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CHANGES IN THE REFRACTIVE POWER OF THE CORNEA DURING GROWTH*

OBSERVATIONS ON THE RABBIT

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MANY studies have been made of the changes of refraction of the eye during infancy and childhood, but little is known of the changes in the individual components of total refraction. Such changes must be of considerable magnitude to compensate for the axial elongation of the globe during growth, for the refraction of the adult eye with its longer axis differs but little from that seen in early life. Axial elongation during growth, considered by itself, should produce a change of the order of some 20 or 30 D., for the eye of the newborn child is some 16 mm. long, whereas that of the adult is 23 or 24 mm. That no such marked change in refraction occurs is obvious from daily experience. Axial elongation must therefore be compensated for by a reduction in the refractive power of the cornea-lens system, but actual evidence of this process is lacking.

The following observations, carried out on the rabbit, aimed at determining the changes in the refraction of the cornea over some 6 months from the 4th week of life (when the rabbit could be safely handled). These changes were related to observations on the refraction of the eye as a whole.

The cornea of the adult rabbit—as determined in 24 animals—shows a radius of curvature ranging between 7.5 and 8.25 mm., the common values being 7.7 to 8.0 mm. The common refractive power of the cornea is therefore about 42 to 44 D. In attempting to measure the radius of curvature of the baby rabbit at 4 weeks it was found that no readings could be recorded on the Javal-Schiötz keratometer (Haag-Streit), which is calibrated to an upper limit of 5.5 mm. (corresponding to about 61.5 D). It was only when the rabbit was 6 weeks old that a reading could be obtained. The Table shows the keratometer reading in mm. of the radius of curvature in four litter-mates, taken at weekly intervals for about 2 months, and at longer intervals subsequently. In the Figure the readings recorded in dioptres are shown against the refraction of the eye as determined by retinoscopy under atropine cycloplegia at the same time. It will be seen that in the rabbit, as in man, there is relatively little change in refraction of the eye during growth—and this in spite of the fact that over the 6 months of observation the refraction of the cornea declined from a value of over 60 D. to well below 50 D., and is

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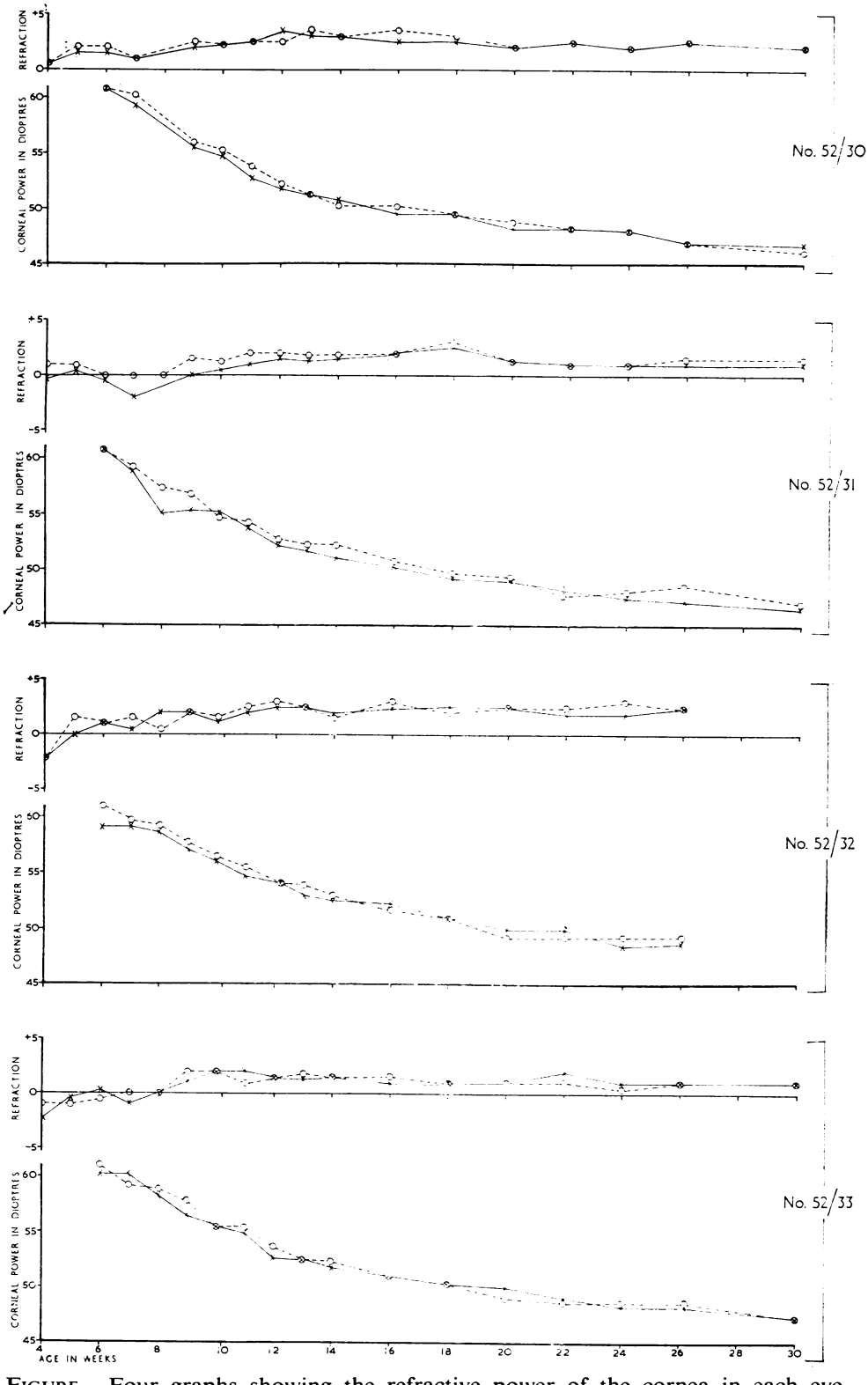

FIGURE.—Four graphs showing the refractive power of the cornea in each eye during the period 6 to 30 weeks in four rabbit litter-mates, set against refraction of the eye under atropine cycloplegia during the period 4 to 30 weeks.
Full line = right eye; broken line = left eye.
Corneal power and refraction of the eye both shown in vertical meridian only.

TABLE

RADIUS OF CURVATURE OF CORNEA (mm.) IN FOUR RABBIT LITTER-MATES

Rabbit Number		52 30♂				52 31♂				52 32♀				52 33♀			
Eye		Right		Left		Right		Left		Right		Left		Right		Left	
Meridian ..		V	H	V	H	V	H	V	H	V	H	V	H	V	H	V	H
Age in Weeks	4	Beyond the limit of the keratometer scale															
	5																
	6	5·55	5·55	5·55	5·57	5·55	5·55	5·55	5·55	5·68	5·63	5·53	5·58	5·58	5·63	5·53	5·60
	7	5·71	5·59	5·62	5·72	5·73	5·68	5·70	5·73	5·68	5·65	5·65	5·68	5·60	5·69	5·70	5·78
	8	—	—	—	—	6·15	5·99	5·88	5·94	5·73	5·70	5·69	5·76	5·78	5·77	5·74	5·74
	9	6·08	6·05	6·02	6·10	6·10	5·99	5·96	6·08	5·91	5·95	5·83	5·95	5·98	5·99	5·85	5·93
	10	6·15	6·20	6·12	6·25	6·15	6·00	6·17	6·10	6·02	5·99	5·98	6·05	6·08	6·08	6·08	6·17
	11	6·41	6·32	6·30	6·42	6·22	6·22	6·28	6·50	6·17	6·08	6·07	6·18	6·12	6·09	6·10	6·20
	12	6·52	6·55	6·45	6·51	6·44	6·42	6·38	6·41	6·22	6·24	6·22	6·28	6·40	6·40	6·30	6·35
	13	6·60	6·67	6·58	6·68	6·52	6·46	6·45	6·51	6·37	6·42	6·27	6·32	6·43	6·40	6·43	6·42
	14	6·62	6·60	6·65	6·81	6·60	6·49	6·45	6·66	6·40	6·36	6·38	6·36	6·51	6·45	6·48	6·50
	16	6·80	6·72	6·75	6·88	6·70	6·70	6·65	6·70	6·48	6·51	6·52	6·48	6·62	6·62	6·62	6·75
	18	6·82	6·80	6·82	6·89	6·88	6·78	6·81	6·78	6·62	6·63	6·62	6·70	6·70	6·78	6·71	6·78
	20	7·00	6·73	6·95	7·18	6·92	6·88	6·88	6·98	6·75	6·72	6·84	6·78	6·75	6·78	6·89	6·88
	22	7·00	7·00	7·00	7·08	7·01	6·92	7·05	7·02	6·75	6·78	6·84	6·73	6·95	6·90	6·89	6·95
	24	7·05	7·10	7·05	7·10	7·11	7·00	7·06	7·08	6·95	6·83	6·84	6·88	7·02	6·96	6·98	7·00
	26	7·19	7·10	7·20	7·19	7·15	7·00	6·95	7·19	6·91	6·94	6·85	6·91	7·02	7·05	6·98	7·00
	30	7·21	7·12	7·30	7·28	7·24	7·13	7·18	7·25	—	—	—	—	7.14	7·14	7·14	7·20

V = Vertical H = Horizontal

still falling: the adult value has not yet been reached, though the rabbits are almost fully grown. In these observations no attempt was made to assess changes in the refraction of the lens or in the depth of the anterior chamber.

Changes in the baby rabbit are, of course, not strictly applicable to man, for the baby rabbit is more immature than the human infant. The valid observation is that during the growth of the rabbit eye—and this was obvious and considerable, though not actually measured—the refraction as determined by retinoscopy changed but little, whilst the decline in the refractive power of the cornea was marked. Some 15 D. of total refraction were lost by changes in the cornea of these baby rabbits during the time when the axis of the eye became longer and therefore tended to produce myopia. " Growth myopia " was fully compensated.