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NOTE ON COAT COLOR AND PHYSIOGNOMY IN NORWAY RATS[1]

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Sir Arthur Keith (1922) recognized that the bony structure of the human face may be greatly modified in certain individuals by pituitary hyperactivity (gigantism, acromegaly) and thyroid hypoactivity (achondroplasia, cretinism, mongolism). He also postulated that the tendency toward similarity in shape of face and form of body found in many individuals belonging to the same race are due in a large measure to inherited variations in quantity of the several hormone secretions that go to make up the particular glandular balance most frequently present in individuals of a particular racial group. On this basis of facial features and body form, Keith suggested that Mongolians (as compared with Caucasians) tend to have reduced adrenal, reduced interstitial, reduced pituitary, and reduced thyroid glands. Negroes in general (as compared with Caucasians) have greatly reduced adrenal, reduced interstitial, reduced pituitary, and reduced thyroid. Long legged Nilotic Negroes (as compared with Caucasians) have greatly reduced adrenal, greatly reduced interstitial, reduced pituitary, and reduced thyroid. Pygmies (as compared with Caucasians) have greatly reduced adrenal, reduced interstitial, greatly reduced pituitary, and reduced thyroid.

These racial trends in body development and face shape are very difficult to study statistically and to correlate with measureable glandular function, especially because of the great amount of hereditary variability found in each so-called race of mankind, which variability causes the races to overlap with respect to most characteristics studied. These modal racial types postulated by Keith undoubtedly represent the effects of multiple genetic factors affecting endocrine output in the several glands of internal secretion. Keith's proposition will probably long remain in the form of an "hypothesis" because usually the effects of single genes in a racial complex cannot be identified. For the present, at least, such material is incapable of complete analysis.

Some light may be thrown on the problem of the relationship of glandular function to physiognomy by the study of face shape of specific pigment variants found in human populations. The face shape effects should be particularly recognizable in populations in which the residual hereditary background upon which the effects of the mutant gene are displayed, has been made more homogeneous through inbreeding. Thus, the Moon-child (Keeler, 1950) of the Caribe-Cuna tribe of Indians probably tends toward brachycephaly with underdevelopment of the bony structures about the base of the nose. Part of

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the associated glandular variation appears to be hypothyroidism, but more extensive studies are desirable.

A glance at the products of hybridization of the many recognized breeds of dogs adds evidence for inherited glandular effects on face and body form (Stockard, Anderson, and James, 1941). Here, as in

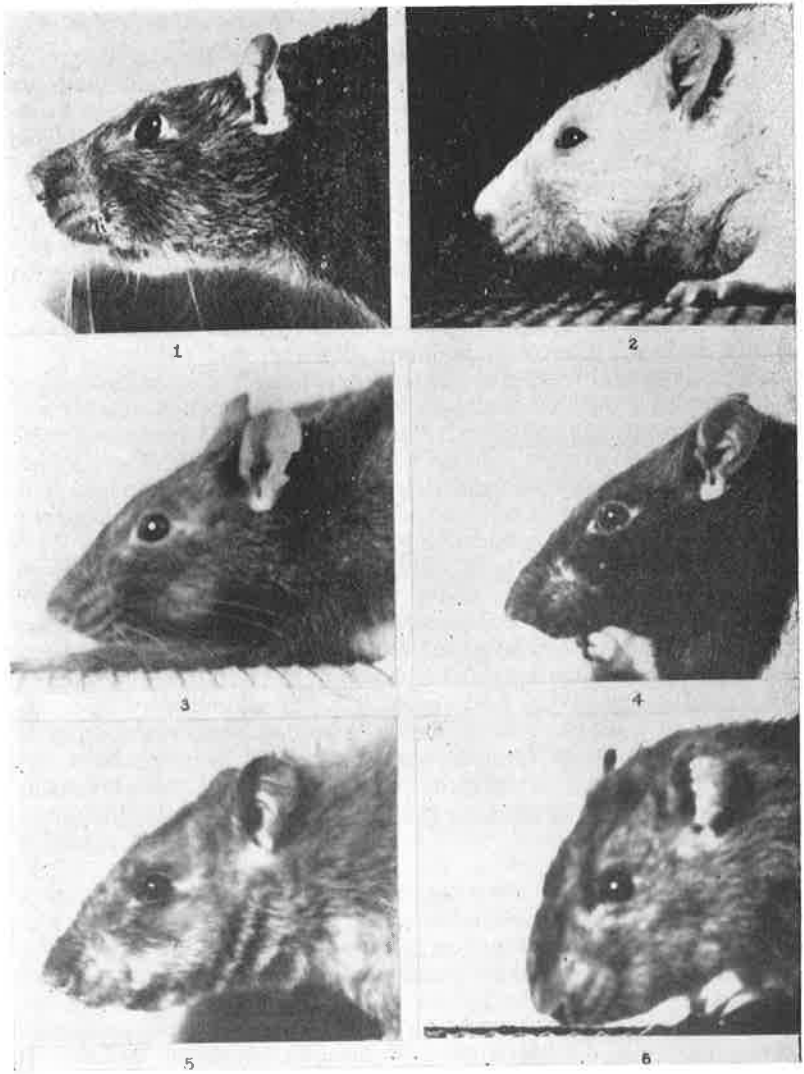

Plate I. Face shapes of various strains of Norway rats from mutations occurring in wild gray laboratory stocks. Tip of nose in figure 1 and leg in figure 3 retouched. Fig. 1, wild gray Norway male. Fig. 2, albino mutant male. Fig. 3, black (non-agouti) mutant male. Fig. 4, male rat bearing a combination of black and hooded (piebald) mutations. Fig. 5, curly haired mutant male. Fig. 6, cinnamon mutant male.

most human cases, we cannot analyze the matter further because we have no labels on the many genetic units that cause the modifications and usually, therefore, we cannot synthesize face shape types at will by making combinations of the monogenetically induced differences in glandular function. However, certain other mammals such as fur foxes, fur mink, and Norway rats may provide more useful experimental materials because specific glandular modifications are among the pleiotropic effects of certain pigment-modifying genes that are simply inherited.

For thirteen years I have been studying the pleiotropic effects of certain coat color genes in the Norway rat. During this period it has become increasingly evident that certain pigment-modifying genes do affect face shape, presumably through the intermediation of the glands of internal secretion that affect development of bony structures locally as well as generally. For this study it is only necessary to observe a strain of wild, gray, Norway rats that is inbred (thus, acquiring a uniform residual hereditary background) and to compare these individuals with those of strains that arise from the gray strain by mutations at single gene loci.

In order not to complicate the study with a consideration of sex differences, I have compared adult males of similar ages. Profile photographs were taken of several mutant strains derived from the inbred wild gray strain. The glandular comparisons between these strains have been considered previously (Keeler, 1947). The wild gray Norway male has a strongly constructed head with powerful jaws and a well built nose, for olfaction is the dominant sense in the wild, gray, Norway rat (Fig. 1). The albino mutant has the nose somewhat reduced and shortened (Fig. 2). The eyes are not prominent and this may indicate thyroid deficiency, although the albino mutant is a plucky and vicious antagonist. The black (non-agouti) mutant has the face pointed with a receding upper lip and jaw (Fig. 3). The olfactory bulbs are greatly reduced in size as is the brain. The eyes are fairly prominent but less so than in the wild gray. As Arthur Cohen says of them, "They look as though you stuck their faces into a pencil sharpener." Black mutants do not compete well with grays in battle. The black-piebalds have long, narrow heads with pointed faces and drooping noses (Fig. 4). Their eyes usually protrude. The curly rat is known to have enlarged thyroids, and as a result, its behavior is nervous and erratic. Its face is pointed (Fig. 5). The jaws appear weakly developed and the eyes pop. The cinnamons tend to become acromegalics with wide heads, massive lower jaws, and relatively small, pop eyes (Fig. 6). The upper lip does not appear to be enlarged. Cinnamons tend to grow larger than wild grays and hence the pituitary is probably hyperactive. Such an overactive pituitary would account for the trend toward acromegaly.

The important thing about this material is that by using coat color and hair form as labels for these several monogenic alterations in glandular function, individuals may be synthesized in which are combined the coat colors and hence the accompanying glandular effects

of several genes. For example, what will be the result in face shape produced by combining curly (hyperthyroid) with albino (hypothyroid)? Or what will be the result of combining cinnamon (hyperpituitary) with black (non-agouti) (hypothyroid, hypointerstitial, hypoadrenal)?

I believe that such Norway rat materials in the hands of competent experimenters over a long period of time can yield much concerning the analysis and the synthesis of specific body types and especially of face shapes.

Bibliography

Keeler, C. E. 1947. Modifications of brain and endocrine glands, as an explanation of altered behavior trends, in coat character mutant strains of the Norway rat. *Jour. Tenn. Acad. Sci.,* 22:202-209.

Keeler, C. E. 1950. An attempt to eliminate a genetic syndrome in man. *Eugenial News,* 35:3-7.

Keith, Sir Arthur. 1922. The evolution of human races in the light of the hormone theory. *Johns Hopkins Hosp.,* Bull. 33:155-159, 195-201.

Stockard, C. R., O. D. Anderson, and W. T. James. 1941. Genetic and endocrinic basis for differences in form and behavior as elucidated by studies of contrasted pure-line dog breeds and their hybrids. *Amer. Naturalist Memoirs,* No. 19. Wistar Institute, Philadelphia.

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of enzymatic oxygen removal in chemical protection against x-ray inactivation of bacteria. *Jour. Bact.,* 63:805.

Stephenson, C. V., and Ernest A. Jones (Vanderbilt U.). 1952. Force constants and calculated thermodynamic properties of nitrosyl fluoride. *Jour. Chem. Phys.,* 20:135-136.

Woltz, P. J., Ernest A. Jones, and A. H. Nielsen (Vanderbilt U.). 1952. Infra red spectrum of nitrosyl fluoride. *Jour. Chem. Phys.,* 20:378-380.