and to student alike, for the fact is generally overlooked that they are alone strictly applicable to the elements in the state of *perfect gas*. I could not suggest a better illustration of the kind of error to which the careless use of "molecular formulæ" commonly leads than that unconsciously provided by "Science Master" himself. His equation above given has no justification in fact, as far, at least, as the symbol Na_2 is concerned. The experiment to which it refers is not one made with sodium *gas*, whose molecule *may* contain two atoms (though V. Meyer thinks this doubtful), but with the liquid or solid element, whose molecule may contain 200 atoms for aught we know to the contrary!

As mistakes such as that into which "Science Master" has so innocently fallen are very common, even amongst writers of text-books, it may be well to point out the grounds for the cautious position now taken by an increasing number of chemists in reference to this matter. All the facts known to us concerning gases or vapors near to their condensing point, lead to the conclusion that their molecules are then much more complex in atomic structure than when they are in the state of perfect gas, and it is difficult to resist the conclusion that their complexity must be still greater when the liquid and solid states are reached. We have not any means at present of determining the extent of this atomic condensation, hence it is more in accordance with the spirit of science to put aside mere assumptions and keep well within our facts. And that is just what I have done; for while carefully teaching the two-atom structure of the gaseous molecules in the singularly small number of cases about which we have direct evidence, the general formulæ used are confined to the simplest expressions which can accurately represent the relative atomic weights concerned in chemical changes. By so doing we avoid attempting to teach more than we really know, and so escape pitfalls such as those into which "Science Master" so easily stumbled.

I am, dear sir,

Faithfully yours,

J. EMERSON REYNOLDS.

J. Seath, Esq.,
Inspector of High Schools.

To the Editor of the EDUCATIONAL WEEKLY.

DEAR SIR,—About Mr. Merchant's communication with reference to the study of chemistry in high schools, I wish to say a few words.

With the essential parts of my letter to the WEEKLY he agrees, still, there are a few points upon which a little information may be gained.

Mr. Merchant misapplies his utilitarian idea in regard to the theory of chemistry, for if he were well up in all the principles of the study, I am sure he would find that to keep to theory in every respect would serve the true utilitarian idea as well as furnish the best mental training. The Education Department, I maintain, has virtually selected a text-book on chemistry.

Does Mr. Merchant suppose that, when the student knows that he is to be examined on Reynolds' Chemistry, he will not buy the book? I believe that in the majority of cases the book will be procured. Then there are always a number who study the subject while teaching, and get no instruction other than from a text-book. Will they not buy the work? Mr. Merchant makes some very nice statements about the student investigating everything for himself. I am of the opinion that hardly one out of every ten schools will be able to furnish each student in the class, apparatus, etc., to make each experiment. They haven't the time, nor will one-tenth of the schools be so amply furnished with materials to permit it. How are students who know very little, if any, chemistry, to be suddenly transformed into original investigators? It takes time to be a discoverer in chemistry. One requires to know vastly more than the little he has time to learn in the six or ten months he has at his disposal in the ordinary high school laboratory.

The science of chemistry has made great progress only since Dalton proposed the "atomic" theory, and Avogadro discovered the simple relation that exists between the volumes of gases entering into combination and the resulting volume. The study of chemistry has become vastly easier since the "atomic" theory was advanced. To understand the theory of chemistry thoroughly, and to be able to apply it in the case of all compounds, furnishes the best training to the mind; and I maintain that, to keep the theory, which has done so much to develop chemistry, and which is its foundation, intact as far as possible, one must represent actually what takes place in a reaction, even if it is possible to represent it more simply. This idea is exactly in accord with the teaching of the learned Professor of Chemistry in University College, Toronto. If Mr. Merchant has to prepare any students for a university examination it would be well for him to teach the correct equations, or confusion may be the result. Tilden, the author of a book on chemical philosophy, a work, the study of which would give the student a true and complete idea of chemistry, says: "Chemical changes involve neither the destruction nor creation of matter, but simply a redistribution of the materials of which the acting masses are composed. In order, therefore," he goes on to say, "to represent symbolically the results of any given action, it is only necessary to write down the formulæ of bodies engaged, and then to transpose their symbols in such a manner as to build up the formulæ of bodies which are produced." For instance, we have free hydrogen and free chlorine acting on each other, there is merely a redistribution of the molecules. Thus: $H_2 + Cl_2 = HCl + HCl$, or $2HCl$. Wurtz in his "Atomic Theory," a text-book on the programme of studies in University College, Toronto, treats the point in question in a similar way.

Thus I think I have shown that Mr. Merchant is not quite correct when he makes the statement that it is customary with chemists to use the simplest ratios in representing reactions.

Since writing the above, Mr. Spotton's letter has appeared. A few words with regard to it. Reynolds' book is full of mistakes if the objection I take to it is correct, and I contend it is. I have given some good authorities as to the point of contention. Mr. Spotton has very conveniently taken a very isolated case from Tilden's book. Instead of the equation $2KClO_3 = 2KCl + 3O_2$, one may take $KClO_3 = KCl + 1\frac{1}{2}O_2$ for the comparison of weights. If it is only for convenience in calculating the weights that the latter is taken why not cancel the 2's, thus, $KClO_3 = KCl + 3O$, and then calculate the weights? One would avoid fractions, have it just as simple, and besides, we would use a correct equation. Tilden uniformly uses molecular formulæ. The above equation is about the only one in which he divides the molecule. It is some time since Mr. Spotton graduated. Things have changed since then. Therefore, I would recommend him to obtain the opinion of Professor Pike, of the University of Toronto, and I think he will find that my views accord with his. When, for the sake of simplicity merely, you represent what is not true, then you are doing what is wrong.

Mr. Ellis is, I think, correct in saying that the student's time, which is generally limited, will be wasted if he has to investigate everything for himself. I believe there are very few schools in the Province in which every student, if the class be of any size, will perform every experiment.

I wonder how many high schools will furnish all the apparatus necessary for the experiments mentioned in Reynolds' book!

Second class candidates, who haven't studied the subject before, will find the abstract considerations about atomicity and calculations of atomic weights of less practical value than if they were taught a good general idea of chemical substances together with sufficient theory that they may understand the composition of compounds. I imagine that the nice little reasoning contained in Chapter V. of Reynolds' book would be but poorly appreciated by a student who knows nothing more about chemistry than is contained in the preceding four chapters.

Thanking you for the space required for communication, I am, yours truly,

SCIENCE MASTER.

November 30, 1885.

THE special committee appointed by the Board of Education to purchase physical and chemical apparatus for Paris High School is proceeding with the work as rapidly as circumstances will permit. The selection has been made and the purchase is now only a matter of price and quality. The vacant room at the high school has been fitted up as a laboratory where experiments will be conducted as soon as the new arrangements are perfected. A reference library for the use of teachers and pupils is also spoken of. The new regulations issued by the Education Department entailed considerable expense upon the country, and it is to be hoped that there will be corresponding benefit to the pupils.—*Paris Star-Transcript.*

A COMMUNICATION from A. Cruickshank was read, stating that the executive committee of the Hamilton Teachers' Association are desirous of holding a general meeting during the year in order to secure the Government grant, and advance the interests of the body. They asked that Friday, the 27th inst., be given for that purpose. The chairman asked the board what was their will with regard to Mr. Cruickshank's letter? He (Mr. Morgan) had discountenanced the idea of a holiday when consulted on the subject by Mr. Cruickshank. Mr. Brennen moved, seconded by Mr. Smith, "That the request of Mr. Cruickshank be not granted."—Carried. It seems to be the general opinion of the board that the teachers could attend to the matter in their own time (say on Saturday) without disarranging the schools.—*Report of Hamilton Board of Education.*