sodium concentration in the blood serum. During the next week her condition became critical and the concentration of sodium fell still further to a level of 107.8 m.eq. per l. and the potassium rose to 7.1 m.eq. She was given only one injection of 10 cc of "Eschatin," a commercial preparation of adrenal cortex substance, intravenously and then received 12 to 15 gms of NaCl daily. It is interesting to note that after one week of NaCl administration the patient became almost entirely symptom-free and that simultaneously the abnormalities of her blood practically disappeared.

The mechanism of base loss in Addison's disease is not clear, but seems to be intimately related to the clinical picture of adrenal insufficiency and is being studied at the present time. It seems possible that the symptom complex may in part depend upon the profound changes in the relative concentrations of sodium and potassium. Whether or not the replacement of base in the patient M. W. was responsible for the amelioration of symptoms can not be stated, but the improvement which has persisted for two months with forced NaCl administration is impressive.

In conclusion, it may be stated that the clinical picture of severe adrenal insufficiency in many respects simulates that of other disease conditions, in which the loss of inorganic base plays an important rôle. Furthermore, a definite decrease in the sodium content of the blood serum, with a simultaneous tendency for potassium to increase in concentration, has been observed in three cases of Addison's disease. The patient treated with large doses of NaCl showed striking clinical improvement with the reestablishment of a more normal electrolyte structure in the blood serum.

ROBERT F. LOEB

HEREDITARY VARIATIONS IN THE SKULL OF THE RABBIT

THE skull of the rabbit presents a group of striking hereditary variations, including two distinctive types which may be designated as *dome* and *ridge* skulls. The exact mechanism of inheritance of these conditions has not been determined with certainty, but, so far, more than 500 skulls have been studied and a brief summary of the results may be given.

Dome and ridge skulls appear to be expressions of the combined action of a group of unit factors which affect the size and shape of individual bones, the number of bones, suture patterns and the character and angle of bony union with the bregma, the coronal and sagittal sutures as visible foci of action. The bones chiefly affected are the frontals and parietals.

Considered individually, the variations concerned may be designated as "reversed suture," "accessory bone" and "fused suture." These conditions are present at birth and with continued growth of the skull lead to or become associated with other structural alterations.

In general, the coronal and sagittal sutures of the rabbit intersect at right angles or the coronal dips forward to form a slight V. In the typical "reversed suture," the coronal turns posteromedially at some distance from the bregma to intersect the sagittal in its middle third. The size and shape of the frontal bone is thus altered and the parietal correspondingly affected.

The condition described as "accessory bone" is one in which a supernumerary bone is produced by the formation of an accessory suture extending from the coronal to the sagittal suture. This suture usually follows a course similar to that of a reversed suture giving the resulting bone a roughly triangular shape. Rarely an accessory bone is found with a disproportionately long sagittal border in which case the accessory suture branches from the sagittal and runs close to and parallel with it to intersect the coronal a short distance from the bregma. The course of the coronal is often modified, its junction with the sagittal lying some distance anterior to that of the opposite side, so that the accessory bone lies partly in the frontal and partly in the parietal area.

The term "fused suture" has been applied to a condition in which the serrated markings of the suture and even the line of demarcation between bones are largely or entirely obliterated and, on the outer surface of the skull, are replaced by a smooth overgrowth of bone which creates the visual impression of continuity; in reality, the bones are still separable. The sutures affected by this change are mainly the coronal and sagittal.

The conditions described occur as unilateral or bilateral variations and in various combinations, symmetrical or asymmetrical. Individually, they produce comparatively little alteration in the general appearance of the skull, but, in combination, profound modifications of form and size are produced.

The ridge skull results from variations affecting the sagittal suture and the parietal bones. In the normal skull, the slope of the parietals as they approach the sagittal suture is very gradual and the upper face of the calvarium is comparatively flat. In the ridge skull, however, the parietals unite at an angle and their line of union, the sagittal suture, is fused. The vertical distance between the sagittal and squamosal sutures is increased and the vertex falls posterior to the bregma. Fusion of the sagittal is most pronounced in the region between the parietal bosses where normally its denticulations are widest. Parietal bosses are small but distinctly outlined and lie close to the sagittal suture. The antero-posterior arch of

the parietals is increased and the plane of the interparietal bone and the supraoccipital portion of the occipital bone is more vertical than normal. Reversed sutures and accessory bones may occur in combination with the ridge condition.

The conformation of the skull is extensively altered in the dome variation. The vertex of the normal skull is in the frontal suture between the frontal eminences and, posterior to it, the slope of the calvarium is continuous except for a slight depression at the bregma. In the dome skull this slope is interrupted by the angular union of frontals with parietals, and the vertex is at the bregma. Frontal eminences are absent and the posterior supraorbital processes show a marked lateral curvature with their extremities in contact with the anterior tips of the temporal lines. Parietal bones are flattened with inconspicuous bosses and form more posterior walls than roofs of the cranial cavity. The plane of the interparietal bone and the supraoccipital portion of the occipital bone is less vertical than normal.

Particularly interesting is the skull possessing both ridge and dome features. The sagittal and coronal sutures are fused, and the angular union of parietals and of parietals with frontals produces a sharp raised peak, the apex of which is formed by the bregma. Parietals are extremely flattened and may be slightly concave. The inclination of the interparietal and supraoccipital bones does not differ appreciably from the normal. This is the peak skull.

When unilateral, the dome condition causes a complete loss of symmetry and a bending of the whole skull toward the affected side. The parietal and frontal bones are shorter and the nasal bone longer in antero-posterior extent on the dome side, and the arches of the normal side are accentuated. The sagittal and frontal sutures, instead of forming a straight line between the lambda and nasion, describe a curve convex toward the normal side. The contour of the interparietal bone is definitely changed, the portion on the affected side being much larger than that on the normal side. The position of the bone is also altered, its plane facing posterolaterally rather than directly posterior as in the normal skull. The cutting edge of the upper incisor teeth is sloped due to a gradual shortening toward the dome side. Fusion of the sagittal suture may occur, causing increased flattening of the parietal on the dome side and decrease in the arch of the other. A reversed suture or an accessory bone may occur opposite a unilateral dome. Both of these combinations increase the distortion and accentuate the lateral curvature of the skull.

While these descriptions deal largely with the calvarium, it may be pointed out that the base of the skull and the cranial cavity are subjected to alteration and there is some evidence to indicate that the brain may be affected by these changes.

With reference to the inheritance of this group of skull variations, the conditions described as "reverse suture," "accessory bone" and "fused suture" are inherited as distinct entities. They show some variation in expression, but, in general, they are recessive to the corresponding normal condition and are either definitely expressed or absent. They are also differentiated into right and left sided characters, as indicated above, and may occur in any combination with normal characters or with other variations, but certain combinations are of more frequent occurrence than others.

The precise combination of genetic factors which produces the ridge, dome and related forms of skull is still uncertain. The typical ridge skull is comparatively rare and little is known concerning its breeding characteristics. The dome skull, from which all other variations have been derived, does not breed true in all cases, and the series of characters derived from one parent by hybrid matings may differ in some respect with those derived from another. The problem is further complicated by the wide-spread presence of factors for one or more of the characters concerned in the production of the more complex types. The implications of these findings are clear.

Genetically, the importance of the observations recorded lies in the fact that a profound variation in the form of the skull can be transmitted, unaltered, from parent to offspring; by crossing an animal possessing a skull of this type with a normal, the original variation can be resolved into a group of component parts which bear little or no resemblance to the original condition, but these are inherited as distinct entities; they are differentiated into right and left sided characters and can be recombined to form the parental type as well as new types which are capable of further transmission.

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