PHYSICS

XXVII. PRESENT DAY OBJECTIVES IN PHYSICS

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(Abstract)

The primary interest of Physicists is to discover the ultimate nature of matter and the laws describing the activities of matter. At present much investigation is concerned with the internal structure of the atom. In the nineties, evidence rapidly accumulated showing that there was a vast unexplored region within the atom. The isolation of the electron, or negative unit of electricity, opened the way. A little later, radioactivity was discovered and its phenomona found to be intimately connected with atomic structure.

It is now known that the ninety odd elements contain nothing but electricity. Each atom is made up of a nucleus of closely packed particles of positive and negative electricity, called protons and electrons respectively. Around this core there revolve other electrons. Physicists are at present very much concerned with the study of the arrangement and motion of the electric charges which for the present may be regarded as the ultimate units of which all matter is composed.

One of the results of this simplification of ideas about matter is a unification of many of the fields of physics. Conduction of electricity in gases, radioactivity, X-rays and spectroscopy, to name a few apparently different fields, all meet upon common ground. The phenomena of all are based upon the activities of protons and electrons.

Each field however has its own peculiar problems and each field makes its contributions for the benefit of mankind. Radioactive substances and X-rays as curative agents, the X-ray as a powerful aid in diagnosis, radio communication, the modern electric light and many other appliactions of modern physics illustrate the fact that a part of the energy of physicists is directed to so-called practical applications. The increasingly important demands of industry for men with an understanding of modern physics and an ability to apply this knowledge in commercial enterprises is creating the new profession of engineering physics. Within a few decades applied physics is likely to give us new sources of energy by placing at our disposal the enormous stores of energy which exist

within the atoms. Already the dreams of the alchemists are coming true, for nitrogen has been pounded to pieces by electrically charged atomic hammers, yielding simpler forms. When the heavier elements can simularly be broken up the production of gold from lead may be commonplace.

It is interesting to recall that at that while the most minute divisions of matter are being studied by certain physicists, others are measuring the diameters of the stars and Einstein is asking us to rearrange some of our most cherished ideas concerning time and space.

XXVIII. THE CAUSE OF THE OPTIMUM ANGLE IN A RECEIVING CONICAL HORN

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Suppose that plane waves of constant amplitude and frequency are incident upon the opening of a conical horn in the direction of the axis of the horn. Let the length of the horn be adjusted for fundamental resonance to the incident waves. Let the amplification of the horn be defined as the ratio of the amplitude of pressure variation at the vertex of the horn to that in the incident plane waves. We shall consider that the horn is used as a receiver, in which case there is an energy loss at the vertex. Neglecting the energy loss due to the non-rigidity of the horn and that due to the viscosity of the medium, the only other energy loss is that due to the spherical waves radiated outwards from the opening of the horn.

Consider first the energy loss at the vertex. For horns of different sized opening all in fundamental resonance with the same incident plane waves, the rate of loss of energy is proportional to the square of the amplification and hence proportional to the square of the energy input per unit area of the opening by the incident waves. For horns of sufficiently small openings the energy radiated from the open end can be neglected in comparison to that abstrated at the vertex. In this case, in the steady state of vibration, when the energy input equals the output, the energy input per unit area, and hence the amplification, must be proportional to the area of the opening of the horn.

Consider next the energy radiated at the open end of the horn. For horns of different sized openings all in fundamental resonance with the same incident plane waves, the rate of loss of energy is proportional to the square of the energy input. For horns