Original Articles.

EYESTRAIN, ITS IMPORTANCE, AND ITS LIMITATIONS.*

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THE question of eyestrain and its effects upon the nervous system is still under discussion. The most conservative allow that headache may sometimes be caused by eyestrain, but limit the application of this principle to the most obvious cases, eliminating cases in which there is no pain in the eyes, no conjunctivitis, no pain during the use of the eyes, and those in which no error of refraction can be demonstrated by crude tests without a mydriatic. The enthusiast, on the other hand, finds in eyestrain, not only a potent, but a curable, factor in the production of headache, epilepsy, chorea, indigestion, mental disturbance and nutritional changes, local as well as general, and in glasses a panacea for many of these ills. While the former gives, perhaps, too little weight to clinical evidence, the latter draws, perhaps, too sweeping inferences from insufficient evidence, is inclined to overlook other sources of nervous and mental disturbance, and especially to disregard the constitutional taint which predisposes to nervous and mental disturbance, a taint of which the error of refraction is merely one sign.

At the risk of being accused of blowing hot and cold on the same proposition, I wish to call attention, on the one hand, to the neglect on the part of the profession to recognize and adequately treat the cases in which headache does result from eyestrain, and on the other hand, to speak of the constitutional tendency underlying not only such disorders as epilepsy, but also that variety of headache perhaps most commonly and most erroneously attributed to eyestrain, namely, the constitutional headache of the deviate.

My experience, while confirming the prevailing scepticism regarding the cure of epilepsy and chorea by glasses, tends to support the proposition that, after eliminating such obvious causes as organic brain or frontal sinus disease and well-recognized toxic conditions, eyestrain is one of the commonest, if not the commonest, exciting cause of headache in the otherwise healthy, particularly of the frequently recurring headaches among the young and middle-aged, generally frontal, or frontal and occipital, sometimes unilateral, sometimes accompanied by nausea and blurred vision, and sometimes replaced by the latter. This class, which I shall term migranoid, includes the paroxysmal form known as migraine, sick headache or blind headache, which is not infrequently replaced after youth has passed by headaches showing these characteristics in moderate degree and of less paroxysmal violence. These headaches generally have a run of several hours to a day with intervals of freedom, do not, as a rule, keep the patient awake, but often disappear during sleep. They appear sometimes

on waking in the morning, sometimes during the day. Eyestrain in these cases may be, and probably is, superimposed upon an inherent predisposition, but notwithstanding this fact I have come to believe that the adjustment of glasses will do more for their relief than any other treatment, though absolute disappearance of the tendency can hardly be expected under any treatment.

Whenever a young or middle-aged individual bears a frown and has been since childhood subject to periodic, frontal, or fronto-occipital headaches, with or without nausea or vomiting, and with or without twinkling scotoma, the suspicion that refractive error is the exciting cause of the trouble should not be dismissed on account of the statement that the frown is a family characteristic, and that the pain is not directly connected with overuse of the eyes. The headache and frown are relieved in such cases upon the use of spectacles so often, and to so marked a degree, that little weight can be given to these arguments.

There is another variety of headache which may be fairly well distinguished from these migranoid headaches, namely, the headache occurring at intervals of many months, even years, only on mental exhaustion, particularly exhaustion from continued application to a single subject. This headache is also apt to be frontal, but is, as a rule, unaccompanied by nausea or blur. This headache, which may be termed brain fag headache, is probably not due to, or excited by, eyestrain. Of the constitutional headache I shall speak further on.

The etiology, pathology, and treatment of migraine has been made the subject of extended investigation and discussion. The general trend of such investigation is illustrated in a recent contribution by Levi.¹ This author places the center for the phenomenon in the floor of the fourth ventricle, and explains the visual, auditory and other accompaniments by tracing the central connections between the fibers of the trigeminal nerve and those of the other cranial nerves involved. Excitability of this center he regards as hereditary, and compares the attacks and remissions to those of gout and uremia. He cites as accessory causes psychic excitation, sensorial or visceral, emotion, and exogenous intoxication, gastric disturbance and constipation.

The treatment, he states, should be directed toward lessening the excitability, increasing the resistance, and avoiding or diminishing the exciting causes.

I have no special quarrel with this line of reasoning, but would suggest that refractive error be given a prominent place, in fact, the prominent place, among the exciting causes, and that a due amount of effort be made in each case to remove this exciting cause. To neglect this effort is to ignore without investigation a mass of evidence collected by competent observers.

It occurred to me that some light might be thrown on this subject by ascertaining the fre-

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¹ Rev. Neurologique, Feb. 15, 1905.

quency of headache among those totally blind from infancy, in other words, among those in whom the element of eyestrain could be practically eliminated. The results were very suggestive and sufficiently striking to encourage further study. This study was made through the kindness of Mr. Anagnos, Superintendent of the Perkins Institute for the Blind at Boston, of Mr. Campbell, Superintendent of the Experimental Station for Adult Blind at Cambridge, and Mr. E. E. Allen, Superintendent of the Pennsylvania Institute for the Blind at Philadelphia.

By way of establishing a control, I have questioned, regarding headache, 100 healthy individuals with sight, including 68 members of the Boston Normal School of Gymnastics, through the kindness of Miss Homans. Of these 100 individuals, only 31 (31%) had never had headaches. Of the remaining 69 cases, 24 (35%) had occasional headaches (less often than once in three months); 45 (65%) were subject to frequent headaches. The prevalent seat was the forehead; the duration, in general, varied from a few hours to a day or two, and the headache disappeared generally during the night. In the cases of frequent headache scotoma and nausea were common. Unilateral seat was not infrequent. In 17 cases typical attacks of sick headache with nausea, vomiting and blur had appeared at some period in the life. The proportion of these attacks was practically the same in the two sexes, contrary to the popular opinion.

By way of still further control, 42 cases were examined who were either partially blind (whether the blindness was acquired or congenital), or who suffered from acquired blindness coming on at an age after the habit of fixation and convergence was well established. The proportion of individuals in this class who had never suffered from headache was 29%, that is, practically the same as among persons having sight. A further reason for including this class in the examination was to cover the question of surroundings and diet, since these conditions were the same as in the third class examined.

The third class contained individuals totally blind since infancy. In this class, therefore, eyestrain was reduced to the lowest possible terms. Of this number, 90 were examined, and of these 90 cases 59, or 66%, promptly stated that they had never had headaches, in marked contrast with the 31% of individuals with sight, and the 29% of the cases with partial and acquired blindness.

When the headaches were present, they recurred with about the same frequency as in individuals having sight. In 38% they occurred less than once in three months, in 62% oftener than that. The prevalent seat of headache was also in the forehead, the duration was generally a matter of hours to a day or two. Nausea was not uncommon, especially in the cases of frequent recurrence. Nothing allied to scintillating scotoma could be elicited, unless the statement of one individual that he felt a "prickling in the eyes" be so regarded. In five instances the

headache was unilateral. The migranoid character was sufficiently suggested to practically *negative* the supposition that *all* migraine results from eyestrain.

It should be added that the answers of a number of the blind children suggested that they were describing attacks of pain in, and directly about, the eyes, rather than true headache, so that the number of headaches recorded among them was probably too large rather than too small.

It is interesting to note also in this connection that some of the congenitally blind individuals stated that they were in the habit of mentally fixing their gaze upon their work. This would indicate an instinctive tendency to co-ordinate the accommodative mechanism with that controlling the hands. It is possible, therefore, that even in those totally blind from infancy, accommodative or fixation effort is not necessarily absent, but it must surely play a very insignificant part.

These figures would indicate then that headache is twice as common among those subject to eyestrain as among those in whom this element is wanting. Conversely, it would seem fair to infer that one-half the headaches occurring in ordinary individuals in health are due to eyestrain.

One argument frequently advanced against eyestrain as causing migraine is worthy of being taken up in detail, namely, the fact that glasses have been already tried without relief. *In such cases it will often be noted that the glasses have been used only on occasion; that eyeglasses, not spectacles, have been worn; that no care has been taken in the centering of the glasses, and no care in keeping them properly adjusted; that the patient has taken no pains to look through their center instead of from side to side, and that he has not given up the effort of straining to see objects beyond his legitimate range, and even, perhaps, that the glasses have been prescribed by someone not thoroughly conversant with this branch of practice.*

Here are six commonplace and legitimate reasons for nonefficiency of glasses, any one of which may suffice, but several or all of which are likely to co-exist, to say nothing of numerous technical difficulties.

If the patient is to reap the full benefit of ocular treatment these considerations, at least, must be borne in mind by the neurologist as well as the oculist.

With regard to the question of *eyeglasses* or *spectacles*, an occasional nose may be formed so that eyeglasses will maintain all day the exact angle desired for the correction of astigmatism, but in many more cases the reverse will be true, especially in case of the old-fashioned glasses, and I have more than once seen the simple change from eyeglasses to spectacles work a miracle. The so-called Shuron glasses, I am informed, are less objectionable than the older forms, but do not really replace spectacles.

The *occasional use of glasses* forces repeated change from accommodative relaxation to accommodative strain, a change which naturally handi-

caps the result which is to be hoped for only through relief of accommodative strain. A single accommodative over-effort may interfere to a certain extent with the beneficial effect of spectacles, and many such over-efforts in the course of the day will surely do so. Dr. Dixon in a recent article² has emphasized the importance of wearing glasses while resting the eyes as well as while using them, because complete rest is impossible for the uncorrected, imperfect eye, even while looking off.

It is not generally known outside ophthalmological circles that the *centering of glasses* is of paramount importance, but continuous discomfort may be produced by moderate misplacement of a strong, spherical lens, or of a cylindrical lens, with other than a horizontal axis.

Care of glasses is also important. In a case of astigmatism of only one half a diopter, a deviation of 5° from the proper angle may produce migranoid headache in the susceptible individual. Spectacles should, therefore, be chosen in which no loose rivet can cause a variation in the angle, on which account glasses with rims are, perhaps, somewhat safer than the rimless, though the latter also may be solidly constructed and are less objectionable to most persons. The glasses should never be carelessly handled by the side pieces; they should be removed carefully and laid down clear of other objects, not jammed carelessly into a case. In fact, whenever it can be arranged it is better not to use a case. Again, frequent visits should be made to the optician; such a visit may not only abort an individual attack of migraine after twinkling scotoma has appeared, but may even relieve a headache well under way.

No one can straighten his own spectacles with the fingers and no one should attempt to do so, though perhaps with the proper forceps and with instruction and practice one may learn to correct a simple tilt. In a case of astigmatism it is out of the question that a pair of spectacles fitted months or years ago should do efficient work to-day without readjustment.

With regard to the question of *how to look through spectacles*: The patient should be warned that each time he looks from side to side or up or down he is looking through the wrong curve, and may thus increase, rather than lessen, his refractive error, though this may be obviated to some degree by using toric lenses. The patient should also be warned that efforts to see clearly objects at a distance by straining the eyes, with the spectacles on, only reproduces the trouble for which the glasses are prescribed. When a distant object cannot be easily made out by resting the eyes upon it without strain, the patient should learn to say to himself, "That object is beyond my range of vision." This is a variety of self-restraint particularly hard to practice at the theatre or ball game.

Even when all these precautions are carefully stated by the neurologist and by the oculist, there still remains an element of uncertainty in their

accomplishment, but until the attempt has been made to obviate at least these every-day chances of non-success, the assertion that correction of refraction has been given a thorough trial is hardly justifiable.

The following note will be of interest in this connection:

DR. WALTON:

Dear Sir, — I thought you might like to know how much better I have been since I have become accustomed to Dr. —'s glasses. I have scarcely had a headache and am feeling in every way much better. Am trying to follow all the good advice you gave me that day, looking directly through the center of my glasses, etc. Thanking you for sending me to Dr. —, I am,

Sincerely yours,

This patient, notwithstanding previous attempts at relief by ocular and other treatment, *had suffered for a long period from weekly attacks of migraine during which vomiting occurred sometimes as many as six times a day.*

Even assuming the patient to be mistaken in ascribing any part of the benefit to these details, and that the success was due to a fortunate change or prescription on the part of the final oculist consulted, the incident will serve to illustrate the importance of persistence in this line of investigation.

The following is cited as a striking instance not only of general cerebral disturbance resulting from eyestrain, but also of a definite reflex symptom probably similarly produced, and apparently relieved by attention to the details I have indicated.

CASE. A stout, athletic man of forty-one has been engaged continuously for some time without vacation upon important head work and has noticed of late a gradually increasing disagreeable sensation in the head falling short of headache. During the past month there has appeared and increased a thick feeling about the chin and mouth and in the left side of the tongue. He formerly smoked a number of cigars a day; of late, two a day. There is no numbness of the hands and feet, no central scotoma, no cardiac irregularity; in other words, no definite sign of nicotine poisoning. Physical examination shows a normal heart, normal urine, normal reflexes and perfect physical condition. The vision in the right eye is normal, in the left 20—30 without correction. He was advised to discontinue tobacco entirely, and to take a vacation after having obtained glasses. These were prescribed by Dr. Proctor.

One month later, after returning from his vacation, he found himself still unable to work for more than an hour or two, after which it was impossible to think consecutively. He had been all right during his vacation, but now felt that it was impossible for him to go on with his work and seriously contemplated giving it up entirely. He had been wearing eyeglasses, and those only at his work. He was advised to replace the eyeglasses by spectacles and to wear them constantly. He reported later that he found himself able to work all day without trouble immediately upon putting on the spectacles. The thick feeling in the tongue and chin which had existed continuously for three months disappeared that day and has not reappeared. He is now continuing his work without trouble.

² Journ. Am. Med. Asso., April 22, 1905.

My only fear in such cases is that continued absence of headache and other symptoms may cause relapse in the care of the details these patients are now following with strict attention.

"Eternal vigilance is the price of safety."

It is probable that eyestrain headaches occurring in cases of optic neuritis may sometimes be mistaken for the headache of new growth, and I strongly suspect this is often true in the pseudotumor cases described by Nonne. This combination in a young man sent me by Dr. Harrower some time ago led me strongly to suspect new growth, though no other signs were present. On seeing him recently, however, I found that the headaches had materially lessened since he had lost his sight to such a degree that he no longer attempted to read. No further symptoms of cerebral disease had appeared. Noting that he still frowned I questioned him more closely and it appeared that the headaches were always frontal and occipital, that they never kept him awake at night though they were extremely severe at times, and sometimes were accompanied by vomiting, and that the patient himself noticed they were worse after the use of the eyes. Dr. Mansur, who also saw the case, called my attention to a very wide excursion of the pupils on accommodative effort, in marked contrast to the slight reaction to light, showing that he is still capable of extreme accommodative effort. It seems probable, then, that these were mainly, if not purely, eyestrain headaches.

Let us now view the other side of the shield.

I have already referred to the fact that a predisposing constitutional tendency may underlie migraine, even though eyestrain may be the exciting cause of the attacks. There is another form of headache for which glasses are not infrequently prescribed, in which the constitutional tendency so dominates the picture that even if eyestrain exists, it is of minor importance in the etiology, and its treatment is almost uniformly unavailing. I refer to the so-called *constitutional headache*. This headache is mentioned by writers on degeneration, but its adequate description I do not find in the literature.

The headache which I have come to recognize under this title is quite different from migraine. This variety of headache is likely to appear, not in childhood, but during adolescence. The patient is perhaps a young woman, who has passed through a comparatively robust and uneventful girlhood, but who lacks the vitality to carry her into womanhood on the same plane of health, and to enable her to assume with comfort and ease the duties and responsibilities of adult life. Such a patient may take up the burden, notwithstanding the handicap, or she may fall at this time into the invalid, or semi-invalid, not to say hypochondriacal, habit. Among other symptoms such a patient gives prominence to constant headache, described as excruciating, frightful, in short, as torture. The pain is apt to be vaguely localized, perhaps affecting the whole head, perhaps vertical, rarely definitely referred, like the results of eyestrain, to the forehead,

temples and occiput, and rarely migranoid in character.

Although it is stated that the headache is present during the visit, the patient may be smiling and pleasant, and show no more exhaustion after a long examination than the examiner, perhaps not so much. Imagination, that expression so obnoxious to neurotics, is the term often applied to this variety of headache, but these patients probably really have a certain discomfort through the acute realization of the sensation physiologically accompanying mental effort, a phenomenon unnoted by the normal individual, whose attention is directed elsewhere, but not only realized, but even interpreted as agonizing pain by the individual whose ruling obsession is the desire to be free from all except agreeable sensations. This headache is perhaps analogous to that of brain fog, but out of proportion to the fog.

Such a patient will, on the chances, be found to have astigmatism, but the most painstaking correction is likely to prove unavailing. It is not unusual, in fact, for such patients to pass through the hands also of the rhinologist and the gynecologist for undoubted nasal and uterine defects, but without avail. Such cases have doubtless done much to further the skepticism regarding reflex symptoms from these various organs as well as from eyestrain.

It is desirable that such cases should be recognized at the outset, and that the fact should be patent that in these cases the astigmatism, the deviated septum, and the infantile or congenitally misplaced uterus are simply corroborative signs of constitutional defect, and that the morbid nervous symptoms are part and parcel of this constitutional tendency rather than reflex phenomena.

Nervous irritability appears to be sometimes lessened by the adjustment of glasses, but here again care should be taken to eliminate the irritability of the ideo-obsessive. Before promising relief from glasses the oculist as well as the neurologist should learn to note the fussiness of the constitutionally psycho-neurotic, shown, for example, by persistent change in the position of the chair placed by the examiner, by complaints of the temperature of the room, the call for a fan, or glass of water, the shading of a light, the closing or opening of a window; the nail biting, the grunting, sniffing, blinking, the vocalized cough and other compulsive manifestations of the ideo-obsessive, even amounting sometimes to *tic convulsif*, or more properly *tic obsessif*, in which the most bizarre movements are made, apparently to complete a mental picture. In this connection should be mentioned also the antagonistic attitude, the resentment at the various steps in the examination, and the reproaches because other steps are not taken, which the patient regards as important, particularly an inspection of the back, to which so many anomalous sensations are referred.

If spectacles are prescribed these patients can rarely accustom themselves to the reflection from the glass, the sight of the rim or the feeling of the bow over the ear, phenomena unnoted by

the average individual, but giving rise to a degree of discomfort in the ideo-obsessive, which gives a clew to the nature of the constitutional headache itself.

If the visit is preceded by a letter containing a statement of the symptoms, is accompanied by frequent reference to notes, and is followed by letters setting forth with great particularity points not completely elucidated during the visit, the oculist as well as the neurologist should recognize the confirmed hypochondriac, for whom other than mental treatment is sure to prove unavailing, and mental treatment itself only useful in very exceptional, and comparatively early, cases.

A word regarding *epilepsy* and *chorea*. It is doubtless true that a large percentage of refractive error will be found in these disorders. It is also true that an overloaded stomach sometimes precedes an epileptic attack, but there seems as little hope of curing these disorders by applying glasses as by regulating the digestion. This should not, of course, deter us from removing all such sources of irritation, a procedure which may materially benefit chorea, but must keep our expectations within legitimate bounds. If the overuse of other muscles than those of accommodation could furnish an analogue for the epileptic attacks there would be theoretical ground for the belief that eyestrain could produce epilepsy, even though refractive treatment in practice proved unavailing. In point of fact, however, while we have in the pain and cramp in other occupation neuroses, the analogue of the accommodative spasm and headache, there is nothing to suggest the generalized spasm and unconsciousness of epilepsy.

The following cases are cited as instances in which glasses have been vainly prescribed for symptoms supposed to be reflex, but really due to constitutional tendencies.

CASE. A business man, insurance agent, thirty-one years old, was sent for consultation by Dr. Proctor. Has had headaches for ten years, largely in the occipital region, also extending to this region from the eyes. There is no blur with the headaches, and no nausea or vomiting. They may come any time in the day. It bores him to talk; he is sleepless. He has bad dreams and worries at night with regard to business. The top of his head is sore at times. There is a scraping in the head at times like a broken violin string. Six months ago, he drank a strong cup of coffee which prevented his sleeping and which he thinks has upset him ever since. As a boy he was always shy and sensitive; would cross the street to avoid people when not feeling well. He is very conscientious and his wife states that he takes his work very hard, worries excessively on making mistakes, and carries his business to bed with him. His sister is highstrung, nervous and irritable, as was the entire family on the father's side. He has been treated hopefully by various oculists who have recommended prisms and lenses, both cylindrical and spherical, without effect. One year ago he was treated by a rhinologist for three or four months on account of contact between turbinate bone and the septum; no result followed. He was then treated on the theory that uric acid caused the headache, but this treatment gave no benefit. His family doctor

then diagnosticated nervous exhaustion. My diagnosis was constitutional headache.

CASE. A man of forty-four has had for a year occipital and vertical headache, practically constant during the day, but always disappearing at night. Heat or worry increases the pain and mental distraction causes it to disappear. It sometimes feels as if the top of the head would lift off. Has had three attacks during the year of abdominal tenderness and inflation lasting a day only; during these attacks the headaches disappeared. The third of these attacks occurred during worry on account of the illness of a child.

He has a brother and sister, extremely nervous, tremulous and sensitive. The sister has had an attack of nervous prostration, before which she was hysterical. A paternal uncle is in an insane hospital. His father was a very "set" man, his father's brother still more so.

Physical examination shows a well built, rugged man, who frequently clears his throat in the automatic manner peculiar to the obsessive. Abdominal examination is negative. His refractive error is apparently perfectly corrected by glasses.

CASE. A professional man has given up his work on account of trouble with the eyes. This trouble was of gradual onset commencing with difficulty in opening the lids. This trouble persists, but the eyes will open perfectly when the mind is engaged or when the mouth is open. Sometimes when the eyes are open the breath must be held. There is a neurotic family history. The patient was always sensitive and little things would worry him. He has a dread of being in a crowd, and has been subject to urticaria for several years, large welts appearing upon the skin whenever he is chilled.

The eyes are closed most of the time, being occasionally held open for a second or two. Occasionally rapid winking appears, also twitching movements of the mouth. The patient repeatedly makes an expiratory noise in the throat of which he states he is unaware.

Various oculists have been consulted and, on the theory that the symptoms were reflex, glasses, both cylindrical and prismatic, have been prescribed, correcting the refractive error, but without affording relief. The middle turbinate on one side has been also removed and the middle and inferior turbinates on the other, without result, except that during the cocaineization of the nasal cavity the trouble with the lids temporarily disappeared.

A word upon the *biographical study of eyestrain*. A careful study of the lives of prominent men would indicate that they were hampered by eyestrain (Gould), but it is a question if enthusiasts in other branches of medicine might not find evidence that their mental and physical peculiarities were due to, and might have been cured by, treatment of other pathological states than eyestrain. Might not the dentist attribute De Quincey's indigestion to his defective teeth, or the diatetic enthusiast find an excess of uric acid the cause of Carlyle's unfortunate disposition? However this may be, the history of such cases reveals signs, physical, mental, or both, of constitutional peculiarity. Carlyle in his boyhood was shy, proud, pugnacious, with strong affections and with equally violent antipathies. In later life he made war upon the neighbors' poultry and had constructed for his labors a room proof against sound. De Quincey was a man of

diminutive stature, given to day dreaming before he became addicted to the habit the inability to resist which may quite as plausibly be attributed to constitutional weakness as to the discomfort caused by eyestrain.

It is, perhaps, partly through lack, not of knowledge, but of discriminating attention to the distinctions I have reviewed that so much discouragement exists among neurologists regarding the relief of nervous symptoms by recourse to glasses. It is also possible that extreme claims have aroused the negativism of the practitioner and thus prevented systematic effort. If I have induced anyone present to renew an abandoned effort to help some sufferer from migraine by glasses, the main object of this paper has been attained.

CONCLUSIONS.

(1) Among individuals totally blind since infancy, 66% were free from tendency to headache, as contrasted with 31% of those having sight, and 29% of those with partial or with acquired blindness.

(2) If these figures should prove constant the inference would seem justifiable that half the headaches in health are due to eyestrain.

(3) The headache, when present among those totally blind since infancy, partook sufficiently often of the migranoid character to preclude the supposition that *all* migraine is due to eyestrain.

(4) The results of this study would indicate that while migraine and migranoid headaches have a constitutional basis, and while other factors than eyestrain may act as exciting causes, still, eyestrain is one of the most, if not the most, important of these exciting causes, and steps for its relief are imperative.

(5) In no case has correction of refraction been given a thorough trial until (a) the glasses are properly centered, (b) their continued readjustment is practiced, (c) the patient looks as much as possible through their centers instead of from side to side, (d) efforts are avoided at straining the eyes to see distant objects with the glasses, (e) spectacles instead of eyeglasses are used, and (f) the use of spectacles is constant, not intermittent.

(6) The constitutional headache of the deviate is probably allied to the headache of "brain fag," but is out of all proportion to the sources of fag. Little can here be expected of spectacles.

(7) In the proportion in which obsessive tendencies and other signs of constitutional peculiarity accompany errors of refraction, efforts at the correction of refraction will prove unavailing for the relief of nervous symptoms.

THE PRESERVATION OF THE URINE.

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THE preservation of the urine is a subject with which every physician has to deal at some time, but one which is, unfortunately, neglected and sometimes considered of little importance. But

it is essential that a urine be in a fairly fresh condition in order that a satisfactory examination be made, so that the use of a preservative is at times imperative.

It is often necessary to collect the twenty-four-hour quantity of urine and to have it in a fresh condition at the end of twenty-four or forty-eight hours, or even at the end of seventy-two hours. This becomes a difficult matter, particularly in warm weather. It is also often important that a sample of a single micturition or a sample of the mixed twenty-four hour urine be sent to the physician's office or to a clinical laboratory either by mail or express, requiring two or three days for transportation, and that the specimen arrive in a condition suitable for examination. The problems of what to use and how much should be used naturally arise.

It is, of course, essential that a preservative be used which will modify the composition of the urine as little as possible, and one which will not interfere with the chemical tests or the microscopic examination of the sediment. Unfortunately, most preservatives modify the urine to a slight degree, and some to a greater extent than others; these facts I hope to make clear in the consideration of the individual substances.

The length of time that a urine, which is free from preservatives, will remain suitable for a chemical and microscopical examination will depend upon (1) the temperature at which it is kept, (2) the degree of concentration, and (3) the presence or absence of pathological elements such as albumin and sugar.

It is well known that a urine will decompose much more rapidly at a temperature of 80° F. than at 60° F.¹ We also know that a urine with a low specific gravity (*e. g.* 1.010) will decompose much more rapidly than one with a specific gravity of 1.021, and a urine with a gravity of 1.030, but free from sugar, will remain fresh a much longer time than one with a gravity of 1.021. A specimen that contains more than a very slight trace of albumin will generally undergo rapid ammoniacal decomposition, or become so filled with bacteria that the sediment is unfit for examination. When 1% or more of sugar is present in a urine, ammoniacal decomposition rarely occurs; indeed, the reaction usually becomes more acid due to the formation of acids in the process of fermentation. As soon, however, as fermentation of the sugar begins, the progress of which depends largely upon the temperature, the sediment soon becomes unfit for examination because of the abundant development of sugar spores (*torula cerevisiæ*).

The subject-matter of this paper is based upon 140 experiments with various preservatives in urines of varying composition: (1) Those with a normal, a high, and a low specific gravity; (2) those with albumin and without albumin; (3) those with sugar and free from sugar; (4) those with a variety of casts and without casts; (5) those containing pus and blood; and (6) those

¹ All statements in this paper as to the use of preservatives apply to room temperature, — about 70° F.