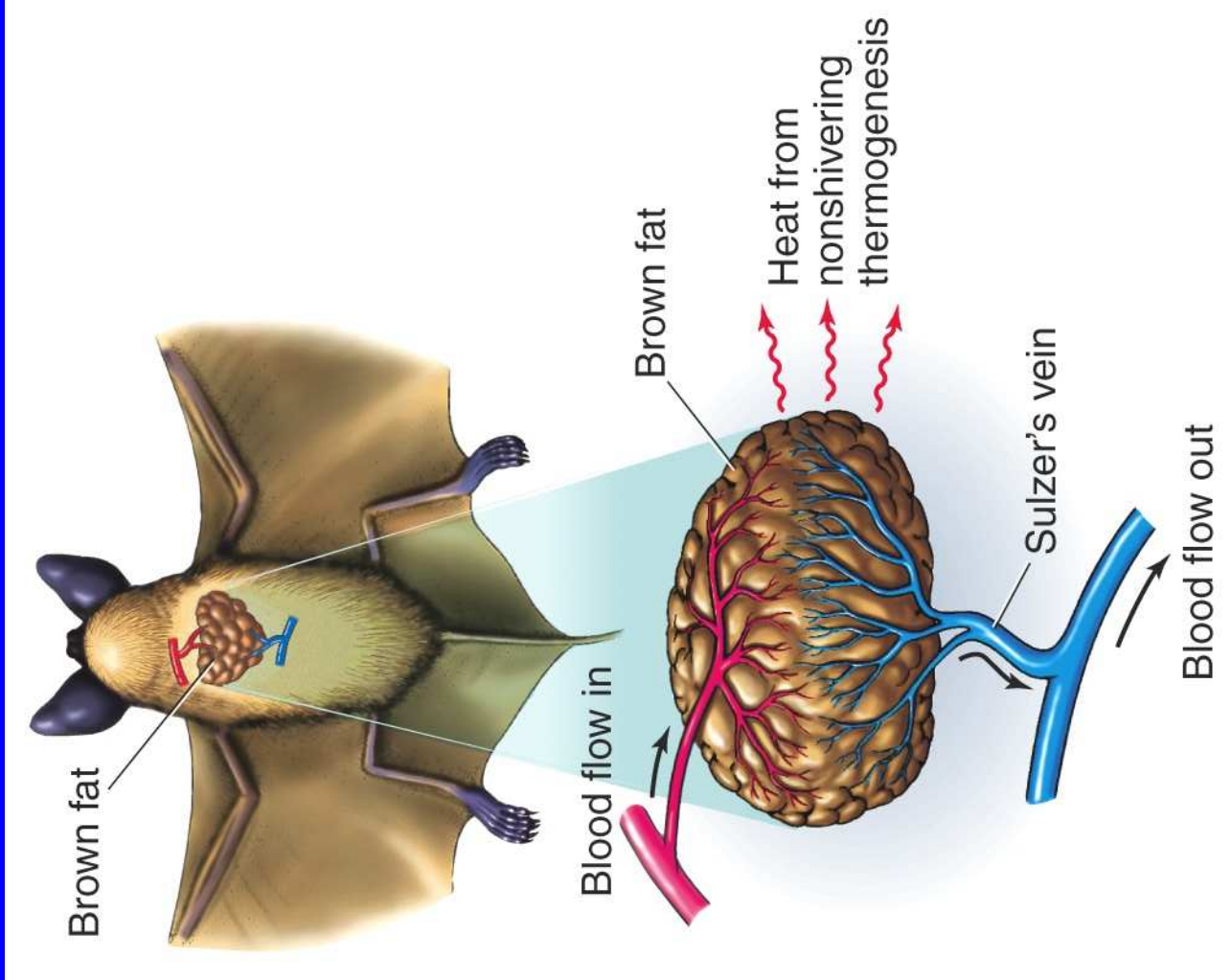
Photo: © Bill Schmoker

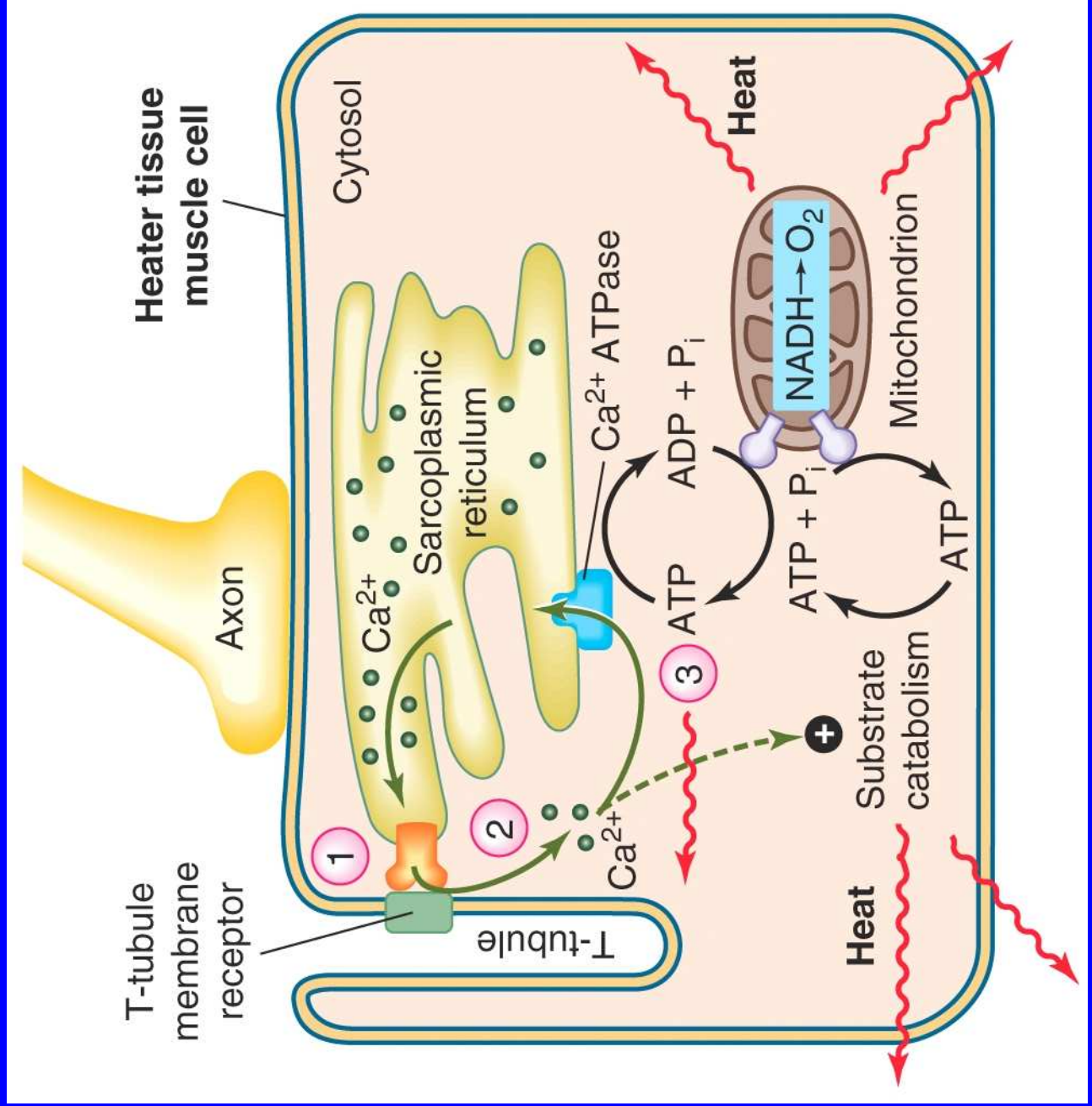
A roadrunner ruffles its feathers to expose its dark skin, which absorbs sunlight to help heat the animal's blood.





(a)





Adaptations: Three time scales

- **Genetic Adaptations**

- Alterations that favor survival of a species or strain in a particular environment
- Part of the genetic heritage (millions of years)

- **Periodic Adaptations**

- Adaptations to regular (cyclic) changes imposed by movements of solar system (e.g., monthly, annual)

- **Short-term Adaptations**

- Rapid **responses** to the immediate environment

Types of Adaptations

1) Capacity Adaptations

- Functional properties that permit relative constancy of biological activity over a normal “varying” environment
(e.g., positive metabolic or enzymatic adaptations)
- Often measured as rate functions (e.g., Q_{10})
- Commonly seen in cycling environments

Types of Adaptation

2) Resistance Adaptations

- Occur at environmental extremes
 - (e.g., most animals narrowly limited by temperature; resistance adaptations allow them to withstand lower or high temperature than those at which activity is optimal)
- Limit the geographic and seasonal distribution of plants and animals
- May involve extensive biochemical changes
- Measures include: reproduction, survival, protein denaturation

Adaptations Basically Serve Two Functions

1. Maintain an essential constancy despite changing environmental conditions
“right a wrong”;
compensatory adaptations
2. Effect continuing or permanent changes to better meet environmental demands
gives organism new potential for making use of environment or invading new environment
exploitatory adaptations