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February 13, 1851.

SIR BENJAMIN C. BRODIE, Bart., V.P., in the Chair.

A paper was read, entitled, "On Rubian and its Products of Decomposition." By Edward Schunck, Esq., F.R.S. Received January 9, 1851.

After advertng to the obscurity in which the inquiry concerning the state in which the colouring matter of Madder originally exists in this root is involved, the author refers to the change which takes place in the root, especially if in a state of powder, during the lapse of time, and to the little light which has been thrown by chemical investigations on the nature of the process by which the change is effected. He states that it has been suspected by several chemists that there exists originally some substance in madder, which, by the action of fermentation, or oxidation, is decomposed, and gives rise by its decomposition to the various substances endowed either with a red or yellow colour, which have been discovered during the chemical investigations of this root. In his papers on the colouring matter of madder, he has described four substances derived from madder, only one of which is a true colouring matter, but all of them capable under certain circumstances, as for instance in combination with alkalis, of developing red or purple colours of various intensity. After referring to the opinions of M. Persoz and the investigations of Mr. Higgin relative to xanthine and alizarine, the author observes that, by adding a variety of substances to an extract of madder with cold water, he was enabled to ascertain under what circumstances and by what means the tinctorial power of the liquid is destroyed, and consequently what is the general character of the substance or substances to which it is due. He found that by adding sulphuric, or muriatic acid to the extract, and heating, the liquid, after neutralization of the acid, was no longer capable of dyeing. The tinctorial power was also destroyed by the addition of hydrate of alumina, magnesia, protoxide of tin, and various metallic oxides, but not by carbonate of lime, or carbonate of lead. In all cases in which the property of dyeing in the extract was destroyed, he invariably found that its bitter taste and bright yellow colour were destroyed. Having shown, in his former papers on this subject, that the intensely bitter taste of madder and its extracts is due to a peculiar substance to which he has given the name of *rubian*; and as it appeared from these preliminary experiments that this substance, though itself no colouring matter, is in some way concerned in the changes whereby a formation of colouring matter is induced in aqueous extracts of madder, he proposed to himself to examine its properties and products of decomposition more in detail than he had hitherto done.

After numerous experiments, undertaken with the view of obtaining pure rubian in quantities sufficiently large for the purposes of examination, he discovered a property of that substance, by which he was enabled to obtain it in a state of purity, namely the remark-

able attraction manifested by it towards all substances of a porous or finely-divided nature, which is perhaps more characteristic of it than any other. The method he finally adopted, and which, he states, surpasses all others in facility and certainty of execution, is fully detailed.

Rubian, when prepared according to this method, is a hard, dry, brittle, shining, perfectly uncrystalline substance, similar to gum or dried varnish. It is not in the least deliquescent, as xanthine is described to be. In thin layers it is perfectly transparent, and of a beautiful dark yellow colour; in large masses it appears dark brown. It is very soluble in water and in alcohol, more so in the former than in the latter; but insoluble in æther, which precipitates it in brown drops from its alcoholic solution. Its solutions have an intensely bitter taste. When it is pure, its solution in water gives no precipitates with the mineral or organic acids, nor with salts of the alkalis or alkaline earths. Basic acetate of lead, however, gives a copious light red precipitate in a solution of pure rubian, the solution becoming colourless; but this is the only definite compound of rubian with which the author is acquainted. He states that rubian cannot be considered as a colouring matter in the ordinary sense of the word. It is decomposed by acids, alkalis, chlorine, heat and ferments. The formula for rubian appears to be $C^{56} H^{34} O^{30}$.

The action of sulphuric acid on rubian is stated to be precisely the same. The products of the decomposition by those acids are,—1st, *Alizarine*; 2nd, the substance which the author formerly termed Beta-resin, but which he now calls *Verantine*; 3rd, the substance which the author in former papers has called Alpha-resin, but to which he now prefers giving the name of *Rubiretine*; 4th, a body which has not hitherto been observed, and which he denominates *Rubianine*; and 5th, a sugar obtained from the acid liquid after the complete decomposition of the rubian.

1. The alizarine obtained from the decomposition of rubian exhibits all the usual properties of this well-known substance. Its colour is dark yellow, without any tinge of brown or red. The crystals possess a lustre which the author has never seen equalled in this substance. The analysis gave the formula $C^{14} H^5 O^4$. Thus by simply losing 14 equivs. of water, 1 equiv. of rubian is converted into 4 equivs. of alizarine.

2. Verantine, in most of its properties, coincides with the substance to which the author formerly gave the name of Beta-resin of madder. When prepared according to the method described in the paper, it is obtained in the form of a reddish-brown powder. When heated on platinum foil, it melts, and then burns away without leaving any residue. It dissolves in concentrated sulphuric acid, with a brown colour, and is reprecipitated by water in brown flocks. On heating the solution in concentrated sulphuric acid, it becomes black, sulphurous acid is disengaged, and the substance is decomposed. Concentrated nitric acid dissolves it on boiling, with a disengagement of nitrous acid, forming a yellow liquid, from which nothing separates on cooling. It is almost insoluble in boiling water, but readily

soluble in boiling alcohol, and is again deposited, on the alcohol cooling, as a brown powder, which is its most characteristic property.

From an experiment described in the paper, the author is inclined to conclude that alizarine and verantine are capable of forming a double compound with alumina soluble in boiling water, and that a mixture of the two in the proportion in which they exist in this compound constitutes what has been called purpurine.

Although the difficulty of obtaining pure verantine in sufficient quantity for the purposes of analysis prevented the author from determining its composition with the requisite accuracy, he obtained approximations sufficiently near to remove almost all doubts on the question. The formula deduced from four experiments is $C^{14} H^5 O^5$; so that it appears that verantine differs from alizarine by containing 1 equiv. more of oxygen.

3. Rubiretine is identical with the substance which the author formerly called Alpha-resin of madder. He endeavoured in vain to determine the atomic weight of this substance; but states that there is only one formula which is in accordance with his analyses, and at the same time satisfactorily explains its formation. This formula is $C^{14} H^6 O^4$; so that 2 equivs. of verantine and 2 equivs. of rubiretine with 12 equivs. of water give 1 equiv. of rubian.

4. Rubianine greatly resembles rubiacine in its appearance and many of its properties. It may however easily be distinguished by several characteristics, and above all by its composition. It is obtained from a solution in boiling alcohol in the form of bright lemon-yellow silky needles, which when dry form an interwoven mass. It is less soluble in alcohol, but more so in boiling water, than any of the preceding substances. On the solution in boiling water cooling, it crystallizes out again in yellow silky needles. Its colour is lighter than that of rubiacine. When heated on platinum foil, it melts to a brown liquid; then burns, leaving a carbonaceous residue, which on further heating disappears entirely. It is soluble in concentrated sulphuric acid, with a yellow colour; the solution on boiling becomes black, and gives off sulphurous acid. It is not affected either by dilute or concentrated nitric acid even on boiling; it merely dissolves in them, and, on the acid cooling, crystallizes out again as from boiling water.

There are three formulæ, all of which give for 100 parts of this substance numbers not widely differing from those deduced from the analyses, viz. $C^{28} H^{17} O^{13}$, $C^{32} H^{19} O^{15}$, $C^{44} H^{24} O^{20}$, but the last is that with which they best agree.

5. The sugar is always obtained in the form of a transparent yellow syrup, which neither crystallizes, however long its solution may be left to stand, nor becomes dry unless heated to $100^{\circ} C$. There are two formulæ, $C^{14} H^{14} O^{14}$ and $C^{12} H^{12} O^{12}$, both of which agree with the analyses of this substance, and explain its formation. The author states the views to which each of these formulæ gives rise, and the reasons for adopting the latter.

Although five substances are produced by the action of acids on rubian, the author does not consider that these substances are all

formed together, or in other words, that one atom of rubian, by its decomposition, gives rise to all five at the same time; but that, from the composition of these substances as compared with that of rubian, it follows, that the decomposition affects three separate atoms of rubian. One of these atoms loses 14 atoms of water, and is converted into alizarine. The second loses 12 atoms of water, and then splits up into verantine and rubiretine. The third takes up the elements of water, and then splits up into rubianine and sugar. Whether it would be possible to confine the decomposition of rubian entirely to one of these processes, or whether all three are essential, he considers is a question of the highest importance, not so much in a theoretical as in a practical point of view; and that should any chemist succeed in changing rubian entirely into alizarine, he would be the means of giving a great stimulus to many branches of manufacture and adding largely to the national wealth.

February 20, 1851.

LIEUT.-COL. SABINE, V.P. and Treas., in the Chair.

The Chairman stated, that Mr. John Scott Russell, who ceased at the last Anniversary to be a Fellow of the Society in consequence of the non-payment of his subscription, had applied to the Council to be reinstated, alleging that his numerous avocations and absence from England caused him to overlook the fact of his subscription not having been paid. The Chairman therefore gave notice, that, in accordance with the statutes, the question of the readmission of Mr. Russell into the Society would be put to the vote at the ensuing meeting.

A paper was in part read, entitled "On Periodical Laws discoverable in the mean effects of the larger Magnetic Disturbances," by Lieut.-Col. Sabine, V.P. and Treas. R.S., &c.

February 27, 1851.

SIR FREDERICK POLLOCK, Lord Chief Baron, V.P.,
in the Chair.

The question of Mr. J. S. Russell's re-admission into the Society was put to the vote and carried.

Lieut.-Colonel Sabine's paper, entitled "On Periodical Laws discoverable in the mean effects of the larger Magnetic Disturbances," was concluded.

In a discussion of the *two-hourly* observations of the magnetic declination, made in 1841 and 1842 at the observatories of Toronto and Hobarton, published in 1843 and 1845, the author expressed an opinion that the magnetic disturbances, of large amount and apparently irregular occurrence, commonly called magnetic storms or shocks,