gence, amounting to rather more than 0.8 dioptrie eleven hours after the instillation; and he makes the very significant remark that "hypermetropes, under the double advantage of smaller circles of diffusion and of easier tension of accommodation, lose for a time their asthenopia." The introduction of pilocarpine in ophthalmic therapeutics has made it practicable to keep up a moderate myotic action for an almost indefinite period, without injurious spasm of accommodation. In cases of asthenopia in young persons, associated with hypermetropia of low grade, pilocarpine may be employed in the form of a weak solution, instilling any desired fraction of a minim, measured by means of a slender glass pipette. The instillation may be made morning and evening, and after a few weeks at night only; or the effect may be gradually diminished by reducing the quantity used or the strength of the solution. In this way it is often practicable to tide over an attack of asthenopia in a young person without interrupting school work, and so to postpone the use of glasses for perhaps many years.

In asthenopia dependent on hypermetropia of high grade, the only effective resource is in the use of convex glasses, and these should be of a strength sufficient to correct fully the refractive error. Owing to the fact that a part of the hypermetropia is almost always latent (see *Hypermetropia*), fully correcting (neutralizing) glasses often prove less acceptable in the beginning than those of less power, but in every case the selection of glasses should be made with distinct reference to the total hypermetropia, and in the expectation of ultimately applying the full correction. In a few cases of asthenopia any exercise of the accommodation even with convex glasses is attended with pain, so that it may be found necessary to have recourse to atropine for the purpose of maintaining for a time a state of complete physiological rest. During the maintenance of the mydriasis reading may be permitted with the aid of stronger convex glasses which must be exchanged for neutralizing glasses when the accommodation is allowed to resume its function. The hypermetrope who requires convex glasses for reading sees perfectly at a distance with the same glasses, and, as a rule, finds it more convenient and comfortable to wear them constantly; but in this he may generally be permitted to follow his own pleasure. If for any reason he is disinclined to wear glasses constantly, a compromise may often be effected by prescribing spectacles for continuous reading and an eyeglass (*pince-nez*) for occasional use.

In muscular asthenopia the treatment consists primarily in the correction of the myopia, together with any astigmatism that may be present, by means of neutralizing concave spherical or spherico-cylindrical glasses. The glasses should, as a rule, be mounted in a spectacle frame rather than as a *pince-nez*, and they should be worn continuously. The relief afforded by neutralizing glasses is generally immediate and complete, but in a few cases it may be necessary to prescribe stronger concave glasses, which shall over-correct the myopia and so compel some exercise of the accommodation in distant vision and a correspondingly increased exercise of the accommodation in near work. This over-correction, which may be carried as high as three dioptries in children or in young adults with ample range of accommodation, is free from the dangers and disabilities which attend the wearing of too strong concave glasses in uncomplicated myopia.

The decentration of concave glasses outwards, or, what amounts to the same thing, the grinding of the necessary concave spherical or spherical and cylindrical surfaces on prisms of from 1° to 8° angle, set with bases of the prisms toward the nose, is occasionally of advantage by correcting the refractive error and at the same time giving some measure of direct relief to the recti interni muscles. In the higher grades of relative muscular insufficiency, division of the tendon of the rectus externus muscle in one eye or in both eyes may be indicated, but operative interference should be considered only after an exhaustive investigation of each particular case, and generally after a full trial of less radical methods.*

In the treatment of asthenopia, whether accommodative or muscular, the chief reliance is to be placed upon the correction of the underlying error of refraction (hypermetropia, myopia, astigmatism, anisometropia) by means of appropriate glasses (convex, concave, cylindrical, or of different power for the two eyes). A practically normal relation of accommodation to convergence is thus established, and, apart from subsequent structural changes in the eyes, the glasses which perfectly correct the refractive error in youth suffice until, with advancing age, the sight begins to be presbyopic (see *Accommodation and Refraction, Astigmatism, Hypermetropia, Myopia, Presbyopia, Spectacles*).

John Green.

ASTHMA.—Symptomatology. — Asthma is a disease characterized by attacks of true intermittent, but severe, dyspnœa, accompanied by general sibilant râles. In a typical case of the complaint the patient may retire to bed in apparently good health, and with no more warning of the impending attack than in a case of nocturnal epilepsy; but after a few hours' sleep his respiration becomes labored and whistling, so that it even may be heard by others while he is still asleep. Soon he is himself awakened by his difficulty of breathing, though if accustomed to such visitations he may endeavor to continue his slumber, and for a while succeed in doing so. Ere long, however, not only sleep, but all rest becomes impossible by the supervention of a most urgent dyspnœa, whose symptoms would indicate great peril to life in any other disease. In asthma, however, though the distress be great, alarm is significantly absent from the patient.

Careful observation now will show that the difficulty in the breathing is mainly due to some interference with the *expiration*. Unlike croup, asthma allows the air to readily enter with the inspiration, but the expiration appears as a laborious struggle which succeeds in forcing the air out only with painful slowness, rendering this process from two to four times the length of the inspiration. This disproportionate expiration is characteristic, for though the expiration is prolonged in emphysema and phthisis, yet it never equals the delay of asthma. The patients, therefore, dread the most ordinary acts which entail a prolongation of the expiration, like coughing, or even speaking, but especially laughing, for in some this is itself sufficient to induce an attack, while on the other hand a forced inspiration will often serve to break up the paroxysm.

Owing to this impeded exit the residual air increases in the lungs to such an extent that the intercostal spaces become much widened and the girth of the chest so expanded that the ordinarily worn clothes of the patient will not come together by from one to three inches. The upper abdomen also becomes similarly distended by the forced descent of the diaphragm pushing down the liver, stomach, and spleen. The walls of the chest finally seem too fixed to allow of any but the slightest expansion and retraction in breathing, and this condition gives to the patient a sense of suffocative tightness, as if caused by some external compression. Salter notes also, as a frequent symptom, a persistent itching of the chin, and often between the shoulder blades and sternum as well, supervening with the first symptoms of asthmatic breathing and passing off with the full development of the paroxysm.

Diagnosis.—Physical exploration of the chest now affords a group of characteristic symptoms which render the diagnosis of asthma a matter of no great difficulty. The lung distention exaggerates the pulmonary resonance on percussion and extends its area in every direction, behind the clavicles, over the heart, and downward over the regions of normal splenic and hepatic dulness. From the same cause the vocal fremitus either disappears or is much diminished in those localities where it is well marked in health. Auscultation, however, is the most decisive in its indications, for the normal vesicular murmur is quite displaced by high-pitched sibilant râles, which often attract the attention of bystanders, as they become audible to some distance from the patient. On applying the ear to the chest, however, one distinguishes very fine râles, mingled with others larger and graver in tone, which, moreover, seem to shift in location as if sometimes near to the ear, and then farther off, like a wavy passage of air over various musical tubes. In simple asthma these râles are purely sibilant, but in prolonged attacks, or when bronchitis is also present, they become more or less crackling.

As the disordered respiration continues, the sufferings of the patient for breath become extreme. His whole frame partakes in the struggle for air, which leads him involuntarily to try to expand the chest yet more and more. He strives to make immovable his back, shoulders, and head, so that from them the accessory muscles of respiration may pull upon the already tense walls of the thorax. Hence he fixes his arms or plants his elbows on a table or other support, while his head is thrown back, his mouth panting, his eyes widely opened and fixed, and his face pale and bedewed with perspiration. He speaks only in monosyllables, and resents everything which calls him off, even for a moment, from his efforts to breathe. The pulse grows small and feeble, and the patient becomes so cyanotic and cold that his wet, clammy skin and ghastly expression are apt to inspire strangers with fear of his near dissolution.

The duration of an attack varies greatly, not only in different patients, but in the same patient at different times. The attack may come on in the night and pass off soon after daylight, or it may be prolonged into a series of exacerbations and incomplete remissions for several successive days and nights, until the sufferer becomes almost fatally exhausted. In like manner the subsidence bears little relation to the severity or duration of the attack. Either as the effect of remedies or spontaneously, the breathing may become suddenly easier, the rigidity of the chest walls pass off, the inspirations grow fuller and the expirations shorter, and the patient, who but a few moments before seemed about to perish in his distress, will soon return, after a moderate expectoration of a clear frothy mucus, to regular and natural breathing, with no other indication of his recent sufferings than an expression of fatigue. At other times, especially if bronchitis supervenes, the attack passes off in a series of irregular paroxysms of difficult breathing, alternating with coughing and free expectoration. In many fully developed attacks, however, the patient has carefully to watch for its decline by avoiding all causes of exacerbation or relapse, especially from eating, so that some asthmatics are obliged to go to bed fasting if they are to pass that night free from dyspnœa.

Etiology.—In asthma, as in other markedly spasmodic diseases, the afferent impression which induces the attacks varies indefinitely, both in kind and in seat. The sensory nerves, however, which are distributed to the mucous membrane of the respiratory tract, including the olfactories, afford the most frequent instances of the curious impressibility which excites reflexly the asthmatic spasm. On this account bronchitis itself takes the lead, for asthmatic breathing occurs in so large a proportion of both acute and chronic forms of this affection that some writers have gone the length of ascribing all asthmas to bronchitis. It is easy to show, however, that asthma lacks no element of a true neurosis, and that in many typical cases there is no bronchitis whatever. Yet, so great is the proclivity to it in bronchitis, that even comparatively transient affections, like measles and pertussis, sometimes entail a lifelong asthma as a sequel to the bronchial irritation attendant upon their course. In the initial or "dry" stage of acute bronchitis, along with the sense of soreness and tightness across the chest, auscultation reveals the presence of true asthmatic wheezing, while in chronic bronchitis asthmatic attacks often occur upon very slight provocations, such as by rising too suddenly, or from attempting too long a sentence in talking.

After the irritation of bronchitis, the list of excitants of asthma which take their start from the sensory nerves of the respiratory mucous membrane varies in a most extraordinary degree. Nearly every asthmatic has his specialty of the kind, so to speak, often with a most unaccountable caprice of choice. The writer has known of a gentleman who, while in his room on an upper floor, yet could tell at once by his breathing that buckwheat flour had just been brought into the house. The proximity of certain animals, especially cats, will induce an attack with many asthmatics, who may suffer from this cause for a long time without being aware of its origin until they accidentally discover that the tightness comes on so soon as they come near a horse or a dog, or pay a visit to a menagerie. The proclivity to asthma from deranged innervation within the nasal cavity is also illustrated by numerous histories of cures by the removal of polypi or other causes of nasal obstruction or irritation. The smell of powdered ipecacuanha is often mentioned as a similar excitant, but although this may be ascribed to irritation by minute particles of ipecac inhaled—and the like may be said of asthma from the inhalation of mustard or of the fumes of a sulphur match—yet such an explanation cannot hold good in asthma caused by the smell of violets or of other fragrant flowers. In fact nothing can be more whimsical than the behavior of asthma as regards either what may be resented as an ingredient of the air inspired, or simply from the general character of the outer atmosphere. One asthmatic may find comfort in the air of a particular locality which another asthmatic can enter only at his peril. Salter mentions the instance of two friends who could not exchange visits at their country houses, which were on opposite sides of a ridge, though both were suited with the air of London. The air of large cities, in fact, despite its smoke and dust, agrees oftener with asthmatics than does the pure air of the country.

Next to the respiratory tract, the most frequent excitants of asthmatic attacks proceed from the alimentary canal, especially from its gastro-duodenal portion. Most asthmatics, indeed, are also dyspeptics, and are thus doubly obliged to be particular in their dietary. The list of forbidden articles is singularly varied, as we might expect from the range in this respect among dyspeptics as a class. Some will have asthma if they take cheese, others almonds, others apples or wine or tea or tobacco, etc.; the peculiarity being that the particular idiosyncrasy is generally consistently adhered to, perhaps for many years, or at least as long as natural tastes or likings are apt to last. With many patients, however, it is not so much a particular article which brings on a paroxysm, but a too hearty meal for them of any kind. On the other hand, constipation is the sure provocative with some who are also often promptly relieved by a cathartic. In women, uterine derangements have their share in the causation of asthma, though not as frequently as they serve to excite other spasmodic diseases; while a certain proportion remains whose attacks seem to be induced solely by mental excitement, particularly of a depressing kind.

Among the special predisposing causes of asthmatic seizures is the state of sleep, for the majority of distinct attacks set in after the patient has been asleep for some time, and oftenest during the hours of profound slumber, after midnight. Some asthmatics are obliged to keep awake after noting certain of their usual premonitory

* The indiscriminate cutting of the recti and even of the oblique muscles, in the hope of thereby curing asthenopia, which was at one time somewhat extensively practised, has been justly referred to by Donders as "a melancholy page in the history of operative ophthalmic surgery." Exaggerated or perverted ideas regarding disturbed balance of the ocular muscles, as the determining cause not only of different conditions of disability more or less closely simulating asthenopia, but also of all sorts of nervous manifestations occurring in other and even remote parts of the body, have borne fruit, in recent times, in reports of numerous and oft-repeated operations on one and the same muscle or on different muscles, for which it is difficult to find justification in the known facts of physiology or pathology. Operations on the ocular muscles have a legitimate place in the treatment of muscular asthenopia, as truly as in strabismus; in both conditions grave and often irreparable harm may result from a hasty or ill-considered resort to operative procedures.