SCIENCE NEWS

THE CHEMICAL CLASSIFICATION OF THE STARS

Science Service

THE great Henry Draper Catalogue of stellar spectra will be extended to include thousands of faint stars, especially those along the central line of the milky way, according to an announcement made by the Harvard College Obervatory, which has carried on for more than twenty years the classification of the heavenly bodies on the basis of chemical constitution.

In the analysis and classification of a star the light is resolved by means of a stellar spectroscope, an instrument used in various forms, but in its simplest arrangement comprising a prism of glass mounted in front of a photographic telescope. Many different telescopes and prisms were used in collecting the photographs of stellar spectra used in the compilation of the Draper Catalogue. The work was made possible through gifts by Dr. and Mrs. Henry Draper, of New York.

When the light of stars is analyzed with the spectroscope they are found to differ very greatly from each other. For the hottest stars the elements hydrogen and helium predominate in the radioactive layers of the stellar atmospheres. For the stars of intermediate temperatures, such as the sun, the metallic elements like iron, nickel, calcium and sodium are indicated in the hot vapors; and for the cooler and redder stars chemical compounds appear. The Harvard classification, which is universally used by astronomers, recognizes more than thirty types.

For the southern stars in the Draper Catalogue the photographs were made at Arequipa, Peru. The high altitude of that station made it possible to photograph much fainter stars than an instrument of equal power could photograph at the central station of the observatory in Cambridge. As a consequence, the northern stars are less completely known than those south of the celestial equator and improved photographs of these northern regions are now being made for the extension of the great catalogue.

Since a very large majority of the fainter stars is concentrated into that band of light know as the Milky Way, the Harvard observers will confine their future classification work largely to the regions along the central line of the Milky Way. It is announced that some of the new photographs will permit the classification of five to ten times as many stars as could be included from the early photographs.

The original catalogue is in constant use at all observatories. It is published in the *Annals* of the Harvard College Observatory in nine large quarto volumes, the last two of which are being printed this year. The entire catalogue gives the chemical classification of nearly a quarter of a million stars.

The extension of this analysis of the stars will include not only a record of the type of spectrum and the position of the stars, but also a new determination of their brightness. It is found that the labor of determining accurately the brightness of these faint Milky Way stars is greater than that of their classification into spectral types and will involve the making of hundreds of photographs with the Harvard telescopes. The work of extension is being undertaken under the direction of Professor Harlow Shapley, director of the Harvard Observatory, and the classification of the spectra will be made, as previously for the main catalogue, by Miss Annie J. Cannon.

A NEW RADIO ALPHABET

Science Service

A NEW method of transmitting a new radio telegraph alphabet that will eliminate interference and double the speed of sending was proposed by Major General George O. Squier, chief signal officer of the United States Army, in an address before the National Academy of Sciences.

The system, briefly, depends upon a difference in amplitude of current vibrations, instead of upon a difference in length of the vibrations, to distinguish between the dots and dashes of the code. Universal use of the new system will practically eliminate interference from radio telegraph stations.

"Due to the rapid expansion of the use of radio telephony and telegraphy, the problem of interference, both natural and artificial, is becoming each day more and more pressing for solution. The conservation of the ether lanes is suddenly rising to international importance. In addition, the daily growing use of radio for the solution of auxiliary problems such as range finding and navigation, further serves to complicate the problem. It may be said, therefore, that the fundamental problem for the radio engineer is to devise methods to utilize these limited channels to the greatest possible extent and to bend his efforts to the extension of their limits both high and low.

In the case of artificial disturbances the

chief offender, from an engineering standpoint, is the radio telegraph practice as it is universally conducted at present. It is impossible to tune out the high power radio telegraph stations, especially when in close proximity. They produce a veritable eruption in the ether, creating disturbance over a wide range of frequencies and these serve to interfere with any form of radio receiver yet devised.

Signals are universally emitted from the transmitting antenna in the form of sudden interruptions in the antenna circuit or sudden variations in this current. This produces about the worst possible source of disturbances in the ether for the reason that the disturbance has no regularity of any kind and the speed of operating the sending key has a marked influence on the whole phenomena. Present practice is drifting away from complete interruption of the antenna current, but the present methods of irregular variations of the current are still a long way from scientific solution.

Static or atmospherics will also be eliminated by the new method, General Squier believes, since these natural disturbances have higher frequencies than the low modulating frequencies that are employed by the new method.

The new system developed from one originally planned as an improved method of sending through the submarine cables. This is a continuous wave system developed by means of an unbroken alternating current. It abandoned the Morse principle of different lengths of time for the signals and adopted the plan that all individual signal units should occupy equal lengths of time and have equal importance, whether they were dots, dashes or spaces. They are distinguished by varying the intensity or amplitude of current.

Great speed can be obtained by the use of the new method and the printing telegraph, as General Squier pointed out, that a modulating frequency of sixty cycles per second, the usual alternating current power frequency corresponds to a speed of 450 words a minute of five letters each, although these may prove to be too high for traffic reasons.

At present the radio engineer has utilized and made his own all the audio frequency range and at least several octaves of the radio frequency range and has devised apparatus for the amplification and rectification of both of these ranges, audio and radio. This plan proposes to enter the unused infra-audio range, which would not only add a most useful band of frequencies to those now used, but would give a band below the range of the human ear. If this band were employed for telegraphy, an additional advantage would be that it could not interfere with any radio receiving. This method of eliminating interference is the most effective.

Finally, it is seen that by the method proposed here it is possible to modulate a single radio frequency by a number of modulating frequencies and thus multiply the capacity of each radio channel.

HEREDITARY IMMUNITY TO DISEASE

Science Service

THAT artificially induced resistance to infection may be transmitted to later generations is the conclusion reached by Professor M. F. Guyer, of the University of Wisconsin, after years of experimentation on animals at the University of Wisconsin. Professor Guyer, speaking before the American Philosophical Society about his latest investigations on the question of the inheritance of acquired characteristics, stated that inoculating successive generations of rabbits with the germs of typhoid fever he was able to develop in their blood an anti-body which is transmitted from mother to offspring and renders them more immune to the disease. Rabbits of the fourth or fifth generation so treated may be made capable of overcoming an injection of thirty to forty times as many typhoid bacilli as the original rabbits could stand. Whether such acquired immunity is also transmissible through the paternal side has not yet been determined but as Professor Guyer says: It is of interest to learn that young may not only acquire immunity reactions from their mothers but may retain them sufficiently to transmit them in a measurable degree, without further immunization, to their offspring. Even if this is nothing more than maternal transmission it may be of practical importance since a large percentage of a population might in time through such transmission come to exhibit some degree of immunity to a widely prevalent disease. If the results of our future experiments bear out our present data it becomes evident that when succeeding generations of rabbits are immunized to typhoid bacilli some modification is made in the immunity mechanism whereby individuals of later generations are capable of developing higher resistance against these germs than were the individuals of the first generation treated.

If Professor Guyer's results are confirmed by further experimentation, they will throw a new light on the mechanism of heredity and the mode of evolution. They may explain how certain races have acquired immunity to diseases fatal to others; for instance, why measles, which is with us a mild infantile malady, has almost wiped out the adult population of some Pacific islands

when the disease was introduced there. Professor Guyer has proved in previous experiments that an eye defect, artificially induced in a rabbit, may be passed down to the ninth generation and probably becomes permanently hereditary. His researches are generally regarded as having dealt a death-blow to the theory formerly held, that acquired characteristics are never inherited.

WEATHER FORECASTS FROM SHIPS

U. S. Department of Agriculture Press Service

A NEW development in weather forecasting in which the Weather Bureau, United States Department of Agriculture, is much interested is the possibility of making forecasts from aboard vessels in the North Atlantic ocean. E. H. Bowie, chief forecaster of the Weather Bureau, who returned last week from a cruise on the French training ship, *Jacques Cartier*, is convinced that it is entirely practicable to forecast winds, weather and storms at sea. During the voyage to and from France, the *Jacques Cartier* received broadcasts of meteorological observations twice a day from Europe and America, and many vessels within range forwarded by radio their observations of the barometric pressure, temperature, wind, weather and state of the ocean. From these observations, both on land and on sea, weather charts were constructed twice each day, and from them forecasts of wind, weather and storms were prepared and broadcast to all ships.

The weather charts constructed on board the vessel were even more comprehensive than those constructed in Washington, for the reason that meteorological observations from the sea were available. Forecaster Bowie states that forecasting at sea is simpler than forecasting on land areas because diversified topography does not have to be taken into consideration in its effect on winds, weather and the movement of cyclones and anticyclones, which move with more regularity on the sea.

A weather and storm forecast service on the North Atlantic would benefit shipping and make it possible to retransmit sea observations to the meteorological services on land, so as to more accurately forecast the wind, temperature and weather conditions along the eastern shores of the United States and over western Europe.

STORAGE OF BITUMINOUS COAL

Bulletin of the Bureau of Mines

SAFE storage of bituminous coal is probably the only solution of the problem of stabilizing the coal industry, according to investigators of the United States Bureau of Mines and the Carnegie Institute of Technology, who have just completed a study of the spontaneous combustion of soft coal. As long as the peaks of demand react back to the miners, the coal industry will be a seasonal one, with a resultant unsatisfactory labor situation, states Joseph D. Davis, fuel chemist, and John F. Byrne, research fellow, who conducted the investigation. If some system could be devised whereby coal could be stored economically, with little deterioration and danger of spontaneous combustion, the mines would be operated practically the whole year—say, 300 working days instead of 180 to 270 days, as in 1920—at a uniform rate of production. Unfortunately no such general storage system has yet been devised.

The loss by deterioration of coal at ordinary temperatures is small when compared with that caused by rapid oxidation at elevated temperatures and the loss by spontaneous ignition. To overcome the hazards of self-heating and spontaneous combustion, various means of storage have been suggested, such as storing under water or in an atmosphere of carbon dioxide; screening the coal and storing only large sizes; cooling the coal pile by means of ventilating pipes; covering the coal pile with sand or with a layer of fine coal to prevent breathing of the heap, and so forth. Many of these methods do more harm than good, and others are prohibitive on account of their cost.

The tendency of coals to fire spontaneously differs with their age—the younger coals being the most dangerous. No case has been recorded in which anthracite coal fired spontaneously—even fines and slack storing safely. At the other extreme is lignite, which can not be stored, even in lumps, with safety, except under water. Between these two extremes are the various grades of bituminous coals, the class which is most commonly stored. The liability of different bituminous coals to fire varies widely on account of differences in the coal; but, broadly speaking, the bituminous coals of the eastern part of the United States store better than the coals of the middle west. These, in turn, are safer to store than the sub-bituminous coals of the intermountain region. While the tendency to fire will vary widely in any one class of coal, generally speaking, the higher the rank the less the danger of fire and the less the deterioration in storage. The classification as to self-heating coincides with the classification of coals, beginning with lignite as the most dangerous, ranging through sub-bituminous, bituminous, semi-bituminous, and anthacite as the least prone to spontaneous combustion.

The solution of the problem of spontaneous

combustion may lie in the microscopic examination of coals and its correlation with the rate of heating. Coal is composed of three parts, namely, anthraxylon, or bright coal, attritus, or dull coal, and mineral charcoal, and may be separated into almost pure samples of each. These three constituents differ in their ease of oxidation and rate of heating. Tests indciate that the anthraxylon is the constituent that heats first in the spontaneous heating of coal.

As the results of the experiments of Messrs. Davis and Byrne, it is stated that the presence of fines in a coal pile should be avoided. Coal should be handled as little as possible and should be screened wherever practicable before storing. Coal coarser than 1/4-inch showed no rapid self-heating throughout the experiments.

The experiments show that with the same coal, moist air will give a lower "critical" or spontaneous combustion temperature than dry air. Therefore, wetting the coal pile to retard heating is not good practice unless the coal is completely immersed.

Instead of hastening spontaneous combustion, partly oxidized coal seems to act as a deterrent when mixed with fresh coal. It appears that the danger in mixing two grades of coal, or in storing coal on the same pile at different times, arises from physical rather than chemical causes. If no heating has occurred at the surface of the heap, it is safe to pile more coal on top, provided there is no accumulation of fines at the contact of the new and old coal. A mixture of two kinds of coal will heat more rapidly than the poorer of the two.

Artificial mixtures of coal and pyrite in various proportions showed a critical temperature no lower than that of the coal alone, while pure pyrites had a critical temperature 26°C. higher than the coal. From this it appears that massive pyrite or "brass lumps" are not dangerous in a coal pile.

On account of the low conductivity of coal, cooling by artificial ventilation is almost impossible unless the air reaches every part of the pile. Generally the air travels through the stack in currents, and exerts no cooling effects on parts a short distance away from its channels. Exclusion of air as much as possible, in order to stop oxidation, is more successful than attempts at ventilation to dissipate the heat generated.

Coals, under various physical and chemical conditions, have been tested to determine the temperature at which they generate heat so rapidly that, provided no deterrent is applied, the coal will eventually ignite. This temperature has been arbitrarily called the "critical temperature." Under similar conditions of heating and aerating, this critical temperature is an index of the liability of a coal to fire spontaneously. The "critical temperature" method of testing coal may be applied to the various coals of the country for grading their relative tendencies to fire spontaneously, and the Bureau of Mines expects to develop this method further and apply it in a survey of the coals of the United States.

ITEMS

Science Service

MANY so-called West Indian hurricanes really originate in the neighborhood of the Cape Verde Islands 1,000 miles or more to the eastward, according to Charles L. Mitchell, meteorologist of the United States Weather Bureau, who spoke before a meeting of the American Meteorological Society in Washington on April 17. None ever originate in the eastern third of the Caribbean Sea, he asserted. Those formerly supposed to have this place of origin really started far to the eastward. The hurricane season is generally considered to be the months from June to November inclusive, but the month of August and the first half of September was the time when the most of such storms of Cape Verde Island origin were found. Many of these curved to the northward before reaching the Lesser Antilles, while others continued across the Caribbean or the Gulf of Mexico. Other hurricanes were found to originate either in the western Carribean or the Gulf of Mexico.

USE of the surplus explosives of the government left over from wartime, as aids in the study of earthquakes was suggested by Professor R. A. Daly of Harvard University to the American Geophysical Union at their recent meeting in Washington. The idea is to cause miniature earthquakes, the details of which would be known. From a study of them more would be learned about the big earthquakes. Professor Daly suggested that the explosives be set off in abandoned and worked out mines and the rate of the vibrations through the different layers of the earth's crust studied. It is known that earthquake waves travel at differing rates in the different strata but accurate measurement of these rates and differences are difficult in the case of natural earthquakes since it is seldom known accurately just when one occurs at the place of its origin, nor how deep is its beginning.

MORE than eighty-five per cent. of the corn raised in this country is fed to live stock and less than ten per cent. is used directly for human food.