periments showed that a stiffened membrane is much more sensitive than is a simple stretched membrane.

It is clear that in evolving the ear nature has utilized sound physical principles to improve communication. In terms of these principles it is possible to account for many peculiarities in the structure and arrangement of the parts of the middle ear. G.V.B.

The Structure of the Middle Ear and the Hearing of One's Own Voice by Bone-Conduction. By Georg v. Békésy. *J. Acous. Soc. Am. 21: 217, May, 1949.*

The Proton's Magnetic Moment

The magnetic moment of the proton is one of the important physical properties of one of the fundamental particles of nature. A measurement of this property in terms of the magnetic moment of another fundamental particle, the electron, has been made by the application of molecular beam techniques. In essence the method involves a measurement at some fixed field of the frequency corresponding to a reorientation of the proton in the sodium hydroxide molecule and the frequencies of chosen lines in the hyperfine spectra of certain atoms. An application to the experimental data of our knowledge of the properties of atomic energy states and of the intrinsic magnetic moment of the electron yields the value of the proton moment in terms of the electron moment. Outside of the intrinsic importance of a knowledge of this important physical constant, the present result provides a scale in terms of which the magnetic moments of all other particles may be determined. Of equal importance is the use of the new result, in conjunction with other recent experimental results, in determining the values of two important physical constants, the fine structure constant and the specific charge of the electron. P.K.

The Magnetic Moment of the Proton. By H. Taub and P. Kusch. *Phys. Rev. 75: 1481, May 15, 1949.*

Solar Radio Noise

Recent studies of solar radiation within the radio spectrum indicate that associated with sun spot activity there occur bursts of radiation whose intensity occasionally exceeds the normal radiation by a factor of several million. It has been previously suggested that these anomalous radiations are caused by oscillations of electron gas or plasma existing in the solar atmosphere. However, no detailed picture of the mechanism of excitation of the plasma has ever been given.

The solution of the problem now appears as a by-product of research in the field of electron tubes. A search for better methods of generation and amplification of microwave energy has led to the conception and a successful development at the Naval Research Laboratory of an entirely new method based on space charge wave amplification effects. The theory and experiment showed that if a stream of charged particles is injected into evacuated space occupied by another stream of particles there occurs a partial conversion of the kinetic energy of the particles into the energy of electromagnetic fields associated with periodic groupings of particles, or space-charge waves. This mechanism of energy amplification was used successfully in special microwave tubes called "electron-wave tubes" in which energy amplification of over a million was obtained.

Intermingling streams of charged particles of different velocities emerging from sun spots, particularly during solar flares, constitute a medium which according to the space-charge wave theory tends to amplify small fluctuations. Thus the kinetic energy of solar particles can be partially converted into the energy of space-charge waves and eventually radiated. The theory of space-charge waves makes it possible to compute the intensity and the frequency at which maximum radiation will be observed if the number of particles emerging from the sun and their velocities are known. Estimates of these quantities are possible from measurements of variation of the magnetic field of the earth during magnetic storms since these storms are caused by solar corpuscles arriving upon the earth. Computed from such estimates the wavelength and the absolute intensity of this anomalous solar radiation is found to be in good agreement with observations. A.V.H.

The Origin of Solar Radio Noise. By Andrew V. Haeff. *Phys. Rev. 75: 1546, May 15, 1949.*

Heavy Element Spectra

Because spectrochemical analysis has proved useful in establishing the purity of very small samples of the new heavy elements as they were produced in turn by the Plutonium Project, photographs of the spectra of these elements have accumulated. These plates have been measured and several hundred lines each have been listed for protoactinium, neptunium, plutonium, and americium. The wavelengths could be measured only roughly in a limited spectral region, but should be adequate for identification purposes. The heavy elements follow the pattern of the rare earths more closely than had been anticipated. While it had been recognized that the heavy elements form a second rare earth series, the analogy is not exact. It is now clear that there is an abrupt decrease in complexity of the heavy elements at americium, indicating that for this element the 5f shell is half-filled, by analogy with the simplicity of the europium spectrum among the rare earths. Hence the ground state of americium-I corresponds to europium. This similarity is being used as a guide in an attempt to make a term analysis of the americium spectrum. M.F.

The Spectra of the Heavy Elements. By Frank S. Tomkins and Mark Fred. *J. Opt. Soc. Am. 39: 357, May, 1949.*

Eye Aberration

It has been recognized for many years that the human eye, like most simple lenses, is afflicted to a certain extent with spherical aberration. Accurate measurements of the aberration are remarkably few, however, and the methods employed in the past give a rather incomplete picture of the aberration, from which it is difficult to infer much about its effect on vision. New measurements were undertaken in the course of an investigation to determine whether spherical aberration or some other prop-

erty of the eye is the principal cause of the nighttime nearsightedness which many persons experience.

The problem was approached by examining the aberrations of the eye in much the same way as one does an ordinary lens. A resolution target was observed through a series of annular artificial pupils centered over the eye. Spectacle lenses were introduced directly in front of the eye and the lens power was determined which gave the greatest resolution for the various sized annular apertures. Accommodation was controlled by reflecting a second target into the field of view over a separate path through a three millimeter centered circular pupil.

It was found that the eyes of all three observers showed under-corrected spherical aberration; when the eye was forced to accommodate, the aberration was reduced for all eyes examined and in one case became reversed in sign. This indicates that the center of the eye lens is more responsive than the outer region to the accommodation process. In further experiments the accommodation of the subjects' eyes was paralyzed and the pupils dilated with homatropine. Under these conditions the spherical aberration for two of three subjects was reduced. It is clear from these results that the spherical aberration of the eye should be measured for the particular subject used for vision research and that cycloplegia should be used with caution whenever this aberration is involved in the vision phenomenon under investigation. R.T.

Spherical Aberration of the Eye. By M. Koomen, R. Tousey, and R. Scolnik. *J. Opt. Soc. Am. 39: 370, May, 1949.*

Origin of Chemical Elements

In the last ten years, physicists and astronomers from all over the world have been trying to account for the observed relative abundances of the chemical elements. Most authors believe that the chemical elements were formed in a statistical equilibrium at extremely high temperatures and densities. These extreme conditions can be found in the interior of stars belonging to special categories. The papers on the subject mostly deal only with some particular aspect of the problem. The present paper attempts to give a unified picture. It turns out that this is well possible and also that the origin of the chemical elements can well be considered to be a part of the picture given by von Weizsäcker in his general cosmogony. There are still a number of difficulties which have to be overcome before such an equilibrium theory can be generally accepted. The same, however, is also true for the recent theory proposed by Gamow and Alpher who wish to account for the chemical elements by a building up process which should have taken place in the first seconds of the existence of our universe, when the expansion of the universe had only just started. D.T.H.

Can We Account for the Observed Abundance of the Chemical Elements? By D. ter Haar. *Am. J. Phys. 17: 282, May, 1949.*

High Current Carbon Arc

The most powerful and one of the most interesting known sources of high brightness and highest temperature, the high current carbon arc, is treated here both experimentally and theoretically. A rising current-voltage characteristic, an anodic vapor stream which causes its excellent radiation features, and a contracted arc stream of high current density, distinguish the high current carbon arc from the well known low current carbon arc. The paper presents a general discussion and theoretical explanation of the more prominent features of the high current carbon arc. Starting from the anodic mechanism of the low current carbon arc, the anodic mechanism of the high current arc is developed. Its distinguishing characteristics are explained as a consequence of a potential drop in front of the anode which increases with increased current density and is caused by a very rapid evaporation of the anodic material. It is pointed out that the magnetic field of the arc current plays an important role in the stabilization of all high current arcs. The author believes that this unique high temperature arc has bearing on other arc and spark discharges, and also will play an important role in future developments of high temperature physics and chemistry. W.F.

The High Current Carbon Arc and Its Mechanism. By W. Finkelnburg. *J. App. Phys. 20: 468, May, 1949.*