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AND

JOURNAL OF PHYSICAL SCIENCE:

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY
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AMERICAN SUPPLEMENT.

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The New French Dictionary of Chemistry.

THREE parts of this work are now before us, and they carry it 480 pages, beginning with Abichite and ending with Atropine. The work is not planned on so great a scale as Watts' Dictionary, and the style of writing is not so precise and compact as that of the latter. Yet it is to be prepared by some of the most competent of the French authors, and there will be good opportunities to correct the deficiencies of the English work, as well as to add the latest developments of the science. It is a very great advantage to the editors to have so perfect a model as Watts' Dictionary to guide them and to suggest improvements.

We expect to find a great deal worth reading, especially in the articles on the various departments of chemical philosophy, inasmuch as French chemists are always theorists, and as Wurtz, Naquet, and some others of the editors are recognized as leaders.

We believe that we cannot do our readers a greater favor touching this work than to give as a sample of it the following introduction of its article on Atomicity:

"*Atomicity.*—Thus we name the capacity of combination of atoms. We know that—

1 atom of chlorine	combines with	1 atom	of hydrogen.
1 " oxygen	"	2 atoms	"
1 " nitrogen	"	3 "	"
1 " carbon	"	4 "	"

These simple bodies differ from each other in their capacity of combination for hydrogen, and this capacity is measured by the number of atoms of hydrogen which they are able to fix. We see, then, that capacity of combination is not synonymous with affinity. The energy with which a body is combined with another body is independent of the faculty which it possesses of attracting one or several of the atoms of the latter.

"The first is affinity, the second atomicity: both are manifestations of the chemical force.

"Affinity is measured by the quantity of *vis viva* which is transformed in the effect of combination, and is manifested as heat.

"Atomicity is measured by the number of atoms of hydrogen, or of an analogous element, which a given body can fix. The atoms of chlorine and those of hydrogen are so made that one atom of the first attracts always one atom of the second. The force with which it attracts is affinity; the virtue of contenting itself with a single atom is atomicity. In the latter respect the atoms of chlorine and of hydrogen are of the same value: one atom of the one is fixed by one atom only of the other. The force which resides in them is a powerful force, but simple. The force which resides in an atom of oxygen is powerful also, but of a more complex nature, since it is able to attach two atoms of hydrogen, when an atom of chlorine can attract but a single one.

"Here, are atoms of chlorine; as they come into the sphere of activity of the atoms of hydrogen, an atom of the one is precipitated upon an atom of the other: there is a combination. There, are atoms of oxygen which penetrate into the sphere of activity of atoms of hydrogen; an atom of one attracts two of the other: there is a combination. Thus we demonstrate, in the force which attracts the atoms of one body towards the atoms of another body, two distinct things, namely: 1st, its intensity; 2d, its action, simple or multiple. These two manifestations of the chemical force are independent of each other. In fact, the energy of affinity is not a measure of the degree of atomicity.

"Chlorine attracts hydrogen with more force than carbon, and yet one atom of carbon can unite itself with four atoms of hydrogen, while an atom of chlorine takes but a single one of hydrogen.

"Atomicity is, then, that peculiar property of an atom of attracting a number greater or less of other atoms. It is its value, or, as we say, its capacity of combination in relation to those other atoms."

The article, on the introduction as above, proceeds to consider the measure of atomicity, atomicity as a means of classification, atomicity considered in chemical reactions, and, finally, atomicity as a means of determining the manner of the arrangement of atoms in compounds. The whole article covers ten pages of the dictionary, and our quotation comprises a little less than half a page of it.

The Numerical Relations of Atoms. New Elements Predicted.

IN the following table the elements are arranged in two columns, according to their even or odd atomicities, and at the same time observing the order of their atomic numbers:

Artiads.		*Perissads.*	
		Hydrogen,	1
Glucinum,	9·3	Lithium,	7
Carbon,	12	Boron,	11
		Nitrogen,	14
Oxygen,	16	Fluorine,	19
Magnesium,	24	Sodium,	23
Aluminum,	27·4		
Silicon,	28		
		Phosphorus,	31
Sulphur,	32	Chlorine,	35·5
Calcium,	40	Potassium,	39·1
Titanium,	50	Vanadium,	51·4
Chromium,	52·2		
Manganese,	55		
Iron,	56		
Nickel,	58·8		
Cobalt,	58·8		
Yttrium,	61·7		
Copper,	63·4		
Zinc,	65·2		
Indium,	72		
		Arsenic,	75
Selenium,	79·4	Bromine,	80
Strontium,	87·6	Rubidium,	85·4
Zirconium,	89·6		
Cerium,	92		
Lanthanum,	93·6	Columbium,	94
Molybdenum,	96		
Ruthenium,	104·4		
Rhodium,	104·4		
Palladium,	106·6	Silver,	108
Cadmium,	112		
Erbium,	112·6		
Tin,	118	Uranium,	120
		Antimony,	122
Tellurium,	128	Iodine,	127
Barium,	137	Cæsium,	133
Tungsten,	184	Tantalum,	182

Artiads.		*Perissads.*	
Didymium,	195		
Iridium,	196		
Platinum,	197.4	Gold,	197
Osmium,	199·2		
Mercury,	200		
Lead,	207	Thallium,	204
		Bismuth,	210
Thorinum,	231		

An inspection of this table shows that the elements are brought into something like a natural relation with each other. Where the atomic numbers agree in the two columns, there is a still further agreement in the corresponding elements; the element of even atomicity is paired, or mated, with an element of odd atomicity. Probably for each column there is a progression of properties from the top to the bottom in the order and in the proportion of the numbers, and the discovery of such properties is a fair and open problem. Also the columns readily break up into smaller columns or groups, some of which have been recognized for a long time. Below are examples:

1.

Lithium,	7	Glucinum,	9·3
Sodium,	23	Magnesium,	24
Potassium,	39	Calcium,	40
Rubidium,	85·4	Strontium,	87·6
Cæsium,	133	Barium,	137

2.

Fluorine,	19	Oxygen,	16
Chlorine,	35·5	Sulphur,	32
Bromine,	80	Selenium,	79·4
Iodine,	127	Tellurium,	128

And we add some of the most striking of the remaining couples:

Silver,	108	Palladium,	106·6
Gold,	197	Platinum,	197·4
Lead,	200	Thallium,	204

The peculiar relationship of the artiads and perissads in (1) is very striking. On one side are all the metals of the known alkalies, and each is paired with a metal of a well-known akaline earth. Moreover, on each side there is a plain progression of properties in the order of the atomic numbers.

The standing out, unpaired, of hydrogen, nitrogen, phosphorus, arsenic, antimony, and bismuth is very noticeable, for these are the only unmated elements of the perissad column. What is the explanation? Can we bring them into relation with the fluorine and oxygen group?

But there are many artiads which have no corresponding perissads, and it is very noticeable that so many of these occur together. From titanium 50 to selenium 79·4 there is no pairing.

Is it possible that these vacant places are to be filled by the discovery of new elements? That this question has a fair foundation will be concluded when it is remarked what a very appropriate place had been reserved for rubidium and cæsium at the side of strontium and barium. If the theory here suggested is tenable, we may continue the search for new elements with confidence, and we may know in advance something of their nature and properties. We may, for example, look for more alkali metals, and especially such as will take a place between potassium and rubidium, between rubidium and cæsium, and below cæsium.

HO or H_2O. The Atomic Notation.

Dalton's atomic theory implied exact numerical relations between the atoms of different kinds of matter. The theory having been accepted, there was no labor more urgent among chemists than the determination of the atomic numbers, for under these numbers lay untold treasures of knowledge. From that time forward the atomic theory and the atomic numbers have become and will ever remain the foundation of our science and our art of chemistry. Where would be our chemistry without them?

Dalton made the first effort to determine the relative weights of some of the atoms. But Dalton was a philosopher, and he had a great work as reformer and instructor to perform; he had not the time nor the aptitude for nice chemical analyses. His object was to illustrate and enforce his atomic theory, and the numbers he gave were sufficiently near the truth for that.

Shortly afterwards the great Berzelius, than whom perhaps no one who has ever lived was better endowed by nature and education for the service, commenced a systematic course of experiment and analyses, with the view of determining with extreme exactness the true atomic numbers. This work occupied the best part of his long and industrious life. Berzelius' table of atomic numbers is one of the noblest and most enduring monuments which the patience and skill of a single man has ever reared.

Dalton supposed an atom of water to be made up of one atom of hydrogen and one of oxygen. He used properly all the criteria of judgment he had, and made a mistake. In his time it was possible to determine, with considerable exactness, the relative weight of hydrogen and oxygen in water, but there were not sufficient data for determining the ratio of the number of their atoms:—It was known that the total hydrogen was to total oxygen, by weight, as 1 : 8; but there was then no sufficient reason for fixing the number of the atoms of each. Dalton's atoms, like his analytical data, were therefore only temporary or provisional, and to be set aside as soon as the truth could be more exactly stated. Berzelius satisfied himself that the atom of water is composed of three atoms, viz., two of hydrogen and one of oxygen, and so he taught. His criteria of judgment were good; in fact, nearly all that we use at the present day. But his critics, especially Gmelin, assailed his reasoning with vigor, and they prevailed. To-day this truth, crushed to earth, is risen again in new strength, and hereafter it will take its place among our most impregnable doctrines.

The true atomic constitution of water being established, we respectfully suggest to the teachers that they are unwise and unsafe in persisting in teaching a false doctrine. Why not cut adrift, with a single effort, all the text-books which are not based on the true atomic notation? The chemical world have been searching for sixty years after truthful atomic numbers, and now that we have them, why should we hesitate to adopt them?

The atomic notation lies at the foundation of the modern chemical philosophy. When it is accepted and understood, the doctrine of atomicity and the overthrow of the dualistic theory follow without an effort. In the light of the atomic notation, what was mystery beyond the scrutiny of the greatest intellects becomes simple facts which can be taught to children.

There appears to be a notion prevailing among those who have not studied the new chemical philosophy, that

will have taken up in the process of formation of iron ore-beds,—may this have been a dry or a wet process, —most of the phosphoric acid, so that the iron ore proper, it being considered a mixture of a pure compound of iron with some gangue, or as the Germans call it, "begleiter," will only contain a very small amount of it. This amount of phosphoric acid, which necessarily is contained in iron ores, will be less in the magnetic than in the hematite varieties, inasmuch as the strong combining power of the sesquioxide in the former has been satisfied to some extent by the protoxide present, and we are therefore able to obtain, under similar conditions, a better iron from those than we can from hematites.

"This slight amount of phosphoric acid in the iron ore proper will enter into the mass of metallic iron by the process of reduction and smelting, and in combination with other constituents give it its distinctive character. This small percentage of phosphorus in metallic iron I hold to be necessary to constitute it a good article; and I do not doubt that a less amount of it, as in the case of iron made from some magnetic and titanic varieties, will be substituted there by some other substance, say sulphur or carbon. A difference in the relative proportions of carbon, sulphur, and phosphorus, will change the properties of the metal in a way to render it more or less adapted to certain practical uses. As, however, very few exact analyses of metallic iron exist, we first have to ascertain those proportions of carbon, sulphur, and phosphorus, and their relations to the changes they effect in the properties of pure iron, before we are able to produce an iron of a certain character by the mixing of different ores the composition of which we know.

"We have also to distinguish two things, the phosphoric acid in the ore proper, and the phosphoric acid in the gangue. This latter I believe to be comparatively easy to eliminate and bring completely into the slag. The proof of this, and an attempt to remove an excess of phosphoric acid that by some peculiarity of composition or form may have entered into combination with the ore proper, will be the subject of another series of experiments which at some future time I will have the honor to bring before the Lyceum."

A Frozen Mine. The Theory of Dew.

Near Georgetown, Clear Creek Co., Colorado, in about the latitude of Washington, pretty extensive mining operations are carried on in soil and rock which are perpetually frozen. This frozen ground is part, and probably the greater part, of a hill or mountain which rises above the surrounding plateau only about 1.500 feet. During the summer the soil thaws to the depth of a few feet, and sufficient to permit a good crop of grass; in winter everything is solid. Three mining tunnels or levels, of the length respectively of 250, 180 and 100 feet, have been led into the mountain, and still no limit to the ice is reached. The mining operations are, of course, not impeded by running water, but in place of water the ice has proved to be about as great a nuisance. The rock is saturated with ice, and the ice is abundant in the fissures. It is found necessary to thaw out the rock as a preliminary to the ordinary mining work. Fires are therefore kept burning during the night, and in the morning they are extinguished, and the mine cleared of smoke for the workmen. As it is practicable in this way to thaw only the roof of the mine, the blasting and digging is all upward.

The frozen ground extends neither to the top nor the bottom of the hill, but occupies the space between. At the foot of the hill is a gorge in which there is a stream of water in the early spring and late in the fall. In the neighborhood are other hills, but the ice phenomenon has not been noticed in them.

The particulars of this interesting case are furnished by Mr. Frank Dibben, who has resided near the spot for several years. The theory which he proposes seems sufficient and satisfactory. Indeed, the statement of the further material facts will make the explanation evident. It is only the north side of the hill which is frozen, the side on which the sun's rays never fairly strike; the frozen side is in the shade. The plateau on which the hill rests is 10,000 feet above the sea-level, and consequently the surrounding air is thin and dry. Such air does not easily become warmed by the sun, and thus assists very little in conveying warmth to the shady places. Moreover, it becomes a positive cooling agent by promoting rapid evaporation, and radiation of heat into space goes on freely through it. And to sum up the whole matter, very little sun-heat directly and fairly strikes the frozen side, and that little is neutralized by free radiation and evaporation.

In the neighborhood of this mountain the clear summer nights are always cold, and when the proper precautions are taken, water may be frozen with certainty and economically. Mr. Dibben has observed that the freezing of water under a clear summer sky is due more to the rapid evaporation of the water, than, as is stated in many of the text-books, to the radiation of heat into space. The importance of radiation in this case, and in the theory of dew and frost, is greatly overestimated.

The Pairing of the Elements a Test of the Atomic Numbers.

We propose the pairing of the elements as exhibited in the April Supplement as a new confirmation of the modern atomic weights, and of the doctrine of atomicity.

The fact of the pairing cannot be denied, and it is so conspicuous that it cannot be attributed to chance. No accidental mixing up of the names of the elements would allow them to be brought out in two columns with such extraordinary coincidences as our table shows; if a deliberate attempt were made to pair the elements of even and odd atomicities, independent of the atomic numbers, it would result in a table substantially such as we have presented. The purpose or the utility of the pairing is, indeed, not so evident; when it becomes so, the pairing will be established as a natural law.

The pairing does not appear to be the result of any of the known properties of matter, and is thus a new and independent phenomenon. Any arrangements based on it, and consequences deduced from it, may therefore stand alone, and have an independent force; they may serve to confirm or to refute, or to test other statements.

Now the pairing is exhibited by an arrangement depending upon certain atomicities and atomic numbers. If the pairing can be brought about only by certain exact conditions, there is a peculiar virtue in the conditions. Here is a remarkable relation of numbers, atomicities, and pairing, and these three facts are at the same time quite independent of each other, and neither is comprehended in another. Here are facts of different sorts, obtained in different ways, and for different purposes, and which, when brought in conjunction, develop a new and remarkable relation. This new relation is a confirmation and test of the authenticity of the facts.

The atomic numbers and the doctrine of atomicity develop an unsuspected harmony; they are in beautiful accord with other facts which were not known to have any relation with them. Truth is always consistent with other truth, and the very harmony is sometimes sufficient to establish the truth. The atomic numbers and the doctrine of atomicity are true, by reason of harmony with the laws of gaseous volume, specific heat, &c.; and now for the new reason that they pair the elements among themselves, in accord with their well-known properties.

That new criteria or tests of atomic numbers are by no means superfluous, is apparent when we observe that the determination of the numbers which are now accepted has employed the best genius and talent of the chemical world for more than fifty years, while the material considerations which were the basis of all the estimations were known or suspected from the beginning. It is only within the past ten years that the arguments have been fully summed up and a final judgment recorded. The recognized tests of atomic numbers are not altogether what is to be desired. Some of them are, in certain cases, wholly inapplicable, or even give conflicting results. It is only by a careful comparison of all the facts in a case, and a process of reasoning, that any number is established. Moreover, the fundamental facts rest upon the testimony of a very few experimenters, and they cannot be verified except at great cost. The test of the pairing, although not so important as the other tests, is yet one that all can easily apply and understand, and it may be that it will secure the decision in doubtful cases.

A Question in Mechanics.

WE have received a communication from Professor Henry F. Walling, of La Fayette College, Easton, Pa., on the question in mechanics which we presented in the January supplement. The letter commences by alluding to the origin of the discussion of the question, and to the fact that mathematicians of eminence are still divided among themselves; asserts that the expressions MV and MV^2 are both proper, but independent measures of force; and then continues as follows:—

"We may avoid all confusion in this matter by adopting the modern expedient of giving different names to the same agent, in considering the different effects which it causes. If we define force to be that which, when associated with matter, causes it to move, the appropriate measure of quantity of force is 'quantity of motion,' or *momentum*, represented by *MV*; but when we consider the *work* which is performed, or to be performed, we find it convenient to use a unit of measurement entirely different in its nature from that of quantity of force or motion; and when measured by this unit, we term the acting cause '*power*' or '*energy*.' The performance of work may be generally defined as the moving of bodies, or parts of bodies, through certain definite *spaces*, against continuous 'resistances,' or opposing forces. It may be represented in the form of an equation, thus—$P=ps$, proportional to MV^2, in which P represents the quantity of power or energy; *p*, the continuous pressure, or its equal, the resistance; and *s*, the distance passed through.

"If any doubt should arise as to which measure is the proper one to make use of, we have only to ask ourselves what kind of effects are to be taken into consideration. In all the operations in which muscular power or motive power of any kind, acting through machinery, is concerned, *space effects* are what we have to do with—that is, we have to estimate the spaces through which matter is moved against opposing force; and *ps*, or its equivalent, MV^2, becomes the convenient and proper measure. On the other hand, when we consider the effect of a uniformly acting force like terrestrial gravity (within narrow limits), in giving motion to a body freely acted upon, we see that the force which becomes associated will be directly as the time—that is, equal increments of force will be added in equal times; and since we find that equal increments of velocity are also added, we have $F=ft$, proportional to MV: F representing the entire associated force; *f*, the force developed in a unit of time; and *t*, the time.

"In applying these principles to any 'question in mechanics'—that of the railway-train, for instance—it is only necessary to state the question clearly, and its answer is easily given. There are circumstances attending the motion of the train which tend to complicate the solution of the problem, namely, the resistance of the air, friction, &c. Frictional resistance is a consequence of motion imparted to molecules, by which their heat is augmented; the resistance of the air is simply due to its inertia, and thus a large part of the power of the locomotive is consumed in space effects upon the air, and the atoms or molecules of the rails, wheels, axles, &c. Having no exact means of determining the aggregate amount of these motions, we can only ascertain it by actual experiment.

"We may, however, simplify the question by supposing the rails to have just sufficient inclination downwards in all parts of the train's progress to exactly balance the external resistances above mentioned. If, now, you would know the *moving force* required to give the train a certain velocity, it is clearly measured by MV, as shown in the previous editorial article; but if you wish to estimate the *work done* in giving it this velocity, or the work the moving train is capable of doing, if rendered independent of the locomotive, as the distance on a level, or up an inclined plane, it will move against a constant resistance, this quantity must be measured in units of its own kind—that is, of *ps*, proportional to MV^2.

"In estimating the amount of coal which must be consumed to perform a certain amount of work, we may suppose that the effect is due to the *falling together* of the atoms of carbon and oxygen, increasing the molecular motion or heat of the compound atoms of carbonic acid thus formed. This motion is transferred to the aqueous molecules, converting them into steam; the molecular motion of the steam imparts motion to the piston of the locomotive, and, finally, to the train itself. The sum of all the atomic weights, or rather attractions, multiplied by the distance through which the atoms have fallen, is the amount of work which they are capable of doing. Hence the power thus generated is measured in units of *ps*, and is in direct proportion to the quantity of coal consumed.

"We perceive, to sum up, that while MV is the true measure of pure *force*, as an abstract quantity, *ps* or MV^2 is the proper measure for *power* to perform all mechanical operations."

laboratory, and are as complete as the small quantity of material used in the work would allow. It was impracticable to determine the contents of gases and organic matter. An examination under more favorable circumstances will shortly be made, and it is confidently expected that in some of these waters a notable amount of the rare alkali metals may be found. The names at the top of the table designate the stations as represented on the railroad time-table.

	Rawlings	Separation	Washakie	Red Desert	Bitter Creek	Black Butter	Point of Rocks	Rock Spring	Green River
Sulphate of Soda	28.49	107.73	167.79	106.61	45.70	38.64	57.30	431.13	13.37
Sulphate of Potassa	....	24.64	....	3.78	....	10.71	....	....	2.31
Sulphate of Lime	24.15	178.15	73.08	17.99	23.10	12.60	25.41	354.76	3.01
Sulphate of Magnesia	....	80.08	35.49	5.67	....	....	1.96	258.51	....
Chloride of Sodium	28.84	....	5.74	...	18.20	....	17.15	285.25	....
Chloride of Potassium	5.11	23.66	23.38	2.17	25.55	7.21	32.90	284.55	3.64
Carbonate of Lime	6.65	....	....	....	....	3.01	....	....	2.59
Carbonate of Magnesia	8.05	41.72	....	....	52.29	15.68	15.82	....	3.92
Silica	..	3.08	.63	....	....	....	6.30	1.05	....
Alumina and Oxide of Iron	....	....	.35	....	....	...	....	5.67	....
Residues, per gallon	101.29	459.06	306.46	136.22	164.85	87.85	156.87	1,620.92	28.84

The Aurora and the Telegraph.

ON Thursday evening, April 15th, there was the most brilliant auroral display that has been seen in this hemisphere since 1859. It was attended with the phenomena which usually characterize these exhibitions. The telegraph was in all parts of the country affected to such an extent as to render them almost useless for two or three hours. Mr. Dolan, the night manager of the Western Union office, at 145 Broadway, reports that the strongest effects were shown on the wires running east and west. The atmospheric current was very strong, and affected the instruments very much like a large main battery on short circuits. The battery was taken off the wires between this city and Boston, and for a quarter of an hour business was exchanged on the auroral circuits. The auroral current was very heavy west of Buffalo, but was less marked south, and the printing instruments between New York and Washington worked well throughout the evening. The first interruption to the wires in this vicinity occurred on the Long Island wires, and immediately afterwards the effect was thrown on the wires running east. The reports from other offices are of similar character.—*The Telegrapher.*

Again on the afternoon of May 13th the aurora manifested itself in disturbing the telegraph, and business was seriously interfered with, and, as before, especially on the lines running east and west. The following statement is copied from the Washington *Republican*: "About twelve o'clock yesterday auroral currents became quite observable upon the telegraphic wires, and rapidly increased in force until they interfered materially with the working of the lines, and at times entirely stopped the transmission of despatches. The effect of these currents was felt upon the wires of the Western Union Company all over the country—especially between Philadelphia and Pittsburgh and between this city and Lynchburgh, Va.—both of these lines being worked with considerable facility upon the auroral currents alone, the galvanic batteries having been detached.

"Some of the wires between Washington and New York were also worked in the same way, and Mr. Marean, the chief operator of the day force, succeeded in an interesting experiment, viz., the substitution of a return wire for the ordinary ground circuit, upon which the same phenomena were observable as when the ends of the wire were connected with the earth. The interruptions continued until between six and seven o'clock, when they entirely ceased, and during the night the wires worked as finely as ever.

"There are several questions which will suggest themselves to the *savans* in regard to these demonstrations, among others whether the mountains over which the two lines most affected pass had any influence in inducing an excessive auroral current to pass. The Philadelphia and Pittsburgh line was the first to discover that the auroral current could be used in transmitting messages, and has upon all occasions of its presence had more than an average of these favors."

The Pairing of the Elements.

THE table of paired elements which appeared in the April SUPPLEMENT, and the remarks we made about it in the May SUPPLEMENT, have attracted considerable attention among those who are interested in chemical philosophy. The prevailing opinion appears to be that the pairing, which at present may not be regarded as anything beyond a curious fact, may be found at last to be allied or dependent upon some as yet undefined law of matter.

Of the letters which we have received upon the subject, the following is the most important:

"Your remarks on atomic weights in the April Number of CHEMICAL NEWS have suggested to me the enclosed table. You perceive that I have put the different elements at heights representing their atomic weights, and those of one series in columns together. The regularity observable is certainly a very rude one. But considering that every different combination of molecular elasticities (as shown by spectral lines) must give a new set of chemical properties, and considering that only about sixty elementary substances, out of the myriads which there might probably be, are known to us, we ought to expect no more accurate a classification of them than could be made of the animal kingdom, if only sixty animals were known.

TCSP

"You will perceive, however, that the atomic weights seem to arrange themselves on the diagram in parallel shelving lines. Also, that there is a correspondence between the series of artiads and perissads which have the highest atomic weight—that is to say, Na, K, Rb, Cs, Tl, on the one hand, and Mg, Ca, Sr, Ba, Pb, on the other, inasmuch as they form strong bases and peroxides, but no suboxides or acids. A correspondence is also to be traced between the two series having the next highest atomic weights; that is to say, Fl, Cl, Br, I, and O, S, Se, Te, inasmuch as they have a strong tendency to unite in simple proportions with the members of the two groups just mentioned, forming definite and distinct compounds, and also form strong acids with oxygen, but never bases. There is also some correspondence between the next highest groups on each side, that is between N, P, As, Sb, Bi, and C, Si, Ti, Zr, Sn, Pt, inasmuch as they form acids which unite in the most complicated proportions with bases, putting types at defiance, and also (as far as the higher members of each series are concerned) have some tendency to form weak bases.

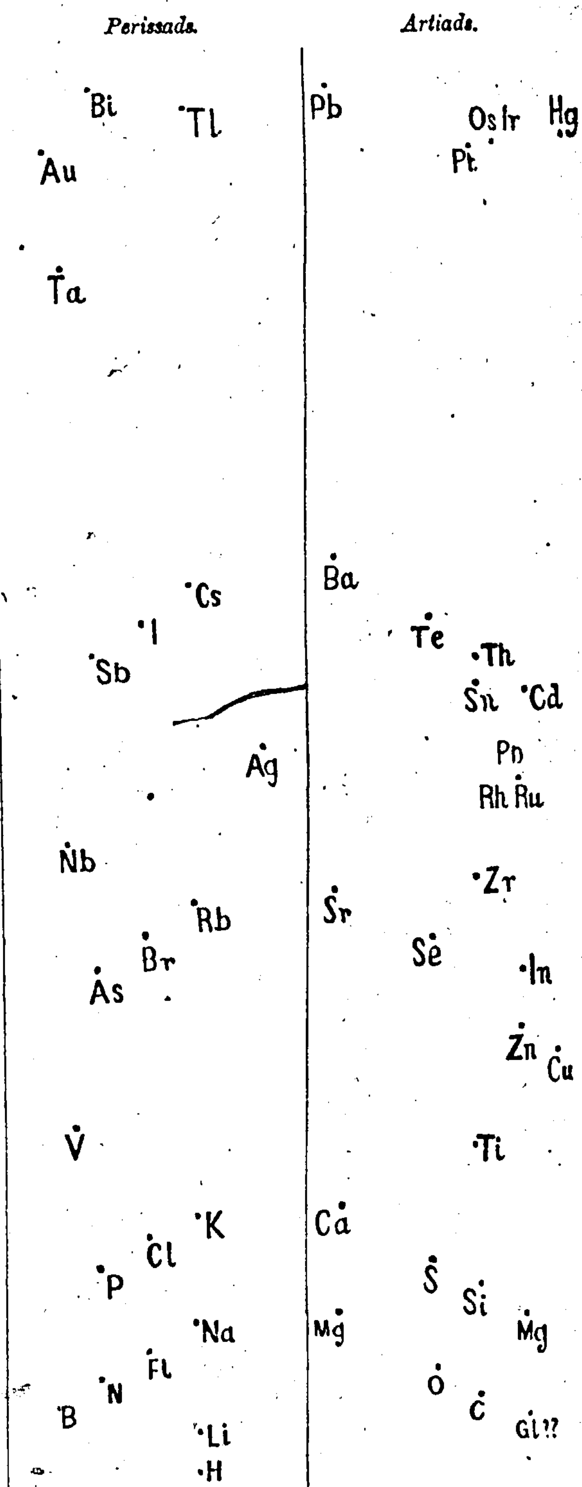
"I also notice that there is a much greater difference in chemical characters between K and Na (not isomorphous), between Fl and Cl (the fluorides being very insoluble), between N and P (N_2O_5 being monobasic), between O and S, between C and Si, and between Gl and Mg, than between any other two adjacent members of their respective series. Also that the maximum of resemblance is between As and Sb, Br and I, Rb and Cs, Sr and Ba, Se and Te, Zn and Cd.

"Finally, there is, as you point out, special resemblance between elements occupying corresponding places in the series, as between C and B, O and Fl, S and P, Ca and K, Se and As, Sr and Rb, Ag and Pd, Au and Os, Tl and Pb, &c."

The table sent to us was drawn on engineers' profile paper, and is somewhat easier to be understood and to be verified than the engraving. The engraving is, however, a faithful copy of the original, excepting the ruled lines. The profile paper and the cross-section paper of the engineers is exceedingly convenient for preparing similar tables and charts.

Our correspondent's table, besides being a very admirable exposition of the facts of pairing, at the same time illustrates almost everything of value which has been written on the classification of the elements and the numerical relations of the atomic weights. It will well repay a careful study.

There is one point on which we suggest a different view from that of our correspondent: the probable number of the elements. Is not our classification at present—of perissads and artiads, paired groups and paired individuals—about as perfect and satisfactory as any classification of natural history? Our classification, so far as it goes, is good; and is there plainly room for new classes or new individuals? In our last we suggested that it might be agreed that some of the unpaired elements are endowed with both atomicities, and thus be paired with themselves. The suggestion (by no means a new one) is applicable especially to iron, manganese, chromium, copper, and mercury. Iron, in FeS_2, is an artiad; in Fe_2O_3, may it not be a perissad? Dr. Odling says, "The ferrous and ferric atoms have distinct chemical properties, and form distinct series of compounds, which differ more from one another than do the salts of ferrum from those of aluminium and bismuth. So great indeed is the difference that, had we been unacquainted with the methods of converting ferrous and ferric compounds into one another, we should never have suspected them to have contained the same metal, or even similar metals." If



it be determined that the pairing is an order of nature, and that the known elements are nearly all paired, and that the known groups appear filled, we ought not to expect many new elements.

table by CSP