

to this used by Kayser and Runge, but they found that some of their constants varied little from element to element. In that way they not only obtained the first term of a series, but the whole series throughout the entire length of the spectrum, and where observations had been made in the case of the different elements they could of course check their calculations by the actual observations so made, and see how the theory seemed to be justified as the work was extended. The first line in a series must be considered to be comparable to a fundamental note in music. It represents really the longest light wave in the same way that the fundamental note in music represents the longest sound wave. Both series of results, obtained in the way I have described by Kayser and Runge and by Rydberg, show us that, in many cases, we may be almost certain to obtain from the higgledy-piggledy arrangement of the lines in the spectrum of any one substance two or three beautiful regular series like those that I have already shown you in the case of helium and asterium. There is a little difference in the nomenclature employed by the investigators to whom I have referred, as shown in the annexed table.

*Series Nomenclature.*

Intensity.	Kayser and Runge.	Rydberg.
Strongest ... ..	Principal series	Principal series
Weaker ... ..	1st subordinate series	Nebulous series
Weakest ... ..	2nd subordinate series	Sharp series

The strongest lines which they observed at the temperatures they worked with, they put into what they call a "principal series," and then the weaker lines were distributed among other two series. Kayser and Runge called them the "first-" and "second-subordinate" series; Rydberg calls them the "nebulous-series" and the "sharp-series." It is important to remember this in case you come across any reference to these matters, in order that you may see what the exact equivalent is. The lines of the principal series almost always reverse themselves very easily indeed—that is to say, that the absorption is indicated by them more readily than it is by the other lines. Then, when we come to the second subordinate or sharp series, it is found that these sometimes broaden out towards the red end of the spectrum.

This work, of course, has required considerable investigation; the first attempts were not quite satisfactory, because the observations on which it was based had not been of sufficient accuracy. With greater dispersion it has been found that some of the lines which were supposed at first to be single are really double; so that it is quite usual now when we consider this question of series to suppose that in some cases the series are composed of single lines, in other cases of doubles, and in other cases of triplets; and it was at first, indeed, imagined that in these differences we were face to face with a very important physical difference between the various elements, but Rydberg has suggested that possibly after all it may be a difference merely in the seeing.

He says:<sup>1</sup>

"The difference between the doubles and triplets is only relative. This opinion is confirmed by the fact that the triplets appear often in the form of doubles, the most refrangible component not having sufficient intensity to become visible. Further, the relative intensity of the components of the doubles seems equal to that of the two less refrangible components of the triplets.

"For these reasons I have dared to propose the hypothesis that the two kinds of component rays are of the same order, or that the doubles are only triplets of which

the most refrangible component is too feeble to be seen, or has perhaps the absolute value of zero. . . ."

If the lines are more difficult to see, and if the sub-series of lines get stronger towards either the red end or the blue end, then we are more likely to see one line than two, and more likely to see two lines than three.

I have already referred to the many years old suggestion that a line is a remnant of a fluting. If you could see the whole fluting, you would see what is represented in the upper horizon of the diagram; if you

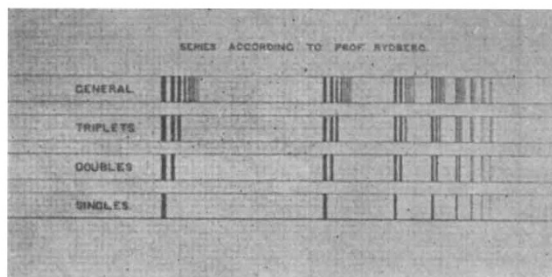


FIG. 5.—Diagram illustrating Rydberg's idea of the appearance of triplets, doubles, &c.

could not see the whole of it, you would get what is represented in the second horizon, that is to say, a triplet. If the third line were very difficult of observation you would only see a doublet, and if the inside line were weaker than the other you would only see a single line.

Single lines		Doubles		Triplets	
Principal series	Subordinate series	Principal series	Subordinate series	Principal series	Subordinate series
Helium	Asterium	Hydrogen (?)	Helium	Oxygen	Oxygen
Asterium	Asterium	Lithium (?)	Hydrogen	Sulphur	Sulphur
		Sodium	Lithium (?)	Selenium	Selenium
		Potassium	Sodium		Magnesium
		Rubidium	Potassium		Calcium
		Cobalt			Strontium
			Copper		Zinc
			Silver		Cadmium
			Aluminium		Mercury
			Indium		
			Thallium		

There is only a very small number of the chemical elements which give us single lines; in the principal series, so far, we only know of helium and asterium; in the subordinate series we only know of asterium. The number of doubles, you will observe, is very much greater, but it is not so great in relation to the principal series as it is in the case of the subordinate series; but although we have nine elements giving us triplets in the subordinate series, we have only three which give them in the principal series.

(To be continued.)

*THE DOVER MEETING OF THE BRITISH ASSOCIATION.*

THE final arrangements for this year's meeting are now sufficiently completed for a fairly accurate forecast to be made. Whether the meeting will be large or small it is still too early to judge, but whether large or small it will certainly be a very interesting one. As to accommodation in the town, there is little doubt but that at the time of meeting ample accommodation will be available, though the committee have had great difficulties in inducing hotel keepers and lodging-house owners to

<sup>1</sup> *Kon. Sv. Vet. Ak. Hand.*, vol. 23, ii. p. 135.

reserve rooms for members of the Association, and have only partially succeeded. Dover being a sea-side resort, there has been a natural dislike on the part of owners of hotels and lodgings to offer to disturb those visitors who may possibly have come for a longer stay for the sake of members of the Association who may only wish to spend a week or so. There will, however, be accommodation available in Deal, Canterbury and Folkestone for those who cannot find rooms in Dover. It will be well, however, that intending visitors to the Dover Meeting should inform the local secretaries (E. Wollaston Knocker, C.B., and W. H. Pendlebury, M.A., Castle Hill House, Dover) of their intention, so that approximately the amount of extra accommodation may be known.

It has been usually the case that the secretaries of the various sections are accommodated at the same hotel to facilitate sectional arrangements. This year the Hospitality Committee has been able to arrange with the Head Masters and House Masters of Dover College to entertain the secretaries in the various boarding houses. Unfortunately, the accommodation is limited to the rooms usually occupied by the boys (each of whom has a separate bedroom to himself), so that it is impossible to take in secretaries accompanied by their wives. There will be a few other guests entertained by the Local Committee under the same conditions. The Masters of the various houses will act as hosts on behalf of the Hospitality Committee, and will look after the comfort of their guests. The College Masters will also give the first of the larger garden parties on Thursday, September 14. The Rev. J. N. Bacon has kindly undertaken to make a balloon ascent with objects similar to those which induced him to make an ascent at the Clifton College garden party. The situation of Dover with regard to the sea will doubtless add to the interest of such an ascent.

Lord Northbourne and Lord George Hamilton have kindly consented to allow members of the Association to inspect Betteshanger Park and Deal Castle respectively.

Owing to the fact that two of the days usually given up to excursions are required for the visit of the French Association to Boulogne and the return visit of the British Association to Boulogne, the number of excursions arranged for will be smaller than usual. The geologists and anthropologists have arranged a number of smaller excursions for the afternoons as usual, and these will, of course, not be interfered with. On the last day of the meeting (Wednesday) the Association is invited by the Dean and Chapter and Mayor and Corporation of Canterbury to pay a visit to that city to meet 200 members of the French Association, who will have previously been entertained to luncheon there. The Mayor and Corporation will entertain the British Association to tea. On the following day (Thursday) an excursion has been arranged to Rochester and Chatham Dockyard for those who do not care to go over to Boulogne. An opportunity will be given to visit the Agricultural College at Wye, near Ashford, which has been so successfully started by the County Councils of Kent and Surrey. The Principal, Mr. A. D. Hall, has invited members of the Association to pay the College a visit and inspect the experimental stations. It may be well to recall the fact that Wye College is especially included in the new University of London, though considerably outside the limit. For those members of the Association who visit Boulogne a most interesting programme has been arranged on the lines laid down in a former article (p. 181). The luncheon will be given by the civic authorities. The French Government has taken a great amount of interest in the gathering, and it is very likely that some prominent French statesman will attend to welcome the British Association in the name of the Government. In such case it is very likely that a similar compliment will be paid to the French Association on their visit to Dover. The French Government has also

given instructions to the various Mayors and Prefects of the districts, through which the British Association will pass, in the five days' excursion at the conclusion of the meeting, to take official notice of the tour. The motor-car exhibition arranged by the Mayor of Dover for the Tuesday afternoon has been declared by the Board of Trade an international exhibition, so that no patents will be invalidated by premature disclosure at the Dover show. The French Association intends to give a considerable amount of attention to the automobile.

The Mayor of Dover will give a *conversazione* in the Town Hall and a garden party in the Connaught Park in addition to the reception at the motor-car exhibition.

The programme of local arrangements will be completed in a few days, and it will then be possible to make a fuller statement of the entertainments prepared for those members of the British Association who may visit Dover.

W. H. PENDLEBURY.

#### "THE WEST INDIAN BULLETIN."

IT was on August 2 of last year that Mr. Chamberlain announced in the House of Commons the decision of the Government, based on the recommendations of the West India Royal Commissioners, to create a special Department of Agriculture for the distressed Colonies, to be presided over by Dr. Morris, of Kew Gardens, who had acted as scientific adviser to the Commissioners. Immediately the proposals were sanctioned by Parliament, active steps were taken to vigorously carry out the scheme. By the middle of September Dr. Morris had left for Barbados, which had been selected as the headquarters of the new establishment, and tours were at once undertaken to ascertain the requirements of the several islands. The result was the organising of a conference of the authorities on agricultural matters in the West Indian Colonies, each island sending delegates to attend the meetings, which were held, under the presidency of Dr. Morris at Barbados, in January last. On the first anniversary of the day on which the Colonial Secretary publicly set the scheme in motion there arrived in this country the first number of the *West Indian Bulletin*, the journal of the Imperial Agricultural Department for the West Indies, a publication which it is intended to supply gratis to all residents in the islands who ask for it. Its prototype is, naturally, the *Kew Bulletin*, but apparently it will not be issued at regular monthly intervals, only as occasion may require. The first part is a double number of 141 pages, devoted almost wholly to the proceedings at the agricultural conference of January already referred to, the subjects dealt with being primarily of interest to the Colonists. In addition to the presidential address, dealing generally with the objects of the new Department, there were papers by Prof. d'Albuquerque on "Sugar-cane manurial experiments," and "The teaching of agricultural science at colleges"; by Mr. Bovell on the "Field treatment of the diseases of the sugar-cane," and the "Cost of growing sugar-canes in Barbados"; by Mr. Fawcett on "Agricultural instruction in agricultural schools in Jamaica," "Practical field instruction in Jamaica," and "The prevention of the introduction and spread of fungoid and insect pests in the West Indies"; by Mr. Francis Watts on "Central factories," Mr. William Douglas also dealing with the same subject. The Rev. William Simms discussed "Agricultural education"; Dr. Alfred Nicholls, C.M.G., "Suggestions for agricultural development in the Leeward Islands"; Mr. Hart, "Improvement in agricultural methods in the West Indies"; and Prof. Carmody made "Brief suggestions on Colonial industries." The bare recital of the titles of the papers will show what a wide field of investigation and action was opened out, and it behoves all who are interested in the future welfare of