

yellow female is  $YY$ . The constitution of these four parent forms would then be:  $BB$ , black female;  $B—$ , black male;  $YY$ , yellow female; and  $Y—$ , yellow male.

If then we make the cross yellow male,  $Y—$ ,  $\times$  yellow female,  $YY$ , all the young should be yellow, one half being males and one half females. In this cross 5 young have been obtained, 3 males and 2 females, *all yellow*.

If we make the cross black female,  $BB$ ,  $\times$  yellow male,  $Y—$ , we have in  $F_1$  two types of individuals, viz.,  $BY$ , tortoise females, and  $B—$ , black male. Theoretically these two types should be formed in equal numbers; actually the tortoise females are 8, the black males 7. The reciprocal cross is yellow female,  $YY$ ,  $\times$  black male,  $B—$ ;  $F_1$  has two types of individuals, viz.,  $BY$ , tortoise female, and  $Y—$ , yellow male. This expectation coincides with the facts observed by Doncaster. We have, however, an important cross under way which must be carried out more fully before the hypothesis, given above, can be considered as proved. This mating is: tortoise female,  $BY$ ,  $\times$  yellow male,  $Y—$ . The expected result is  $BY$ , tortoise females;  $YY$ , yellow females;  $B—$ , black males; and  $Y—$ , yellow males. One litter has been obtained from this cross; it contained one tortoise female, one black male and three yellows (dead), the sex of which was unfortunately undetermined before the caretaker discarded them. It is interesting to note that Doncaster cites this mating as producing "blacks, tortoises and oranges," though he does not record the sexes.

The cross tortoise female  $\times$  black male has been recorded by Doncaster. It gave tortoise females, orange males, black females and black males. By the hypothesis here suggested this is to be expected. Thus tortoise female,  $BY$ ,  $\times$  black male,  $B—$ , should give  $BB$ , black females;  $B—$ , black males;  $Y—$ , yellow males; and  $BY$ , tortoise females.

Male "tortoise shells" occasionally occur, and it seems probable from their rarity that they are due to some distinct mutation such as that which produces tortoise guinea-pigs,

and not to heterozygosis between black and yellow. Theoretically, if such were the case, tortoise females of a similar nature might be produced. Such animals would be indistinguishable externally from the common form of "tortoise," but would differ in gametic composition, and therefore in their behavior in crosses.

So far as first-hand evidence goes the observed experimental facts are best explained by the hypothesis outlined above, which considers the factor for black coat color in cats to be linked with the  $X$  element, and therefore to be sex limited. Doncaster's suggestion that tortoise is merely the female heterozygote obtained in crosses between yellow and black would not explain the fact that reciprocal crosses of black with yellow produce males differing in color, one cross producing black males, the reciprocal cross producing yellow males. Indeed the last-mentioned fact in itself makes the case unique among mammals. If, then, the hypothesis of "sex-limited" characters outlined above is found to be substantiated by the cross, tortoise female  $\times$  yellow male, we shall have established a case of the same general character as those described by Morgan as occurring in *Drosophila*. Further experiments bearing upon the matter are in progress.

C. C. LITTLE

April 23, 1912

#### THE AMERICAN PHILOSOPHICAL SOCIETY

THE annual general meeting of the American Philosophical Society was held in the rooms of the society at Philadelphia, April 18 to 21 inclusive, and constituted perhaps the most notable series of sessions ever held by the society. The papers were all of a high order of merit and presented in many cases for the first time the results of original investigation by the authors.

The meeting was opened on Thursday afternoon, President W. W. Keen, LL.D., in the chair, when the following papers were read:

*Some Former Members of the American Philosophical Society:* THOMAS WILLING BALCH.

The writer said that besides Franklin, the founder of the society, Washington, Jefferson and Cleveland were members. Many other political

men were members: John Dickinson, Albert Gallatin, De Witt Clinton, Alexander James Dallas, Thomas Francis Bayard and Carl Schurz, for example. The painters, Benjamin West, Charles Wilkes, Peale and Thomas Sully, belonged to the society. Of jurists, John Jay, John Marshall and Roger Brooke Taney were members. Among others whose names are on the roll of the society were: Joseph Bonaparte, King of Spain; Louis Philippe, King of the French; George Gordon Meade, the victor of Gettysburg; Commodore Wilkes, Bishop Charles Magnus von Wrangel, of the Church of Sweden; the Rev. John Witherspoon, of the Church of Scotland and president of Princeton. Among publicists, John Stuart Mill was a member, as also Noah Webster, de Tocqueville, Henry Wheaton, President Woolsey of Yale, Sir Henry Sumner Maine, Henry Charles Lea, Dupont de Nemours, Michel Chevalier. The writer showed that the society had recognized all knowledge in choosing its members.

*The Diary of a Voyage to the United States, by Moreau de Saint Méry*: STEWART L. MIMS. Introduced by Mr. J. G. Rosengarten.

Mr. Mims told the story of his good fortune in finding the diary in the Colonial Archives at Paris, where it had lain covered with dust, all but unnoticed and forgotten, for three generations. The author of the diary was born at Fort Royal, Martinique, in 1750, went to Paris at nineteen to study law and returned to Cap Français (to-day Cape Haiti) in the French colony of St. Domingo, where he practised law for eight years and was then elected to the Conseil Supérieur. The task of codifying the laws of St. Domingo called him back to Paris, where he published successively, from 1784-1790, the six volumes of his famous collection of laws concerning the French West Indies. At the outbreak of the French Revolution he became an ardent champion of the Revolutionary cause. He was made one of the electors of Paris, who governed France during the space of one month. It was as their president that he was "King of Paris during three days." With the accession of Robespierre to power Moreau was forced to flee from Paris into Normandy and later to Havre, whence he took ship for the United States on November 9, 1793. Owing to strong head winds and many storms, his vessel did not reach Norfolk before March 8, 1794. He remained as an exile in this country until August, 1798, when he returned to France.

It is of this sojourn in America that the diary

records the story. After calling attention to the value of certain passages where the author records his impressions of such cities as Norfolk, Baltimore, New York and Philadelphia, and to other passages containing the author's comments upon such public men as Washington, John Adams and Alexander Hamilton, Mr. Mims laid special stress upon the interesting material which the diary contains for Philadelphians.

Moreau de St. Méry spent no less than three years and ten months of his exile in this city, maintaining a bookstore and printing shop at Front and Walnut Streets. He offered for sale in his bookstore a large collection of foreign books which attracted many cultured Philadelphians. At his printing press were published in French, besides other works, three of his own well-known books, "La Danse," "La description de la partie espagnole de St. Dominique" and "La description de la partie française de St. Dominique." Besides, at this same press was published in French from October 15, 1795, to March 14, 1796, a daily newspaper, entitled "Le Courier de la France et des Colonies," a most unique publication which recorded for the exiles the latest news from France and the West Indies, and served as an organ for the society of Frenchmen who resided then in Philadelphia.

Moreau's shop became in a sense the place of rendezvous for such famous exiles as Talleyrand, Beaumetz, Blacon, de Noailles, Talon, la Rochefoucauld de Liancourt, who had taken refuge "in the ark of Noah," which one of them wittily called Philadelphia at that time. In this connection, the speaker called attention to the very intimate relations existing between Talleyrand and Moreau, stating that the diary contained no less than seventeen unpublished letters from the hand of Talleyrand which were written to Moreau. One passage was quoted from the diary which gave a most striking picture of the famous diplomat, sipping away at a glass of good old Madeira and chatting with his congenial companions, both oblivious of time, until the good wife of Moreau came to drive away the garrulous bishop, reminding him that he might spend his morning lazily in bed, whereas his friend must be up early at the daily duties of his shop. It is interesting to add that Talleyrand, after he had regained power in France, never forgot the friend of his days of exile, but succeeded in reopening the doors of France for his return and providing for his welfare in later life.

In conclusion the speaker expressed confidence that the publication of the diary at the Yale University Press during the coming summer would prove of interest to all students of Philadelphia's history and would add another diary of value to the many interesting records of travel by foreigners in the United States.

*The Legendary and Myth-making Process in Histories of the American Revolution:* SYDNEY GEORGE FISHER.

*Bardaisan and the Odes of Solomon:* WILLIAM ROMAINE NEWBOLD.

*Sumerian Bookkeeping Five Thousand Years Ago* (Illustrated): GEORGE A. BARTON.

*The Political Ideals of Ulrich von Hutten:* KUNO FRANCKE.

Recent German criticism is inclined to undervalue the services rendered by Ulrich von Hutten to the cause of liberalism. In his personality German humanism finds its most ravishing and irresistible expression. In him the Erasmian enlightenment burns into a revolutionary power. It is a mistake to think of him primarily as an ally of the Lutheran reformation. Hutten would have been the last to submit to the dogmas of the Lutheran church. His aim was the political and intellectual reconstruction of Germany. Abolition of the monasteries, confiscation of church property, secularization of the schools and the higher institutions of learning, safeguarding of free thought and free inquiry, centralization of the empire, limitation of the power of the territorial princes, creation of a powerful public opinion based upon an alliance of the cities and the knighthood—these were his political ideals. If he failed in his efforts to put these ideals into practice, he has at least given a powerful stimulus to the modern conception of the state as the legitimate upholder of liberal culture and spiritual progress.

*Some Anthropological Aspects of the Brain with Reference to Race, Sex and Intellect:* EDW. ANTHONY SPITZKA.

A discussion of the weight and morphologic appearances of the human brain and its several parts resulting from a series of studies upon specimens of various races and notable individuals, including those of Andamanese, Nicobarese, Chinese, Eskimos, Negroes, as well as eminent scholars from civilized nations. Particular attention is called to the relative redundancy of certain association areas of the cerebral cortex in eminent men and women and also to the relatively larger

callosum, or great commissure associating the hemispheres of the brain. The lecture was illustrated by lantern slides.

*Waterway Conservation:* LEWIS M. HAUPT.

This paper treats of population as the basis of wealth and points out the enormous increase which must follow in the coming century, if the existing ratio continues, which would give a population of nearly 600,000,000 by 2012 and which will seriously tax our political and social conditions, while it also increases enormously the wealth due to the "unearned increment" and the desire to exploit our natural resources.

The great increase in transportation, which has almost doubled in the last decade, is cited as indicating the inability of the overland carriers to cope with the future demand and the absolute necessity of supplementing the railroads by greatly improved water- and highways is urged as a measure of relief and regulation.

Attention is directed to the efforts to secure conservation by statute laws which have become so intricate that great differences of opinion have arisen as to their interpretation, scope and application and a corresponding paralysis has resulted between state and governmental jurisdiction, thus retarding development and increasing the cost of living.

Violations of natural and physical laws have also resulted in great floods and consequent devastation, as is being forcibly impressed by the trail of disaster along the Ohio and Mississippi rivers at the present time, which have overtopped the levees with a lesser discharge than in former years, due to the closure of the outlets and confining of the sediment to the bed of the streams, by the extension of the levees.

These conditions are the sequences of the centralization of authority and control in the general government over all the waters of the country and the general demand from all sections for national appropriations from the federal treasury, which can not be met, and result in sectional jealousies and political pressure for patronage to the great detriment of local initiative and of open competition by states and localities in immediate need of relief.

The illustrations accompanying the paper showed how the energy of currents might be utilized to create automatic channels and remove bars in rivers and harbors at much less cost both for construction and maintenance than by the current means of dredging or the use of extensive jetties

in pairs, which obstruct the tides and create deposits in the pathway of commerce, thus increasing the cost.

On Thursday evening a celebration of the centenary of the introduction of gas as an illuminant, under the auspices of the American Philosophical Society, the Franklin Institute, the American Chemical Society and the American Gas Institute, was held in the hall of the Franklin Institute, Philadelphia, with President Keen in the chair.

A paper on "By-products in Gas Manufacture," by Charles E. Munroe, was read.

#### FRIDAY, APRIL 19—MORNING SESSION

President Keen in the chair

*Heredity of Feeble-mindedness*: HENRY H. GODDARD. Introduced by Dr. Henry H. Donaldson.

*The Inheritable Factors of Epilepsy*: DAVID F. WEEKS. Introduced by Dr. Henry H. Donaldson.

*Is the Control of Embryonic Development a Practical Problem?* CHARLES R. STOCKARD. Introduced by Dr. Henry H. Donaldson.

Many deformities occur among animals in nature and a great number of deformed human beings are born. Many other individuals suffer from minor defects in bodily structure. These defects are often internal and may be unknown to their possessor, yet they frequently give rise to disease conditions which sometimes actually result in death. There are, for example, many congenital defects of the heart and other parts of the circulatory system, digestive tract, reproductive organs and developmental arrests may occur in almost all parts of the body.

These conditions must be regarded as a structural disease which causes the death of a number of children before they are born and handicaps many others throughout their lives. The cause of such defects must be ascertained, then a possible means of control may be found.

Observations on human families and experiments on lower animals prove that these conditions are due to one of two causes as the case may be. First, the embryo may have developed in an unfavorable chemical environment; or secondly, the germ cells of one or both parents may have been defective.

When the eggs of lower animals are treated with various poisons during their development they give rise to monstrous individuals. For example, when developing fish's eggs are treated for a short time with alcohol in some cases as many as 98 in 100

of the eggs give rise to fish which show almost all known deformities of the brain, eyes and other parts of the nervous system.

Guinea-pigs have been put into a state of chronic alcoholism and when such animals are mated either together or with normal individuals the resulting offspring are greatly affected. Many are aborted early in development, or reach term and are then born dead. Only a few are born alive and the great majority of these die after a short time, showing many nervous disorders and dying in convulsions.

A normal female when mated with an alcoholic male gives an almost equally poor result. This shows that the paternal germ cells are affected by the alcohol and are thus rendered unable to give a normal combination and abnormal offspring are produced.

Abnormal and deformed individuals may thus be artificially produced at will and the provoking cause is proved to be an unfavorable chemical environment acting on the germ cells of the parent or directly upon the embryo. The proposition of reversing the experiments thus presents itself, and some mode of treatment or control should be devised by which parents may be put into the proper state to produce as nearly as possible a normally vigorous offspring. Enough is known at present to make the control of development possible to a slight degree at least.

*An Avian Tumor in its Relation to the Tumor Problem*: PEYTON ROUS. Introduced by Dr. Alexander C. Abbott.

The paper reports the results of an experimental investigation into the cause of a malignant tumor. For the work a sarcoma of the chicken has been employed. This growth is transplantable from fowl to fowl, and presents the typical picture of a malignant tumor. It has been studied under many different conditions, not only in the adult fowl, but, by a special technic, in the chick previous to hatching.

Attempts to isolate a cause for the sarcoma have been successful. By filtration, or by drying, there can be separated from the living tumor tissue an agent which will produce the growth in fowls previously healthy. This active agent has not been directly observed, and is in all probability ultramicroscopic, since it will pass through filters which hold back minute bacteria. Its properties identify it as a living organism. In giving rise to a tumor it seems able to act only exceptionally and at points and upon tissues which have been

injured in some way. This dependence on a preliminary tissue derangement explains why the disease is not infectious in the ordinary sense.

The chicken sarcoma, like the tumors in general, can not be transmitted to other species; and the facts with regard to its cause must not be taken as applying directly to the tumors of other creatures. But these facts constitute the first demonstration of the cause of a malignant tumor, and they not unlikely illustrate a general truth.

*Protein Poison: Its Preparation and Its Nature:*

VICTOR C. VAUGHAN.

It has long been known that the protein molecule contains a poisonous group. This has been demonstrated by the administration of foreign proteins, parenterally, to heterologous animals. It has also been shown that peptones are poisons when injected subcutaneously and intravenously. The writer, together with Dr. Wheeler in 1903, succeeded in splitting up the protein molecule so as to get a highly poisonous body. This has never been obtained in a state of chemical purity, and its exact composition is not known. Its effects upon animals have been closely studied, and it may be prepared from all kinds of proteins, bacterial, vegetable and animal.

*Bacterial Vaccines, with Special Reference to Typhoid Prophylaxis:* FREDERICK F. RUSSELL.

Introduced by Dr. Alexander C. Abbott.

*Alternate Life:* ALEXIS CARRELL.

*Dynamical Theory of the Globular Clusters and of the Clustering Power Inferred by Herschel from the Observed Figures of Sidereal Systems of High Order:* T. J. J. SEE. By title.

*Some Notes on Persian Mystic Poetry:* A. V. WILLIAMS JACKSON.

FRIDAY, APRIL 19—AFTERNOON SESSION

Vice-president William B. Scott in the chair

*Exhibition of Volumes of Illustrations of North American Vegetation:* JOHN W. HARSHBERGER.

*History of the Fungus of the Chestnut-tree Disease:* WILLIAM G. FARLOW.

*The Classification of the Black Oaks* (Illustrated): WILLIAM TRELEASE.

Attention to bud and fruit characters has led to a classification of the black oaks quite different from their usual arrangement according to leaf-form, and five groups of species are recognized, three of the eastern states, one of the southwest and one of the Pacific states. The eastern groups are the black oaks (black jack, turkey oak, Spanish oak and quercitron), scarlet oaks (scarlet oak, gray oak, Hill's oak, red oak, Texas red oak and

bear oak) and swamp oaks, these two sets, the water oaks (water oak, pin oak and Stone Mountain oak) and willow oaks (shingle oak, willow oak, laurel oak, running oak, cinnamon oak and myrtle oak). The southwestern olive oaks (Emory's oak and white-leaf oak) and the Californian holly oaks (evergreen oak, highland oak and Kellogg's oak) are less related to one another and to the eastern black oaks than these are to one another, and appear to have originated independently of these.

*The Mammals of the Patagonian Miocene* (Illustrated): WILLIAM B. SCOTT.

*Illustrations of Remarkable Cambrian Fossils from British Columbia* (Illustrated): CHARLES D. WALCOTT.

Dr. Walcott described a very remarkable and ancient fauna that he found in connection with geological explorations in the higher Rocky Mountains of British Columbia. From a camp at 7,000 feet elevation, he climbed a thousand feet to a ledge of rocks where the ancient Cambrian fossils are so perfectly preserved that the internal anatomy of many of the worms and crabs may be reproduced by photography.

His description of the fossils was illustrated by lantern slides made direct from the photographs of specimens representing over fifty genera heretofore unknown. The bay in which the mud was deposited, which now forms the rocks containing the fossils, was connected with the open ocean, and at the spot where the fossils were found the waters must have swarmed with the invertebrate life of the time. No fishes or other vertebrates were found to have existed at this ancient epoch. The earliest vertebrate remains known are several thousand feet higher up in the strata, and are many thousands of years younger than the Burgess shale fossils.

The marine worms are so perfectly preserved that they show not only the exterior form, but the interior intestine and the long proboscis which the worms thrust out through the mouth to secure food and to aid in drawing themselves through the mud.

The crabs show the intestinal canal, liver and a beautiful series of legs, gills and claws connected with the appendages about the mouth.

Specimens of *Medusæ*, or jelly fish, are beautifully preserved, even to the details of the thread-like swimming muscles. Dr. Walcott also showed upon the screen illustrations of the sponges, and many other rare forms of life.

*Some Considerations Bearing upon the Origin of Lava* (Illustrated): WILLIAM H. HOBBS.

The ideas which are generally held concerning the origin of lava have all gone out from the idea of a liquid interior to the earth. It has, however, been shown in recent years that the earth can not have a fluid interior, but on the other hand must be as rigid as a ball of glass of the same size. Within the earth the temperatures of the rock would easily melt it under surface conditions, but the pressure from the super-incumbent load elevates the point of fusion and so keeps the rock rigid, or as we might say "solid," though realizing that the condition may in many respects be quite unlike that of bodies at the surface of the earth. There must, however, be local and probably temporary reservoirs which supply the lava which exudes or is rejected from volcanoes. It is shown in the paper that the position of active volcanoes, particularly about the Pacific, suggests that the lava reservoirs which supply their lava have been due to local reliefs from pressure beneath arches of strong formations developed in the process of mountain making. The relative strengths of different sedimentary formations lead inevitably to the conclusion that the type of formation which thus fuses and produces lava, is what is known as shale or slate. Studies of the chemical composition of igneous rocks, which compositions are limited in range, support this view; and the study of the gases which lavas give off affords some further striking confirmations of the theory.

*Recent Archeological Discoveries in Peru* (Illustrated): HIRAM BINGHAM. Introduced by Mr. Henry G. Bryant.

*The Discovery of the Continent of Antarctica by Americans—An Historical Vindication*: General ADOLPHUS W. GREELY.

The speaker spoke of the unfamiliarity of the people of the United States with early American explorations of the South-polar regions, historical importance of vindicating America's title to the earliest discovery of the Antarctic continent, and to the first explorations that discovered and recognized its continental extent; discovery in 1821 of the northernmost lands of Antarctica, by Captain N. B. Palmer, a Connecticut sealer. Palmer Land was charted by George Powell with South Shetlands in 1822, and recognized by France in 1824. A voyage in 1831 of Master (retired) John Biscoe, R.N., was referred to, whereby Palmer Land was replaced on

British charts by Graham Land, named after the first lord of the admiralty. Palmer Land, ignored in the British Antarctic Manual, 1901, is recognized by only two lines in the Americanized Encyclopedia Britannica, 1911, which gives a column to Biscoe and Graham Land.

Emphasis was laid on Wilkes's discovery of extended and widely separated lands in 1840, with their recognition as forming the Antarctic continent, ignored by Capt. J. C. Ross in 1843, discredited by Encyclopedia Britannica in 1875, and declared non-existent by Capt. R. E. Scott, R.N., in 1905. Meanwhile Sir Clements Markham claimed in 1889 the honor of discovering the continent for Ross. British Antarctic Manual, 1901, admits the existence of one point (Knox Land). Mill in 1911 Encyclopedia Britannica admits in general that Wilkes's discoveries are to be indefinitely accepted. Occupation in 1912 by Mawson's Australian expedition of Adelie Land and Termination Land, vindicates Wilkes. Importance of incorporating these facts in appropriate American text-books was urged as a patriotic and educative duty.

*The Interrelations of Eight Fundamental Properties of Classes of Functions*: ARTHUR D. PITCHER. Introduced by Professor Eliakim H. Moore.

On Friday evening Professor R. W. Wood, of Johns Hopkins University, delivered a lecture before the society and guests at the College of Physicians on "The Study of Nature by Invisible Light, with Especial Reference to Astronomy and Physics."

The lecture was followed by an informal reception.

On Saturday morning at 9:30 o'clock an executive session was held in the hall of the society at which candidates for membership were balloted for. As a result of the election the following new members were announced: Albert T. Clay, B.A., Ph.D., New Haven; George W. Crile, M.D., Ph.D., Cleveland; Arthur Louis Day, Ph.D., Washington; Edward Curtis Franklin, Ph.D., Washington; John Grier Hibben, Ph.D., LL.D., Princeton; G. Carl Huber, M.D., Ann Arbor; James Furman Kemp, Sc.D., New York; Arthur Henry Lea, B.A., Philadelphia; John Matthews Manly, Ph.D., Chicago; Edward Bennett Rosa, Sc.D., Ph.D., Washington; Frank Schlesinger, M.A., Ph.D., Allegheny, Pa.; George E. de Schweinitz, M.D., Philadelphia; Frederick Winslow Taylor, M.E., Philadelphia; Roland Thaxter, A.M., Ph.D., Cambridge, Mass.;

Oswald Veblen, Princeton; George Friedrich Julius Arthur Auwers, Ph.D., Berlin; Wilhelm Ostwald, Sc.D., LL.D., Leipzig; Magnus Gustaf Retzius, Stockholm.

SATURDAY, APRIL 20—MORNING SESSION

President Keen in the chair

*Some Geochemical Statistics:* FRANK W. CLARKE.

The author first discussed the average composition of the igneous rocks, and then compared them with rocks of sedimentary origin. From the amount of soda lost by the decomposition of the igneous rocks, and the amounts retained by the sedimentaries or leached into the ocean, he showed that about 78,000,000 cubic miles of the primitive crust of the earth had been decomposed, forming a mass of rock consisting of about 80 per cent. shales, 15 per cent. sandstones and 5 per cent. limestones. He next compared the rate at which river waters transport dissolved salts to the ocean, with the composition of the ocean itself, and from these data computed the probable age of the earth since the continents assumed their present form at something near 83,000,000 years. The saline matter of the ocean alone amounts to about 5,000,000 cubic miles, or enough to cover the entire surface of the United States with a solid mass a mile and three quarters thick. The rate at which sediments are being deposited in the ocean was also determined, and found to be about 0.000027 inch annually.

*Some General Results of the Work of a Century on the Atomic Weights of the Chemical Elements:* GUSTAVUS D. HINRICHS.

*Absorption Spectra and the Solvate Theory of Solution* (Illustrated): HARRY C. JONES.

A large number of lines of evidence have been brought to light in the laboratory of the author, all pointing to the conclusion that a dissolved substance combines with more or less of the solvent in which it dissolves, about 7,000 solutions have now been studied with respect to their power to absorb light. It has been found that a given colored compound dissolved in different colorless solvents absorbs light very differently in the different solvents. This is interpreted as being due to a combination of the different solvents with the dissolved substance, forming the different compounds which absorb light differently. The bearing of this work on the nature of solution is important, and solution is the most important condition known to man from the standpoint of natural science in general.

Matter in the pure homogeneous condition does not enter into chemical reaction. It becomes active chemically only when dissolved. Chemistry, biology and geology owe their existence to matter in the dissolved state, and any light thrown on the nature of solution is of importance for the natural sciences in general.

The theory of solution hitherto held has been found to be insufficient, not applying to the very solutions that give us natural science.

In dealing with solutions we must always take into account the part of the solvent combined with the dissolved substance.

*The Classification of Carbon Compounds:* MARSTON T. BOGERT.

The subject is considered primarily from the standpoint of classification for purposes of instruction in organic chemistry. The various ways in which carbon compounds have been classified from time to time are traced historically, from the earliest period to the present, and the author expresses himself in favor of the present day of a classification based on chemical structure, grouping together all compounds of essentially similar function. Thus, all hydrocarbons, saturated and unsaturated, acyclic and cyclic, should be considered together, all simple halogen derivatives, and so forth. The author has used this method with his students at Columbia University for the past ten years and has found it very satisfactory.

*An Autocollimating Mounting for a Concave Grating* (Illustrated): HORACE CLARK RICHARDS.  
*Thermal Relations of Solutions:* WILLIAM F. MAGIE.

The heat capacity of electrolytes dissolved in water is related to the temperature change of the heat of dilution. Experiments to demonstrate this were described and it was pointed out that the heat of dilution is a difference between two quantities of heat—one evolved in an amount proportional to the absolute temperature—the other absorbed in an amount independent of the temperature. One of these quantities is proportional to the dissociation which occurs on dilution and measures the energy lost by the solute as its ions combine with water. The other involves as a part of its value the heat absorbed by the dissociation.

A formula for the relations of the osmotic pressure to the temperature was proposed, from which the heat of dilution can be deduced. It was shown for solutions of common salt that the constants of this equation can be calculated from the freezing points and the boiling points of the solution, and

that they lead to the observed values of the heat of dilution.

The special significance of these relations lies in the strong support which they give to the theory that the molecules and ions of a salt in solution are associated or combined with the molecules of water.

*The Measurement of Temperature up to 1750° C.* (Illustrated): ARTHUR L. DAY. Introduced by Professor William F. Magie.

The gas thermometer is the standard thermometer in terms of which all temperatures are defined.

The gas thermometer problem at the present stage of its development has become primarily a problem for experimental study with two definite purposes, one to increase the accuracy of the measurements, the other to increase their range. The range through which temperatures can now be determined in terms of the fundamental definition (the expansion of gas under constant volume or pressure) has now reached nearly to the absolute zero downward, and to 1550° C. upward. The present investigation is concerned with the higher temperatures lying between 300° and 1550°. The accuracy attained in the present investigation within this region is about 0.2° in the vicinity of 300° and 2° at 1550°.

For the purpose of establishing temperatures of reference in this region for general use, the following constants have been determined:

Cadmium (melting point) . . . . .	$320.8 \pm 0.1$
Zinc (melting point) . . . . .	$419.3 \pm 0.1$
Sulphur (boiling point) . . . . .	$444.5 \pm 0.1$
Antimony (melting point) . . . . .	$629.8 \pm 0.2$
Silver (melting point) . . . . .	$960.0 \pm 0.7$
Gold (melting point) . . . . .	$1062.4 \pm 0.8$
Copper (melting point) . . . . .	$1082.6 \pm 0.8$
$\text{Li}_2\text{SiO}_3$ (melting point) . . . . .	$1201.0 \pm 1.0$
Nickel (melting point) . . . . .	$1452.3 \pm 2.0$
Palladium (melting point) . . . . .	$1549.2 \pm 2.0$
Platinum (melting point) . . . . .	$1752.0 \pm 5.0$

*Selective Scattering Reflection and Absorption by Resonating Gas Molecules* (Illustrated): ROBERT WILLIAMS WOOD.

*Some Observations on the Transmission of Sound through Walls*: ARTHUR GORDON WEBSTER.

*New Magnetic Charts of the Indian Ocean* (Illustrated): LOUIS A. BAUER.

The charts exhibited embody the results of magnetic observations made during the summer and fall of 1911 on board the non-magnetic yacht *Carnegie* operating under the direction of Dr. L.

A. Bauer, director of the department of terrestrial magnetism of the Carnegie Institution of Washington.

The necessity of the new charts arose from the exceptionally large errors found in the magnetic charts at present in use by mariners. Thus, for example, the errors in the charted compass directions for two of the most recent charts approximate respectively four degrees and six degrees, though one of the charts was issued as recently as 1910. With the exception of a few values found by the vessel used in the Pacific Ocean work, namely, the *Galilee*, these are the largest errors thus far revealed. In the portions of the Atlantic Ocean covered by the *Carnegie* the compass chart errors have generally been below two degrees, though running at times up to two and a half degrees.

The chart errors in the compass directions are usually found to be systematic, that is, in the same direction for large stretches, and are to be ascribed largely to erroneous secular changes allowed for in attempting to bring previously observed values up to date.

Thus, for example, by comparing the *Carnegie* values of 1911 with those obtained on board the German Antarctic vessel, the *Gauss*, in 1903, it is found that the north end of the compass moved to the eastward (hence diminished west declination) at the average rate of about 11' per year off the southeast end of Africa, whereas in the vicinity of the islands of St. Paul and New Amsterdam in the Indian Ocean (lat. 35° 16' S., long. 74° 46' E.) it moved to the westward (increased west declination) at the average rate of about 13' per year. The charts give secular changes of only about one fourth of these amounts, so that the error of reduction in but ten years amounts almost to 2°. It is doubtless due to these large secular changes disclosed in the Indian Ocean, and especially their rapid variation with geographic position, that the large errors mentioned have crept into the charts.

The errors in the other magnetic elements, while of less importance to the mariner, are of consequence to theoretical investigations regarding the earth's magnetism. In the magnetic dip, the errors on the present cruise have amounted at times to 4°, and in the horizontal intensity to about one twentieth part. While some of the results derived from previous analyses of the earth's magnetic field have pointed to the possibility of large and more or less systematic chart errors, it was not suspected that they would reach



the magnitude disclosed by the work of the *Galilee* and of the *Carnegie*.

The *Carnegie* is at present making a circumnavigation cruise and is expected back in New York towards the end of 1913, having left the same port in June, 1910. Up to February 1, 1912, this vessel has already covered about fifty thousand miles. She left Manila on March 23, in command of W. J. Peters, bound for the Fiji Islands.

Owing to the non-magnetic construction of the *Carnegie* and the absence in consequence of any deviation corrections, it is possible to obtain and communicate results expeditiously. The data are promptly transmitted to the chief hydrographic establishments issuing magnetic charts in order to enable them to make the necessary corrections from time to time.

#### SATURDAY, APRIL 20—AFTERNOON SESSION

Vice-president Edward C. Pickering in the chair  
*Symposium on Stellar Spectroscopy—Radial Velocity* (Illustrated): WILLIAM W. CAMPBELL.

Our knowledge of motions of the planets around the sun and of the satellites around the planets has been reduced to a system, of remarkable accuracy. Knowledge concerning the motions of the stars is growing rapidly: shall we be able to develop this knowledge into a system?

Stellar motions are studied through their components known as *proper motions* and *radial velocities*. Proper motion studies of the stars have been fruitful, but limited in value by our ignorance of stellar distances. Radial velocities have the advantage that they are independent of stellar distances.

All observed stellar motions contain components due to the motions of the observer. The first step in studies of stellar motions is to determine the elements of the solar motion and to eliminate its effects from the observed motions of the stars, thus leaving the motions with reference to the stellar system.

The direction of the solar motion has long been fairly well known: the solar system is approaching a point  $10^\circ$  or  $15^\circ$  southwest of *Vega*. The speed determined from 1,200 radial velocities is  $19\frac{1}{2}$  kilometers (12 miles) per second.

The velocities of the stars are functions of their spectral classes; *i. e.*, of their effective ages. The young stars are traveling slowly—12 kilometers per second, on the average; the middle-aged stars more rapidly— $28 \pm$  km. per second; and the old stars the most rapidly— $34 \pm$  km. per second. Our sun,

as a middle-aged star, is traveling with a speed,  $19\frac{1}{2}$  km. per second, far below the average of its class. We do not know why stars increase their speeds as they grow older.

Amongst the brighter and nearer stars those resembling our sun in effective age predominate; and they partake somewhat of the solar motion. Neglecting these brighter middle-aged stars, the remaining stars form a fairly homogeneous mixture of stars of all ages.

Radial velocity data increase our estimate of the scale of the universe about 50 per cent. above proper motion estimates.

Observers with great telescopes have found that one star in eighteen, down to the 9th magnitude, is a double star, and that one in eleven or twelve brighter than the 5th magnitude is double. The spectrograph has shown that *at least one star in four*, down to the 5th magnitude, is a double star; with components so close together that they have never been seen separately in our most powerful telescopes. For young stars the observed proportion is greatest, the components are closer together, and the orbits are rounder. For the old stars the proportion of observed doubles is smallest, the orbits are larger and more elongated. The proportion of discovered doubles, especially amongst the old stars, is rapidly increasing. Conclusion: Double stars have been joined and developed from parent gaseous masses, substantially as mathematical astronomers had predicted. There is the utmost need for cooperation amongst astronomers in observing the radial velocities of stars between the fifth and seventh magnitudes.

*Objective Prism Spectra*: EDWARD C. PICKERING.  
*On the Prospect of Obtaining Radial Velocities by Means of the Objective Prism*: FRANK SCHLESINGER.

*Relations between the Spectra and other Characteristics of the Stars* (Illustrated): HENRY N. RUSSELL.

Among the stars whose distances can be measured with some approach to accuracy, and whose real brightness can thus be determined, there exists, with few exceptions, a very marked relation between the actual brightness and the class of spectrum. The stars of spectrum A (resembling Sirius) are on the average about 50 times as bright as the sun; those of spectrum F5 (like Procyon) about five times as bright as the sun; those with spectra like the sun's (class G) are nearly equal to the sun in brightness; while the orange stars of spectrum K average only one sixth as bright, and

the red stars of classes K5 and M are usually less than one fiftieth as bright as the sun. On the average, the stars of each spectral class are seven times as bright as those of the following class. This rule holds true both for the stars relatively near us, whose individual distances can be measured, and for those belonging to clusters whose distances are known.

There exist, however, many stars of great brightness, of all spectral types, which are almost all so remote that their distances can not be accurately measured. From the best available data, these stars appear to be on the average from 100 to 250 times as bright as the sun, without much difference between the different spectral types.

Among the stars redder than the sun, these two groups, of different brightness, are widely separated; but among the whiter stars they run together, and become identical for the whitest stars (class B), which average more than 250 times as bright as the sun.

In the cluster of the Pleiades (whose distance has so far been unknown) all spectral classes from B5 to G are represented, and the relative brightness of the different types follows very closely the law which holds good for the fainter stars already mentioned. If it is assumed that the stars of the Pleiades also follow the same law as regards their actual brightness, the distance of the cluster is found to be such that their light takes 600 years to reach us.

From a study of double stars it is found that the stars of the brighter class do not greatly exceed those of the fainter class in mass, and hence that they are either much less dense, or much brighter per unit of surface, or both. The average density of the stars of classes B and A can be found with the aid of certain stars which eclipse one another, and it follows that these stars give off much more light per square mile of surface than the sun does. It can also be shown that the faint red stars give out much less light per square mile than the sun.

If the same is true of the other kind of red stars (which several lines of argument make very probable) these stars must be of enormous size, but very low density.

An arrangement of all these groups of stars in order of increasing density would begin with the bright red stars of the type of Antares, run up the series of stars of great brightness to those of spectrum B, and then down the series of fainter stars, past those like the sun, to the faintest and

reddest stars. It seems probable that this arrangement represents the evolutionary history of a star, which at first becomes heated more and more by its own contraction, and finally, as it becomes too dense to admit of further shrinkage, cools off like a solid body.

At the annual dinner on Saturday evening at the Bellevue-Stratford nearly eighty members and guests were present, the toasts being responded to as follows:

"The Memory of Franklin," by Professor John Bassett Moore.

"Our Sister Societies," by Professor Chas. F. Chandler.

"Our Universities," by Professor Ernest W. Brown.

"The American Philosophical Society," by Professor Francis B. Gummere.

An important feature of this occasion was the presentation of the Henry M. Phillips prize of two thousand dollars to the author of the crowned essay on "The Treaty-making Power of the United States and the Methods of its Enforcement as Affecting the Police Powers of the United States." The successful competitor was Charles H. Burr, Esq., of Philadelphia, the judges of award being Joseph Choate, former ambassador to Great Britain; Judge John C. Gray, of Harvard College; Henry Wade Rogers, dean of the Yale Law School; J. M. Dickinson, former Secretary of War; and Joseph Brown Scott, of the Department of State at Washington.

In their sealed verdict the judges declared that they found great difficulty in deciding the essay of Mr. Burr and that of Edward S. Corwin, of Princeton University.

ARTHUR WILLIS GOODSPEED

#### SOCIETIES AND ACADEMIES

##### THE TENNESSEE ACADEMY OF SCIENCE

ON March 9, 1912, a meeting was held in Nashville, Tennessee, to make plans and prepare a constitution for a Tennessee Academy of Science. The meeting was called by Dr. Geo. H. Ashley, then state geologist.

The first general meeting, which was largely attended, was held at the Carnegie Library, Nashville, on April 6, at which time the following officers were elected: C. H. Gordon, president; J. I. D. Hinds, vice-president; Wilbur A. Nelson, secretary, Capitol Annex, Nashville; S. M. Barton, treasurer, and E. S. Reynolds, editor; after which the following papers were read: