$CaCO_3$, *i.e.*, calcium carbonate constitutes about one-quarter of the weight of the dry fruit. There were also present 1.2 per cent. of oxides of iron and aluminum, and 2.4 per cent. silica. The moisture content of the fruit as received ranged from 15 to 19 per cent.

Payen,[4] in 1854, analyzed the pits of the hackberry and proved that the calcium is present as carbonate by placing the ground, dried pits in dilute hydrochloric acid and weighing the carbon dioxide given off. The results of his analysis are as follows:

Organic matter	28.7 per cent.
Calcium carbonate	64.2 per cent.
Calcium phosphate	trace
Silica	7.0 per cent.

While it is apparent that most of the calcium in the fruit is present in the pit as carbonate, the possibility of the presence of other calcium salts must not be overlooked. In order to investigate this possibility 4.1 kilos of ground hackberries were extracted twice with boiling water. The dried presscake (1.7 kilos) contained 28.7 per cent. CaO and 54.7 per cent. ash. Direct determination showed that 23.6 per cent. of CO_2 was given off on addition of mineral acid to the ground fruit, thus confirming Payen's results and showing that the ash of the extracted material is mostly calcium carbonate. There were also 3.9 per cent silica, and 0.3 per cent MgO in the ash.

The water solution was extracted with ether and on evaporating the ether 16.5 gms of a yellow fatty oil, probably kernel oil, remained. The solution was then precipitated with alcohol. The resulting gummy precipitate weighed 45 gms and contained 10.1 per cent CaO (total ash 23.2 per cent.).

The aqueous-alcoholic solution was precipitated with lead subacetate, and the recovered acids were converted into ethyl esters (62.8 gms) and fractionated. The different fractions were identified by means of the hydrazides. Fraction 1 (0.7 gm) yielded oxalic hydrazide (m.p. 235°). The hydrazide of fraction 2 (1.6 gm) was identified as that of malic acid (m.p. 179°). Fractions 4–8 (23 gms) yielded citric trihydrazide (m.p. 106°). Fraction 9 produced an oily hydrazide. The acid of this fraction is an unsaturated acid which, on oxidation with cold 5 per cent. $KMnO_4$, yields succinic acid and an oily acid.

The conclusion therefore must be drawn that, although most of the calcium in hackberries is in the form of carbonate, there are also calcium salts of malic, citric and oxalic acids, and of some gummy acids, and an unsaturated acid of unknown constitution.

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A recessive zygotic lethal resulting in 2:1 ratios for normal vs. male-sterile and colored vs. colorless pericarp in F_2 of certain maize hybrids: R. A. EMERSON. Maize hybrids between types with red and others with colorless ears normally have colored ears in the first generation, F_1, and exhibit in the second generation, F_2, the typical mendelian ratio of three colored to one colorless, with one third of the colored individuals breeding true in the next generation, F_3. A Peruvian maize with red mosaic ears, when crossed with local inbred strains having colorless ears, gave a 2:1 ratio in F_2 and later generations involving over 1,100 plants. Moreover, the ratio of true breeding to segregating individuals among the colored ears was 1:87, instead of 1:2 as expected. Evidently the 2:1 relation in F_2 is due to the almost complete elimination of the true breeding colored individuals. One of the inbred colorless strains used in crossing with the Peruvian maize was male-sterile, *i.e.*, it produced no good pollen. F_1 was normal, but in F_2 and later generations the normals were to the male-steriles as 2:1, just as with ear color. Of the normals, only one in 37 was colorless and of the male-steriles, only one in 46 was

colored. Obviously, this male-sterility is closely linked with ear color, so that whatever distorts the normal ratio of colored to colorless affects similarly the ratio of normal to male-sterile. If there be assumed a genetic factor, closely linked with the factor for colored ears, which prevents the development of the kernels which receive it from both the egg and pollen, the results obtained are readily accounted for. This hypothesis is rendered the more plausible by the fact that self-pollinated colored ears are not well filled with kernels.

The chromosomes of haploid maize, with special reference to the double nature of the univalent chromosomes in the early meiotic prophase: L. F. RANDOLPH (introduced by R. A. Emerson). Certain characteristics of the chromosomes in the root-tip cells and in the microsporocytes of haploid individuals are described and illustrated. The presence of 10 chromosomes in each cell instead of the 20 present in normal diploids facilitated the study of individual differences between the members of the group in the somatic cells, and their existence as univalents rather than as bivalents in the meiotic prophase simplified the interpretation of the double condition of the chromosomes in this stage. At the time of the differentiation of the leptotene threads in the very early

[4] *Compt. Rend.*, 38, 241, 1854. Payen's *Celtis cordata* is synonymous with *C. occidentalis*.

prophase the chromosomes were clearly double. The evidence for an interpretation of this doubleness as a longitudinal division of the univalent chromosome is presented. The significance of this observation is discussed in relation to its direct bearing on certain current theories of synapsis and crossing-over, which are based on the assumption that synapsis precedes the longitudinal division of the chromosomes. Non-correspondence of chromomeres in corresponding regions of sister chromatids was observed frequently throughout the early prophase stages. This suggests that in maize these structures have little or no morphological significance.

Effects of monochromatic radiation in the visible and ultra-violet on the virus of typical tobacco mosaic: B. M. DUGGAR and ALEXANDER HOLLAENDER. The virus of typical tobacco mosaic, approximately purified, was exposed in solution of v/100 to monochromatic light at approximately 0° C. The virus dilution was made up, after pasteurization, in physiological salt solution in which was diffused *Bacillus prodigiosus* for purposes of comparison. The bacteria were at a concentration approximately 300,000 cells per cc. Exposure was made in a quartz cell provided with a quartz stirrer. The energy thrown in was measured by the usual thermopile-galvanometer procedure. Likewise, the energy absorbed by the solution was measured except in a few cases. Exposures for various intervals were made at suitable lines in the mercury spectrum from 6150 Å as the longest wave-length to 2537 Å as the shortest. Twelve spectral lines were employed, and with another monochromator and a spark source of radiation 2144 and 2315 Å were used. From the exposed solutions inoculation of tobacco plants were made at suitable dilutions. At the same time dilution cultures were made for bacterial counts, thus furnishing quantitative biological criteria. Tables and curves have been prepared, showing the lethal effects for both virus and bacteria. The results indicate that far greater intensities are required to inactivate the virus than to kill the cells of bacteria under precisely the same conditions. In general, within the range of time periods which are practicable, the inactivation of virus is limited to wave-lengths shorter than 3350 Å. A direct method of leaf radiation has been devised for work at different temperatures.

On the stability of physiological characters of bacteria: E. B. FRED. Variations which are more or less permanent changes in cultures are conceivably of two types—those concerned in possible life-cycles or dissociative changes in the bacteria and those of a deteriorative nature, resulting from prolonged exposure to the so-called "artificial" conditions of the laboratory culture. It is the purpose of the present paper to consider the latter type, citing cases of observations on certain biochemical characters of cultures freshly isolated and of the same cultures after some years of existence in the laboratory. Any tendency toward uniformity of cultures may be forgotten in the flood of publications which have focused attention on the problem of bacterial variation. Striking examples of such stability, covering the activities of a wide variety of bacteria, spore-forming and non-spore-forming, motile and non-motile, aerobic and anaerobic, were cited. No attempt was made to deal with bacterial dissociation or life cycles, but rather to present certain observed facts which relate to the stability of different groups of bacteria when kept for years under suitable artificial conditions. To the author it appears that the claims of gradual deterioration are not always supported by facts. The results of this study, therefore, support the fundamental concept of the stability of pure cultures of bacteria under suitable artificial conditions.

Henry as a physicist: W. F. MAGIE.

Henry as an electrical pioneer: BANCROFT GHERARDI.

Henry as an administrator: CHARLES GREELEY ABBOT.

Cosmic-ray energies and their bearing on the photon and neutron hypotheses: ROBERT A. MILLIKAN and CARL D. ANDERSON.

Distances and luminosities of four thousand of the brighter stars: WALTER S. ADAMS. The spectroscopic method of determining the distances of stars is based upon the fact that among stars of the same spectral type, that is, the same surface temperature, many of the spectral lines show differences in intensity which are correlated with the luminosity of the stars. Highly luminous stars with temperatures equal to or lower than that of the sun are of great size and have low densities, a condition which favors ionization in their atmospheres. Hence the lines due to the ionized atom are prominent in giant stars whereas the lines of the neutral atom, especially for elements of low ionization potential, are marked in the less luminous or dwarf stars. Stars of known luminosity are used to establish quantitative correlation curves between the intensities of selected spectral lines and the intrinsic brightness. The method, which was discovered at the Mount Wilson Observatory, has been applied to about 4,000 stars with temperatures ranging from over 10,000° C. to 3,000° C. The chief results of the study are: first, the striking evidence of the separation of stars with temperatures less than that of the sun into distinct classes of giants and dwarfs with no stars of intermediate luminosity; second, the merging of these classes among stars of the higher temperatures; and third, the remarkable tendency of both giant and dwarf stars of lower temperatures, but especially the giants, to fall within definite narrow limits of luminosity. An immense majority of such stars have almost exactly the same candle-power.

Nebulous objects in Messier 31 provisionally identified as globular clusters: EDWIN HUBBLE. One hundred and forty objects have been found in or close to the borders of Messier 31, the Andromeda nebula which, from their numbers, their distribution and the radial velocity of a typical example, are presumably to be associated with the spiral. From their forms, structure, colors, luminosities and dimensions, they are provisionally identified as

globular clusters. Absolute photographic magnitudes range from − 4 to − 7 with maxima at − 5.0 and − 6.2. Diameters range from 4 to 16 parsecs. Galactic globular clusters, according to Shapley's data, are systematically brighter than the objects in M 31 by amounts varying from 0.75 to 1.95 mag., depending on the interpretation of the data. Known clusters in the Magellanic Clouds are comparable with the brighter objects in M 31. Objects apparently similar to those in M 31 are found in NGC 6822, M 33, M 81 and M 101.

The determination of the orbit of an object moving under the attraction of the sun and of the combined mass of earth and moon: A. O. LEUSCHNER and E. C. BOWER. As a measure of preparedness in case of the discovery of an object so close to the earth that the usual methods of orbit determinations do not apply, a solution is proposed, based on the equations of motion for three bodies, which in the first approximation determines whether the object is a planet or a satellite to the earth. A satellite would be revealed graphically through the intersection of a straight line with a bump in a curve, due to parallaxic terms arising from the difference of direction of the object as seen from the observer and the center of the mass of the earth-moon system. The process was illustrated by application to the recently discovered fast-moving Delporte object. The earlier observations of this object indicated the possibilities of its nature. It could be either a planet moving in a cometary orbit similar to that of Eros and passing through perihelion about the time of discovery near the earth. In that case its distance from the sun would be nearly the same as the distance of the earth from the sun. Or the object might be a new but tiny satellite to the earth, giving us a second moon. In fact in that case its distance from the earth would have been about 1.5 times the distance of the moon and its period of revolution about five months. Application of the new method of solution readily revealed that the latter possibility is definitely excluded and that the object is a planet moving in a cometary orbit. It may have been observed years ago as a comet. Its importance lies in the fact that it can approach closer to the earth than Eros and therefore furnishes the best opportunity for more accurate determination of the distance of the sun from the earth.

Trial of a projection method for measuring astronomical photographs: FRANK SCHLESINGER and ARTHUR L. BENNETT. In this method of measuring, a strong light is placed behind the photographic plate and is kept in the line of collimation of the measuring microscope. The images of the plate and of the cross wires are then thrown upon a white mat surface with a magnification of about thirty. The microscope being moved with reference to the plate by means of a long and accurate micronometer screw, the settings are made by superimposing the image of the cross wires upon the star images. A large number of plates were measured in this way and also by the usual method; the two results are equally accurate, or if there is any difference it is in favor of the projection method. The new method has the advantages of being a little more rapid and far less tiring.

Curvature theorems in dynamics (illustrated): EDWARD KASNER.

A deaf speaker: FREDERICK BEDELL (introduced by Ernest Merritt). The microphone, phonograph and radio, and the loud speaker which they operate have reached a high stage of development for the entertainment and education of people with normal hearing, and the benefits of this development have been far-reaching. There are, however, in this country some fifteen million people who on account of defects in hearing are completely debarred, or to a large extent debarred, from enjoying these benefits. The need, therefore, is evident for a ''deaf'' speaker which will give audition to the deaf similar to the audition given by a ''loud'' speaker to those who have normal hearing. Such a speaker for the deaf, utilizing bone conduction from a vibrating applicator applied to the teeth or bony structure of the head, has been developed. Sound vibrations are thus detoured around the middle ear, where defects causing deafness are usually located, and are picked up by the bone-encased fluid of the inner ear. Special attention has been paid to matching mechanical impedance, so that the vibrations are given proper force and amplitude for transmission through the bone, and to controlling frequency response so as to give best audition for different types of deafness. In this way people who have not heard for years have been able to hear.

On the theory of ferromagnetism: PAUL S. EPSTEIN. According to Heisenberg the ferromagnetic phenomena are due to the magnetic spin moments of the valency electrons. In spite of some work done by Bloch and others, the theory was not sufficiently carried through mathematically, so that there remained doubts whether the spin moments are a sufficient cause of ferromagnetism. The author succeeded in finding expressions for the probability of a given magnetic moment of a crystal which are rigorous within the simplifying assumptions of the theory. They permit to set up the criteria for a substance becoming ferromagnetic and to say positively that, under certain conditions, the spin moments can produce ferromagnetism.

(To be concluded)

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