The case here shown is the retina from an injected right eye taken at *post mortem* from a female aged 71 who had suffered from diabetes for twenty-six years. There is a Stage III diabetic retinopathy with micro-aneurysms, irregular haemorrhages, macular and punctate exudates. Although the injection is not as complete as we have obtained in freshly excised eyes, it is satisfactory for a *post mortem* specimen and the picture clearly shows some thousands of micro-aneurysms. Beading, localised dilatations and looping of the vessels and multiple haemorrhages can be seen. It is believed that it has not previously been realised how surprisingly numerous micro-aneurysms are and the picture is a depressing one for one wonders how it can ever be possible to reverse such a gross and widespread process by the administration of drugs or the control of diet. At best we can only hope to prevent the development of such lesions or, once the condition is established, to attempt to control the haemorrhages.

I am indebted to Dr. Peter Hansell for the photographs.

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CONVERGENCE DEFICIENCY*

An investigation into the results of treatment

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OVER the period of twelve months which covered the present investigation, 88 patients attending the out-patient department of the Glasgow Eye Infirmary manifested the subjective and objective features of convergence deficiency. Their ages ranged from 14 to 50 years, 32 being below 20 years of age, 37 in the third decade, 15 in the fourth decade, and 4 in the fifth decade. Of the 88 patients, 51 were females, and 37 males. Thirty-seven cases were emmetropic; in 43 hypermetropia or hypermetropic astigmatism was present, and in 8 myopia or myopic astigmatism.

Fifteen of the 88 cases were considered unsuitable for orthoptic treatment. Of these, 12 suffered from so pronounced a degree of neurosis, that the immediate consideration was the treatment of

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the functional nervous disorder, and in their cases the convergence deficiency was obviously relatively unimportant. Indeed, 6 of the 12 were already receiving psychotherapy; the remaining 6 were referred for similar treatment. Three further cases were deemed unsuitable; two suffered from a post-concussional syndrome of recent origin, and one had sustained a recent subarachnoid haemorrhage. Seventy-three cases remained, but this number was further reduced since 10 failed to attend or defaulted before the completion of treatment.

An analysis of these ten cases presents features of interest. Three attended on several occasions, and made rapid progress; perhaps with the relief of subjective symptoms they considered that further treatment was unnecessary. In the remaining 7 a marked anxiety state existed. It is not a difficult matter to segregate those individuals who are unlikely to persist with treatment, and much of the orthoptist's time may be saved by judicious selection.

Sixty-three cases completed treatment. This series may be divided into two groups, depending on the association of the neurotic state with the convergence deficiency. There were 48 neurotic subjects, an incidence of 76 per cent. Of the residual 15, in 6 the symptoms had first appeared shortly after an acute illness or debilitating malady, while in the other 9 no apparent precipitating factor was evident.

Thirty-seven patients of the neurotic group were considered to be cured as the result of treatment; four were improved, and seven made no progress. All the 6 cases whose convergence defect succeeded an acute illness or debilitating condition responded to treatment. Of the remaining 9 cases of unknown etiology, 5 were relieved entirely of their symptoms, 3 improved, and 1 proved resistant to treatment.

There is no great discrepancy in the percentage of cures and failures between the two groups. Any true estimation of "cure" must take cognisance of possible relapse—an occurrence which is well recognised—and accordingly relief of symptoms alone can form a true working basis only if the patient is observed over a sufficiently long period. How long the latter should be is difficult to assess. In the present investigation an obvious shortcoming is the inadequacy of follow-up, and the term "cure" must here refer to the immediate relief of symptoms. It should be emphasised, however, that such relief was always attended in this investigation by objective signs of improved convergence power. The converse did not hold true, since it was found that in some of the failures, objective improvement, even up to the full standard of "cure," occurred without corresponding improvement in the symptoms.

It is noteworthy that all 6 cases in which the symptoms developed after an illness were cured. Obviously the prognosis in these cases is excellent, provided one can exclude psychological complications.

Symptomless Convergence Deficiency.—The amount of convergence normally employed in ordinary reading is 21 prism dioptres. Individuals who are capable only of this degree of adduction are employing their maximum convergence continuously while reading or performing equivalent work at near. For comfort, a wider range than this is required, but apparently there exists a group of people with even less than this minimum, who do not complain of symptoms referable to their defective convergence. Among them are to be found workers who, in the course of their occupation, require close application of the eyes for long periods throughout the day.

The number of people in this group, *i.e.*, having less than 21 dioptres of convergence, was 18, and of these, 9 were males and 9 females. Five were engaged in close work, such as clerking, scientific instrument making, etc.; 15 had hypermetropia or hypermetropic astigmatism, and 3 myopia or myopic astigmatism. Their age distribution is shown in the following table.

Age in yrs.	0-20	21-30	31-40	41-50	51-60	61+
No.	4	4	3	5	1	1

In no case was the degree of convergence less than 14 dioptres, and only those showing less than 21 dioptres of convergence have been included. The explanation for the absence of symptoms in this group is not as yet evident.

Symptoms of Convergence Deficiency in the absence of Objective Signs.

There were 29 patients in this group. In all cases, the refraction had been corrected, the phorias were within normal limits, and the duction power was easily sufficient to allow them to carry on their daily work. Nevertheless, all complained bitterly of those symptoms which are typically associated with convergence deficiency. Their ages ranged from 15 to 56 years. The age distribution is shown in the following table.

Age in years	0-20	21-30	31-40	41-50	51-60
No.	7	17	4	0	1

A study of the refractive state of this group revealed that 12 were emmetropic, 12 had hypermetropia or hypermetropic astigmatism, and 5 had myopia or myopic astigmatism. 14 of the cases were engaged in close work.

Associated Conditions.—Two patients showed evidence of rheumatic heart disease, one suffered from sinusitis and asthma, and in one the symptoms had first appeared following an attack of asthma. Twenty-two patients demonstrated the features of established nervous disorder of the category of anxiety neurosis. Three of the latter patients had previously suffered a nervous breakdown; 11 were receiving treatment from their doctor, or had recently been under medical treatment for “nerves”; while the remaining 8 presented symptoms which are associated with functional nervous disorder. In 3 cases there was no obvious cause for the ocular symptoms.

Functional nervous disorder has been recognised for many years as a basis of symptoms simulating convergence deficiency (Mann). The high incidence in the present series—76 per cent.—suggests that it is by far the commonest etiological factor in this group. The question of why the neurotic subject should fix upon the ocular system for his psychosomatic manifestations remains to be answered; in future investigations of this aspect, the co-operation of the psychologist might go far to clarify the association.

DISCUSSION

The relationship between convergence function and the general condition of the patient has been recognised for the past sixty years, since Maddox advised constitutional measures for the treatment of the symptoms. Heath mentioned its association with general conditions and nervous prostration, while the use of strychnine in treatment was described by Oppenheimer.

Bielschowsky and Howe, among others, considered the general health an important relationship to convergence insufficiency. The significance of the endocrine glands has been stressed by Mayer (exophthalmic goitre), Fridenberg, Bryant, Howard (hypothyroidism), Davis (endocrine disorders), and others. Zentmayer mentioned over-stimulation of the body followed by fatigue as a cause of convergence insufficiency, while Duane recommended attention to the general health after correction of refractive errors. Fox was of the opinion that the condition had a close relationship to the general health, while Field remarked on its dependence on the general physical condition.

Modern writers begin to stress the importance of the psychological state of the patient in the aetiology of convergence insufficiency. Mann considers that an essential factor is arrested development of the function of convergence, and that the majority of patients are normal individuals with an arrested functional

development which only begins to trouble them when they are employed in excessive close work. In older patients psychological difficulties are liable to precipitate the onset of symptoms. This would make an attractive theory, introducing Adler's conception of organ inferiority. It would be necessary, however, to prove that these patients had deficient convergence before the onset of symptoms. Others assign to psychological factors alone a more important role in the aetiology.

There is a similar uncertainty and divergence of views on the permanent effects of orthoptic treatment. Abraham considers that orthoptic training can be of palliative value only, and that the continual exercise of convergence during the waking hours should be expected to be more effective than a short period of special training, even if given daily. Local exercises he holds to be of little permanent therapeutic value. Others regard convergence at the near point as a trick that can be learned with practice. The majority of writers, however, agree that considerable immediate benefit and cure can be obtained in a large proportion of cases by orthoptic exercises.

The cure of psychological symptoms by physical methods is a well-recognised phenomenon in many branches of medicine, and is not confined to ophthalmology. The influence of suggestion and the personalities of the physician, surgeon, physio-therapist or orthoptist may all or individually play the major role. During the course of treatment psychological difficulties may become ameliorated or resolve, with consequent benefit to, or disappearance of the symptoms.

Although in the present investigation cure of the symptoms was always accompanied by improvement in the objective signs, it has been noted by many observers that this is not invariably the case. Disappearance of the symptoms may be accompanied by persistence of, or but slight improvement in the objective signs. This raises the question of the part which suggestion plays in the cure of such cases, and the importance of this factor should not be under-estimated.

That patients can relapse with re-appearance of the typical symptoms, without manifesting any of the objective signs, is also well established. This brings these cases into line with the untreated group which exhibits the classical symptoms without ever having shown any of the signs of convergence defect.

The question of fatiguability of convergence was investigated in several subjects. After their convergence was measured, they were allowed to read till symptoms developed, when the readings were repeated. No appreciable differences were found.

A further point worthy of consideration is whether in some cases the signs elicited, namely convergence deficiency, are suggested to the patients by the method of examination. This is the probable explanation of the expanding and contracting spiral fields of vision found in neurasthenia (Traquair). The extraordinarily rapid progress made by some patients under a skilled orthoptist in the course of one or two "lessons" certainly would make one suspect whether a similar cause operated here.

Summary

The results of treatment of 88 cases of convergence deficiency are described. The question is raised whether convergence deficiency is a psychosomatic manifestation, and suggestions are made for further research.

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