and chlorine atoms become respectively combined with water. With sufficient water present the original union between the sodium and chlorine atoms will become entirely severed, the Faraday bundle starting with its positive extremity on the sodium atom will terminate at its negative end *by means of a plurality of strands on a number of water molecules*, and similarly the Faraday bundle emanating by its negative extremity from the chlorine atom will terminate at its positive end in a plurality of strands also on a number of water molecules. In such a solution we should thus have independence of the sodium and chlorine atoms, or the phenomenon of ionisation. In such a solution, moreover, the union between sodium and chlorine would be entirely abolished through the complete diversion of the strands of the Faraday bundle formerly uniting them, whilst the union between the oxygen and hydrogen of the water molecules would be but slightly weakened owing to only a small fraction of the total number of strands in the bundles uniting the oxygen and hydrogen in each molecule being diverted by the sodium and the chlorine. The dissociation into its ions of an electrolyte on solution in water would thus be the consequence of the antecedent hydration of the ions.

Some of the colour changes attending the attachment of water of crystallisation may be interpreted in the same way. Thus anhydrous copper sulphate is colourless, whilst the crystallised salt containing five molecules of water is blue. The direct union of the copper atom by means of two Faraday bundles with the SO_4-group leads to the production of a colourless compound, whilst by the diversion of the strands of these bundles, through the attachment of five molecules of water, the copper atom and the SO_4-group become severed, and the blue colour characteristic of the copper ion makes its appearance.

According to this view solution should always be attended by the weakening of the union between at least one pair of bonds in the molecule of the solute owing to the diversion of at any rate some strands of the bundle or bundles, and such loosening is betrayed in the greater chemical reactivity of substances in solution.

Similarly in catalytic phenomena, the catalytic agent may be regarded as diverting some of the constituent strands of bundles, and the action of water in effecting ionisation, *i.e.* complete diversion of bundles, would thus appear as an extreme case of catalysis, leading to such an acceleration of the velocity of reaction between electrolytes that reactions between ionised electrolytes are practically instantaneous.

It is needless to say that this is merely a preliminary and very imperfect attempt to apply the electronic theory to a few of the most familiar and important chemical phenomena. Sir Oliver Lodge's suggestion with regard to the electrical interpretation of valency and bonds is indeed so luminous and stimulating that it should provoke the careful review of chemical facts by the light of this new conception of the possibility of an indefinite number of different grades of chemical union, of which the union by chemical bond, hitherto the only one generally recognised, is to be regarded merely as an extreme case.

Birmingham, June 27. PERCY F. FRANKLAND.

Science in the Common Examination for Entrance to Public Schools.

IN the interests of education, may I ask you to find room in your columns for the enclosed copy of the science paper recently set in the above examination? The average age of the candidates may be taken as about thirteen years. Comment is almost superfluous. The effect, whether intentional or not on the part of those who set the questions, of such an examination paper must be to discourage science in the preparatory schools. No boy of thirteen years of age could or should be expected to answer more than a very small portion of so advanced a paper. If headmasters of preparatory schools are led to imagine that this is the kind of thing that is expected of their pupils, in very despair they will be forced to abandon science entirely, and fall back upon its alternative in this examination—Latin verse.

This common examination has now been held for the first time, and it is important that an emphatic protest should be raised without delay. If the science paper is allowed to be of this unreasonable character, the subject will receive a set-back that will go far towards undoing all that has been tardily achieved during the last twenty years in regard to scientific teaching in our public schools.

OSWALD H. LATTER.

Charterhouse, Godalming, July 2.

June 29, 1904.—SEVENTH PAPER.
(Alternative with Latin Verse.)

COMMON EXAMINATION FOR ENTRANCE TO PUBLIC SCHOOLS.

SCIENCE.—(*One hour.*)

I.—*Physics.*

(1) A weight hangs by two strings each making an angle of 60° with the vertical. Show that the tension of each string is equal to the weight.

(2) A uniform rod 10 feet long and weighing 5 lb. is pivoted 3 feet from one end. A weight of 50 lb. is hung on the end nearer to the pivot. Find what weight must be hung on the opposite end to balance the rod.

(3) Gravity is often measured by the number 32. Explain this. A body is thrown up with a velocity of 48 f. s. In what time will it lose its velocity? In what time will it return to the hand? How high will it go?

(4) A rectangular vessel on a square base is filled with water. Find the relation between the height of the vessel and a side of the base in order that the fluid pressure on one vertical face may equal that on the base.

II.—*Botany.*

(1) Enumerate the floral whorls from outside inwards. Explain what is meant by cohesion and adhesion among floral organs. Make a careful drawing of the section through a flower in which petals and stamens adhere to the calyx tube. Name a flower in which you have observed this structure.

(2) A potato is often spoken of as a root. Is this correct? Give reasons. Name three other cases in which a similar error is made, explaining the real nature of the organ in question.

(3) Draw sections shown in cutting lengthwise through a bean (or acorn) and a grain of barley (or date stone). What difference would be observed during their early growth? Of what great divisions of plants are these characteristic respectively?

(4) What plants would you expect to find in flower in a damp wood on a clay soil in April? Describe one or more of them.

An Early Mercury Pump.

IT may interest some of your readers to know that as early as 1820 an air pump was described depending on the formation of a Torricellian vacuum, and therefore on the same principle as Geissler's and its successors. The paper is by M. Fafchamps—"Description d'une machine pneumatique à l'aide de laquelle on opère le vide sans le secours de la pompe" (*Annales générales des Sciences physiques*, Bruxelles, vol. vi., 1820, pp. 101–2).

A vertical tube standing in a trough is provided with a stop-cock near its upper end. The tube above the stop-cock has a reservoir at the top, and on each side is a stop-cock, one connected with the vessel to be exhausted and the other to a large funnel. The upper end of the reservoir is also provided with a stop-cock. To work the machine the reservoir is first filled with mercury or some other liquid which is introduced through the funnel, the air being expelled through the stop-cock at the top of the reservoir. When filled with liquid the stop-cock of the reservoir is closed, and communication with the funnel is cut off. The stop-cock on the tube is now opened, when a Torricellian vacuum is produced in the reservoir; on opening the cock connected with the receiver air is withdrawn, and so on.

The author remarks that if mercury is used, the vertical tube must be 758 mm. long; if water, the tube must be more than 10 metres, but the length of the tube may be reduced by diminishing the atmospheric pressure on the

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