This fact leads, under proper conditions, to an unequal distribution of the diffusible crystalloidal ions between a protein solution and an outside aqueous solution; or between a protein gel and an aqueous solution. In this distribution the total concentration of crystalloidal ions is always greater inside the protein solution or inside a gel than in the surrounding aqueous solution. This is the cause of the colloidal behavior of protein solutions and protein gels. Measurements of membrane potentials have shown that this excess of the concentration of crystalloidal ions inside over the concentration of the crystalloidal ions outside the protein solution or the gel, and consequently all the effects of electrolytes on osmotic pressure, swelling and viscosity of proteins, can be calculated with a satisfactory degree of accuracy from Donnan's equilibrium equation, which is not an empirical but a rationalistic mathematical formula. We can therefore state that it is possible to explain the colloidal behavior of proteins quantitatively on the basis of a rationalistic mathematical formula. What appeared at first as a new chemistry, the so-called colloid chemistry, now seems to have been only an overlooked equilibrium condition of classical chemistry; at least as far as the proteins are concerned. The oversight was due to two facts, first, to the failure of colloid chemists to measure the hydrogen ion concentration of their solutions, which happens to be the chief variable in the case, and second, to their neglect of measuring and taking into consideration the membrane potentials of protein solutions and protein gels, which furnish the proof that the theory of membrane equilibria must be used to explain the colloidal behavior of proteins.

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THE AWARD OF THE HENRY DRAPER MEDAL

THE Henry Draper medal for 1921, awarded by the National Academy of Sciences to Professor Henry Norris Russell, professor of astronomy at Princeton University, was presented to him by Dr. C. G. Abbot, assistant director of the Smithsonian Institution at the annual dinner in New York City on November 15. Dr. Abbot spoke as follows:

The brilliant and penetrating insight of Dr. Henry Norris Russell, of Princeton University, has led in recent years to a development of astronomy so rapid that it has proved thus far impossible to publish really up-to-date text-books on the subject. Before the manuscript of a text on astronomy can be prepared, much less carried through the press, new knowledge renders the treatment stale.

Dr. Russell has made basic contributions to the great problem of stellar evolution. He saw clearly that the brightness of a star as we see it depends on several factors. First, there is the intrinsic brightness of the star as a source of light. What the tallow candle is to the electric arc, so one star may be to another in the brightness of its shining surface. Secondly, the total amount of light which a star sends out depends upon its diameter. Quite recently it has been shown, for instance, that the star Alpha Orionis is three hundred times the diameter of the sun, and accordingly its cross-sectional area is ninety thousand times the cross-sectional area of the sun. Hence, if they were of equal surface brightness, the star Alpha Orionis would send out ninety thousand times as much light as the sun. In the third place, the brightness of the star depends upon its distance from the earth and falls off as the square of that distance. Thus, the sun, which is so near that it takes light eight minutes to come from it, being about two hundred thousand times as near as the next nearest star which takes light three or four years to reach the earth will appear forty million times brighter on that account.

With these conditions in mind, Dr. Russell, in collaboration with Dr. Hinks, of England, began by the application of a new photographic method of determining the distance of stars, and in 1910 published the results showing the approximate distance of 55 stars. With this and other such information which had been laboriously acquired by others, he was able to show that the red stars evidently must fall into two classes: one class sending out very much more light than our sun, and another sending out very much less, and that between these two very widely separated extremes there are no red stars intervening.

Going on, he applied the, until then little used, knowledge of the eclipsing variable stars with the most penetrating theoretical ability. For many years measurements have been going on at Harvard Observatory and elsewhere on the march of brightness of such stars as Algol, in which we see a pair of objects which in their rotation about their common center of gravity periodically eclipse each other. Dr. Russell showed how the elements of the eclipse, comprising the observed brightness and the corresponding times, could be treated in order to give probable relative values of the densities of stars in the different eclipsing systems, and with his pupil and collaborator, Dr. Shapley, who applied Russell's methods, the results for 87 stars were obtained and published in 1913.

In the meanwhile, many additional stars had been measured for distance from the earth, and by combining the information then available, Russell showed in 1913 that the stars may be divided into two extraordinary sequences which, following Hertzsprung, he called the "giants and dwarfs."

In short, the "giants" beginning with the red and going on to the yellow, white and blue, form a series of substantially equal output of light far in excess of that which is expended by our sun, and their densities, beginning with the red stars which are so rare that the material of which they are composed is more to be compared to a fairly high vacuum than to ordinary gaseous, liquid or solid densities, increase as the sequence goes on until with the blue stars the density has become much more considerable.

From this point the descending series of the dwarfs begins, and the density reaches in our yellow sun about one and one half times that of water and from this goes on to the very red and small stars whose density is as great or greater than that of the earth itself.

So regular is the light progress of this fascinating series of dwarf stars that if one merely observes the type of spectrum which one of its members possesses he can tell with reasonable limits the total amount of light which is emitted and therefore, in connection with its apparent brightness, can determine the probable distance away from the earth in space.

On the other hand, if a cluster, such, for instance, as the great cluster in Hercules which are known to be stars of substantially equal distance from the earth, contains a group of stars of approximately equal brightness ranging through all the types of spectrum from the blue to the red, it follows that they are all giants and therefore emitting light of a roughly known quantity thousands of times in excess of that emitted by the sun, and from this the distance of the cluster can be fairly well estimated. Such considerations have been pursued by Dr. Shapley in regard to a great many of the clusters of stars, and have led him to assign distances in the stellar system some tenfold in excess of those which have been generally assumed before.

Professor Russell, taking as his text the frescoes on the walls of the banquet hall which, being known as the "College Room," was decorated exclusively with scenes of college sport, replied as follows:

Team work wins in science as well as in games. But there is this important difference, that scientific team work is free cooperation; there is no coaching and no central control.

If I have done anything to deserve this medal, it is because of the many men who have contributed to these investigations. I was particularly indebted to Professor Pickering of Harvard for the encouragement that he gave to a young and unknown instructor in his science. When I talked to him about my proposed work on stellar parallaxes, he volunteered his aid and provided me with observations of the magnitudes and spectra of 300 stars, which gave me the first evidence of the existence of giant and dwarf stars. Robert Ball says that "astronomy consists in sitting up all night and doing arithmetic all day." Some men like the one thing better than the other. My part has been largely doing arithmetic. But this would not have amounted to anything without the men who were willing to sit up all night. Here, again, is scientific team work.

At Princeton we are working on double stars. If you can guess how massive a star is, you can calculate how far away it is. If you can guess at the mass of a double star you can calculate its distance. Now double stars—at least, those with spectra of the same sort—are remarkably alike in mass, so that the guess that those which we have not yet investigated are similar to those which we know about is likely to be a very good guess. In this way we have nearly finished calculating the distances of about 1,600 double stars. To calibrate our formulæ, we use parallaxes determined in other ways, which have been generously sent us (published and unpublished material alike) by Drs. Adams and Schlesinger. All the investigators of stellar distances are now playing on the same team.

Not only must astronomers cooperate in research, but they must have the aid of the physicists and chemists. To know more about the stars we must know more about atoms. In fact, we would not know anything about the stars, even their existence, if it were not for the atoms, which send us information by means of light. As we now know, each particular kind of light comes from one particular atom behaving in a particular way, each line in the spectrum is due to a special kind of atomic behavior.

As seen with the spectroscope, the white or hottest stars seem to be made of permanent gases, and the red and cooler stars to consist of metallic vapors. The difference in the character of the stars is probably not due so much to differences in constitution as to the character of the radiation given off by the atoms. If an electron is knocked off by an atom we get a new set of spectral lines. If another electron is knocked off, we may get an ultra violet spectrum, which can not be seen or even photographed, since the air is opaque to such short wave lengths. Such gases as oxygen, nitrogen and helium are hard to excite, so they do not show at low temperatures. But in the hot stars they get stirred up and become visible. In this case the metals are so knocked to pieces that they do not make themselves visible at all. All the stars may have similar composition, but, since the physical conditions are different, different elements reveal their presence in the spectra.

The relative degree of ionization of different elements (which determines the appearance of the spectra) depends on an equilibrium under the law of mass action.

I had always supposed that this law was the exclusive property of the chemist; but now it appears to be of fundamental importance in astro-physics. We need the chemist on our team, and we may help in their game too. By comparing the spectroscopic behavior of their lines in the sun, sun-spots and stars, it appears that the ionization potentials of all the elements in the periodic table between calcium and nickel are between 6 and 9 volts, increasing steadily along the series. So here astronomy gives information about properties of atoms, which have not as yet been measured in our laboratories, owing to practical difficulties. There is no limit in sight to the possibilities of team work such as this.

APPEAL ON BEHALF OF THE LEAGUE OF NATIONS FOR AID TO AUSTRIAN INTELLECTUAL WORKERS

No greater danger can threaten a civilization than the successive destruction of its homes of learning. It is beyond dispute that the war and its economic consequences have brought intellectual life in one entire region of Europe into an extremely precarious position. The machinery of intellectual life has been seriously impaired in almost all those nations of eastern Europe, to say nothing of Russia, which extend from the Baltic to the Ægean. One of them—Austria—is suffering from economic distress to a degree which threatens soon to bring all intellectual work to a standstill in the winter of 1922-1923.

The truth of this statement is demonstrated by the report which we attach to this letter. Since the report was drawn up, the situation has been greatly aggravated, and its consequences are: (1) intellectual isolation; (2) a complete lack of all the appliances which are indispensable for intellectual work; (3) the formation of an intellectual proletariat, less favorably situated than the working-class proletariat—for muscle commands better wages than brain; (4) diminishing numbers of students and a dearth of recruits of the cultured classes for the liberal professions and for the teaching staffs.

The committee on intellectual cooperation, constituted by the League of Nations, decided, at its first meeting on August 1, 1922, "expressly to call the attention of the Council of the League of Nations to the desperate situation of intellectual life in certain European countries and the urgent need of intervention." These words had special reference to the case of Austria.

At its meeting of October 4, the Council of the League of Nations requested the committee to launch an urgent appeal to universities, academies and learned societies in all countries in aid of Austrian intellectual workers and intellectual life in Austria. We have accordingly the honor, in the present letter, to invite you to organize measures of relief as soon as possible, with the object of saving one of the most cultured countries in Europe—a country which formerly possessed one of the chief centers of European civilization—from the fate of seeing its higher education and learning disappear from sheer want.

We leave it to your judgment to organize