most of the older buildings of the university. The group of medical school buildings now in use have cost altogether about 80,000*l.*, including, with the building opened on Saturday, the Thompson-Yates laboratory and the Johnston laboratory. The Chancellor of the university, Lord Derby, formally inaugurated the new buildings on the same afternoon as Lord Kelvin opened the new university laboratory for physics. With these fresh additions to its accommodation and teaching equipment, and with the fine new laboratories for zoology and for electrical engineering now rapidly nearing completion, the University of Liverpool will rank among the best provided university institutions in the country.

PROF. MENDELÉEFF ON THE CHEMICAL ELEMENTS.

THE last half-volume (eightieth) of the new Russian "Encyclopædic Dictionary" contains a remarkable paper by Prof. Mendeléeff on the chemical elements, of which the following is a slightly abridged translation. Together with the articles on matter and on the periodic law, which Mendeléeff contributed to previous issues of the same dictionary, and a paper, "An Attempt at a Chemical Comprehension of the World's Ether," published in a Russian review, this article represents the fundamental physical and chemical conceptions of the great chemist as they now appear in connection with the discoveries of recent years.

"Human thought," he begins, "has always endeavoured to simplify the immense variety of phenomena and substances in nature by admitting, if not the full unity of the fundamental elements (Democritus, Epicurus), at least the existence of a limited number of elements capable of producing all the variety of substances. In antiquity this tendency often resulted even in confusing the phenomena with the substances (earth, water, air, and fire)." Since the time of Lavoisier such a confusion has become certainly impossible: the substances are sharply separated from the phenomena which are associated with them. Of course, there may be partial returns to the old view. "However," Mendeléeff continues, "the solidity of the now prevailing conception as to the profound difference existing between substances and phenomena is the result of such a mass of coordinated knowledge that it cannot be shattered in the least even if a small portion of the men of science return to the "dynamism" of old which endeavoured to represent matter also as one of the forms of phenomena. Consequently we are bound now to recognise the substances (the masses) and the phenomena (the movements) as two quite separate, independent categories, such as space and time, the substance of which our thought has not yet penetrated, but without which it cannot work. Thus, for example, we are far yet from understanding the cause of gravitation, but with its aid we understand many phenomena, even though up till now it is not quite evident whether attraction acts through the aid of an intervening medium or represents a fundamental force which acts at a distance. Progress in the understanding of nature depends, therefore, not upon our reducing everything to one final conception—to one 'principle of all principles'—but in reducing the great variety of substances and phenomena which act upon our senses to a small number of recognised fundamental conceptions, even though these last be disconnected. One of such conceptions is that of the recognised chemical elements.

"The simplest way of conceiving matter in this case is to consider it as the result of combinations of elements which themselves are matter; and the phenomena as the results of movements which are the property of these elements or their aggregations. It was from this point of view that the conceptions were elaborated as to the distinction, not only between phenomena and substances, but also between simple bodies and elements; because the conception of a simple body implies the idea of an impossibility of transforming certain bodies into other bodies, while the conception of a chemical element is merely determined by the desire of diminishing the number of substances which are required for explaining the great variety of the latter."

Mendeléeff passes next to the so-called "rare" elements. Leaving aside historical details concerning them, he remarks that it is the more necessary to dwell upon them as they complete to a great extent our knowledge of the periodic law. "Our information about them," he continues, "can also, in our opinion, contribute towards explaining the relations between the phenomena and the substances in nature; because for the understanding of a multitude of natural phenomena it is necessary to resort to the conception of the so-called luminiferous ether, which by all means must be considered as a ponderable substance, and consequently must have its place in the system of elements, inasmuch as it reminds us of the properties of helium, argon, and other similar elements. The conception of the ether was resorted to at the outset exclusively for explaining the phenomena of light, which, as is known, can be best understood as the result of vibrations of the ether. However, later on, ether, considered as being distributed throughout the universe, was resorted to in order to explain, not only electrical phenomena, but also gravitation itself. In consequence of that, a very great importance has to be attributed to the ether; and as it cannot be considered as anything but ponderable matter, we are bound to apply to it all the conceptions which we apply to matter in general, including also the chemical relations. But as, at the same time, we are bound to admit that this matter is not only distributed throughout stellar space (in order to explain the light which reaches us from the stars), but also penetrates all other substances; and as also we must admit that the ether has no capacity of entering into chemical reactions, or of undergoing any sort of chemical condensation, therefore the above mentioned elements, helium and argon, which are characterised precisely by the absence of that property of entering into chemical reactions with other substances, show in this respect a certain similarity with the ether.[1]"

Referring further to radium, Mendeléeff remarks that there can be no doubt as to its being a separate element, extremely rare in nature. As to the emanation of helium by radium, and the presence of the helium spectrum in the spectrum of radium, he explains these facts by the occlusion of helium in a compound of radium, and considers that "nothing gives us reason to think that radium should be transformed into helium." "Notwithstanding the extremely small quantities of radium occurring in nature, Madame Curie has succeeded in obtaining a compound of it, and in establishing its kinship with barium, as also in finding its atomic weight to be near 224, which permits us to complete the periodic system of elements by placing radium in the second group, in the 12th row, in which we have already thorium and uranium, the ores of which are possessed of radio-activity.[2]

"As to argon and its congeners—neon, krypton, and xenon—these simple gases, discovered by Ramsay, differ from all the known elements in that, up till now, notwithstanding the most varied attempts, they could not be brought into combination with any other substance, or with each other. This gives them a separate place, quite distinct from all other known elements in the periodic system, and induces us to complete the system by a new separate group, the group zero, which precedes group i., the representatives of which are hydrogen, lithium, sodium, and so on.

"The placing of these elements in a new group is fully supported by the atomic weights which are deduced for these gases on the basis of their densities, if we admit that the molecule of each of them contains but one atom.

[1] "About this resemblance between argon and helium and the substance of the world's ether I have already written in a separate article entitled 'An Attempt at a Chemical Comprehension of the Ether,' in the review *Messenger and Library of Self-Education*, in the first four numbers of 1903. This article was translated into German in the *Prometheus* of 1903 by M. Tshulok, and into English by M. Kamenskiy under the title 'A Chemical Conception of the Ether' (Longmans, Green and Co., London, 1904). I must, however, remark that the German translation is a complete one, but that the editors of the English translation have omitted the introductory general philosophical remarks about the fundamental distinction between substances (masses), forces (energy), and spirit. This omission deprives the article of the realistic meaning which I intended to give it by introducing ether into the system of elements."

[2] "Some later researches lead us to believe that the atomic weight of radium is slightly above the figure found by Madame Curie, but it seems to me that it still remains doubtful whether the conclusion of Madame Curie has to be altered."

Thus, helium must be placed before lithium, and argon before potassium, as is seen from the table, into which radium has also been introduced. In this table there are, in the group zero, two unknown elements, x and y, which have been introduced for two reasons: first, because in the corona of the sun, above the region of incandescent hydrogen, there has been noticed an element which has an independent spectrum, and therefore is named coronium; and although it is yet unknown (helium was also first characterised by Crookes as an element, on account of the independence of its spectrum), it must have a density, and consequently an atomic weight, both smaller than those of hydrogen (in the table, this element is marked as y); and secondly, because there is no reason to believe that the system of elements is limited in the direction of the lightest ones by hydrogen. The presence of the elements x and y in the group zero makes us think that the elements which correspond to these positions in the system will be distinguished by the absence, in a high degree, of the capacity of chemical combination—a property which belongs also, as has been already pointed out, to helium, argon, and their analogues.

"The same property must be attributed to the substance of the ether, which must possess, moreover, an extremely low density, and consequently a very great rapidity of motion of its molecules, in order to have the possibility of escaping from the spheres of attraction, not only from the atmosphere of the earth, but also from the atmospheres of our sun and other suns the masses of which are greater than that of ours. The researches concerning the double stars prove that the masses of the stars which we know do not exceed the mass of our sun more than thirty-two times, while in other cases they are equal to it; therefore, if we attribute to the ether the properties of gases, we must admit, on the basis of the kinetic theory of gases, that its specific gravity must be very much smaller than the specific gravity of hydrogen. In order that the ether may escape from the sphere of attraction of stars the mass of which is fifty times greater than the mass of the sun, it must, while it chemically resembles argon and helium, have an atomic weight not more than 0·000 000 000 053 (and a density, in relation to hydrogen, half as large, as I have proved in the above mentioned article on ether). The very small value of this figure already explains why there is little hope of isolating the substance of the ether in the near future, as it also explains why it penetrates all substances, and why it is condensed in a small degree, or collects in a physicomechanical way, round ponderable substances—being mostly condensed round such immense masses as that of the sun or of stars.[1]"

Row	Group zero	Group I.	Group II.	Group III.	Group IV.	Group V.	Group VI.	Group VII	Group VIII.
0	x								
1	y	H=1·008							
2	He=4·0	Li=7·03	Be=9·1	B=11·0	C=12·0	N=14·04	O=16·0	F=19·0	
3	Ne=19·9	Na=23·05	Mg=24·1	Al=27·0	Si=28·4	P=31·0	S=32·06	Cl=35·45	
4	Ar=38	K=39·1	Ca=40·1	Sc=44·1	Ti=48·1	V=51·4	Cr=52·1	Mn=55·0	Fe=55·9 Co=59 Ni=59 (Cu)
5		Cu=63·6	Zn=65·4	Ga=70·0	Ge=72·3	As=75·0	Se=79	Br=79·95	
6	Kr=81·8	Rb=85·4	Sr=87·6	Y=89·0	Zr=90·6	Nb=94·0	Mo=96·0	—	Ru=101·7 Rh=103·0 Pd=106·5 (Ag)
7		Ag=107·9	Cd=112·4	In=114·0	Sn=119·0	Sb=120·0	Te=127	I=127	
8	Xe=128	Cs=132·9	Ba=137·4	La=139	Ce=140	—	—	—	— — — (—)
9		—	—	—	—	—	—	—	
10	—	—	—	Yb=173	—	Ta=183	W=184	—	Os=191 Ir=193 Pt=194·9 (Au)
11		Au=197·2	Hg=200·0	Tl=204·1	Pb=206·9	Bi=208	—	—	
12	—	—	Rd=224	—	Th=232	—	U=239	—	

In conclusion, Mendeléeff indicates that while the conception of the chemical elements is connected in the most intimate way with the generally received teachings of Galileo and Newton about the mass and the ponderability of matter, as also with the teaching of Lavoisier concerning the indestructibility of matter, "the conception of the ether originates exclusively from the study of phenomena and the need of reducing them to simpler conceptions. Amongst such conceptions we held for a long time the conception of imponderable substances (such as phlogiston, luminous matter, the substance of the positive and negative electricity, heat, &c.), but gradually this has disappeared, and now we can say with certainty that the luminiferous ether, if it be real, is ponderable, although it cannot be weighed, just as air cannot be weighed in air, or water in water. We cannot exclude the ether from any space; it is everywhere and penetrates everything, owing to its extreme lightness and the rapidity of motion of its molecules. Therefore such conceptions as that of the ether remain abstract, or conceptions of the intellect, like the one which also leads us to the very teaching about a limited number of chemical elements out of which all substances in nature are composed."

[1] "It is worth noting that all the incandescent, self-luminous celestial bodies are immense as regards their masses, in comparison with the cooler bodies like the earth or the moon; perhaps this depends upon the distribution of the ether, which is condensed precisely round such very big masses as the sun and the stars. It is also worth noticing that the atomic weights of radium, as also of thorium and uranium, are very great in comparison with those of the other elements."

WELSH CONFERENCE ON THE TRAINING OF TEACHERS.

THE Welsh National Conference on the Training of Teachers was held in Shrewsbury on November 10 and 11, and although no special reference was made to science teaching, still the subject of education is now in a fair way to be considered a science, since it has been included as a section of the British Association.

The conference was convened by the Central Welsh Board and the University of Wales, and in addition to these bodies, representatives attended from every county education authority in Wales, from every type of educational institution, from the National Executive of Welsh Councils and from all the associations of masters and mistresses. Upwards of 200 delegates attended in all, most of whom remained throughout all four sessions.

At the first session, which was devoted to "The Special Aspect of the Problem of Training Presented in Wales,"