

PROCEEDINGS
OF THE
AMERICAN PHYSICAL SOCIETY

MINUTES OF THE EUGENE MEETING, JUNE 19-21, 1930

The 164th regular meeting of the American Physical society was held in Room 103, Deady Hall, University of Oregon, Eugene, Oregon, on Thursday afternoon, June 19, Friday June 20, and Saturday morning, June 21, in affiliation with Section B, Physics, of the Pacific Division of the American Association for the Advancement of Science.

The session on Thursday afternoon consisted of a joint symposium between the American Physical Society and the Astronomical Society of the Pacific and the general topic was the red shift in the spectra of distant light sources and its physical interpretation. There were three papers by invitation as follows:

1. **Apparent velocity shifts in the spectra of faint nebulae.**—MILTON L. HUMASON, *Mt. Wilson Observatory.*
2. **Distances of nebulae and their correlation with apparent velocities.**—EDWIN HUBBLE, *Mt. Wilson Observatory.*
3. **Significance of the velocity-distance relation from the standpoint of general relativity.**—RICHARD C. TOLMAN, *California Institute of Technology.*

On Friday morning preceding the presentation of papers the regular business session or meeting was opened for discussion of any business which might arise. On nomination Professor W. P. Boynton, Chairman of the Department of Physics, University of Oregon, presided at the meeting. It was moved, seconded and voted that the date of the 167th meeting of the American Physical Society which had been scheduled to be held at the University of California at Los Angeles on December 5 and 6, 1930, be changed as follows: The 167th meeting of the American Physical Society will be held at the University of California at Los Angeles on December 12 and 13, 1930, the meeting being a joint meeting between the American Physical Society and the Acoustical Society of America.

Following the morning session on Friday, there was a joint luncheon of the astronomers and the members of the American Physical Society at which 50 members were present.

Following the session on Saturday morning, June 21, the meeting adjourned, there having been 18 papers on the regular program and 7 papers on the supplementary program of which numbers 10, 16 and 25 were read by title. The abstracts of these papers are given on the following pages. An **Author Index** will be found at the end.

LEONARD B. LOEB, *Secretary for Pacific Coast.*

ABSTRACTS

1. The near infrared spectrum of Hg. H. J. UNGER, *University of Oregon*. (Introduced by E. D. McAlister.)—With a self-recording spectrometer the infrared spectrum of the Hg arc has been studied in the region 1 to 2μ . Several lines hitherto observed as single have been resolved into two or more lines. Of special interest are the groups of lines near 1.7μ and 1.2μ which contain the first and second members of the fundamental triplet series. The results obtained indicate that possibly the fundamental triplets are composed of six lines grouped as in the diffuse series.

2. Continuous spectrum in the region 500–1100. J. J. HOPFIELD, *University of California*.—An intense continuous spectrum has been observed in helium in the region 500–1100A. This is the only continuous spectrum known extending throughout the range 500–900A, and it therefore allows one to explore this interesting region for absorption spectra. I think the grating mounting used imposes the present ultraviolet limit of this spectrum. This spectrum is most intense when the helium bands are best developed, showing that they are closely related phenomena. To produce it the helium should be fairly pure, at a few millimeters pressure and a mild condensed discharge should be used. The spectrum contains the neon and helium lines which are useful as standards. It may also be satisfactorily observed in the second order. The spectrum resembles the continuous spectrum of hydrogen in the Schumann region. Its analogous explanation may be as follows. Two helium atoms each excited to the 2^3S state unite to form the molecule. The energy representing these changes is about 41.8 volts. If the electronic configuration of this molecule changes to that of the “normal,” unstable state it immediately dissociates emitting 41.8 volts of energy. The continuous extension of this spectrum towards the red is due to the non-quantized kinetic energy subtracted from the above amount by the unbound atoms.

3. High resolution in the near infrared. E. D. McALISTER, *University of Oregon*.—With two 60° and one 30° prism (all of flint glass 4 inches high, 6 inches length of face) and a parabolic mirror 5.5 in. in diameter and 24 in. focal length in the Littrow form of mounting an effective slit width of 6A is obtained in the region 1 to 2μ . This type of mounting gives a dispersion equivalent to 5 sixty degree prisms. A special type of thermocouple is used for detection. The spectrograph is self-recording. With a galvanometer distance of 5 meters the zero drift in one hour's time is usually less than one millimeter. The construction of the thermocouple and housing are discussed and typical spectrograms are exhibited.

4. Some properties of the third positive carbon and associated bands. JOSEPH KAPLAN, *University of California at Los Angeles*.—The third positive group of CO, and the two systems usually associated with it, the 5B and 3A, have been studied under a variety of excitation conditions in an attempt to excite progressions other than the $v'=0$ ones. Some interesting observations have been made. No progressions other than the $v'=0$ ones have been observed in spite of the fact that each of these groups has been intensely excited. This, together with other facts and observations can be interpreted as indicating that the levels involved in these three systems are triplet levels. A new system of bands similar in appearance to these bands has been observed. The 0-0 and 0-1 bands of the 5B group are exactly similar in appearance, but differ strikingly from the higher members of the group. The diffuse double-headed band observed outside the third head of the 0-0 5B band and ascribed to CO₂ by Asundi is thought to be a real part of the CO band since a similar doublet is observed in the 0-1 band. A pair of complex but similar bands have been observed on the long wave-length side of the 0-0 5B band and the 0-1 third positive band.

5. The classification of iron lines. HAROLD D. BABCOCK, *Mount Wilson Observatory*.—In an earlier discussion, (Astrophys. J. 67, 240, 1928), mean energy-levels were found for both upper and lower terms associated with each temperature class and pressure group. Repeating this work with more data, with weights proportional to the numbers of lines dependent on each term, and including King's study of dissymmetry in the high-current arc, (Astrophys. J.

62, 238, 1925), a broad parallelism is found between the three systems of classification. The terms of iron fall into three significant groups: 1, even terms of low level; 2, even terms of high level; 3, odd terms of medium level. The methods of classification may have a physical basis in the characteristics of these groups of terms. The energy level of a term, its odd or even character, and its part in the transition, i.e., whether it is the upper or the lower term involved, are factors which apparently determine the kind of lines associated with the term. This review of the data for iron may thus assist in the converse problem of finding the terms from observations of the position and peculiarities of a spectral line.

6. Reflection of x-rays from thin metallic films. JOS. E. HENDERSON AND E. B. JORDAN, *University of Washington*.—The critical angles of reflection for zirconium filtered molybdenum radiation have been investigated for sputtered gold and silver films of thicknesses ranging from very thin transparent films to thick opaque films. The gold films were backed with glass and the silver films with gold. Curves are plotted showing the critical angle as ordinate and thickness of the film as abscissa. For the gold on glass the curve rises, as the thickness increases, from the value for glass to a maximum value and then falls to a value which is independent of the thickness of the gold and therefore characteristic of gold. This value is approximately two-thirds of the maximum. As the above is a case for a material with critical angle larger than the backing material, silver on gold was investigated in order to obtain the opposite condition. The curve in this case again rises to a maximum greater than for gold alone for small thicknesses, falling to a value for large thicknesses which is less than the value for gold alone. A study of gold on silver is now in progress.

7. Experiments on the relative intensities of x-ray lines in the L -spectrum of tantalum. VICTOR HICKS, *University of California*.—The relative intensities of 17 lines in the L -spectrum of Ta have been investigated by the ionization spectrometer. The following precautions were taken: (1) the rays were taken at a glancing angle of 45° from a polished Ta surface, (2) a Ta filament was used, (3) the slits were enclosed in an arm of the tube, reducing the air path of the rays to 7 cm, (4) the coefficient of reflection of the crystal used was measured for the various wave-lengths by means of the double-spectrometer, (5) the absorption coefficients of the mica windows used were directly measured, (6) the rays were completely absorbed in methyl iodide vapor of known pressure, and (7) the slits were sufficiently wide to eliminate effects arising from the different natural widths of the lines. Measurements were taken at 30.6 K.V. and 20.7 K.V. and corrected to high voltage. The results for lines of small wave-length separation agree well with previous results of Allison and Armstrong and Jönsson on tungsten. For lines of larger wave-length separation ($L\alpha_1$, $L\beta_1$) the results of Jönsson are not confirmed, but the previous qualitative estimates of Allison and Armstrong are substantiated. The assumption that the ionization currents produced are proportional to the relative intensities is supported by recent work of A. H. Compton. If the ν^4 correction is made to the intensities at high voltage the sum rules are approximately valid except for lines having initial state L_1 . The intensity results are:

	l	α_2	α_1	η	β_4	β_1	β_3	β_2	β_7	$\beta_5 + \beta_{10}$
Rel. Int. at 30.6 K.V.	1.5	10.2	100	1.3	9.4	92.6	13.5	40.6	0.8	1.1
Rel. Int. at high V.	1.5	10.2	100	1.4	11.1	102.7	15.9	40.6	0.8	1.1

	β_8	γ_8	γ_1	γ_6	γ_2	γ_3	γ_4
Rel. Int. at 30.6 K.V.	0.8	1.24	29.1	0.6	4.98	7.08	2.20
Rel. Int. at high V.	0.8	1.38	32.3	0.7	5.88	8.37	2.60

8. Electronic emission from a metal target: bombarded with positive ions. C. L. UTTERBACK AND W. GEER, *University of Washington*.—Metal targets have been bombarded by positive ions whose energies varied from 200 to 750 volts, while the characteristics of the electron emission were studied. The secondary emission and positive ion currents were measured by galvanometers of sensitivities $8 \cdot 10^{-11}$ amperes and $6 \cdot 10^{-10}$ amperes, respectively. The secondary

emission has been found to depend upon the previous treatment of the target, especially in regard to the kind and amount of gas adsorbed and to the duration of the bombardment. These studies were made with positive ion currents as low as $3 \cdot 10^{-9}$ amperes, which is a smaller current than has been heretofore used in this connection.

9. The scattering of electrons in small angles by gas molecules and its effect on the electron absorption coefficient. METTA CLARE GREEN, *University of California*.—An indirect study of the scattering of electrons by gas molecules was made by measuring electron absorption coefficients in an apparatus containing a Faraday cylinder of variable aperture. A straight path method was used in which electrons from an oxide-coated filament were given a desired acceleration and made to traverse a 7.5 path to the collector. A retarding potential between the cylinder and its shield kept out all electrons which had suffered inelastic collisions as well as those which had been scattered outside of the collector opening. Measurements were made in argon, helium, hydrogen, and mercury vapor at accelerating potentials ranging from 11 to 196 volts. The radius of the cylinder aperture was varied from one hundredth to one tenth of the path length. No consistent variation of absorption coefficient with opening was found in any case. Theoretical calculations based on scattering laws obtained from inverse square or fifth power laws of force predicted relatively large variations. Calculations made assuming uniform scattering or the Sommerfeld law indicated small changes of the same order of magnitude as the observed experimental deviations.

10. The magnetic properties of dilute cobalt alloys. F. WOODBRIDGE CONSTANT, *California Institute of Technology*.—Continuing the investigation of the ferromagnetic properties of the cobalt atom when it is further and further isolated from other cobalt atoms by the presence of intervening non-ferromagnetic atoms, alloys of still higher platinum concentration than those previously reported on, (Phys. Rev. **34**, 1217, 1929), were tested magnetically. As found before, decreasing the cobalt content decreased the Curie point and magnetic hysteresis, the former, on the absolute scale, falling linearly. For comparison, similar alloys of palladium and cobalt were investigated, and found to behave similarly, thus confirming the view that the ferromagnetism of these alloys may be attributed to the cobalt atoms. The following table gives the Curie points in degrees Kelvin, and the maximum intensity of magnetization obtainable at the temperature of liquid air, ($-194^{\circ}\text{C}.$):

			Curie Point	I_{max}
10	% Co—90	% Pt	522°K	364
5	% Co—95	% Pt	322°K	254
3	% Co—97	% Pt	191°K	104
1.5	% Co—98.5	% Pt	82°K	7
10	% Co—90	% Pd	508°K	223
5	% Co—95	% Pd	355°K	193

11. Discovery and rough measurement of a new electron inertia effect. S. J. BARNETT, *University of California at Los Angeles and California Institute of Technology*.—This effect, like its converse (Tolman and Stewart), was in the mind of Maxwell long ago (Treatise §574): An e.m.f. applied to a metallic conductor drives the free electrons and the remainder in opposite directions. A solenoid S is suspended vertical in a neutral region. If traversed by a current with its own natural frequency $\nu = \omega/2\pi$, the coil has a magnetic moment $\mu = M \sin \omega t$, and resonant vibration with amplitude A_M occurs. The rod holding the solenoid carries a magnet below, with horizontal moment m_0 , at the center of a small fixed Helmholtz coil H (constant Γ) with axis normal to m_0 . This coil, if traversed by a current $i = I \sin (\omega t + \epsilon)$, produces an amplitude A_I . When A_M is small theory gives

$$\left| 2 \frac{m}{e} \right| = \frac{A_M}{A_I} \cdot \frac{\Gamma m_0 I}{\omega M}$$

If S is surrounded by a longer solenoid S' (constant γ) properly connected in circuit (resistance R) with H , the sum of the torque on S due to electron inertia ($-2m/e \cdot \dot{\mu}$) and that on the mag-

net $(-\Gamma\gamma m_0 \cdot \mu)/R$, together with the amplitude, will vanish for one value R_0 of R . Then $-2m/e = (\Gamma\gamma m_0)/R_0$. For copper $2m/e$ has been determined both ways. The sign (from null method) proves e negative, and the magnitude is that expected within the limits of the experimental error (about 10%). The theory has been worked out completely. For large amplitudes the inertia torque contains a term involving the number of electrons per unit volume, whose determination refinements may perhaps make possible.

12. The recombination of ions in air and oxygen in relation to the nature of gaseous ions.

OVERTON LUHR, *University of California*.—The coefficient of recombination of ions in air and oxygen has been measured using an improved form of the method previously described by L. C. Marshall. The coefficient of recombination, α given by the law $dn/dt = -\alpha n^2$ is calculated from the integrated form $\alpha = 1/t(1/n - 1/n_0)$. It is found that α varies continuously with the age of the ions, dropping sharply within 0.05 seconds from 2.7×10^{-6} to 1.4×10^{-6} , then dropping more slowly to about 0.4×10^{-6} when the age of the ions is two seconds. Higher values of α are obtained when the initial concentration of the ions is smaller or when pure oxygen is used in place of air. In accord with Marshall and other observers, the sharp initial drop in α is assumed to be due to the initial non-random distribution of the ions. The later more gradual drop may be explained by assuming that the ions form heavy, slow moving clusters with molecules of impurity. The faster ions are constantly being removed at a high rate by recombination leaving the slow ions behind with a resulting increasingly low coefficient of recombination. The impurities may consist of nitric oxides, O_3 , or H_2O_2 formed by the ionizing agent. Taking the point at which the rapid decrease in α ends and the more gradual drop due to clustering begins, an "absolute value" of α for air is set at $1.4 \pm 0.1 \times 10^{-6}$.

13. Cataphoresis in rotating electric fields. E. M. PUGH AND C. A. SWARTZ, *California*

Institute of Technology.—A new method of making cataphoresis measurements on colloid particles has been developed and tested. The method makes use of a rotating electric field which causes the particles to move in circles. In this way, it is easily possible to test the effect of variable speed of the particle on the distribution of the diffuse electric double layer surrounding it. The results obtained indicate that this effect is negligible. Furthermore, it has been discovered that the mobility of the small particles (below 10^{-4} cm in diameter) fluctuates widely and this is made very evident to the eye by the fluctuations in the circular paths of the particles. The fluctuations are quite violent with particles as small as 10^{-6} cm diameter. Considerable study of these variations has been made as well as an attempt to explain them qualitatively.

14. Equations of state and thermodynamic functions for a substance with variable specific

heat. W. P. BOYNTON, *University of Oregon*.—General relations between the specific heat at constant volume (not assumed constant) and pressure, temperature and volume are deduced from the first and second laws of thermodynamics. Applying these to a generalized equation of the van der Waals type, expressions are derived for the specific heat at constant volume, energy and entropy. The Boynton and Bramley equation proposed in 1922 is shown to be a special case. Its difficulties and limitations are briefly discussed, and a modification having some advantages for very low temperatures is suggested.

15. A note on the quantization of the solar system. A. E. CASWELL, *University of Oregon*.—

A study of the relations between the mean distances of the planets from the sun, and of the satellites from their respective planets, the periodic times and the masses, seems to point to the operation of a number of causes, which results in a sort of quantization of distances, periods, and energies. Such a study gives some promise of revealing new principles that may aid in the solution of the problem of n bodies moving under the influence of an inverse square law.

16. Thermal expansion of M-M-M alloy. PETER HIDNERT AND W. T. SWEENEY, *U. S.*

Bureau of Standards.—In 1923 determinations were made at the Bureau of Standards, on the linear thermal expansion of a nickel alloy known as M-M-M alloy. This alloy was cast in a sand mold. The approximate composition was as follows: Nickel 61, copper 25, tin 9, iron

$3\frac{1}{2}$, manganese $\frac{3}{4}$, silicon $\frac{3}{4}$ percent. It is claimed that this alloy is acid resistant and resistant to the erosion of high temperature, high pressure steam. Manning, Maxwell and Moore, Inc., Bridgeport, Conn., prepared the alloy and furnished information about the treatment and the chemical composition. Data on tensile properties of M-M-M alloy are given in Circular of the Bureau of Standards No. 100 (2nd edition), p. 107. The following coefficients of linear expansion were obtained:

Temperature range	Average coefficient of expansion per degree centigrade
20 to 180°C	14.1×10^{-6}
180 to 350	15.6
350 to 485	18.5
20 to 350	14.8
350 to 500	18.7
20 to 485	15.9
20 to 500	16.0

After heating to 500° C. and cooling to room temperature, the cast alloy was found to be 0.02 percent shorter than the original length.

17. Polar properties of single crystals of ice. JOHN MEAD ADAMS, *University of California at Los Angeles*.—That the ice-crystal is unsymmetrical with respect to the basal (0001) plane has now been established by the observation that crystals twinned on this plane are separable into two kinds: (a) those which may develop pits at the ends of the *C* axis, and (b) those which may develop a cavity at the *middle* of the *C* axis. The phenomenon appears to suggest that the polar character of the crystal extends to the mechanism of thermal conduction in it.

18. Absorption coefficient of slow hydrogen positive rays in hydrogen. R. E. HOLZER, *University of California*.—With an ionization tube of the type employed by Smyth, Hogness and Lunn and others, and a magnetic field for resolution, the absorption coefficients of H^+ , H_2^+ , and H_3^+ in hydrogen were studied in the region between 50 and 300 volts. The gas pressures in the ionization and scattering chambers were controlled by steady flow through capillary tubes and were made nearly independent by the introduction of a high speed pump between the chambers. The variation of the intensity of a beam of ions of given mass and velocity was observed by means of a Compton electrometer as the pressure in the scattering chamber was changed. H_2^+ was absorbed more strongly than H_3^+ , and H^+ appreciably less than the other ions. All of the absorption coefficients rose with decreasing velocity.

19. The quenching of mercury resonance radiation by nitrogen and carbon monoxide. JOSEPH KAPLAN, *University of California at Los Angeles*.—All of the experiments on the quenching of mercury resonance radiation by foreign gases yield the result that CO is more effective than N_2 . The discovery by the writer of an intense single band in CO at 2575A has suggested a more thorough comparison of the quenching powers of CO and N_2 than has heretofore been done. The new band appears under unusual discharge conditions and very closely resembles the fourth positive bands of CO. Therefore if it is interpreted as arising in a transition from some low lying level to the normal level of CO, the greater quenching power of CO over N_2 can be explained. N_2 possesses no electronic level around 5 volts and a calculation of the vibrational states of CO associated with the normal state shows that none of them agree as well with the energies of the 2^3P_1 and 2^3P_0 states of Hg as do the X_{18} and X_{19} states of N_2 . The latter fit almost perfectly and this close agreement suggests a discussion of the relative quenching power of N_2 and H_2 as well as a new explanation of Gaviola's photosensitized fluorescence of NH.

20. The recombination of ions in argon, nitrogen and hydrogen. OVERTON LUHR, *University of California*.—Since free electrons are known to exist in ionized A, N_2 and H_2 these gases are employed in an effort to measure directly the coefficient of recombination between

positive ions and electrons. Previous indirect methods and theory indicate that the coefficient of recombination, α is of the order of 10^{-10} for ions and electrons compared to 10^{-6} for positive and negative ions. In the present work results similar to those in air are obtained, only a slight change in α being observed when sufficient oxygen is added to cause instant attachment of the free electrons. Hence it is probable that recombination was taking place between positive and negative ions although free electrons were present initially in the pure gases. It is assumed that negative ions are formed by attachment to excited metastable molecules in the case of A and N_2 , and by attachment to atoms or triatomic molecules in the case of H_2 . In accordance with the criterion established in a previous paper for air, "absolute values" of α are set as follows: air, $1.4 \pm 0.1 \times 10^{-6}$; O_2 , $1.5 \pm 0.1 \times 10^{-6}$; A and N_2 , $1.2 \pm 0.1 \times 10^{-6}$; H_2 , $0.32 \pm 0.05 \times 10^{-6}$. The results in H_2 show a constant value of $0.32 \pm 0.05 \times 10^{-6}$ which is much lower than in the other gases contrary to the prediction of the J. J. Thomson theory of recombination. However, the theory is deficient in certain respects which may explain this discrepancy.

21. Further work on the rotation of soft iron and permalloy by magnetization and the gyromagnetic anomaly. S. J. BARNETT, *University of California at Los Angeles and California Institute of Technology*.—This is an extension of work reported in June 1927 and April 1928. By hundreds of days and hundreds of nights of labor, much interfered with by magnetic storms, great improvements have been effected in the methods and in the precision of the results. Nearly all of the observations have been made by one of the large deflection methods, perfected by (1) the use of improved commutators and brush systems, (2) the adoption of devices to eliminate rapidly systematic errors due to magnetostriction, and (3) the adoption of a more rigorous and systematic time schedule in the observation of deflections. The frequency range has been extended upward to about 21 cycles per second, and the range of magnetic field strengths has been extended downward to 2 and upward to 80 gauss (uncorrected for end effects). No differences in the gyromagnetic ratio have been revealed, except that (as formerly) the value found for permalloy slightly exceeds that found for iron. The new values are close to those previously published, m/e , the orthodox value for a spinning electron, being exceeded by several percent with great probability.

22. New oxygen spectra in the ultraviolet. J. J. HOPFIELD, *University of California*.—The resonance series of atomic oxygen has been extended to about twelve members and strong continuous spectrum was found to set in at the series limit and extend towards the ultraviolet. Many new lines, probably due chiefly to O_1 , have been found in oxygen and in oxygen-helium mixtures. A new progression of bands, forming a series of final vibration states, has been found in oxygen mixed with helium when a condensed discharge was employed. These seem to be fluorescent bands similar to those found in hydrogen by Lyman. The bands belong to an electronic system which has not been previously observed. The fine structure appearance seems to indicate that they are bands of normal O_2 . They resemble the Schumann bands in appearance, but they are degraded to the ultraviolet whereas the Schumann bands shade towards the red. The wave-lengths in vacuum are $\lambda 2031.5A$, (2077.3A), 2123.8A, 2170.7A and 2218.2A. The second band is masked by second order atomic lines. The first differences in cm^{-1} are (1085), (1053), 1018 and 987. The second differences are about $32\ cm^{-1}$. $\lambda 2031A$ is probably the $v' = 0$ band but it is not certain that $v' = 0$ in this case.

23. New spectra in nitrogen. JOHN J. HOPFIELD, *University of California*.—With helium as a source of continuous light absorption band spectra of nitrogen have been found in the region $\lambda 600-1100A$. The bands in the region 750–1100A have not yet been measured. The only bands occurring below 750 are $\lambda 723.2$, 694.2, 681.7, 675.2 and 671.2A in absorption, and 715.2, 690.9, 680.1, and 674.3A is emission. They form approximate Rydberg series with the common limit of 18.6 volts, and represent the first case of a Rydberg series in molecules other than hydrogen and helium. These bands are provisionally ascribed to nitrogen and the limit (18.6) would represent ionization from an electronic state deeper than the normal one. In a nitrogen-helium mixture the resonance series of N_1 with $2p^4S(117345)$ as limit have been extended to ten members and a strong continuous spectrum has been found at the series limit. The

value of the 4S term remains unaltered by these new measurements. The series of lines ending on the metastable states $2p^2D$ and $2p^2P$ of nitrogen have been greatly extended but as yet not measured. In the helium-nitrogen mixture a new system of bands in emission has been observed. The bands shade towards the red and show alternating intensities of the lines. Approximate frequencies and provisional designations of the bands are: (0,0) $\lambda 1846.16A$, $\nu 54166$; (0,1) 52263, (0,2) 50390, (1,0) 56142, (1,1) 54235, (1,2) 52371, (1,3) 50532, (2,1) 56181, (2,2) 54311, (2,3) 52475, (2,4) 50677, (3,2) 56221, (3,4), 52584, (3,5) 50824.

24. On an electromagnetic theory of sight and color vision. S. R. COOK, *College of the Pacific*.—The paper reviews briefly the theories of color vision from that of Thomas Young to the latest photoelectric theory of Jenett Clark. It then makes the general hypothesis that the transmission of sight is a process equivalent to an alternating current of electricity set up in the rods and cones of the retina by the electromagnetic vibrations of light. The time of vibrations of this alternating current process is represented by the well-known formula $\nu = 1/2\pi[(1/CL) - (R^2/4L^2)]^{1/2}$. The receptors in the rods are tuned to all wave-lengths of light. The receptors in the cones are tuned to the special vibrations which they transmit, that is, some are tuned to red, others to green, and others to blue. Color blindness is the imperfect tuning of one or more special classes of receptors in the cones. Residual or after images may be the result of electrolytic action in the nuclear and ganglion cells, or it may be a physiological and psychological effect in the brain.

25. Mobility of Na^+ ions in H_2 . LEONARD B. LOEB, *University of California*.—A study of the mobility of Na^+ ions from a Kunsman catalyst source has been made in H_2 gas using a square wave from an oscillator with the original Rutherford A.C. method as adapted for use with a Kunsman source. The preliminary results cover measurements made from 0.6 to 7.0 cm Hg pressure, the chamber being of brass and filled with tank H_2 passed over hot copper and a purifying train of a standard sort used by the writer, including liquid air traps. Preliminary results were obtained for frequencies from 1000–50,000 half cycles. The reduced mobilities corrected for *density* but not for temperature (mobilities are little affected by temperature in moderate ranges) varied from 5 to 7 cm/sec per volt/cm at from 1000–5000 half cycles. Above this frequency they increased to a value of about 12 to 16 cm/sec per volt/cm at from 20,000 half cycles upward. The lower values were about those to be expected for normal positive ions in H_2 as affected by the uncertainty of gas temperature and density with the gradients produced by the source. The higher values probably correspond to the mobility of the Na^+ ions in H_2 , without any modification. The nature of the mobility curves obtained indicates that there are probably two carriers of different mobility existing simultaneously in the intermediate frequency range. This would point to a more or less abrupt transition from the one type of ion to the other.

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