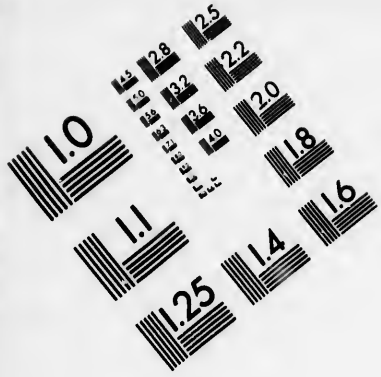

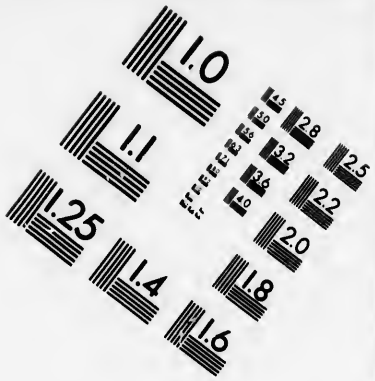

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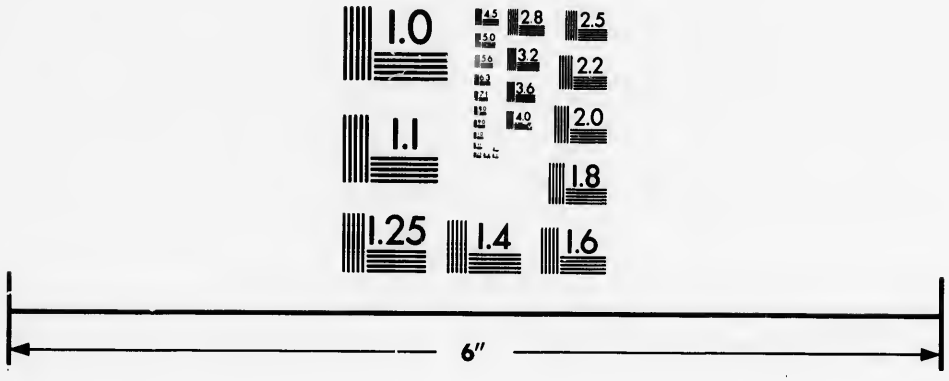

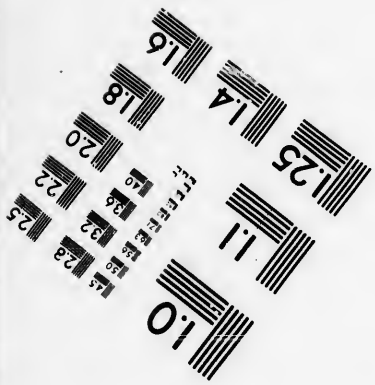

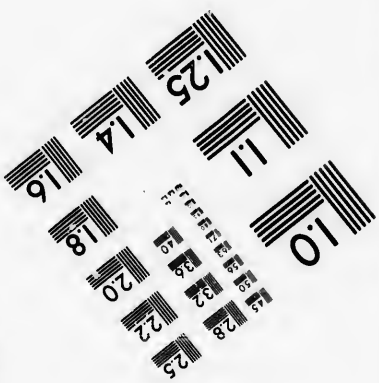

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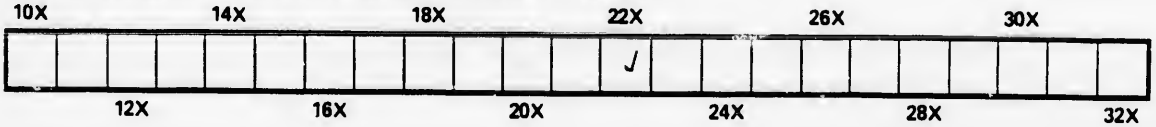

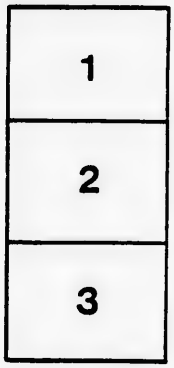

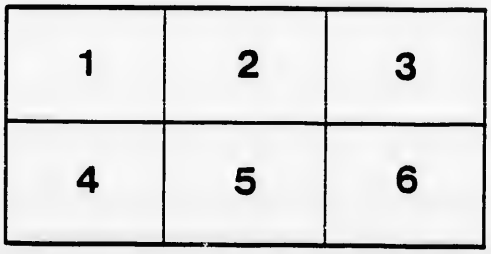

THE USE OF COCAIN IN MEASURING THE AMOUNT OF HETEROPHORIA.

PROFESSOR L. GUAITA AND DR. L. BARDELLI,

SIENNA, ITALY,

OF THE OPHTHALMIC CLINIC, ROYAL UNIVERSITY OF SIENNA, ITALY.

[Written for the *Annali di Ottalmologia* and the ANNALS OF OPHTHALMOLOGY. Translated into English by Casey A. Wood, Chicago.]

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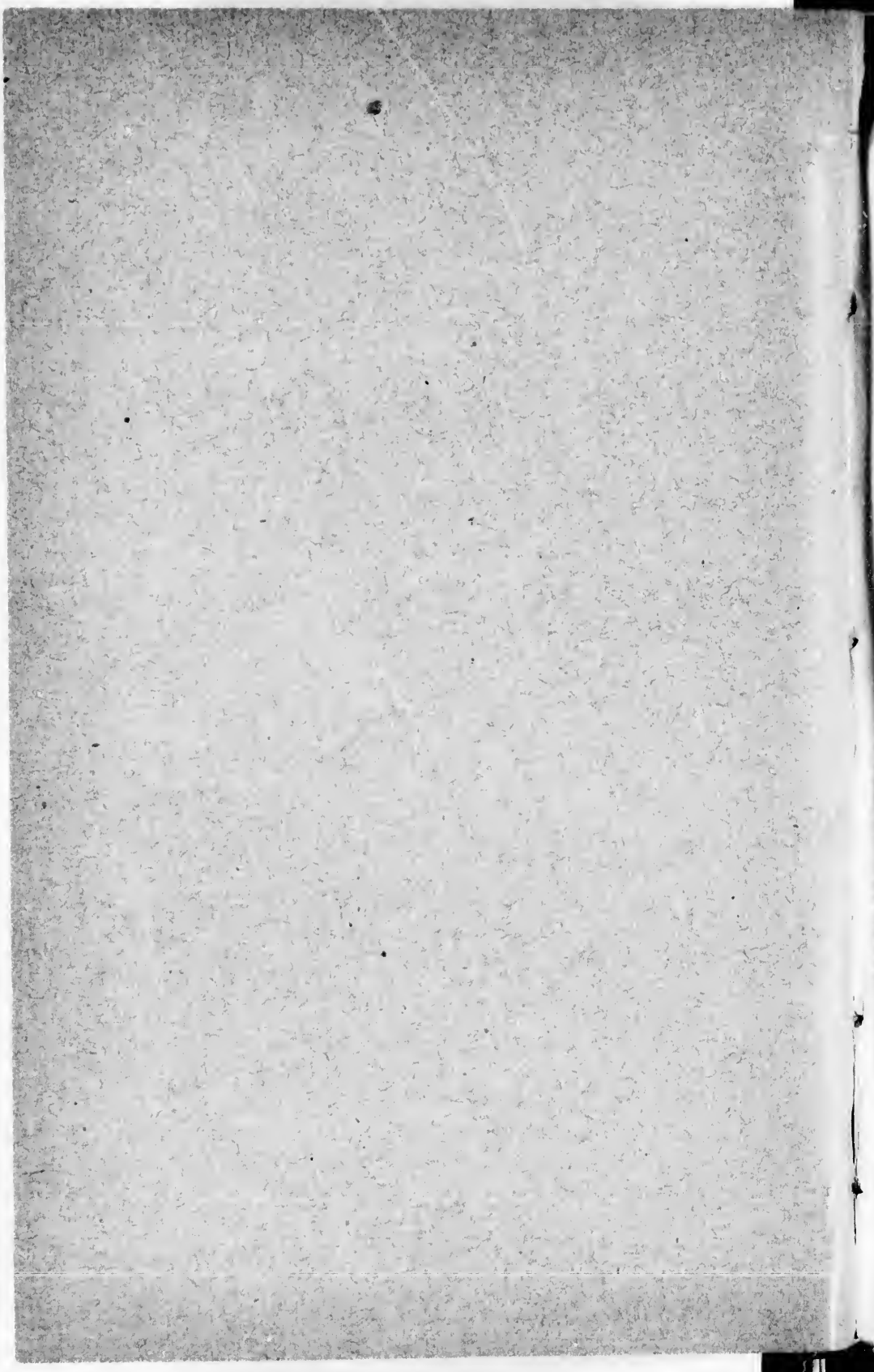

THE USE OF COCAIN IN MEASURING THE AMOUNT OF HETEROPHORIA.*

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PRELIMINARY NOTE.

In attempting to determine the degree of heterophoria we are confronted by certain difficulties, the principal one being the tendency of the double images to coalesce, so that either a portion or the whole of the muscular defect is masked. In the article by Stevens,† in the Norris and Oliver System of Diseases of the Eye, he refers to this obstacle and says that "in all examinations relating to the equlibrium of the eye-muscles the fact that the element of voluntary effort on the part of the person examined can rarely be eliminated is not to be underrated." Further on‡ he states that if prisms of certain strength are employed, diplopia may be induced; and on the theory that, single vision being impossible, the voluntary effort to adjust the eyes will be withdrawn, it is assumed that the visual lines will take the direction which would be given by the minimum nervous impulse acting upon the eye muscles. "This assumption is true only in a measure, and is often without foundation in fact, as it is frequently impracticable for the individual to permit the eye muscles to become entirely passive. Notwithstanding the imperfections of this theory, we possess no method of investigation in heterophoria so available as the artificial induction of diplopia." There is, however, another consideration. In heterophoria the muscle or groups of muscles that are continually obliged to exert themselves in a direction opposite to that which the eye has a tendency to deviate

*Applicazione della cocaina per determinare i'l grado dell' Eteroforia.

†G. T. Stevens. The principals of and the methods for the estimation of the balance of the extra-ocular muscles. Vol. II, page 170.

‡*Loco. cit.*, p. 174.

are obliged to make continuous efforts far greater than when the condition is orthophoric. Moreover, owing to the fact that in muscular anomalies an excessive amount of effort is constantly put forth by the stronger muscle or muscles, it is difficult to estimate the physiological force resident in these. For the perfect estimation of heterophoria it is consequently necessary to eliminate this impulse to fuse the doubled images of the eyes under examination.

No one, as far as we know, has so far discovered a method of overcoming the difficulties that chiefly stand in the way of rendering manifest the total amount of heterophoria.

Toward the end of 1885, when cocain had just been introduced, one of us (Prof. Guaita) published the following report of the action of cocain on the ocular muscles: "Dr. Sighicelli in a prize essay giving the results of work in the laboratory of Prof. Albertoni, in Bologna, claims that cocain produces a complete paralysis of the motor muscles of the eyeball and supports this claim by experiments on the lower animals. I have carefully observed the motility of the cocainized globe and am convinced that ordinary doses of cocain retard, although they do not entirely abolish, the excursions of the eye. Patients under the influence of cocain do not readily turn the eye in the direction indicated and this condition lasts for a short time. While their gaze is fixed upon the end of the finger they are able to follow it when the latter is slowly moved to and fro but they are not able to do so when the movements are rapid.

I have not succeeded in producing complete immobility by instilling two drops of a 3 per cent. solution into the eye every two minutes for a quarter of an hour nor by using it every two hours, for therapeutic purposes, for several days. This effect of cocain upon the eye is not a true paralysis but a state of *atony* a relaxation of the muscles. Consequently I consider that the incomplete or lazy excursions of the globe are merely results of this atonic condition. The muscles are, one may say, fatigued or enervated; although they are still under the control of the will they exhibit an indisposition to contract. So far as their *power* is concerned it still exists.

I do not wish to call in question the experiments of

Sighicelli. It may be that in experimenting upon the lower animals cocain produces a complete paralysis but it does not do so in human beings when used in a solution as strong and for as long a time as I would feel justified in employing it in my clinic.

Weber has observed that under the action of cocain adductive power increases while that of abduction and vertical fusion remains as before, or, it may be, diminishes. I have not been able to confirm this statement except in so far as I have observed it to produce an atonic condition of all of the muscles. The recti interni in their efforts to overcome the inertia produced by the cocain and to preserve their proper relations with the accommodation readily overpower the impassive external muscles and thus the power of adduction may seem to be increased." In an article by Dr. Saltini the author has demonstrated by exact measurement that the field of fixation is not restricted by the action of cocain, a fact that has already been related in the article of Prof. Guaita just referred to and which we have again confirmed in cases 2, 3, 4, 5 and 6 and 15 of this paper.

Having established these facts we now approach the question whether cocain is capable of developing the latent heterophoria.

For the purpose of settling this question we determined the state of the refraction and measured the field of fixation before and after the use of cocain. The test of the equilibrium of the extrinsic ocular muscles was made with Ostwalt's phorometer at 5 meters distance before the cocain was instilled, 5 minutes after a single instillation of a 5 per cent. solution of the muriate, 5 minutes after a second instillation and, finally, 5 minutes after a third instillation. In some subjects, moreover, we measured the projection of the eye before and after the application of cocain so as to exclude the possibility of producing an exophthalmus (Königstein) that might interfere with the movements of the eye. For this purpose we employed Antonelli's ophthalmostatometer attached to a Javal-Schiötz ophthalmometer. In no instance did we find the slightest difference in the projection of the eyes examined as above stated, either before or after the application of cocain.

The following table gives the results so far obtained by our investigations and we may conclude that one of the actions of cocain upon the eye is to develop the full degree of heterophoria and even in cases of apparent orthophoria (as in case 11) to render manifest the latent heterophoria.

How does this agent accomplish such results? As yet we are not in a position to do more than state the facts, awaiting further observations and experiments to enable us to give a satisfactory answer to the question.

Number.	Visual Acuity.	Refraction Before Paralysis of Accommodation.	Refraction After Paralysis of Accommodation.	Muscular Condition Before Instilling Cocain.	Muscular Condition Five Minutes After the Third Instillation of Cocain.	Field of Fixation After the Instillation of Cocain.
1	5-5	E.	—	Orthophoria.	Orthophoria.	—
2	5-5	M. — 0.75 D.	—	Esophoria $\frac{3}{4}^0$ Left hyperphori $\frac{3}{4}^0$	Esophoria 2^0 Left hyperphoria $\frac{1}{2}^0$	Unchanged
3	5-5	M. — 1.75 D.	—	Orthophoria	Orthophoria	Unchanged
4	5-5	E.	—	Esophoria $1^0 - 2^0$	Esophoria $2\frac{3}{4}^0 - 3\frac{3}{4}^0$ (1)	Unchanged
5	5-5	Hm. + 0.75 D.	—	Esophoria $\frac{1}{2}^0$	Esophoria $1\frac{3}{4}^0$	Unchanged
	5-5	—	H. D. + 3 D.	Esophoria 2^0	Esophoria $2\frac{1}{2}^0$	Unchanged
6	5-10	Hm. + 3 D.	Orthophoria with refractive correction	Orthophoria	Orthophoria	Unchanged
	5-7.50	—	—	Orthophoria		—
7	5-7.50	M — 10 D.	—	Orthophoria	Orthophoria	—
8	5-5	Hm. + 0.5 D.	—	Exophoria $\frac{1}{2}^0$	Exophoria $1\frac{1}{2}^0$	—
9	5-5	Hm. + 1 D.	—	Esophoria $\frac{1}{2}^0$	Esophoria $\frac{3}{4}^0$	—
	5-5	—	H. + 2 D.	Esophoria $\frac{1}{2}^0$	Esophoria $\frac{1}{2}^0$	—
10	5-7.50	Both eyes with correction.	—	Esophoria $\frac{1}{2}^0$	Esophoria 2^0	—
	5-5		Both eyes with refractive error corrected	Esophoria $2\frac{1}{2}^0$	Esophoria 4^0	—
11	5-15		—	Orthophoria with a tendency to esophoria	Esophoria $\frac{1}{2}^0 - \frac{3}{4}^0$ (1)	—
	5-15	—	With correction.	Esophoria 1^0	Esophoria $3\frac{1}{2}^0 - 3\frac{3}{4}^0$ (1)	—
12	5-10	—	O. D. Merid: vert: H + F $3^0 - 4^0$ D — Merid: hour Ht + 5 D. O. S.	Esophoria	Esophoria $5\frac{1}{2}^0 - 6^0$ (1)	—
			Merid: vert: Ht + 5.5D. Merid: hour: Ht + 5D.	Esophoria $3^0 - 40^0$	Esophoria $5\frac{1}{2}^0 - 6^0$ — (1)	—
13	5-10	Hm. + 1.5 D.	—	Esophoria $1\frac{1}{4}^0 - 1\frac{1}{2}$ (1)	Esophoria $2\frac{1}{2}^0$	—
14	O. D. 5-7.50 O. S. 5-30		—	Esophoria $1\frac{1}{2}^0 - 2^0$	Esophoria $1\frac{1}{2}^0 - 2^0$ (1)	—
	O. D. 5-7.50 O. S. 5-30	—	Ht + 3D	Esophoria 3^0	Esophoria 3^0	—
		—	Irregular As.			
15	5-5	Hm + 0.5 D.	—	Esophoria $2\frac{1}{2}^0$	Esophoria $3\frac{1}{2}^0$	Unchanged

(1) The smaller figures represent the amount of the esophoria shown when the patient first regards the fixed point of the ophthalmometer; the larger ones that subsequently developed.

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