length, the inch being used as the unit. Owing principally to differences in the length of the inch in various countries, this method had great inconveniences, and is now giving place to a universal system, in which the unit is the refrac­tive power of a lens whose focal length is one metre. This unit is called a “dioptric” (usually written “ D ”). A lens of twice its strength has a refractive power of 2 D, and a focal length of half a metre, and so on.

*Concave lenses* are used in the treatment of myopia or short-sight. In this condition the eye is elongated from before backwards, so that the retina lies behind the principal focus. All objects, therefore, which lie beyond a certain point (the conjugate focus of the dioptric system of the eye, the far point) are indistinctly seen ; rays from them have not the necessary divergence to be focused in the retina, but may obtain it by the interposition of suitable concave lenses. Concave lenses should never be used for work within the far point ; but they may be used in all cases to improve distant vision, and in very short-sighted persons to remove the far point so as to enable fine work such as sewing or reading to be done at a convenient distance. The weakest pair of concave lenses with which one can read clearly test types at a distance of 18 feet is the measure of the amount of myopia, and this fully correcting glass may be worn in the slighter forms of short-sight. In higher degrees, where full correction might increase the myopia by inducing a strain of the accommodation, somewhat weaker glasses should be used for near work. In the highest degrees the complete correction may be employed, but lorgnettes are generally preferred, as they can be removed when the eyes become fatigued. It must be remembered that short-sight tends to increase during the early, especially the school, years of life, and that hygienic treatment, good light, good type, and avoidance of stooping are important for its prevention.

*Convex Lenses.—*In hypermetropia the retina is in front of the principal focus of the eye. Hence in its condition of repose such an eye cannot distinctly see parallel rays from a distance and, still less, divergent rays from a near object. The defect may be overcome more or less com­pletely by the use of the accommodation. In the slighter forms no inconvenience may result ; but in higher degrees prolonged work is apt to give rise to aching and watering of the eyes, headache, inability to read or sew for any length of time, and even to double vision and internal strabismus. Such cases should be treated with convex lenses, which should be theoretically of such a strength as to fully correct the hypermetropia. Practically it is found that a certain amount of hypermetropia remains latent, owing to spasm of the accommodation, which relaxes only gradually. At first glasses may be given of such a strength as to relieve the troublesome symptoms ; and the strength may be gradually increased till the total hypermetropia is corrected. Young adults with slighter forms of hypermetropia need glasses only for near work ; elderly people should have one pair of weak glasses for distant and another stronger pair for near vision. These may be conveniently combined, as in Franklin glasses, where the upper half of the spectacle frame contains a weak lens, and the lower half, through which the eye looks when reading, a stronger one.

*Anisometropia.—*It is difficult to lay down rules for the treatment of cases where the refraction of the two eyes is unequal. If only one eye is used, its anomaly should be alone corrected ; where both are used and nearly of equal strength, correction of each often gives satisfactory results.

*Presbyopia.—*Where distant vision remains unaltered, but, owing to gradual failure of the accommodative appa­ratus of the eye, clear vision within 8 inches becomes im­possible, convex lenses should be used for reading of such

a strength as to enable the eye to see clearly about 8 inches distance. Presbyopia is arbitrarily said to commence at the age of forty, because it is then that the need of spectacles for reading is generally felt ; but it appears later in myopia and earlier in hypermetropia. It advances with years, re­quiring from time to time spectacles of increasing strength.

*Cylindrical Lenses.—*In astigmatism, owing to differ­ences in the refractive power of the various meridians of the eye, great defect of sight, frequently accompanied by severe headache, occurs. This condition may be cured completely, or greatly improved, by the use of lenses whose surfaces are segments of cylinders. They may be used either alone or in combination with spherical lenses. The correction of astigmatism is in many cases a matter of con­siderable difficulty, but the results to vision almost always reward the trouble.

Convex spectacles were invented towards the end of the 13th century, perhaps by Roger Bacon. Concave glasses were intro­duced soon afterwards. Airy, the astronomer, about 1827, corrected his own astigmatism by means of a cylindrical lens. Periscopic glasses were introduced by Dr W. H. Wollaston. (A. BR.)

SPECTROSCOPY. The spectroscope is an instrument which separates luminous vibrations of different wave­lengths, as far as is necessary for the object in view. It consists of three parts,—the collimator, the prism or grat­ing, and the telescope. The collimator carries the slit through which the light is admitted and a lens which con­verts the diverging pencil of light into a parallel pencil. The pencils carrying light of different wave-lengths are turned through different angles by the prism or grating, which is therefore the essential portion of the spectro­scope. The telescope serves only to give the necessary magnifying power, and is dispensed with in small direct vision spectroscopes. For a description of the different kinds of prism used, see Optics ; and for an explanation of the action of the grating, see Undulatory Theory. The most important adjustment in the spectroscope is that of the collimator. Especially in instruments of large re­solving power it is essential for good definition that the light should enter the prism or fall on the grating as a parallel pencil. For a method allowing an easy and accurate adjustment for each kind of ray, see an article in *Phil. Mag.,* vol. vii. p. 95 (1879).

Prisms are nearly always used in the position of mini­mum deviation, but, if the collimator is properly adjusted, this is by no means a necessary condition for good defini­tion. Prisms as generally cut, with an isosceles base, give the greatest resolving power in the position of minimum deviation, but the loss in resolving power is not great for a small displacement. The dispersion and magnifying power of a prism can be considerably altered by a change of its position, and a knowledge of this fact is of great value to an experienced observer. The use of a prism in a position different from that of minimum deviation is, however, a luxury which only those acquainted with the laws of optics can indulge in with safety.

Lord Rayleigh has given the theory of the spectro­scope under Optics, and shown on what its resolving power depends. There is no connexion between resolving power and dispersion, any value of resolving power being consistent with any value of dispersion. To obtain large resolving power with small dispersion requires, however, the use of inconveniently large telescopes and prisms or gratings. It is easy, on the other hand, to obtain small resolving power together with large dispersion.

The following definitions would be found of general use if adopted. *Resolving Power.—*The unit resolving power of a spectroscope in any part of the spectrum is that resolving power which allows the separation of two lines differing by the thousandth part of their own wave-length or wave-number,—the wave-number being the number