Conversely, if the lengths a and b of the axes and the orientation of the ellipse is known (i.e. a, b and ψ given) these formulae enable the determination of the amplitudes a_1, a_2 and the phase difference δ. In Chapter XIV, instruments will be described by means of which these quantities may be directly determined.

Before discussing some important special cases, we must say a few words about the terminology. We distinguish two cases of polarization, according to the sense in which the end point of the electric vector describes the ellipse. It seems natural to call the polarization right-handed or left-handed according as to whether the rotation of $\boldsymbol{E}$ and the direction of propagation form a right-handed or left-handed screw. But the traditional terminology is just the opposite—being based on the apparent behaviour of $\boldsymbol{E}$ when "viewed" face on by the observer. We shall conform throughout this book to this customary usage. Thus we say that the polarization is *right-handed* when to an observer looking in the direction from which the light is coming, the end-point of the electric vector would appear to describe the ellipse in the clockwise sense. If we consider the values of (12) for two time instants separated by a quarter of a period, we see that in this case $\sin \delta > 0$, or by (29), $0 < \chi \leqslant \pi/4$. For *left-handed* polarization the opposite is the case, i.e. to an observer looking in the direction from which the light is propagated, the electric vector would appear to describe the ellipse anticlockwise; in this case $\sin \delta < 0$, so that $-\pi/4 \leqslant \chi < 0$.

For reasons connected with the historical development of optics, the direction of the magnetic vector is often called the *direction of polarization* and the plane containing the magnetic vector and the direction of propagation is known as the *plane of polarization.* This terminology is, however, not used by all writers; some define these quantities with respect to the electric rather than the magnetic vector. This lack of uniformity arises partly from the fact that there is no single physical entity which could be described without ambiguity as "the light vector". When particular attention is paid to the physical effect of the field vectors, there would actually be some grounds for regarding $\boldsymbol{E}$ as the light vector. For every action is a consequence of the motion of elementary charged particles (electrons, nuclei) set into motion by the electromagnetic field. The mechanical force $\boldsymbol{F}$ of the field on the particle is then given by LORENTZ' law, § 1.1 (34).

$$\boldsymbol{F} = e\left(\boldsymbol{E} + \frac{\mu}{c}\mathbf{v} \wedge \boldsymbol{H}\right),$$

e being the charge and $\mathbf{v}$ the velocity of the particle. Hence the electric vector is seen to act even when the particle is at rest. On the other hand, the magnetic vector plays a part only when the particle is in motion; however, since v/c is usually very small compared to unity this effect may often be neglected. Nevertheless the "direction of polarization" and the "plane of polarization" are usually associated with the magnetic vector. The reason for this nomenclature will become apparent in the next section when polarization on reflection is discussed.

To avoid confusion we shall, in accordance with more recent practice, not use the terms "direction of polarization" and "plane of polarization"; instead we shall speak of *direction of vibration* and *plane of vibration* to denote the direction of a field vector and the plane containing the field vector and the direction of propagation, the vector in question being specified in each case.

(b) *Linear and circular polarization*

Two special cases are of particular importance, namely when the polarization ellipse degenerates into a straight line or a circle.