with the aid of his scholars is oftentimes the most useful for purposes of instruction. Many and many a school has invested in trifling electrical playthings a sum of money which would have gone far towards the establishment of a simple working laboratory.

"In physics the laboratory practice must needs be somewhat limited. The pupils may handle whatever apparatus happens to be available, learn its manipulation, and assist the teacher in the construction of simple appliances. The magnetization of needles, the electrolysis of liquids, the verification of the fixed points upon a thermometer, and rough determinations of specific gravity, boiling point, and melting point are among the many experiments which ought always to be possible.

"In the chemical laboratory a much greater variety of work is easily attainable. There are the ordinary experiments in manipulation, such as the bending of glass tubes, filtration, precipitation, distillation, &c., the preparation of the commoner gases, acids, and salts; the verification of the more obvious properties of the chemical elements; and lastly, the simpler reactions of qualitative analysis. To the last named subject some time may always be profitably assigned. No other class of exercises will do so much towards impressing the average beginner or towards making him realize the nature of chemical reasoning. At every step it calls his powers of judgment into play. It involves the use of no costly apparatus, and enough can be done for all school purposes with a very moderate supply of the cheaper chemicals. At an expense of a hundred dollars a year a great deal can be accomplished; and an outlay of only one-fifth of that sum may yield results which are by no means to be reckoned as trivial. Again let it be said that success depends upon the teacher and not upon the cost of materials."

We shall in our next issue continue our notice of this interesting report.

ON COMETARY APPEARANCES.[1]

By M. Jamin.

[Translated from the French by the Marchioness Clara Lanza.]

The question of comets seems at present to occupy the attention of all *savants*, and as M. Faye has prevailed upon physicists to take up the subject also, I have decided to enter into the discussion, not with the intention of creating any novel hypothesis, but rather to oppose that which M. Faye imagines to be the correct one. In the first place, it appears to me unnecessary. It contradicts in my opinion, the theory of the vibration of the ether. Besides, it deprives the law of gravitation of its generality and simplicity. In his first work, M. Roche determined, by means of calculation, the form of the horizontal strata of cometary atmospheres subject to the sun's attraction, but he omitted to note the variations of temperature occasioned by the solar rays on the two sides of the comet. In this way he was led to think that the latter must have two tails, one turned towards the sun, the other away from it, which supposition is contrary to reality, as it should be, in fact, inasmuch as it overlooks the cause which manifestly determines the unsymmetrical forms of the two sides. In a second paper, however, he makes a correction, by supposing the existence of a repulsive force diminishing the solar attraction about 1—to 1. ϕ, ϕ, being a force acting unequally upon different substances, and which is in reverse ratio to their density. This hypothesis admits of the calculation being achieved with facility, but it has no physical actuality. It is confined to replacing the warmth of the cometary atmosphere, which should be included in the calculations, but which has been forgotten, with a wholly imaginary action whose existence no experiments have ever confirmed. I shall endeavor to re-establish the effect due to the unequal warmth of the two sides by referring to analogous conditions which should exist between the Earth and comets.

Upon the Earth, every day throughout the year, the solar rays one after the other in regular succession strike normally all the points of a circle perpendicular to the axis of rotation and near the equator. These points on all portions of the globe are those that receive the maximum of heat at noon. They constitute what is termed the *ring of aspiration*. The air there really becomes rarified and ascends, advancing towards the north or the south, as the case may be, determining two gaseous currents called trade winds. These currents are permanent and regular; they come from temperate climates, grow warmed progressively in their course, carry with them an intense evaporation, are slightly deviated towards the west in consequence of the Earth's rotation, and finally meet obliquely upon the ring, to rise to the highest atmospheric limits. There they spread, then taking a contrary course, return, one towards the north, the other towards the south. These are the *counter trade winds*. There are, therefore, on the two sides of the ring of aspiration, two closed atmospheric currents completely enveloping the globe, coming cold from the poles, grazing the Earth, and then returning warm, by a higher route. There is no occasion to dwell upon the chief *role* played by this circulation. It is sufficient to merely demonstrate its necessity, its constancy and its extent, besides recalling the theory due to the famous Halley, which has never been contested.

This circulation would still exist although under changed conditions, if the Earth instead of turning on its axis always presented the same side to the Sun. The ring of aspiration would be reduced to a single point, the trade winds would converge in all directions, while the counter winds would diverge in the same way. All points of the Earth would send to this summit cold air which would grow warm there, *rise in the form of a cone toward the Sun, spread, become bent upon the edges like the chalice of a cyrathiform flower*, leave the Sun by a high route and after a more or less prolonged journey would return to the point of departure grazing the Earth's surface. It is very evident that this double movement would possess an increase of force proportionate to the Earth's approach to the Sun; that its atmosphere would be more extended, and that there would be a greater mass of water to be evaporated. This does not imply any particular repulsive force.

But let us get to the comets. In the long journey which they perform slowly until they are beyond the Solar world, they have plenty of time to lose all the heat received from the Sun, and to efface all traces of perturbation. The tail disappears, the matter is knit together by its own attraction and assumes a nebulous, spherical form. In the centre are the dense, solid substances, the nucleus, then the liquids and finally the gases. An enormous atmosphere and a very small nucleus. In Donati's comet the nucleus measured 1600 km., while the atmosphere was 20,000 km. The comet of 1881 was still more extraordinary. Its aureole measured 2,000,000 km., the nucleus was reduced to 680. This is just contrary to the Earth whose diameter amounts to 12,000 km., while its atmosphere is merely a thin pellicle of 18 or 20 leagues. Comets are so constituted that the most tremendous atmospheric movements are developed be-

[1] See *Comptes Rendus*, August 16, 1881.

neath the Solar action incomparably more accentuated than those exhibited by the Earth.

As no rotatory motion has ever been observed in comets or their atmospheres, we feel authorized in saying that if it does exist it is exceedingly slow, without taking into account the fact that comets always present the same side to the Sun. The second method of heating should therefore be produced. In every plain passing through the centre of the Sun and the nucleus, there will be a double atmospheric circulation. On the interior, the comets advance towards the Sun as though the gravitation there was intensified. On the exterior, they deviate as if the gravitation was diminished, or rather as though there existed some repulsive force emanating from the Sun, affecting the exterior surface of the cometary atmosphere, and acting solely upon it. In reality, this repulsive force does not exist. It seems as though it did, however, and under conditions analagous to those inferred by M. Faye. All the consequences therefore, which he deduced in order to explain the formation of the tails, are developed naturally. There is nothing here to be altered.

I do not think, however, that this theory is sufficient to account for cometary appearances. On the contrary, it is my opinion that electricity has a great deal to do with them. But before entering upon this let us first return to terrestial phenomena.

It has been satisfactorily proved that considerable electricity exists in atmospheric altitudes, and that it increases according to the height. It is admitted generally that atmospheric motion results; that it is developed by evaporation at the ring of aspiration; that it moves from the time it leaves this ring until it reaches the poles under the form of two currents in the rarified air which it illumines. Towards the sun it is the zodiacal light, invisible when close to this planet, but extending a sufficient distance to be perceived, especially near the equator. Close to the poles it is the aurora borealis, which we see obliquely and which appears more luminous than at the zenith, because it has greater density and is more concentrated.

Upon a comet the warmth occurs at the point where the trade winds come together opposite to the sun. But analogous electric actions should be manifested, illuminate the head and produce the appearance of effluviums succeeding each other like the stratifications in a Geissler tube, accompany the counter trade winds to the opposite side to illumine the tail, and be prolonged to a great distance like the luminous rays in Mr. Crookes's apparatuses. No doubt, matter would be contained in the tail, but rarified to an extreme degree and made visible by both the solar light and the electric current.

M. Flammarion would be quite right then to attribute this shining to electricity. On the other hand, M. Berthelot's observation would be justified, and the development of this electricity would be due to the phenomena of evaporation and movement situated in the atmosphere. We must insist upon this point.

The recent study of cometary spectra has shown us beyond the possibility of a doubt that the interior aureole and the tail contain carburetted gases which emit a light of their own. Now, they can only become luminous in two ways; either by combustion or by an electric effluvium. If by combustion, we have yet to explain how they take fire and how they continue to burn indefinitely, which seems very difficult. For in this case, all the materials of which the comet is composed would be red, and the spectrum would contain the bright spectral rays of the metals as we see them in the electric arc burning n mid air. Nothing of this kind occurs. The light is absolutely like that of the arc when the vaporous carbon is transported to the torpid gases without burning. It shows no brilliant metallic bands, any more than this arc. The light, therefore, cannot be the result of fire, but is due to illumination made by the currents.

I think that the Sun determines gaseous currents in cometary atmospheres analogous to terrestrial trade winds and counter trade winds; that this circulation produces near the Sun effluviums arising from the head of the nucleus and transports to the opposite side the substances which are on the exterior, producing upon these substances the effect of a repulsive force emanating from the Sun, a force which has absolutely no *raison d'ètre*. Besides this, I think this circulation is accompanied by an electric movement which illumines the gases either towards the head or tail, as the case may be, making them visible to us notwithstanding the feebleness of their density, and precisely on account of this feebleness.

AMYLOSE: ITS CONSTITUENTS AND METHODS FOR THEIR ESTIMATION.

By H. W. Wiley, Lafayette, Indiana.

I propose the name AMYLOSE for all the varieties of sugar and sugar-like substances derived from starch.

These substances are now known by many different appellations, and often the indiscriminate use of these terms gives rise to a great deal of misunderstanding and confusion. Among them I may mention grape sugar, starch sugar, dextrose, dextrine, glucose, maltose, fruit sugar, etc. These names do not always have the same signification in different localities. For instance, glucose and dextrose, in Europe, signify the same product, while in this country they embrace many other substances besides.

If we designate the starch sugar in general by amylose then the terms glucose, dextrose and maltose can be used to designate certain definite constituents of amylose.

Amylose is composed of three principal ingredients.

1st. Dextrine. Pure dextrine is very difficult to obtain. It is obtained almost pure by the dry roasting of starch. The temperature during torrefaction must not be carried too high, 210°–275°. Starch itself has a specific rotatory power of 214° (1). Bondonneau (*loc. cit.*), asserts that there are three dextrines, (α), in which aj (2) = 186°; (β), in which aj = 176°; (γ), in which aj = 164°. According to Musculus and Grubber (3), there are five dextrines; viz.: (*a*), soluble starch colored wine red by iodine aj = 218; (*b*), Erythro dextrine, red color with iodine; rotating power not given.

(*c*), α Achroodextrine, not colored by iodine, j = 210.

(*d*), β Achroodextrine, aj = 190.

(*e*), γ Achroodextrine, aj = 150.

Of these varieties the first and second do not reduce the alkaline copper solutions while the others do. If the reducing power of dextrose be taken at 100, that of the third of the above dextrines will be 12; the fourth 12 and the fifth 28.

O'Sullivan admits the existence of but one dextrine with a = 214.

Thomsen (4) tries to show by history of multiples in the rotating power of the carbo-hydrates that there are at least three dextrines in which the value of aj is 186, 176 and 164 respectively.

I will not multiply authorities concerning the rotating power of dextrine. I have quoted enough to show the highly chaotic state of our knowledge on the subject.

The chemical properties of dextrine are equally as undeterminable.

Gentele (5) is quite confident that dextrine will reduce the alkaline copper solutions and on this he bases his method of separating dextrine from other reducing substances by ferricyanide of potassium.

Stommer (6), Bondonneau (7) and Rumpff (8), are equally

(1) Bondonneau, Ber. d. Deu. Chem. Gesel., IX, 69.
(2) a = specific rotatory power.
(3) Comptes Rendus, LXXXVI, 1459.
(4) Ber. d. Deutsch. Chem. Gesel., 14—2—158.
(5) Ding. Journal, CLII, p. 139.
(6) " " CLVIII, p. 40.
(7) Bull. de la Soc. Chim., 1874, XXI, p. 50.
(8) Zeit. fur Anal. Chem., 1870, p. 358.