

Baden, French Lick, Mt. Aris, Indian and Trinity Springs. The results were *constant* and *accurate*. It also holds in waters containing much mineral matter and organic matter to 350 parts in 100,000.

Second. Will there, without filtering, be an appreciable error? We produce the following data:

## WITH DISTILLED WATER.

No.	Time.	$\frac{1}{10}$ N Na Cl.	$\frac{1}{10}$ N Ag. NO <sub>3</sub>	$\frac{1}{10}$ Am. Sulph.	Ferric Alum	HNO <sub>3</sub> (1.2)
1 . . .	1	3cc	3.5cc	.78cc	3	3
2 . . .	5	5	3.5	.75	"	"
3 . . .	10	3	3.5	.75	"	"
4 . . .	12	"	"	.82	"	"
5 . . .	10	"	"	.75	"	"
6 . . .	10	6	6.5	1.00	"	"
7 . . .	10	6	6.5	.88	"	"
8 . . .	10	"	"	1.00	"	"

We differed from the authors in this—that the solution was *gently* agitated until the color no longer disappeared. With such a standard the error may reach 1.77 pts. in 100,000 pts. as shown by the eighth titration. The observations justify the following inferences:

First. There is an appreciable reaction between the silver chloride and the ammonium sulphocyanide.

Second. The error varies directly with the quantity of chlorine present, and the time employed.

Third. When the reaction of chlorine upon silver nitrate is effected in the presence of ammonium sulphocyanide, the results are inconstant.

Fourth. That it is necessary to filter off the silver chloride, before adding the ferric salt.

Fifth. That by filtering the results are *very* accurate.

Sixth. That if the solution, unfiltered, be allowed to stand ten minutes, the reactions which take place, will produce very appreciable errors.

## SOME SUGGESTIONS TO TEACHERS OF SCIENCE OR MATHEMATICS IN HIGH SCHOOLS.

By THOS. C. VAN NUYS.

It is the purpose of the writer to endeavor to indicate, as briefly as practicable, the spirit which should influence teachers of science or mathematics in high schools.

It is needless to state in this connection that the spirit, in which a teacher

performs his duty, arises from his conception of what education is, consequently, correct views of education in general, are of very great importance to teachers. No system of education can exist, without grave defects, unless there is in the system a certain degree of uniformity in the curriculum of study. Classes of studies for periods of time should be so grouped, that by the pursuit of them, the pupil is led to the highest degree of discipline and culture. Fortunately, the course of study in the public schools of this country is pretty well formulated, but, unfortunately, the course is better adapted for preparing pupils for technical or business education than for scholarship or the learned professions. This defect, however, may, in part, be remedied by the efficiency of teachers.

In order that the teacher of elementary science or mathematics in a high school may become proficient in his work he should first determine what benefit are the pupils to derive from a course of instruction in mathematics and elementary science. Notwithstanding, the tendency of the age is in favor of technical education, the fact is, no class of studies can take the place of the inflected languages, history and literature for a high degree of discipline and culture, and, that full benefit should be derived from linguistic studies, they should be introduced, early in the course, as training in them is easier at an early age.

The study of the humanities, if pursued early in life, when the emotional faculties are springing into existence, results in refining, cultivating the tastes and engendering a broad philanthropy. This is readily understood when it is taken into consideration that through the study of the ancient languages, the pupil becomes acquainted with different phases of human thought, and, because different from modern thought, they are not the less human.

With thorough training in these studies, early in life, the pupil becomes disciplined and refined, disciplined, by long continued mental drill, necessary in acquiring knowledge of the inflected languages, and refined, by sympathy for mankind acquired by a knowledge of the vicissitudes through which the human race has passed. This comes from the study of the humanities being subjective as well as objective. On the other hand, the study of science and mathematics is objective. In these pursuits, the emotions may be dormant, while reason is called into activity. If this be true, it is readily understood why the study of languages, history and literature should precede the study of the sciences and higher mathematics.

To reach the highest results in education the tastes, the moral faculties

and the sensibilities should be developed as well as the intellectual; otherwise, the development is not symmetrical.

The teacher should not encourage the popular opinion that the education which does not enable a person to superintend a factory, make shoes, or build a bridge, is worthless.

In this materialistic age we are apt to employ our educational forces so as to intensify the mad strife we have about us, to make prominent those studies, by a knowledge of which, wealth is acquired and to neglect those studies which tend to refine, temper and balance the mind.

The word discipline is perhaps the most difficult term in pedagogical science to define. No attempt will be made to offer a definition here, further than to state, that by discipline, the pupil has power of self-control, that by it, undivided attention can be concentrated to the subject under consideration. By discipline, there is economy in mental work. The mind is disciplined when it possesses the art of thinking. To many it would seem absurd that it requires many years of systematic study, under good instruction to read a book, or study a subject with profit and, therefore, with understanding, and yet, it is true. While it is claimed that the study of the inflected languages, history and literature, pursued early in life, is imperative for discipline, culture and scholarship, yet if the study of higher mathematics and science be not subsequently pursued (and it might be added in proper spirit), the work of preparation is incomplete.

It is a recognized fact that the body soon becomes accustomed to certain movements which are, with sufficient practice, made almost unconsciously, so the mind, with practice, soon becomes accustomed to certain processes of reasoning.

Although the study of the humanities presents many aspects of thought, yet the mind of the classical student runs in grooves. For him the study of higher mathematics opens up a new field of thought as the processes of reasoning are essentially different from those employed in the study of the humanities.

Method and system in the processes of reasoning are characteristic of the mathematical mind.

The study of chemistry is of importance as a means of cultivation of the powers of observation, but, perhaps, the greatest value of the study of chemistry, is the knowledge of the constitution of matter and the changes it undergoes, producing new bodies. The cultured pupil reads here a wonderful story. His mind dwells on the growth and consequent changes of

living languages, so rapid are these changes that a language is scarcely the same each decade. Every period of history is stamped with changes. Nations grow like plants, remain in the developed state a time, then they decline and upon their ruins other nations spring up, likewise to perish. The student reads in chemical science a similar story told in symbolic language. Hitherto he knew but little of the laws of matter, he now learns that matter and its laws form the basis of all. Were it not for the facts on which the atomic theory is based and were it not that forces are evolved by the reduction of organic matter there could be no mental process, in fact no brain, no muscle. Now, while this expresses a phase of materialistic philosophy yet the pupil who has a thorough training in the studies of the humanities is not easily thrown off his balance. By his long continued training he recognizes the fact that the moral sense or sentiment is a potent factor in nature, that man is not a selfish animal seeking to survive that he may enjoy his sensuous pleasures. Although the age is becoming more rationalistic, yet there never was a time when society was subject to so much vacillation, frivolity and extremes. The craze for something new or sensational precludes sober thought. We may as a nation excel all others in inventions and conveniences and yet we may become a nation of artisans and tradesmen. The pupil who is educated in the humanities, and therefore has a disciplined mind, does not seek for wild theories, even if founded on the results of modern research. Too many men, who represent the results of the new education are without convictions. The character of too many is reflected by current of popular opinion. The greatest need of this age is a generation of men, cultured and disciplined, who have convictions and therefore are not moved by the great waves of thought which often sweep over the country like an epidemic.

The teacher of science, or higher mathematics, in a preparatory school, should consider himself employed to build over, or bridge a chasm at the end of a long line. He should consider his work a necessity to fill out, and round up the intellectual and moral character of the pupils, under his charge.

However different his work may appear from the work of his colleague who teaches the Greek language, or his colleague who studies, with his classes, Shakspeare, Dante or Milton, his work is along the same line. The teacher of science will benefit his pupils much more by confining his instruction to general principles, whether he teaches elementary chemistry, botany or zoology.

After having spent years of persistent study of languages, literature and history, acquiring a knowledge of the inflections of verbs, memorizing the definition of words and becoming familiar with the outline of all forms of speech, with the political divisions of countries of the remote past—in short, with the life of a world in its childhood and now to be introduced into the world of the present, constitutes the most interesting period in the life of the pupil. The teacher guides with watchful care the mental processes awakened by the study of nature. He witnesses a wonderful mental development, wonderful because it springs from a rich store-house of knowledge and because the mental processes are new.

After all, the ultimate object of education is utilitarian in character. The educated man or woman, who is a useful member of society, who is of value to the state, must be of the world. He must be brought in intimate relationship with the affairs of the present, and, for this purpose, the study of science and mathematics is well adapted. A full degree of utilitarianism is not wholly technical in kind. To become useful in any of the learned professions all of the discipline afforded by classical and scientific training, in addition to the training in the professional studies proper, is required.

If education is to be the safeguard of the nation, if it is to prevent the enactment of extreme measures, if it is to act as the balance wheel in the machinery of the social state, it must result in the development of all the resources of the intellect as well as the sense of justice and love of humanity.

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THE SUGAR BEET IN INDIANA. By H. A. HUSTON.

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FORMS OF NITROGEN FOR WHEAT. By H. A. HUSTON.

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A COPPER AMMONIUM OXIDE. By P. S. BAKER.