KIN. On May 9th, Dr. Charles Sydney Atkin. Qualified 1913.

RSON. On May 6th, Philip Garson, F.R.C.S. Qualified 1924.

CALENDAR

ne

t. 14th Dr. R. Bodley Scott on duty.
Mr. R. S. Corbett on duty.
Mr. R. W. Ballantine on duty.
Tennis: v. St. Georges (A).

t. 21st Dr. E. R. Cullinan on duty.
Mr. J. P. Hosford on duty.
Mr. C. Langton Hower on duty.
Tennis: v. U.C.H. (A)
Cricket: v. Royal Dental and Charing Cross Hospital (H).

t. 28th Medical and Sugical Units on duty.
Mr. G. H. Ellis on duty.
Tennis: v. Middlesex Hospital (H).
Cricket: v. Jesters (H).

July

Sat. 5th Dr. Geoffrey Bourne on duty.
Mr. J. B. Hume on duty.
Mr. F. T. Evans on duty.
Cricket: v. U.C.S. Old Boys (H).
Tennis: v. Dulwich School (H).

Sat. 12th Dr. A. W. Spence on duty.
Mr. C. Naunton Morgan on duty.
Mr. R. A. Bowen on duty.
Cricket: v. Incogniti (H).
Tennis: v. London Hospital (H).

Medical Staff

The following appointments to the medical staff take effect from the dates mentioned:—

Department of Pathology
Senior Registrar: Dr. E. G. Rees going to U.S.A. for 12 months: Dr. J. A. Gobert-Jones will act as Senior Registrar during his absence from 1st October, 1958.

Department of Diagnostic Radiology
Registrar: Mr. A. R. Chrispin: 1.10.58.

Department of Anaesthesia
Registrar: Mr. A. M. Keil.

* * *

APRIL, 1958, CLINICAL ENTRY

Busfield, H. M. B.
Hertford College, Oxford.

Cawdery, J. E.
Oriel College, Oxford.

Meade, T. W.
Christ Church, Oxford.

Stephan, Miss J. C.
St. Hilda's College, Oxford.

Waring, Miss A. M.
Lady Margaret Hall, Oxford.

THE HIDE OF THE RHINOCERUS

by **Prof. A. J. E. CAVE**

IN PINPOINTING the idiosyncrasies of one's fellows, traditional practice invokes, by way of metaphor or simile, the real or imagined characteristics of particular members of the animal kingdom. Such conventional attributions are usually apt, succinct and convenient of employment. This socio-zoological terminology may involve reference to the whole animal (as when a mischievous child is called a monkey or a stubborn man a mule) or to some particular of its anatomy (e.g., the heart of a lion, the brain of a hen, the eye of a hawk). All understand the connotation of

such terms, which compose a considerable repertoire. Therein "the hide of a rhinoceros" enjoys a long-established usage, as the ideal derogatory term to be applied to the "thick-skinned" fellow who is impervious to blandishment and censure alike, whose monumental stolidity is undisturbed by criticism and who rests impenetrably armoured in indifference. Such a one fits awkwardly into community life, wherein, fortunately, he is not over-abundant, though in diverse walks of life in modern societies he may be discerned among those who, of set purpose and from the humblest origins, have attained the summit of worldly success.

The purpose of this notice, however, is not a disquisition upon psychology or sociology, but an examination of the factual basis for the adoption of the rhinoceros as the classical embodiment of thick-hidedness, recalling that some other animals (e.g., elephant, hippopotamus, giraffe) have sufficiently thick skins, yet have not been selected by custom as exemplars. For it is pertinent to ask whether the choice of the rhinoceros in this connexion is merely empirical or whether it rests upon a scientific basis and to determine what distinctive physical characters of rhinoceros skin have so impressed naturalists and hunters and influenced popular opinion.

Despite much information on the subject gleaned from the flaying of wild or captive animals, the final answer to these questions must obviously be sought from the histological examination of rhinoceros skin and the discovery thereby of its exact intimate structure. The opportunity to undertake such examination was recently provided through the generous co-operation of two professional colleagues—Dr. E. H. Williams, of Arua, in the West Nile District of Uganda, and Dr. D. B. Allbrook, of the Anatomy Department, Makerere Medical College, Kampala. Both these gentlemen, indefatigable in sustained efforts to procure rhinoceros material for the writer's researches, have now increased his debt of gratitude by providing items suitable for microscopic examination—Dr. Williams, by collecting in the field (under the greatest difficulties) specimens of the skin and some other organs, Dr. Allbrook by forwarding blocks and slides of the collected material after preservation and processing. The source of the specimens was an immature White Rhinoceros (*Ceratotherium simum*). For the first time, therefore, it has been possible to study the histological nature of rhinoceros skin, of this species at least: that of the other rhinoceros species remains as yet apparently undetermined.

Before detailing the results of its microscopical examination, it is convenient to review that general knowledge of rhinoceros skin gleaned from the observation of living, and the flaying of dead, animals, which has formed the basis of its traditional reputation.

To one familiar with the smooth, supple, hairy skin of most mammals, that of the living rhinoceros appears to be "dead" and inert—a dull, wrinkled (sometimes tuberculated), hairless armour plating, resembling oak-bark rather than mammalian tissue. Not only does it give an impression of extraordinary thickness, but experience demonstrates the difficulty of its penetration save by sufficiently sharp or powerful weapons.

Upon flaying, the detached hide is found to be tremendously thick, heavy beyond expectation and exceedingly difficult of manipulation. It may weigh almost a ton and require a dozen or more men to drag it over the smoothest ground. Its consistency is that of a sheet of thin steel and it defies all attempts at folding (Heller[3]). So thick and rigid is it that it cannot be worked and (beyond the occasional manufacture from it of curios) it lacks commercial value and is of service to the taxidermist only.

It is these pronounced physical properties of density, thickness and inelasticity which have so caught the attention of naturalists and collectors and have conferred on the rhinoceros its unique reputation in respect of its skin. The phrase "the hide of a rhinoceros" is therefore justified by general experience as the most fitting designation of an impenetrable, dense and unyielding exterior.

Microscopical study of White Rhinoceros skin sections reveals the structural basis of its distinctive physical properties, in the form of an enormous augmentation of the dermis proper, found to be composed of the densest possible felting of pure collagen fibres. However, it further discloses the presence in the dermis of hair follicles, sebaceous glands, specialised apocrine sweat glands and blood vessels in fair abundance. The skin is discovered, indeed, to be no inert, lifeless outer wrapping, but instead to be a protective, sensitive, excretory organ, of typically mamma-

lian constitution though specialised in certain particulars in conformity with the animal's mode of life. (As anticipated, sectioning of the skin-blocks proves difficult, and the best sections obtainable measure 15-20μ thick).

The heavily cornified epidermis is unexpectedly thin (averaging 1 mm.), although in regions of the body not examined it may be thicker: it has the classical component layers and sends down into the dermis hair follicles, sebaceous glands and peculiarly large apocrine sweat glands. The dermis is 18-20 times the thickness of the epidermis. A section of the relatively thin belly skin yields the following mensural details:—

epidermis = 1 mm.

stratum corneum	.....	0.25 mm.
„ lucidum	.....	0.5 mm.
„ granulosum „ germinativum	}	0.25 mm.

dermis = 18 mm.

In other situations the stratum corneum equals or exceeds in thickness the stratum Malpighii. The stratum lucidum is not everywhere apparent. The stratum granulosum is some two cells thick. Small melanin granules are present in the stratum corneum.

The extraordinarily thick dermis is a felting of dense collagen fibres, running in all directions relative to the surface. It contains no admixture of elastic fibres, any such present in the sections being confined to the walls of the skin arterioles. It is this extremely thick, non-elastic dermal layer which accounts for the characteristic physical properties of rhinoceros skin.

The hide is attached to the deeper structures by a non-resistant superficial fascia permitting facile removal of the skin. This layer is uniformly rich in subcutaneous fat, which in adult animals is a good inch thick on the back and two inches thick on the belly. Conservation of the body heat is thus assured by so substantial an insulating layer.

The presence of hair follicles containing in their depths the stumps of body hairs is noteworthy, since the animal is generally described as lacking body hairs save for those of the eyelashes and of the ear- and tail-fringes. In certain places hair-shafts extend further up the follicles, some of them even reaching the body surface. Nowhere are hairs discovered freely projecting. A distinct, if scanty, equipment of projecting body hairs, becoming less obvious with increasing age, has been noted by Bigalke[1] in a young White Rhinoceros. It may be that such projecting hairs are duly removed by the repeated friction of mud-bathing and rolling, or that they are shed naturally since any external hairy coat is rendered superfluous by the thickness both of the dermis and its underlying subcutaneous fat.

The sebaceous glands are relatively small and feebly developed: they are of piriform appearance and tend to be arranged in single pairs around individual hair follicles.

The ordinary, small type of sweat gland is not found in any of the sections studied. Instead, relatively enormous apocrine sweat glands (recalling those of human axillary skin) are an obtrusive histological feature. These large glands, not particularly numerous in the sections examined, occur in the superior part of the dermis as coiled networks, disposed in open basket fashion around the bases of the hair follicles, each gland having an individual blood supply. Their ducts spiral surfacewards, being fairly capacious in their intra-dermal, but narrower in their intra-epidermal, extent. Both the glands and the ducts are closely surrounded by numerous myoepithelial cells of remarkably large size, which constitute a distinctive and unexpected structural feature. The large apocrine sweat glands are well vascularised by cutaneous vessels which pierce the deep aspect of the dermis (through 1 mm. wide "foramina") and divide freely within this layer to gain the individual glands.

Thus rhinoceros skin (in this species at least) is typically mammalian in constitution, but is functionally specialised in respect of its dermis and its sweat glands. Physiologically, it is a highly active organ, subserving tactile sensation, the prevention of heat-loss and the elimination of body fluid in exactly comparable fashion to the skin of any other mammal.

Since structure is but the morphological expression of function, the large apocrine sweat glands with their huge myoepithelial cells call for interpretation in terms of the animal's physiology. In the White Rhinoceros, as in other perissodactyl mammals, unwanted body fluid is discharged as sweat or urine. The daily urinary output of this crea-

ture is not known and would appear almost impossible of accurate assessment, even in the case of the captive specimens at present living in zoological gardens (London, Antwerp, Pretoria). This is because of the peculiar mode of micturition, which consists of a discontinuous series of partial bladder contractions, at irregular intervals, during the animal's progress around its territory. Sweat output must complement that of urine, and a certain (but as yet unknown) degree of reciprocity must obtain between the two. But additionally, so large a beast as the rhinoceros has need of some active mechanism whereby body fluid can be discharged suddenly and copiously, as after severe exercise, in order to obviate a deleterious rise in body temperature. Normally, the White Rhinoceros moves about in cool, dull or cloudy weather only, and avoids bright sunshine. When pursued on a hot day it can be seen to sweat, and Coryndon[2] has reported the sudden drenching with sweat of a struggling young animal—a discharge so profuse as to simulate its dousing with a bucketful of water. These facts suggest that the body temperature remains, and must be maintained, at a fairly constant level, and that machinery of some sort is necessary to ensure the occasional sudden release from the body of considerable quantities of fluid in the form of sweat. Such machinery is obviously to hand in the large apocrine sweat glands and in the enormous and numerous myoepithelial cells which are so striking a feature of their structure.

REFERENCES

(1) Bigalke, R. (1950) *Proc. zool. Soc. Lond., 120,* 519-528.
(2) Coryndon, R. T. (1899) in Bryden: *Great and small fauna of Africa,* London, 181-190.
(3) Heller, E. (1913) The White Rhinoceros. *Smithson. Misc. Coll., 61,* No. 1.

A CASE OF HASHIMOTO'S DISEASE

by **D. WEITZMAN**

THE TYPICAL clinical picture of Hashimoto's disease is that of a middle-aged woman, with a goitre of recent onset, and who may or may not have myxoedema (Luxton, 1957). The serum proteins are usually abnormal, with an increase in gamma-globulin; in consequence, abnormal flocculation reactions are obtained with thymol and zinc sulphate, exactly as in liver disease. The thyroid itself is infiltrated with lymphocytes and plasma cells. Recent work (Roitt et al, 1956) has indicated that the disease process is the result of auto-immunisation. Animal experiment (Witebsky, 1957) has shown that thyroglobulin is antigenic: release of this substance into the circulation, following injury to or disease of the thyroid gland, can provoke antibody formation. Individuals naturally vary in their capacity to produce thyroid antibody: should this reach a high titre, an antigen-antibody reaction takes place in the thyroid with destruction of normal histology and its replacement by lymphadenoid tissue. The presence of circulating thyroid antibody can be demonstrated by the technique of Doniach and Roitt (1957). Thyroid extract and the patient's serum are suspended separately in agar with a neutral zone of saline between (Fig. 1). Thyroglobulin and serum gradually diffuse into and meet in the saline zone: if thyroid antibody is present in the serum, precipitation occurs with the formation of an opaque white ring.

It is thus apparent that any form of thyroid disease or injury may be followed by the subsequent development of Hashimoto's disease provided that thyroid antibody is formed in high titre, although it is uncommon for