this observation in two seals (Fig. 3).] The consensus has been that this response is due to profound peripheral vasoconstriction and consequent reduction in the effective size of the systemic circulatory bed. The present experiments strongly suggest that the pulmonary circulatory bed, similarly, is severely reduced in size during diving. Whether mechanical or vasomotor effects are predominantly involved remains to be clarified.

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OSMOREGULATION IN Oniscus asellus

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The most serious problem facing terrestrial arthropods is water conservation. In arachnids and insects, the key to attaining a full degree of terrestrialness was the development of a surface wax layer to restrict water loss from the body. Terrestrial crustacea and myriapods lack such a layer and are essentially cryptozoic; they rely heavily on behavioural mechanisms designed to restrict them to cool damp regions under logs and stones. Although these behavioural mechanisms have been studied extensively, very little is known about the osmoregulatory capacity of these cryptozoic animals. Osmoregulation was, therefore, studied in the terrestrial isopod, Oniscus asellus, which was collected in the vicinity of the laboratory. Animals were kept in small glass dishes containing damp filter paper and pieces of carrot.

The first experiment involved testing the osmoregulatory capacity of animals under the stress of varying degrees of desiccation. Animals were placed individually in small gauze-covered containers and dehydrated over $CaCl_2$. Rate of water loss was very high (10% body weight/hr at 20-22° C) and the animals died after 3 hours. This rapid rate of transpiration is to be compared with that found in insects such as Tenebrio where the presence of a waterproofing wax layer reduces transpiration (0.05% body weight/hr at 23° C). When dehydrated, Oniscus displayed no capacity to regulate its internal milieu. The normal osmotic pressure (475 milliosmoles - range 420-510) increased in proportion to the increase in water loss from the animal. Despite this large increase in osmotic pressure, the animals appeared normal; the only obvious response to desiccation was an increase in activity. A similar response has been noted in behavioural studies on terrestrial isopods and is believed to have adaptive significance in that it plays a part in the orientation mechanisms which are directed toward aggregating the animals in moist environments. In this first experiment the severity of the osmotic stress and the large scatter of points (due partly to the wide range of osmotic pressures found in the normal population) may have masked a limited osmoregulatory capacity. Consequently, a more detailed study was made of those organs which may function in osmoregulation.

The antennary glands represent the major organs of osmoregulation in Crustacea. Careful dissection of the head capsule of Oniscus failed to reveal these organs even after injecting the animals with lissamin green or phenol red. The functional significance of these glands was assessed by following the fate of the above dyes when injected into the animal. Phenol red (200 μg/g) was completely cleared from the blood in approximately 30 minutes and lissamin green (400 μg/g) in about 45 minutes. The animals were kept throughout the post-injection time on clean filter paper and there was no evidence that dye was being eliminated from the body. Subsequent dissections showed that all the dye had accumulated in the lumen of the four large midgut caecae. Further studies revealed that phenol red gradually left the caecae and was eliminated via the faeces. Rate of dye elimination from the body was related to rate of faecal pellet production. Where feeding activity was low, large amounts of dye were still present on the caecae after 7 days but the dye was completely eliminated in 4-5 days from actively feeding animals. These experiments suggest that in terrestrial isopods the excretory function of the antennal glands has been taken over by the gut. A possible role of the gut in osmoregulation was, therefore, investigated.

Osmotic pressure determinations were made on fluid samples obtained by micropuncture from different regions of the gut. Under normal conditions the fluid in the midgut caecae and in the midgut was isosmotic with the blood. In the rectum, however, the fluid was either isosmotic or hypotonic; perhaps the rectum functions in osmoregulation by conserving salts. In dehydrated animals, the fluid in the midgut caecae was mostly hypotonic to the blood, suggesting that osmotic equilibration across the caecal wall was relatively slow. On the other hand, the fluid in the midgut and rectum was isosmotic with the blood. In many cases it was impossible to obtain a fluid sample from the rectal lumen because the faecal pellet was very dry. Whether or not this is achieved by reabsorbing water against an osmotic gradient as occurs in insects remains to be determined.

The results of this investigation clearly indicate that the osmoregulatory mechanisms of _Oniscus_ cannot cope with increasing water loss. Apparently the animal normally regulates its osmotic pressure by striking a delicate balance between loss and intake of water. If _Oniscus_ is dehydrated and then provided with water, it will drink avidly and soon regains its original weight. Internal osmoreceptors probably regulate the rate of fluid intake. When distilled water is provided, the drinking rate declines as the original body weight is approached. However, if the animals are presented with a concentrated sodium chloride solution (630 milliosmoles—approximately isosmotic with the blood of animals which have been desiccated to the same extent) the animals continue to imbibe fluid far in excess of their original body weight. It thus appears as if the drinking response of _Oniscus_ is regulated according to the osmotic pressure of the blood.

Conclusion. The success which terrestrial isopods enjoy on land is due not so much to the development of morphological and physiological mechanisms conferring independence of the environment, but to behavioural mechanisms which restrict them to humid environments. Rather than regulating when faced with drying conditions, they simply withstand the large elevations of their blood osmotic pressure. Mobility remains, thus enabling the behavioural mechanisms to dictate a move to more favourable surroundings and ensuring a return to normal blood concentrations.

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