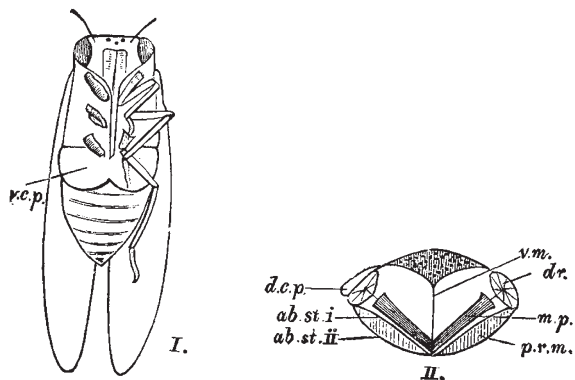


subject some six years ago. They were published in the not readily accessible *Proceedings* of the South African Philosophical Society (1879-80, part iii. p. 161), and were not illustrated by any figure.

The Singerjie (*Platypleura capensis*) is a well-known and tolerably abundant insect at the Cape; and few visitors to the shores of Table Bay can have failed to notice, in the hotter months of the year, the sharp shrill metallic sound produced by the "little singer." It is soon found that the male Cicada alone possesses the power of singing, the female—recognised at once by the long ovipositor folded beneath the abdominal somites—being dumb. If the ventral surface of a male singerjie be examined (Fig. I.) two large ventral cover plates (*v.c.p.*) are seen, one on either side, meeting in the central line and extending backwards from the metathorax over the anterior abdominal somite. On turning the insect over and looking at the dorsal surface, two very much smaller dorsal cover plates are seen extending forward from either side of the first abdominal somite. If one of these plates be removed with fine pointed scissors, there is seen the wrinkled surface of a thickish chitinous membrane, the drum. Turning the insect over again, so as to examine more carefully the ventral aspect, and removing one of the ventral cover plates, two membranes are disclosed, separated by a transverse chitinous support. Of these the anterior is white, narrow, and opaque, the posterior (*p.r.m.*, Fig. II.) translucent, oval, and tightly stretched.



The transverse chitinous support (*ab.st.i*) is the sternum of the first abdominal somite; the membranes are intersternal membranes which would seem to be specially modified to act as resonators. The second ventral cover plate may now be removed, disclosing the anterior and posterior resonator membranes of that side; the anterior resonator membrane of each side may be cut through; and the abdominal portion of the insect may be separated from the thorax. When this is done there are seen, taking their origin from the mid-line of the first abdominal sternum (Fig. II., *ab.st.i*), two muscular pillars (*m.p.*), each of which, proceeding upwards and outwards, terminates in a chitinous plate, the upper surface of which is, in turn, connected by a fine ligament with the drum (*dr.*). Under a low magnifying power this drum is seen to be strengthened with brownish ribs, which, together with its general elasticity, cause it to spring back after it has been drawn forward by the action of the muscular pillars, the fibres of which are beautifully striated. Each time the drum is drawn forward and springs back, by the alternate contraction and relaxation of the muscular pillars, a sharp click is heard, as may readily be proved experimentally on the dead insect. That the well-known metallic sound is produced by a rapid succession of such clicks is put beyond question by the fact that, by irritating the muscular pillars in a freshly killed insect, the singing noise may be set agoing, and will then continue for several seconds or even minutes. This I had the pleasure of

demonstrating to Mr. Roland Trimen, F.R.S., curator of the Cape Town Museum, the abdomen singing merrily when the head and thorax had been pitched out of window or destroyed. A weak current of electricity would also cause the singing to commence. The sound generally ceased after a while in a few isolated clicks, and at that time the waves of contraction in the muscular pillars were plainly visible. The singing noise was less sharp and clear than in the living insect, owing probably to the disruption of some of the resonator membranes; and I have noticed that rhythmical motions of the abdomen in the live insect produce rhythmical alterations in the intensity of the sound. The cover plates are doubtless mainly for protection; but the fact that on their removal the sound is less full and intense shows that they also may play the part of sounding-boards.

Fig. II. is a slightly diagrammatic view of the severed abdomen as seen from the anterior end. *ab.st.i* and *ii* are the sterna of the first and second abdominal somites; *p.r.m.* the posterior resonator membrane stretched between them; *v.m.* a vertical membrane; *m.p.* the muscular pillars; *dr.* the drum; and *d.c.p.* the dorsal cover plate of the right side, that of the left side being removed.

I may mention, by way of appendix, that in this species the rostrum contains only three stylets: two lateral, toothed on their external edges; one central and smooth. Although this central style shows, in some cases, indications of its having arisen by coalescence of two lateral styles, it is distinctly one and indivisible.

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RADIANT LIGHT AND HEAT¹

V.

Evidence afforded by the Spectroscope as to the Nature of the Elements

THE point of greatest speculative interest connected with our subject is perhaps that regarding the constitution of the so-called elements.

What light, it may be asked, does spectrum analysis throw on this vexed question? Does it lead us to imagine that these bodies are truly elementary? Or to believe that they are in reality compounds which might be broken up if we had sufficiently powerful instruments for this purpose at our disposal?

I shall begin my remarks on this subject by taking it for granted that the constitution of matter is atomic and molecular.

When, therefore, two chemically different substances combine together we have the union of two heterogeneous atoms, forming a molecule of the compound substance. Thus, when an atom of chlorine and one of sodium combine together we have, as a result of the combination, chloride of sodium or common salt, and an ultimate molecule or compound atom of chloride of sodium may be described as the smallest portion of that substance which possesses all the properties of common salt, and which, if divided further, would be split up into one atom of sodium and one of chlorine.

The molecules of bodies are very frequently so placed as to have an attraction for each other, under the influence of which the body assumes a solid, or, it may be, a liquid state.

Sometimes, however, we have the body in the state of gas, in which the various molecules are so far apart as to have no perceptible attraction for each other. It is by means of such a gas that we can best study the properties of molecules as far as radiant light and heat are concerned. Now, spectrum analysis unquestionably tells us that at comparatively low temperatures and great nearness of particles we have a comparatively complicated

¹ Continued from p. 254.

molecular structure. When, however, the temperature is high and the particles far apart, this structure, as revealed by its spectrum, is much simpler. A process of splitting up has taken place in the interval.

While, however, this is universally allowed, there is a difference of opinion as to the nature of this simplification, which, we are assured by the spectroscopist, has taken place. Thus we have already seen that in gaseous water or steam we may have, at a somewhat high temperature, a considerable variety of structures and a partial dissociation of the various compound molecules. In such a case we have at the same time portions of the compound and portions of the components, thus exhibiting a more or less complicated structure of the gas. When, however, the temperature gets very high, the dissociation is practically complete, and the compound structures disappear, leaving us with molecules of oxygen and hydrogen. But what will happen if we treat the vapour of iodine in a similar manner? It will be allowed that as the temperature gets higher we shall have a simplification of molecular structure accompanied and exhibited by a great change of spectrum, but will the iodine ever split up into components which bear to iodine a relation similar to that which oxygen and hydrogen bear to water?

In fine, we call iodine a simple body because in the conditions in which we are placed in our laboratories we cannot decompose it; but what is it in the vacuum-tube and under the spectroscopist? Is it still an element, or does it give any evidence of being a compound?

It is taken for granted that at high temperatures its molecules split up, but do they split up into portions of iodine or into portions of the components of iodine? In discussing this and similar questions we shall begin by acknowledging that the strongest and best proof of the compound nature of any element is the exhibition of its components in a separate state, while at the same time we must confess that we are at present unable to do this for the so-called elements. Nevertheless this inability forms no ground for the assertion that the elements are simple bodies, inasmuch as certain substances which we know to be compound reveal their components momentarily in the spectral flame. There is a momentary dissociation at a high temperature followed by a reconstruction at a low.

A good instance of this is the yellow flame produced by introducing chloride of sodium into a Bunsen's burner. This yellow flame attests the existence of sodium in the free state, but this existence is merely temporary, and at the end of the process there is no perceptible trace of the presence of this metal. Thus the only difference between the experiment in which the presence of sodium is temporarily revealed and that in which splitting up takes place when the various elementary gases are brought to a high temperature *may be* that in the former instance we can obtain the sodium by another means, whereas in the latter experiments we cannot obtain these constituents by any other means. We say *may be* because we know that our powers are limited and can very well conceive their extension in the future as we know they have extended in the past. We think it, therefore, unphilosophical to assume that there is any real difference between those bodies which we cannot decompose and those bodies which we can, unless there is some good reason for this distinction apart from our inability to decompose the former. Let us now, therefore, inquire whether any such grounds exist.

Our first remark is that in certain respects the elements, with one or two exceptions, may be looked upon as belonging to a distinct family each member of which possesses the same or nearly the same *atomic heat*. This means that the amount of heat necessary to raise through a given temperature range an atom of any one element is equal to that necessary to raise through the same range an atom of any other element.

This fact was first discovered by Dulong and Petit, and is expressed by saying that the product of the specific heat into the atomic weight, or the atomic heat, as this is called, is nearly the same for all the elements.

This peculiar law is not confined to the elements, for it has been found that in all compound bodies of similar atomic composition the product of the specific heat into the atomic weight is likewise constant. This product is, however, greater in the class of compound bodies than it is for the so-called elements. For the latter the product is about 6, while for the chlorides of barium, strontium, calcium, &c., it is over 18, and for the carbonates of lime, barytes, &c., it is nearly 22.

Thus the distinction which the elements enjoy as a family consists in the fact that their atomic heat is less than that of families of compound substances. In order to perceive the physical meaning of this peculiarity let us imagine that we make a mixture of two substances, A and B, which have no sort of chemical attraction for each other. Now in order to heat this mixture through a certain temperature range, the heat required will be the sum of the heats required for the two components, and neither more nor less, the one being in this respect absolutely independent of the other.

Next let us suppose that A and B are both chemical compounds, but that the atomic constituents of a compound atom of A exercise on each other (in order to form the compound atom) attractions vastly greater than those which the compound atoms of A so formed exercise upon each other.

Let us also imagine that a similar law holds for B, so that in fine we have to deal with the following forces, some of which are strong and others weak. Thus we have:—

(a) The strong forces exercised by the various chemical constituents of a compound atom of A on each other.

(b) The strong forces exercised by the various chemical constituents of a compound atom of B on each other.

(γ) The relatively feeble forces exercised by the various compound atoms of A upon each other.

(δ) The relatively feeble forces exercised by the various compound atoms of B upon each other.

(ε) The relatively feeble forces exercised by the compound atoms of A upon the compound atoms of B.

Under these circumstances there are perhaps theoretical grounds for imagining that when we mix A and B together not only shall we have, as above-mentioned, an independence between the specific heats of A and B, but in addition the specific heat of a compound atom of A will be found to be equal, or nearly so, to that of a compound atom of B.

If we now apply these principles to the so-called elementary bodies, we shall, I presume, be all willing to own in the first place, that (assuming for the sake of argument that they are in reality compounds) the force which binds their various constituents together must at any rate be vastly greater than that which represents the attraction of one so-called element for another. Imagine, now, one atom of barium and two of chlorine to combine together to form one compound atom of chloride of barium, we may safely assert that the strength of the chemical ties which bind together the various constituents of this compound atom must be vastly weaker than those which bind together the assumed constituents of the element chlorine or of the element barium. In conformity therefore with the suggestions we have ventured to make we might expect two things to happen:

First, the heat necessary to heat through a given temperature range a compound atom of chloride of barium ought to be nearly equal to the sum of the heats necessary to heat through the same range an atom of barium and two atoms of chlorine.

Next the heat necessary to heat through this range an atom of chlorine ought to be nearly the same as that

necessary to heat through the same range an atom of barium, provided both substances are taken in the same state—both solids for instance.

If then the specific heat of an elementary atom is represented by 6, that of a compound atom of chloride of barium will be represented by 18. This is in truth the law which Kopp has found to hold with respect to the atomic heat of compound bodies, and the theoretical conclusion to be derived from it, and that of Dulong and Petit, is, not that the elements are essentially different from the compound bodies, but that, if compound, the forces which bind together their constituents are vastly more powerful than those which bind together the so-called constituents of bodies known to be compound.

Again, if we compare together the atomic weights of the so-called elements with those of compound bodies, we shall find that as a whole the former are smaller than the latter—that is to say, the family of elements have on the whole smaller atoms as well as smaller atomic heats than the families of compounds. Now, if the elements are in reality compounds we might expect in like manner that those which have the smallest atoms should have the smallest atomic heats.

We have great reason for supposing that this is the case, for, although we have not obtained the specific heat of either oxygen or hydrogen in the solid state, Kopp has found that his law with regard to compounds will only hold good under the hypothesis that the atomic heats of hydrogen and oxygen are decidedly less than those of the great bulk of the elementary bodies, that of hydrogen being likewise smaller than that of oxygen. Furthermore carbon and boron are two elements which have small atoms. Now if we make the observation at ordinary temperatures it will be found that the atomic heats of these two elements are decidedly less than those of the great bulk of the elements. In fine, elements of small atomic weight and presumed simplicity of structure appear to bear to those of great atomic weight a relation similar to that which the elements as a class bear to the compounds as a class, as far as atomic heat is concerned.

On the whole the result of this discussion appears to be in favour of the so-called elements being in reality compound structures the components of which possess attractions for each other vastly greater than those exhibited in ordinary chemical combinations.

In connexion with this branch of my subject I may allude to the peculiar family relation between certain elements which all chemists are now agreed in recognising.

This means that the various members of a group of the elements consisting, let us say, of A, B, C, and D, bear to one another some peculiar relation different from that which they bear to the other elements. Now this is precisely what happens in the case of groups of substances which we know to be compound, and the impression is thus conveyed that the elements themselves consist of varied groupings of some still simpler substance. Indeed it seems quite possible that there may be only one kind of primordial atom, and the fact that the force of gravitation bears a constant relation to mass quite independently of chemical constitution seems to speak strongly in favour of some such hypothesis.

Let us now try to picture to ourselves what would have happened had spectrum analysis been known as an instrument of research at the time when we were yet unable to isolate the metal sodium. Under such circumstances chloride of sodium and caustic soda would both be considered as separate elements and the spectra of both these bodies exhibiting the same yellow line would lead to the conclusion that these substances contained some common principle which was momentarily dissociated from its surroundings in the spectral flame. This leads us to ask whether there are any such coincident

lines in the spectra of the various so-called elements besides those which may be caused by common impurities. Lockyer, who has greatly studied this subject, tells us that short-line coincidences exist between many metals, the impurities of which have been eliminated, or in which the freedom from mutual impurities has been demonstrated by the absence of the longest lines. Some of his results are exhibited in Fig. 25, in which the lines marked — are due to impurities, while those marked + are common or basic lines. It would thus seem that these short-line coincidences cannot be due to impurities, and the question at once arises whether they do not indicate the presence of some common principle in the spectra before us momentarily dissociated from its surroundings by the high temperature.

It is important here to explain what we really mean when we speak of a coincidence between two spectral lines. We mean simply that there is no perceptible difference in their position when examined with an instrument of a certain power. Mr. Lockyer therefore did not with his instrument perceive any such difference in the spectral position of certain short lines given by various elements. Messrs. Liveing and Dewar, however, applied to some of these lines an instrument of greater power, and succeeded in showing that in many cases there was a slight difference between their spectral positions.

This result raises a new question. We have now to ask ourselves what, under these circumstances, is the value that we can attach to this very near but not quite absolute coincidence between certain short lines of various elements?

Now, in comparing together certain absorptive spectra of compound bodies which have some principle in common, we learn from the researches of Russell and others that we can sometimes trace a band presumably due to the common principle, the spectral position of which is, however, slightly different in the various compounds. The want of perfect freedom may, it is imagined, alter slightly the time of vibration of the molecular groupings, and thus displace the spectral position of the absorption bands. I think we are justified in imagining that something of this kind may take place in the elements, in which, the forces being so intense, our highest attainable temperature may be insufficient to produce complete dissociation. In this case the want of complete concordance in the short lines common to various elements, or *basic lines*, as these have been named by Lockyer, may denote nothing else than this absence of power.

It is imagined that these approximate coincidences are too frequent and too near to be due to chance, but this is a subject that will ultimately require mathematical investigation. In fine, we may conclude this short account of the terrestrial evidence regarding the nature of the elements by saying that—(1) there is no proof that they form a class essentially different from compound bodies, but much to the contrary; and (2) that, if compound, the forces which bind their constituents to one another must be very great.

Before discussing the spectra of the sun and stars it may be well to pause for a moment and ascertain what we mean when we say that sulphur, for instance, is an element. It is quite clear that solid sulphur, liquid sulphur, and gaseous sulphur are different things; also, we may have two kinds of solid sulphur, while if we take the spectrum of gaseous sulphur there is little doubt that the molecular groupings suffer vast changes as the temperature rises.

Now, in all its various states we still call the substance sulphur, because if we bring it down to the temperature of our laboratories it will combine with other bodies as sulphur and as nothing else. Thus the word *sulphur* does not in reality mean a definite arrangement of matter. Similar remarks apply to other elements, several of which are in the form of gas and give us their spectra in

vacuum-tubes. Now it is quite possible that in one of these vacuum tubes as we pass the spark through it, we may have various atomic structures, some of which if we could carry them away to a separate place might on cooling present us with something we had never seen

before. But this is precisely what we cannot do in the conditions under which we are placed, nevertheless it can be done in the atmospheres of the sun and stars. Prof. Pierce has shown that in such atmospheres where gravity is very powerful, the heavier molecular structures will

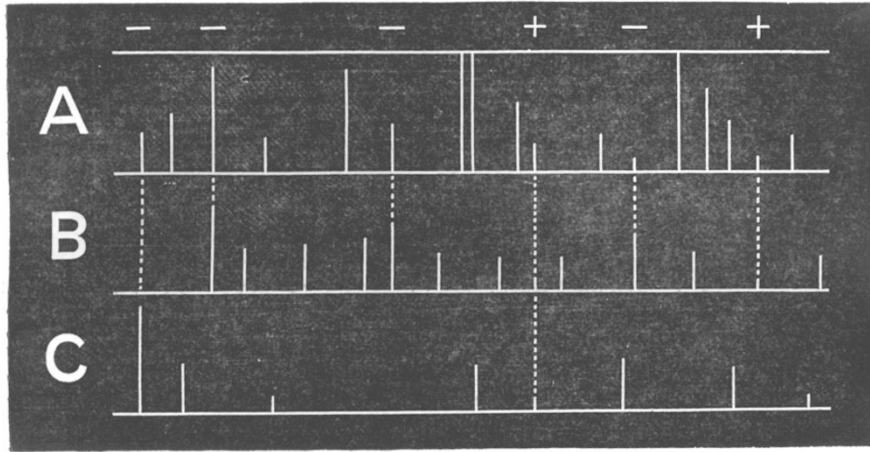


FIG. 25.

naturally separate themselves from the lighter, and seek a lower level. Lockyer therefore imagines that in such atmospheres there is the separation of molecular structures always going on, the heavier falling downwards

until they reach a region of higher temperature where they become dissociated or broken up, and the lighter mounting upwards until they reach a region of lower temperature, where they combine together, and hence become

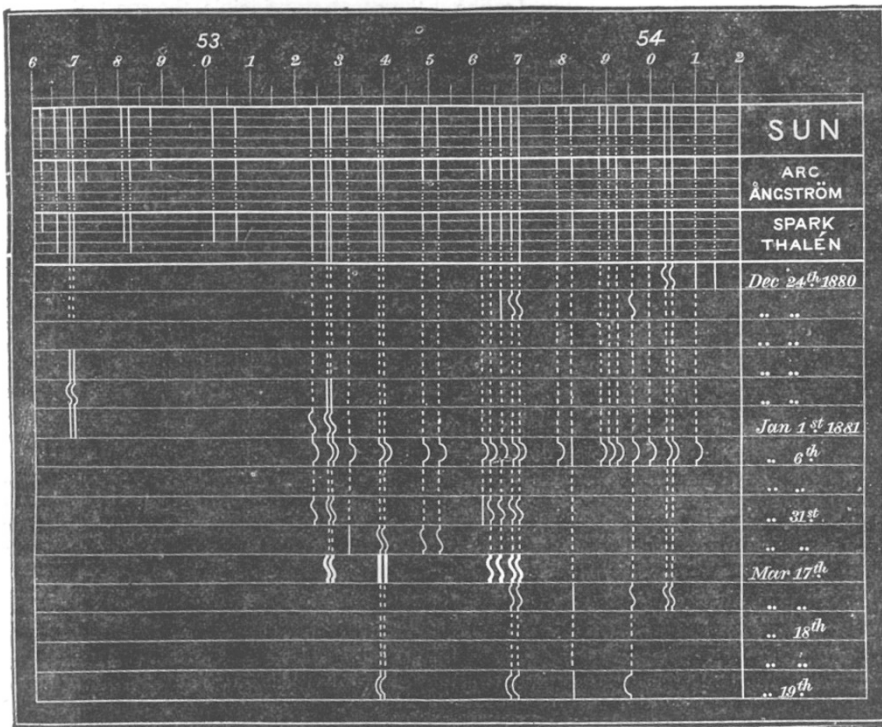


FIG. 26.

heavier. This kind of sifting process must not be confounded with the rapid motions of ascent and descent of the various solar currents, sometimes carrying a body of particles downwards, and thus heating it in the process

and sometimes carrying it upwards and cooling it in the process. Both of these causes must be regarded as at work together in the solar atmosphere, and they give us no doubt the best explanation of a very peculiar circumstance

which Lockyer was the first to observe. It appears that lines which, judging from terrestrial experiments, belong to one element, sometimes appear in the solar spectrum as distorted or displaced in different directions, indicating perhaps that the substance producing the one line is moving towards the eye with great velocity, while that producing the other is moving in a contrary direction. It is thus certain that the substances producing the two lines must be in different places, and under these circumstances we can hardly come to any other conclusion than that these lines are given out by different molecular groupings which have become separated from each other by the sifting process already mentioned.

From Fig. 26 it will be seen that different rates of solar motion are exhibited by different iron lines.

It would thus appear that a study of the solar spectrum is likely to furnish us with much information regarding the modes of vibration of molecular structures. It would also seem that in view of these facts we should revise our nomenclature. What, for instance, do we mean when we say that iron occurs in the sun? Clearly nothing more than that certain molecular structures in the sun's atmosphere are the same as certain terrestrial molecular structures momentarily formed when we obtain the spectrum of iron. But if we could seize upon the various particles that unite in giving out some one iron line, and

put them into a bottle, we might perhaps find that they were not iron, and they might even be different from the thing obtained by treating some other iron line in the same way.

The following statement of Mr. Lockyer's views is taken from the Report of the Solar Physics Committee:—

"The view of the construction of the solar atmosphere to which Mr. Lockyer has been led, may be stated as follows:—If the atmosphere of the sun were quite tranquil, and if we could see the spectrum of a section of it, we should see it divided into an almost innumerable number of layers, each with its appropriate spectrum. So far from each substance (with some notable exceptions), as determined by a spectral line, extending very far above or below its normal position, it would be confined to one heat-level, and the spectrum, taken as a whole, would get simpler as we approach the photosphere from without. The metallic elements, instead of existing as such in a so-called 'reversing-layer,' resting on the photosphere, are entirely broken up there, and their germs are distributed throughout the atmosphere, the molecular groupings getting more complex as the distance from the region of greatest heat increases. The Fraunhofer spectrum, as regards any one element, does not result from the vibration of the molecules of that element existing as such at any given height in the sun's atmosphere, but results

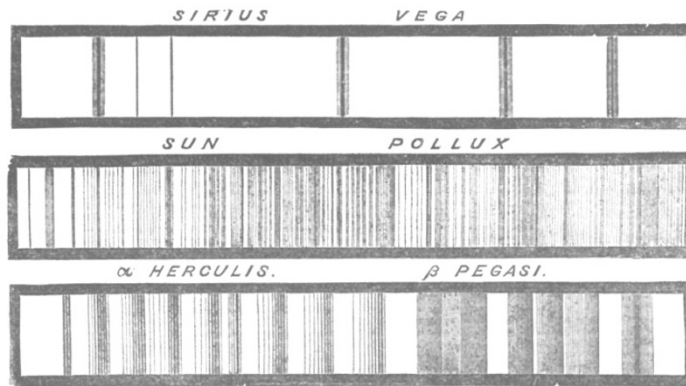


FIG. 27.

from an integration of the vibrations of the germs of that element existing, perhaps distributed, from the top of the atmosphere to the bottom."

It may be said, however, that, while we have strong evidence of a splitting up and also of a sorting or sifting process of the various molecular structures going on in the sun, we are yet without evidence that the molecular structures of two different elements can be split up into the same component. The reply to this will be found in a statement made by Mr. Lockyer (*Proc. R.S.*, December 15, 1881) that the greater part of the lines seen at the bottom of solar spots and in solar flames are lines apparently common to two or more terrestrial substances with the dispersion employed—in other words, basic lines, as these have been termed. He has exhibited some of these results in a diagram which will be found in *NATURE*, vol. xxiv. p. 323. Now, even if we imagine that the coincidence in position of these lines, as derived from two or more substances, is not absolute, yet the fact that such lines form the greater portion of the spectra belonging to the hotter regions of the sun is a very significant one, and surely implies something more than a mere chance correspondence.

Rutherford and Padre Secchi were the first to attempt a preliminary classification of the stars into groups, but for a spectroscopic analysis of these bodies we are especially indebted to Dr. Huggins. Lockyer thus sums up the

information which we have thus obtained (December 12, 1878), the symbols indicating the metallic lines visible in the various spectra:—

Hottest Stars	Lines of	H + Ca + Mg	Metalloids.
Sun... ..		H + Ca + Mg + Na + Fe	
Cooler Stars		— — Mg + Na + Fe + Bi + Hg.	
Cooler ...	Fluted bands of	Metalloids.
		

I may here remark that the hottest stars in the above table are chosen because of their superior brilliancy, and the cooler stars because of their inferior lustre. We are thus entitled to say that the most brilliant and presumably the hottest stars are those in the spectra of which the prominent black lines are the lines of hydrogen, calcium, and magnesium, while in those stars of which the sun is a type we have in addition lines of sodium and of iron. In the cooler stars hydrogen and calcium have disappeared, and we have lines of magnesium, sodium, iron, bismuth, and mercury, while in the coolest stars of all we have no metallic lines but only fluted bands of metalloids. In these last we may imagine that all the metallic lines hav

disappeared through association at the comparatively low temperature of the stars.

Fig. 27 gives us a representation of the three chief types of stellar spectra.

It is thus manifest that in stars where the temperature is very high and the dissociation very great we have fewest lines, or at least fewest lines of that prominence and thickness which entitle us to associate them with substances existing below the surface of the stellar atmosphere. Here let us pause for a moment and reflect what this implies. If each element were in reality a simple body, and if the splitting up which occurs in the spectrum of each were merely molecular and not atomic, the result of a high temperature in a mass of matter containing presumably all the elements would certainly not diminish the number of the spectral lines indefinitely. For, even suppose that it split up all the molecular structures of each element into their simplest forms, yet on the supposition that they are elements, the ultimate molecular structure for one element would be different from that for another, and there would thus be at least as many molecular structures and spectral lines as there are elements. On the other hand, if these substances are not elements, we may imagine them to be split up into a comparatively small number of ultimate structures, and we might even imagine that at an enormously high temperature everything might be reduced to a single structure.

Thus the fact that in the hottest stars we have the fewest atomic structures is in favour of the hypothesis that the elements are not really simple bodies but compounds, it may be, of some primordial atom.

Let us now sum up the evidence derived from terrestrial and celestial sources in favour of this hypothesis.

First. There is experimental evidence of various kinds tending to show that the so-called elements are not essentially different from other bodies.

Secondly. In the terrestrial spectrum of pure metals at a high temperature certain lines are obtained for some one element that are extremely near, if not coincident, in spectral position with those obtained for some other element or elements. These have been called "basic lines."

Thirdly. We know that in the sun's atmosphere there is a process at work tending to separate the various molecular and atomic structures, and we find that the greater number of the lines given out from the sun's hotter regions are basic lines, such as we have above defined.

Fourthly. In the very hottest stars, where the dissociation is greatest, we have only a few prominent lines given out, these being lines belonging to hydrogen, calcium, and magnesium. I think we must conclude that the hypothesis that the elements are in reality compound bodies offers, with our present knowledge, a very good and simple explanation of the results of spectroscopic analysis in the earth, the sun, and the stars.

Now, bearing in mind the extreme usefulness of some such hypothesis to aid us in collecting facts, I do not hesitate to say that this hypothesis can only be legitimately overthrown in one of two ways. We may either, in the first place, obtain some indisputable fact bearing conclusively against the hypothesis that the elements are compounds and in favour of their being essentially simple bodies, and may thus overthrow the above hypothesis in the same way that Fizeau, by his experiment, overthrew the corpuscular theory of light, if, indeed, it had not fallen to pieces before he made the experiment; or, on the other hand, the hypothesis that the elements are essentially simple bodies may be applied by some skilled advocate to our terrestrial and celestial spectroscopic observations and a consistent explanation of these afforded, simpler and better than that given by the above-mentioned hypothesis. But until either of these two things is done we are justified in using the compound nature of the elements as a working hypothesis.

It would, no doubt, be premature to bring it forward at the present moment as an established theory, because an established theory means a working hypothesis which, having overcome the perils of infancy and youth, lives to justify an honourable and useful existence on the principle of the survival of the fittest. BALFOUR STEWART

NOTES

THE Paris Academy of Sciences has suffered another loss in the death of M. Jamin, Perpetual Secretary for the Section of Physical Science, and the immediate successor of M. Dumas. M. Jamin can hardly be said to have filled his office, as he was attacked by disease of the heart very soon after his nomination. He was elected a member of the Academy in 1858 to fill the place vacated by the death of Pouillet. He was a very eloquent teacher and debater, and a frequent contributor to the *Revue des deux Mondes*. His "Cours de Physique à l'École Polytechnique," is a very extensive work. He also published many papers in the *Transactions* of the Academy of Sciences, and patented an electric light. He was born in 1813, and educated at l'École Normale.

THE death of Mr. Edward Thomas, one of the most eminent of English numismatists, took place on the 10th inst. at Kensington, in his seventy-third year. After a distinguished career in the public service in India, he returned home and devoted himself to the study of the antiquities and history of India and Asia generally. He was a Corresponding Member of the French Institute and of the St. Petersburg Academy, as well as a Fellow of the Royal Society. His writings were very numerous, and many of them are still only to be found scattered throughout the journals of different learned Societies, to which he had contributed for upwards of forty years. Amongst his most important works were his edition of Prinsep's "Antiquities," published in 1858; papers on ancient Indian minerals in the *Journal Asiatique*; on early Sassanian inscriptions, seals, and coins; his essay on ancient Indian weights prefixed to the "Numismata Orientalia" is the standard work on the subject. Between 1848 and 1865 he contributed sixteen papers to the *Journal* of the Royal Asiatic Society on Eastern coins. These were subsequently republished under the title of "Tracts on Oriental Literature."

THE death is announced of Dr. Heinrich Fischer, the mineralogist and professor at the Freiburg University, well known through his work on "Jadite and Nephrite."

IN a lively and interesting article in Tuesday's *Times* on the work of the Smithsonian Institution in the field of ethnology it is urged with some force that the British Government is bound to render a similar service to science in the case of the numerous races under our dominion, many of whom are dying out, or changing their old habits and customs. "All the arguments which could be urged for the maintenance of the Smithsonian Bureau of Ethnology apply to the establishment of a similar bureau for the British Empire. In British India the State from time to time undertakes fragments of the task. Elsewhere it is being effected occasionally and piecemeal. The want is of a body which should carry on the enterprise as a whole, and in a manner to borrow light from one quarter to elucidate the rest. Types of tribal, social, and national existence are vanishing on every side. They are changing, or giving place to new. Some had always the germs of incurable decay in them. British civilisation is treading out others. British dominion, whether directly answerable or not for the mortality, is in the position of administrator, and is bound to keep account of the estate of ancient and curious memories. Being where and what it is, it ought to be executing on a scale yet ampler the work the Smithsonian Institution is doing diligently from and at Washington."