schwach war, um eine bestimmte Rheotaxis zu erzeugen, erscheint es richtig, die Temperatur als die wichtigste Variable und folglich das Verhalten der Tiere bei Nacht als eine Thermotaxis zu betrachten.

Der Befund gibt Anlass zu folgenden Betrachtungen:

1. Die Tatsache, dass die Jungfische niemals auf Lichtreize, wohl aber auf Temperaturunterschiede reagieren, weist darauf hin, dass sich die Phototaxis bei diesen Höhlentieren in der Ontogenese später zu entwickeln scheint als die Thermotaxis[2]. 2. Da eine Thermotaxis der jungen Tiere nur bei Nacht zu beobachten war, erscheint es möglich, dass diese Reaktion in Verbindung steht mit Tag- und Nachtrhythmen. 3. Dass die Jungfische im Tageslicht nicht photonegativ sind, dürfte auch mit der Futtersuche zusammenhängen. Die Futtermenge ist bei den beleuchteten Zonen wahrscheinlich grösser als in den dunkleren. Ein ähnlicher Konflikt zwischen Lichtreaktion und Futtersuchen ist schon von anderen Blindfischarten bekannt[3], und dieses Verhalten wäre bei Jungfischen um so eher zu verstehen, als man es hier mit wachsenden und somit relativ viel fressenden Tieren zu tun hat. 4. Die Lichtindifferenz der jungen *Caecobarbus* muss als ein Einwand gegen die postulierte biologische Bedeutung der negativen Phototaxis bei den Höhlenfischen[4] betrachtet werden, denn diese Lichtreaktion fehlt gerade dann, wenn sie am vorteilhaftesten wäre.

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Résumé

L'observation de la phototaxie et de la thermotaxie du poisson aveugle *Caecobarbus geertsi* Blgr (Cyprinidae) dans son environnement naturel montre qu'il existe certaines différences entre les réactions des formes jeunes et celles des formes plus âgées. Observées pendant le jour sur le gradient d'éclairement situé à l'entrée de la grotte occupée par les poissons, les formes jeunes restent indifférentes à l'excitation de la lumière solaire, tandis que les formes plus âgées manifestent une phototaxie négative lorsque l'éclairement atteint environ 8 lx. Observés la nuit, tous les poissons de la population étudiée, quel que soit leur degré de développement, se maintiennent à l'intérieur d'une zone thermique dont le minimum se situe entre 22,8° et 21,8° C. Quelques hypothèses sont proposées pour tenter d'expliquer ces phénomènes.

[2] Bei 3 Monate alten *Anoptichthys jordani* fand KÄHLING, dass diese jungen Fische wesentlich schlechter auf Lichtreize reagierten als adulte Tiere der gleichen Art. J. KÄHLING, Dissert. (Köln 1957). Noch unveröffentlicht.

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Biotin Deficiency in the Hamster

Biotin deficiency has been produced in various laboratory animals by the incorporation of egg white into the diet. Among the deficiency symptoms described for the rat (SULLIVAN and NICHOLLS[1]) and the mouse (WILSON *et al.*[2]) are alopecia, achromotrichia, dermatitis and retarded growth. The data on the biotin requirement of the hamster are inconclusive. SCHWEIGERT[3] and HAMILTON and HOGAN[4] were unable to establish a definite need. COOPERMAN *et al.*[5], employing a diet lacking in biotin, observed retarded growth and dermatitis which were alleviated following administration of 1 microgram of biotin daily.

In an investigation of the relationship between the integument and the distribution of an ectoparasite, *Demodex* sp., of the golden hamster, *Mesocricetus auratus*, an attempt was made to alter the environment of the parasite by producing a biotin deficiency. Reported here are the effects of the deficiency in the hamster with emphasis on those which pertain to the skin and hair.

Table I.—Composition of diets given in grams of dry ingredients and cubic centimeters of liquid ingredients

	DIET	
	I	IC
Vitamin-test casein	7·5	30·0
Egg white	40·0	0·0
Cornstarch (Argo)	21·3	29·0
Crisco	15·0	20·0
Corn oil (Mazola)	3·0	4·0
Cod liver oil	1·5	2·0
Powdered brewer's yeast (GBI)	6·0	8·0
Salt mixture USP XII, No. 2 (GBI)	5·2	7·0
Sulfaguanidine	0·5	0·0

Experimental. Two diets were employed (Table I): test diet I supplemented with sulfaguanidine and containing 40% egg white, and control diet IC lacking these ingredients. All animals were from litters of the thirteenth to fifteenth generations of brother-sister matings. 72 hamsters were isolated and weaned at 18 days of age on test diet I available ad libitum; similarly 33 littermates were introduced and maintained on control diet IC. During development of the deficiency various areas of the dorsum were plucked to observe the effects on hair growth; biopsies were taken frequently for histological examination. In order to establish the presence of a true biotin deficiency animals exhibiting extreme symptoms received daily intraperitoneal injections of 4 micrograms of biotin while being maintained on the test diet.

Results. The development of the deficiency is summarized in Table II. The test diet appears to allow for rapid depletion of biotin stores so that by 6 weeks extreme deficiency is apparent. The gain in weight by this time is less than half of that of control animals. The animals are scrawny and exhibit the characteristic kangaroo stance. Other symptoms of advanced deficiency include nervousness and irritability, jerky movements and a tendency to drag the hind legs. The skin is dry and scaly. The nose and mouth are swollen and the eyes are usually sealed shut with incrustations. Although the animals are almost entirely hairless, tufts or patches of short hairs may be scattered over the dorsum. Individual tufts persist for a short time, elongating at the normal rate of

[1] M. SULLIVAN and J. NICHOLLS, Arch. Derm. Syph. N. Y. *45*, 295 (1942).

[2] J. W. WILSON, E. H. LEDUC, and D. H. WINSTON, J. Nutr. *38*, 73 (1949).

[3] B. S. SCHWEIGERT, Vitam. and Horm. *6*, 55 (1943).

[4] J. W. HAMILTON and A. G. HOGAN, J. Nutr. *27*, 213 (1944).

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Table II.—Summary of development of biotin deficiency symptoms through 6 weeks on test diet

Weeks	Symptoms
2	Dull rough coat
3	Slight achromotrichia
4	Slight alopecia on ventrum
	Coat light colored
	Incrustations about eyes
5	Ventrum bare
	Coat very light colored
	Bare patches on hind dorsum
	Nose and mouth swollen
	Eyes sealed shut
	Jittery, jerky movements
	Kangaroo stance
6	Complete alopecia

approximately 1 mm per day and finally disappearing at about the time full length is attained. The hairs are consistently lighter in color than the normal coat.

Injections of 4 micrograms of biotin per day quickly alleviate the symptoms. During the first week the dermatitis, the swelling of nose and mouth and the incrustations about the eyes disappear; this is accompanied by a sharp increase in weight. By 2 weeks there is great improvement in disposition and behavior. In some denuded areas, hairs appear shortly after the first injection; progressively hairs appear in other areas. The earlier hairs are lighter than normal while those emerging later are light at the tips and dark at the bases. Finally hairs appear which possess full pigmentation. Hairs attaining full length as early as 11 days after the initial injection are retained. By 4–6 weeks all animals appear normal.

Biopsies of skin show the epidermis of deficient animals to be noticeably thicker than that of controls. This thickening is primarily in terms of the stratum corneum although thickening in the stratum germinativum is also apparent. Mitotic figures in the basal layers are plentiful being slightly more numerous than in normal skin. The epidermis is moderately keratotic and contains abundant keratohyalin granules. The orifices of the pilosebaceous units are markedly dilated and are commonly plugged with keratinized debris. The sebaceous glands are for the most part normal although occasionally a gland appears disrupted. The hair follicles appear normal and often exhibit hairs in various stages of development. Also present are resting hairs the clubs of which are normal but frequently the shafts are broken below the surface of the skin.

Discussion. Incorporation of egg white in the diet of the hamster produces symptoms similar to those attributed to biotin deficiency in the mouse. In mice the rate and cycles of hair growth are unaffected by deficiency. The alopecia is the result of faulty hair retention which appears to be due to imperfect keratinization of the hair shaft adjacent to the club (RAUCH[6]). The same is true of the hamster where hairs are observed to elongate at the normal rate but break off as full length is attained. Deficiency produces progressive achromotrichia in the hamster as well as in the mouse. Even during deficiency pigment is elaborated and incorporated into the growing hair. As the biotin level falls, however, so does the intensity of the pigment. In this way, the hair is progressively lighter from tip to base and from one hair generation to the next. The fact that this sequence is easily and quickly reversed upon administration of biotin is further indication that the process of pigment synthesis is particularly sensitive to biotin level.

Skin taken from deficient animals reveals changes resembling more those described by MONTAGNA[7] for the mouse than those of the rat. In the hamster the skin is dry rather than covered with brownish incrustations as in the rat. There is only moderate keratosis in the hamster and the mouse as compared to the extensive hyperkeratosis developed in the rat. The sebaceous glands in the hamster seem to be less disturbed structurally than either in the mouse or rat, although the dryness of the skin is suggestive of impairment of sebaceous secretion.

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Zusammenfassung

Durch einen Eiweissgehalt von 40% in einer Diät wurde ein extremer Biotinmangel erzeugt. Folgende Symptome waren das Resultat: Wachstumshemmung, Hautentzündung (Dermatitis), Haarausfall und Verlust der Haarfarbe. Durch tägliche Dosen von 4 µg Biotin konnte dieser Zustand rasch gebessert werden.

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Zur Frage der entzündungshemmenden Wirkung des Phenylbutazon bei hypothyreotischen Ratten

Am Formalin-Pfotenoedem normaler Ratten zeigt Phenylbutazon (Butazolidin Geigy) eine ausgeprägte anti-inflammatorische Wirkung (DOMENJOZ, THEOBALD, WILHELMI, WILHELMI *et al.*[1]). In der vorliegenden Arbeit berichten wir über den entzündungshemmenden Wirkungsgrad des Phenylbutazon an der Formalinarthritis hypothyreotischer Ratten.

Methodik. Den Versuchstieren verabreichten wir in 24stündigem Abstand 4-Methyl-2-Thiouracil (MTU) während einer Zeitspanne von 18 und 31 Tagen in einer Dosierung von 100 mg/kg/Tag per os (Emulsion mit Gummi arabicum). Der Entzündungsversuch (Methodik nach DOMENJOZ *et al.*[2]) erfolgte 24 Stunden nach der letzten MTU-Verabreichung. Phenylbutazon wurde in einer Dosierung von 200 mg/kg s. c. 30 min vor der subplantaren Injektion von 0,1 cm³ Formalin 3prozentig appliziert. Die Pfotenschwellung wurde 135 min nach Injektion des Phlogistikums gemessen.

Ergebnisse. Aus den Daten der Tabelle ist zu ersehen, dass Phenylbutazon 200 mg/kg s. c. an der normalen Ratte eine intensive Hemmung der Formalinentzündung

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