

THURSDAY, JULY 22, 1880

VICTORIA UNIVERSITY

IT was only the singular moderation and good sense with which the promoters of the New Manchester University movement conducted their case that could have secured that no Parliamentary opposition should be made to the late Government taking a step so momentous, and affecting so many rival interests, as the foundation of a new English university. They were compelled, indeed, like many other strategists, to change front once or twice, and to accept a charter different in two vital respects from that which they had asked. They wanted a university in England on the model of the Scotch and German universities—a university of a single college in a great centre of population. They were compelled, however, to make provision for affiliating Leeds and other colleges, when they become adequately equipped, with full faculties of arts and science, and when it is completed the new University will have to carry out an experiment completely novel. It will occupy a midway place between the Scotch single-college universities, the English universities with their families of colleges bound together by their common locality, and the Central Examining Board for all qualified applicants, which is known as the University of London. The separate colleges will in fact be Universities of the Scotch type complete in themselves before they are affiliated in respect of two important faculties. They will differ vitally from the single colleges of Oxford and Cambridge, each with three or four tutors of its own, but each requiring to lean on the private tutors and the resident university professors and lecturers for the necessary supplement of their teaching. It will be most interesting to see how the University authorities will conciliate the independence and originality of the teaching of the individual colleges with the examination system which must govern and regulate them all. The new University will more nearly resemble the late Queen's University in Ireland than anything else of which we have had experience. It will differ from the Queen's University only in the greater importance of the separate colleges. Meanwhile all these arrangements are *in posse*. The University will be started on the familiar lines of the Scotch and German universities, with a single college, with which for the time being it is practically identified, and whose teaching it will be its sole business to influence.

The other important modification is in the temporary absence of the medical faculty. An important medical school is attached to Owens College. The last Government were occupied with a Medical Bill, the main object of which was to diminish the number of licence-granting medical centres, and to substitute a single authority for the nineteen medical bodies which confer the right to practise on the bodies of Her Majesty's subjects. It was strongly represented to them that it would be an anomaly that they should add a twentieth licensing body to the nineteen at the very moment when they were attempting to fuse the nineteen into one. The charter they have issued to the Victoria University grants it the right to confer all degrees and titles of honour that it is competent to other universities in the United King-

dom to grant, except in the single faculty of medicine. Although the medical professors of Owens College become professors in the University, they will remain in an exceptional position, at all events until the new Government have made up their minds what course to adopt with the Medical Bill. Should the agitation for a medical uniformity die out, and the Government resolve upon no disturbance of the existing arrangements, it will be impossible for them not to complete the charter of the new University by conferring on it the right to grant medical degrees. Should they revive the proposals of their predecessors and succeed in passing them into law, the new University will stand in the same position as that which the older universities will then be reduced to occupy.

The public will be most interested to see on what lines the Victoria University will be developed. Will it strike out a new line for itself? Every university in this country aims at being a *studium generale*, but every university has in practice shown a tendency to the exceptional development of special studies. Oxford is in the main a great classical, and Cambridge a great mathematical, school, and London has been exceptionally distinguished for the high attainments and reputation of its medical graduates. In the Victoria University, so far as it is possible to forecast its future, a similar position seems likely to be asserted by the scientific faculty. It is in that respect that Owens College has been specially strong. In all the older universities the scientific faculties have had to assert for themselves a higher position than they originally occupied, and they have generally done so during the last century of their history. They will start in the Victoria University from a position at least equal to that occupied by the elder "Arts" studies. It would be a mistake if they were to attempt to claim an exclusive predominance, and the first step which the University has taken indicates that there is no such danger. They have appointed as their Chairman of the Board of Studies their Professor of History and English Literature. Every one who has followed the movement in which the University originated knows how deeply it has been indebted, from its commencement to its close, to Prof. Ward, and it is safe to say that no sounder appointment could have been made, and none more likely to secure the impartial appreciation of all the competing claims of the old and the new learning. The authorities of the Victoria University will begin their new career on the broad and satisfactory lines indicated by the words of their founder. Mr. Owens' will pointed to the creation in Manchester of a seat of learning in which the subjects taught in the English universities should be taught in the best way, and the promoters of the movement have never advocated any scheme for making themselves a scientific college, or what is called a technical university. But it will be as difficult as it would be imprudent to ignore the fact that Manchester has special opportunities for becoming a great scientific school, and the eminent teachers who represent its scientific faculty may be confidently trusted to maintain the position which they have secured for their subjects. We may reasonably hope to see the new University set itself to the task of proving that science is as educationally effective an instrument as literature and philosophy. Literature,

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history, and language will hold their own adequate place in its scheme of instruction, but the newer sciences of animate and inanimate nature will certainly start from a fairer platform than usual, in the North of England. The Victoria University will not be hampered, like its elder sisters, by the traditions of the past. There is a great career before it, and the people of England will watch its development with the deepest interest. They may be reasonably confident of one thing, that the new educational "brand," to adopt Prof. Huxley's felicitous expression, will be of as select a character as any of the "brands" with which they are familiar.

ON THE RELATION BETWEEN THE MOLECULAR WEIGHTS OF SUBSTANCES AND THEIR SPECIFIC GRAVITIES WHEN IN THE LIQUID STATE

UNDER this title I have communicated to the Chemical Society the results of a prolonged investigation on the connection existing between the weights of unit volumes of liquid substances and their relative molecular weights (see *Journal of the Chemical Society* for March, April, May, and June, 1880), and in obedience to a request from the Editor of NATURE I will briefly indicate the scope of the inquiry, and point out the main conclusions to which I have been led. The inquiry, I may say in the outset, has resolved itself into a critical and experimental examination of what are known as Kopp's laws of specific volume. That some definite connection between molecular weight and specific gravity would be traced had been surmised more than forty years since, but all our exact knowledge on the subject is contained in the series of classical memoirs which we owe to Hermann Kopp. Kopp first clearly recognised the necessity of comparing the liquids when under strictly analogous conditions. By dividing the specific gravity of a liquid taken at the temperature at which its vapour-tension is equal to the standard atmospheric pressure—that is, at its ordinary boiling-point—into its molecular weight, we obtain its specific volume. If the specific gravity be referred to the point of maximum density of water, this value represents the number of cubic centimetres occupied by the relative molecular weight of the liquid expressed in grams at its boiling-point under the standard pressure. The numbers thus obtained were first shown by Kopp to exhibit certain definite relations which may be briefly stated as follows:—

I. *In many instances differences in specific volume are proportional to differences in corresponding chemical formulae.*—Thus a difference of CH_2 in a homologous series corresponds to a difference of about 22 in the specific volume, or $(\text{CH}_2)_x = 22x$. On comparing the specific volumes of similarly constituted haloïd compounds, it is seen that the substitution of n atoms of bromine for an equal number of chlorine atoms increases the specific volume by $5n$.

II. *Isomeric and metameric liquids have, as a rule, the same specific volume.*—Exceptions are exhibited by certain oxygen and sulphur compounds.

III. *The substitution of an atom of carbon for two of hydrogen makes no alteration in the specific volume of certain groups of organic liquids.*

On the basis of these conclusions Kopp was able to calculate certain numerical values for the specific volumes of the elements in combination. These values are as a rule constant for the particular element: thus, according to Kopp, carbon has invariably the value of 11, hydrogen that of 5.5. Exceptions are observed in the case of the chemical analogues oxygen and sulphur. Each of these bodies has two values depending, it would seem, on its mode of combination, or on its relation to the remaining atoms in the molecule. For example, acetone and allyl alcohol have each the empirical formula $\text{C}_3\text{H}_6\text{O}$, but the specific volume of acetone is 78.2, whilst that of allyl alcohol is 73.8. In the case of acetone the combining power of the oxygen atom is wholly satisfied by carbon; that is, we have reason to know that the oxygen atom is more intimately associated with one of the carbon atoms than it is with any one of those of the other elements; whereas in allyl alcohol a moiety of the combining value would seem to be satisfied by carbon and the remainder by hydrogen. It appears, then, that when oxygen is united to an element by both its affinities its specific volume is 12.2; when it is attached by only one combining unit its specific volume is 7.8. The corresponding values for sulphur are 28.6 and 22.6.

I have already pointed out that these differences in the values for the specific volumes of oxygen and sulphur may be employed to throw light upon the constitution of such bodies as the phosphoryl and thiophosphoryl compounds, and that we may in this way obtain evidence as to the particular affinity-value that an element such as phosphorus, which is variously regarded as a triad and a pentad, exerts, and in the present paper I give additional instances to show that a knowledge of the specific volume of a body is often calculated to furnish valuable information concerning its constitution.

The most accurate method of ascertaining the specific volume of a liquid is (1) to determine its specific gravity at some convenient temperature; (2) to ascertain its boiling-point with the utmost exactitude; and (3) to determine with great care its rate of expansion, say between 0° and this boiling-point.

The space at my disposal forbids me attempting to show how these various physical data were determined for the purpose of the present inquiry. Full details of the methods employed are given in the original paper, and the errors incidental to the various processes are fully discussed. The observations necessitated among other things the frequent determination of the fixed points of the thermometers employed, and the accompanying figure shows how these were found to rise during the progress of the investigation. The abscissæ represent the times in months at which the several observations were taken, and the ordinates the extent of displacement in hundredths of a degree. A represents a thermometer ranging from -10° to 50° C., B from 50° to 105° C., and C from 98° to 144° C. It will be seen that the extent of the displacement is evidently dependent on, or at any rate is greatly influenced by, the amount of molecular disturbance to which the glass envelope is subjected.

The accuracy of the results is of course in great measure dependent upon the purity of the liquids employed, and this fact to some extent limited the number of compounds which could be investigated. Whenever the mode of