the motion of the electron is described by an orbit in a plane that lies wholly between two radii, whereas in the latter the wave function in all of space is different from zero at all but a finite number of values of the radius, and depends on the field at all distances. Thus there could be no separation into "penetrating" and "non-penetrating" orbits.

This raised the question of assignment of quantum numbers. Hartree suggested that $l = k - 1$, and that n be such that $n - l + 1$ be the number of values of the radius r for which the wave function $\Psi = 0$. This agreed with Bohr's principal quantum number for the hydrogen atom.

As in Bohr's theory, Hartree's first goal was to express Schrödinger's equation in as simple a form as possible, eliminating the various physical constants. This he did through defining the so-called "atomic units:"

Unit of length	$a_H = h^2/4\pi^2me^2$
Unit of charge	e, the magnitude of charge on an electron
Unit of mass	m, the mass of the electron
Unit of action	$h/2\pi$
Unit of energy	$e^2/a = 2hcR$, twice the ionization energy of the hydrogen atom with fixed (infinite) nucleus
Unit of time	$1/4\pi cR$

The unit of energy today is called a "Hartree" and denoted by E_h. In these units, the wave equation for the motion in space of a point electron with total energy E, in a static field in which its potential energy is V, is defined by

$$\nabla^2\Psi + 2(E - V)\Psi = 0. \tag{4.1}$$

If the field is of spherical symmetry so that $V = -v(r)$, in spherical polar co-ordinates, Ψ separates into a known spherical harmonic function, $S(\theta, \phi)$, and a radial function, $\chi(r) = P(r)/r$. Then $P(r)$ satisfies the differential equation

$$d^2P/dr^2 + \left[2v - \epsilon - l(l+1)/r^2\right]P = 0, \tag{4.2}$$

where $\epsilon = -2E$ and is related to the wave number through $\epsilon = \nu/R$. He was careful to point out the advantage of working with $P(r)$ rather than $\chi(r)$, the first being that the differential equation was simpler, and the second that $P^2(r)$ (suitably normalized) had the physical interpretation of being a charge density at radius r.

Hartree then went on to discuss the properties of the solution, in the region of large r, small r, variation of the solution (as when v changes by a