is considerable. Thallium has three *oxalates*, much resembling those of the potassium series; their solubility, however, increases (instead of decreasing) as the oxalic factor accumulates. The *normal oxalate* dissolves in 68 parts of water at 15°, and in 11 of boiling water. The density is 6·31. On heating, it behaves like plumbic oxalate. The crystals of this salt belong to the clino-rhombic system, but are quite unrelated to any of the corresponding potassic or ammonic oxalates hitherto described. The plane of the optic axes is parallel to the plane of symmetry; the double refraction is very energetic. *Hydro-thallous oxalate*—

$$TlHC_2O_4 + Aq.$$

crystallises in the clino-rhombic system; but its primitive form is irreconcilable with that of hydro-potassic oxalate. The specific gravity is 3·971. It is soluble in 19 times its weight of water at 15°, and in less than its weight of boiling water. There is also an anhydrous salt, whose primitive form is an oblique rhomboidal prism, likewise incompatible with the potassic salt. In both, the double refraction is energetic, and the acute bisectrix positive: but, in the former, the plane of the optic axes is parallel to the plane of symmetry; in the latter, it is normal to that plane. In the former, the proper dispersion is strong, with $\rho < \nu$; in the latter, it is weak, with $\rho > \nu$. The oxalate— $Tl_2C_2O_4 + 3H_2C_2O_4 + Aq.$ ("quadroxalate"), is closely akin to the corresponding potassic salt, both in composition and geometrical form. It shows a powerful double refraction. The plane of the optic axes is almost normal to the base. The proper dispersion of the axes is decided, with $\rho < \nu$; the acute bisectrix is negative, and very oblique to the base. The crystals are very fragile.

Thallous *picrate* is anhydrous. Its colour is yellow, when prepared with but once cooling; but, by Deville's method, this is gradually modified to a vermilion-red. At 150° the dry red salt is soon transformed into the yellow modification. Thallous picrate is less soluble than potassic picrate, one part of it requiring 280 parts of water at 15°, while potassic picrate requires 245. Its density is 3·039. Even a temperature of 270° fails to decompose it, but at 300° it detonates with violence. The red crystals are clino-rhombic; they have a vitreous lustre, and the plane of their optic axes is parallel to that of symmetry. The mean value of the index of refraction is $\beta = 1{\cdot}827$ (for the yellow line of sodium).

Reduction of Cupric Salts by Tannin

E. PALLUCCI has pointed out that tannin in all its forms reduces cupric oxide in alkaline solution, and forms a red precipitate of cuprous oxide, just in the same way as glucose does; and that the neglect of this circumstance has led to many errors in the estimation of sugar and vegetable juices, and especially in the valuation of the must of the grape: for this liquid contains the tannin derived from the skins of the grapes; and consequently, if the quantity of sugar contained in it is determined by that of the cuprous oxide thrown down, without regard to the reducing power of the tannin, the sugar in the must, and therefore also the alcohol which it is capable of yielding by fermentation, will be over-estimated. This source of error may, however, be easily eliminated by first treating the liquid under examination with basic lead acetate, which completely precipitates the tannin; the glucose may then be estimated in the filtrate.

The importance of attending to this matter in saccharimetric researches will be evident, when it is remembered that tannin is a substance very widely diffused in the vegetable kingdom; and that many vegetable substances, in which sugar is frequently sought for, contain at certain stages of their growth a quantity of tannin two, three, four, or even five times as great as that of their sugar; the greater number of fruits, not excepting the grape, belong indeed to this category. Other substances besides tannin, as for example gallic acid, pyrogallic acid, and many colouring matters, including that of wine, are also capable of reducing the alkaline cupric solution; but all these, as well as tannin, are completely precipitated by basic acetate of lead.—[Ann. di Chem. app. alla Med., Sept. 1869, p. 132.]

IN the preparation of quinine and cinchonine, a black, tarry substance is found in considerable quantity. This product, the "quinoidine" of commerce, contains a number of cinchona alkaloids, but is not used to any great extent in medicine. MM. Henry, Duguet, and Perret have much increased its value by converting the alkaloids into picrates, thus forming a mixture which can be used with advantage as a very cheap and efficient febrifuge.

GEOLOGY

The Tithonian Stage

PROFESSOR PICTET has communicated to the Swiss Society of Natural Sciences a most interesting report, containing a detailed discussion of a question which has lately acquired much importance, namely, the limitation of the cretaceous and jurassic periods. The Tithonian beds (Titonische Etage) of Oppel, as is well known, occupy a sort of intermediate position between the great jurassic and cretaceous series of deposits, and they have been referred by different authors sometimes to one and sometimes to the other of these great formations. Thus, Professor Oppel himself considered that his Tithonian stage brought the jurassic period a step forward in time, whilst M. Hébert regarded the deposits studied by him as carrying the lower part of the cretaceous formation further back. Of late years these doubtful deposits have been detected in many places, scattered from the Carpathians to the Mediterranean, through Italy, Switzerland, France, and Spain.

Professor Pictet considers that wherever these beds occur, the arrangement of the strata is in accordance with the following sectional view:—

1. Neocomian stage proper.
2. Valangian stage and marls with *Belemnites latus.*
3. Berrias limestone.
4. Tithonian stage.
5. Bed with large specimens of *Aptychus* (Kimmeridgian).
6. Jurassic fauna with *Ammonites tenuilobatus.*

The question to be settled is where, if anywhere, in this section the line of division between the jurassic and cretaceous formations is to be drawn, between 3 and 4, between 4 and 5, between 5 and 6, or finally through the middle of 4, dividing it into a jurassic and a cretaceous Tithonian.

The Stramberg limestone, which the author regards as nearly identical with the limestone of the Porte de France and Aizy, contains 55 species of Cephalopoda, of which 50 have been described as new by Zittel, whilst the other 5 have their analogues in the cretaceous period. This would seem to be in favour of the cretaceous nature of this bed; but the Brachiopoda, which have been thoroughly worked out, tell a different tale: of 38 species 26 are new, 11 belong to the jurassic period, and 1 (*Terebratula janitor*, Pict.) is common to this deposit and that of the Porte de France. It appears, however, that the strict contemporaneity of these fossils is somewhat doubtful, inasmuch as Zittel has found that the molluscan fauna of Stramberg (omitting Cephalopoda and Brachiopoda) is nearly identical with those of Wimmis and Mount Salève, which have been hitherto regarded as Corallian. But neither at Wimmis nor at Mount Salève does *Terebratula janitor* occur, nor are any of the Cephalopoda of Stramberg found there, so that it is possible the Stramberg deposit consists of two beds, of which the newer contains the above-mentioned Cephalopods and *Terebratula janitor*, and the older corresponds with the Swiss deposits at Wimmis and Mount Salève—the latter might then be the highest term of the jurassic series, and the upper Stramberg bed the lowest of the cretaceous, thus carrying the divisional line through No. 4 of the above section. M. Coquand has found the fauna of *Terebratula moravica*, which is also that of Wimmis and Mount Salève, occupying deposits in Provence which are covered by beds containing Kimmeridgian and Portlandian Ammonites, and therefore evidently jurassic. From the consideration of these facts the author infers that there have been in different regions two different orders of succession. In one (Provence, Salève, Wimmis,) the stages are nearly in conformity with those which occur in the rest of France, and the limits of the jurassic and cretaceous periods appear to be clear. In the other, included between the Carpathians and Italy (with a portion of the French Alps, &c.), the Tithonian stage prevails upon the confines of the two great periods.

By an investigation of the palæontology of the beds thus characterised as forming the Tithonian stage, Professor Pictet arrives at the following divisions in ascending order:—

1. The fauna of *Ammonites tenuilobatus.*
2. The fauna of the inferior Tithonian, known principally from Rogoznik, the blue marble of the Apennines, and probably the Tyrolese limestone with *Terebratula diphya.*
3. The fauna of the upper Tithonian or Stramberg limestone (*Terebratula janitor*).
4. The lower Neocomian stage, especially the Berrias limestone (*Terebratula diphyoides*).

Jurassic characters predominate in Nos. 1 and 2; No. 3 is rather cretaceous; hence the divisional line, *if drawn at all*, will fall between Nos. 2 and 3. But the author is of opinion that there is no necessity for drawing this line, and he remarks that the whole of the four stages are combined by strong palæontological analogies. Species pass from 1 to 2, from 2 to 3, and from 3 to 4; Nos. 2 and 3 especially, which would be separated by the line of demarcation of the two periods have about one-third of their species in common. This line would therefore be a very feeble one, and we should have to admit that in this Tithonian basin at any rate the separation of the cretaceous from the jurassic periods is singularly compromised.

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PHYSIOLOGY

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