The study of the rates of the various collision processes associated with positrons with energy ranging from thermal up to a few tens of eV is of interest, not only for its own sake but because of the more stringent tests which it imposes on theoretical approximations than does the corresponding study of electron collisions. For example, the elastic scattering of slow electrons by atoms is determined largely by the combined effect of (a) the mean static field of the unperturbed atom (b) the dipole distortion of this field by the incoming electron and (c) electron exchange. Of these the first two always give rise to attractive forces. On the other hand for positrons (a) is always repulsive and is opposed by the dipole distortion (b) which is attractive as for electrons. The accurate evaluation of the net effect of (a) and (b) is often more difficult when they act in opposite sense. For positron collisions, exchange is replaced by virtual positronium formation which tends to provide additional attraction but is difficult to calculate accurately because it depends strongly on
In addition it is possible to observe certain quantities for positron collisions which have no analogue for electrons, depending as they do on positron annihilation rates. These again depend very strongly on electron-positron correlation and so demand an accurate theory for their description and prediction.

Finally, the chemistry of positronium is of special interest as it contains in the extreme the features which are only barely becoming apparent with hydrogen - for example the unusual features associated with the hydrogen bond.

This account will confine itself to some of the less complicated theoretical aspects of the subject but will deal with some quite sophisticated experimental techniques which have recently made it possible to derive more directly interpretable physical data than hitherto. The subject is unusual in that, while the theoretical physics involved is that of atomic collisions, the experimental techniques are essentially those of nuclear physics in so far as the central observational method is the use of sophisticated particle counter techniques.

Observable quantities. The rate of annihilation of positrons in an assembly of electrons is given by

$$\lambda = 4\pi r_0^2 c n_s ,$$

where \( n_s \) is the average number of electrons per unit volume at the position of the positron possessing opposite spin to it. \( r_0(=e^2/mc^2) \) is the classical radius of the electron and \( c \) is the velocity of light. If \( n \) is the concentration of atoms per unit volume we may write