DEPARTMENTAL CONFERENCES.

ASTRONOMY.

The principal paper read was that of Professor G. W. Myers, of the University of Chicago School of Education, on "The Neglect of Astronomy in the High School." Numerous species of apparatus, constructed in part by the members of a high-school class, were shown to illustrate the points emphasized in the paper. In the discussion which followed the argument was strongly brought forward that under the present conditions the teacher could not afford to put so much time into the building of apparatus and into out-of-door observations as required.

Professor Meyer's paper was as follows:

The doctrine of the fundamental importance of science-teaching in primary and secondary education has had numerous friends and foes since the publication of Spencer's *Education*. Of late years the doctrine has been tightening its hold on the minds of practical American educators. The gradual drifting of practical education toward a still greater increase of emphasis, in elementary and secondary schools, upon nature-study and elementary science as a controlling factor of American education, is perceptible in almost every modern educational institution. The conception of the paramount importance of the study of the mother-tongue—a conception inherited a few years since from polyglot Europe—is weakening, and is being superceded by the view that the child uses his mother-tongue as unconsciously as he uses the air he breathes, and that problems connected with his mother-tongue seem to him artificial, and even "trumped up," if the expression may be pardoned. The force of current arguments for the importance of a training in clear, forceful, and idiomatic expression of thought in the mother-tongue is practically *nil* when considered entirely apart from a direct and very particular regard to the character of the ideas to be expressed.

The writer's experience may be exceptional, but so far as he is able to attribute to his school training definite and certain credit for what has been helpful to him in after-life, it must be reckoned mainly to the score of clear, definite, and pertinent ideas, and to the power to draw immediate and well-warranted inferences from those ideas. Given a body of clearly-conceived ideas in which the student has a spontaneous and vital interest, and most of the difficulty of the teacher's problem of securing clear, accurate, and forceful expression disappears. Is not the conception of the supreme importance in education of expression in the form of language a survival of the period when the sole means of carrying on instruction was by word of mouth? Is there not, in the current teaching of English composition, a painful surfeit of effort spent on the attempt to train students to write brilliant little skits about "nothing in particular"? Favorite themes are "How My Washing Came Home," "College Slang," and "The Tale of an Old Shoe." Anything seems to go as subject-matter for training in English.

In many ways the disposition to treat trifling subjects pompously and attractively is directly antagonistic to the formation of scientific habits of thought, which seek to state the greatest possible amount of truth in the fewest simple, terse, and transparent terms. The newspaper reportorial state of mind is an end of doubtful educational value. Every science-teacher knows the difficulty of getting students to weigh the relative import of ideas, and to write of them with due regard to balance and proportion. Balance and proportion are not so much a matter of paragraphing as of thinking. The habit of spreading trifling ideas over several pages of foolscap is positively detrimental to the formation of these scientific habits. The knot to the pedagogical problem of teaching good English is first tied and then drawn into a distressingly hard one, by the pedagogue himself, by an artificial reversal of the natural order of attaining those ends in real life in which consists the very reason for the importance of a rational training of the power of clear, accurate, and forceful expression. In actual life the acquisition of important ideas on important questions is first and foremost, and the need

of communicating them to our fellows in clear, simple, and forceful language is the second step. The second step is made necessary, of course, because concert of action among men is the only means of realizing in practice the consequences of our thinking. The point here insisted upon, however, is that clear, accurate, and forceful ideas furnish the conditions precedent to clear, accurate, and forceful expression. Speaking more astronomically, overemphasis of English teaching by the use of trashy, or inconsequential, subjects looks in at the wrong end of the pedagogical telescope. Natural proportion and perspective are thus lost to the student, and the power of estimating real values is distorted, if not destroyed. Results approximating the grotesque are the natural consequence of such procedure.

It is for those of us who are engaged in actual teaching to remind ourselves often that most of the advance which the race has made has arisen from the *new ideas* that men have discovered, mastered, and applied, and not from the mere polishing of the means of expressing them in language. Free and facile power of expressing these ideas have, of course, greatly aided their introduction and acceptance; but just now it is a question of where the emphasis should rest in the early, more significant, and more difficult stages of school work. Should it rest on the stimulation of clear, worthy, and distinct ideas of some useful sort, and on the arousing of an interest in them, where the normal interest does not already exist; or should it rest upon the clear, simple, and forceful statement of these ideas in language, with but secondary regard to the nature of these ideas? Evidently both are of great importance. Still it is not at all the old question: which is the more important, eating or sleeping? It is rather, which is of *first* importance to the babe, food or exercise? To raise the question is to answer it.

Manual training, which has already passed the stage of being looked upon as a fad and is, we believe, in the schools to stay, has to be credited among other of its pedagogic contributions with demonstrating that ideas may be clearly formed and forcefully applied without language, and moreover, that when ideas are clearly conceived they be clearly and easily expressed. Let

us have in the schools a season of insistence upon thought-stuff having a rich and varied content, and undertake for a time to secure expression—as nowadays we secure so many other good things in education—*incidentally*.

The advocates of the overmastering importance in school work of a study of language are much given to pointing scornfully at the meager results to show for the time and energy put upon the mathematical studies in the elementary and secondary schools. But are our college boys and girls speaking and writing correct, elegant, and forceful English, even in cases in which they have come up to us through the heavy courses of English we have, of late, required them to go through? It must be admitted, I think, that here too the results are disappointing, often painfully so, notwithstanding the fact that English courses are of much less inherent difficulty than are mathematical courses.

But improvement can hardly come from charges and countercharges of disappointment and of pedagogic delinquency. The main point to be insisted upon here is that boys and girls should be given something interesting to think and write about before they should be expected to do much vital thinking or forceful writing or speaking. Expression and thought expressed must not quarrel, but harmonize. Vehement utterance and overdrawn description are not guarantees of vigorous thinking. Immoderate expression implies intemperate judgment. This is the idea which is rapidly creating a more progressive attitude of the general mind toward science work in the schools. The subject of the right sort of school science has the great advantage over all other subject-matters of bringing before the immature minds of boys and girls a body of clear, concrete, real, original, and easily relatable ideas about things embracing so wide and varied a range of interest as to arouse the spontaneous activity of almost every type of normal mind. In fact, it goes far toward normalizing minds which have been artificialized by the unnatural methods of some of the other high-school subjects. This is not the least of its functions in the secondary-school work of today.

But, strange to say, in the midst of a period of unparalleled interest in high-school science work, we see a general disposition

to drop astronomy from the curriculum. Certainly it behooves those who are directly concerned with the teaching of astronomy in any part of the school system to inquire into the causes for this tendency, and so far as lies in their power to seek to discover and to remove the causes. However humiliating it may seem to confess it, it is unfortunately true that there exist the strongest reasons for believing that current teaching of astronomy is largely to blame for the general tendency of school officers to leave the subject out of the courses of the high school. As a matter of fact, the teaching of astronomy in high schools is in the sorest need of study in the light of recent educational advance. One reason why this peculiarly interesting and important science, educationally considered, is not receiving the attention it deserves of school men lies in the fact that astronomy, as taught in high schools, does not deal with what are looked upon as the chief concerns of everyday people. But a reason more damagingly operative lies in stupid and stupefying ways of teaching it. "If a student does not like my subject," says one, "why, then, let him drop it; he does not have to know astronomy." Such sentiments have been allowed to pass muster too long among indolent high-school teachers. A teacher has no right to the attitude "I'll do a good honest day's work and let results take care of themselves." His prime business is precisely to bring results about. No teacher of astronomy worthy either of his science or of his calling ever stooped to the use of these sentiments, of course. But the widely prevalent, though exceedingly erroneous, notion that astronomy is of value to but a comparatively few peculiarly endowed persons allows the science to stand apart from its fellow-sciences as belonging to the category of subjects with regard to which the school can afford to maintain an attitude of indifference. Then this mistaken view is fed by the circumstance that high-school teachers do not handle the subject by methods in any way analogous to those which the other high-school sciences have shown to be indispensable to profitable science study.

How easy it is for us to forget that physics courses and chemistry courses are not in the high-school curriculum prima-

rily to make physicists and chemists! None of us fail to admit, on second thought at least, that these subjects fully justify their ever-increasing demands for time and for fuller recognition in the high school, primarily because, treated by modern methods, they contribute powerfully to the training of youth into scientific methods of study and of thought. Teachers of these sciences have learned to a very considerable degree how to present the truths of these sciences in accordance with the Newtonian law of modern pedagogy: "We learn by doing." They no longer stand on the respectable, but very decrepit and very un-American, dogma: "Teach the subject, no matter whether anyone learns anything." They have learned the practical truth that the teaching act is abortive, and even worse than useless, unless someone learns. Teachers of physics and chemistry pretty generally take their subjects and their students seriously, holding themselves responsible for a tangible result. Excellent courses in these subjects have accordingly been thought out for the secondary grades. The public has, as a consequence, conceived an ardent interest in the experimental work of these sciences as school subjects because they stand for the best training for the work of modern life. Indeed, science work in the high school to the common mind means physiography, physics, and chemistry exclusively. Scientific methods of thought—which means the methods of these three sciences—pass as legal tender in every vocation and avocation of actual life. This is no longer disputed by those who have done some of it. The most that former foes of science are now seeking to prove by their *a priori* arguments is that other subjects, if studied scientifically, are *equally* valuable educationally.

It is surprising to the point of astonishment that the development of courses in astronomy for the secondary schools has not kept pace with the development of courses in physics and chemistry. Fifty years ago astronomy had the decided advantage of these so-called modern courses in the schools. As a rule, astronomy is now studied in the high school almost wholly from the text-book. A college professor of astronomy told the writer only the other day that he could not tell the difference in his

college classes between students who had and students who had not taken a high-school course in astronomy so little had the former profited by their high-school work. He also stated that as astronomy is taught in high schools it is positively of no value at all, and that it even went far toward killing what little normal interest the student once had for the science.

Is it not high time that the general indifference toward astronomy be given our thoughtful consideration? The aversion among college students is not confined to students having a distaste for science. The writer has heard many students, who professed the deepest interest in chemistry and physics, express a decided dislike for astronomy as it had been taught them in high schools. To an inquiry among high-school principals as to the reason why astronomy is not more generally studied in high schools, the replies pretty generally divide into two classes. One class say merely that astronomy is of little bread-and-butter value to people; and the other, and much larger class, claim the lack of attention to it in their schools to be due to archaic and unscientific methods of teaching it. They claim, quite generally, that they cannot get it well taught. They say it is bad enough to teach unscientific subjects by text-book alone; but that it is positively intolerable, in this age, to teach a science by non-scientific methods. The time-honored claim of friends of astronomy that its influence is decentralizing and broadening to the individual no longer appeals to the principal of a high school who knows that, as the subject is taught, it makes no vital appeal to the student—in fact, that it does not take hold of his thought-processes at all.

From some first-hand knowledge of what is going on in the schools, the writer is led to believe—in the light of what intelligent citizens are demanding—that principals of schools are in large measure justified in throwing the subject out of the curricula, and using the time, thus gained, for the better thought-out and more modern courses in physics and chemistry. Fellow-teachers and lovers of astronomical science, we have to face the question: "What ought to be done about it?"

But, you insist, the logical procedure would be to secure

teachers who can and will handle the subject in a scientific way. This remedy, however, like many another remedy for faulty school work, is not so easy to administer. First, because the primary interest of those who are actually teaching astronomy in the high school is usually in some other subject, as mathematics or physics. The astronomy teacher's work in his favorite subject is often of a high grade of excellence, and the school could ill afford to dispense with his services in these lines. In the second place, it is less expensive, less disturbing, and more consonant with the inertia of circumstances to let a moribund subject die than to undertake to rejuvenate it. Nobody seems to care much for it, so why waste energy upon it? In the third place, texts and teachers for the scientific treatment of school astronomy are neither plentiful nor increasing. Publishers remind us that the high-school audience for astronomy is small and on the rapid wane.

Other reasons will readily occur to all, but those enumerated seem to be most efficient in contributing to the neglect of astronomy.

A few believers in the educational value of rightly taught astronomy are disposed to chide the physics, chemistry, and physiography for appropriating to themselves the lion's share of the time allotment to science on the high-school program. The writer is, however, inclined to the opinion that the trouble lies deeper, and that the apparent crowding out is rather a case of the "survival of the fittest," and that it must go on at an accelerated rate until astronomical method adapts itself more perfectly to modern conditions and to modern educational ideas.

An examination of the reasons enumerated will show that every one of them can be removed by earnest and concerted effort on the part of those who love astronomical science, who can teach astronomy, and who wish to teach it in such a way as to enable the student to derive from it its fullest educational value. Is the importance of the resurrection and rehabilitation in the high school of this time-tried and truly worthy subject not great enough to induce this conference to take the initial steps today looking toward bringing about this end?

But while the problem of reviving the interest in astronomy is not an easy one, and can be satisfactorily solved only by concerted effort, still there are some elements of the solution which are so conspicuously fundamental that even isolated efforts will be of value. The psychic acts of observation, comparison, discrimination, classification, generalization, and finally of deduction, so indispensable to all real science work which is directed toward an educational end, are but very feebly appealed to, if at all, by pure text-book methods. Imagination and memory alone receive attention in current high-school astronomy. But even the imagination should start from facts clearly thought out, nor should the memory be burdened with undigested materials swallowed on faith alone. However important the cultivation of memory and of the scientific imagination may be, it is true that these faculties are only the servants of the reasoning faculties, and must never be exalted into matters of exclusive, or even of *chief*, concern in science study. Moreover, there are so many other subjects in the high school which exercise the memory and the imagination that astronomy can scarcely hope to establish for itself a peculiar place in the high school on the basis of peculiar merit as a memory and imagination trainer.

It is my purpose briefly to point out here how, by a little ingenuity and industry on the teacher's part, astronomy may, with almost no expense, be treated as a science by high-school classes. I may be allowed to preface my more specific remarks as to ways of conducting observational and experimental work with a statement of what seems to me should be attempted as a practical means of restoring astronomy to its rightful place in the schools.

First, I would advise an observational course of work having to do with the study of the more obvious celestial bodies and movements, with a view of giving the pupil some first-hand knowledge of those facts of astronomy which lie within the reach of the naked eye and of a twelve-week course of study. The connection of the observed movements with the familiar changes of day and night, and of the seasons, would be involved. The course would consist of a good deal of what is commonly

known as mathematical geography and of the geography of the heavens, or constellation study. A ready knowledge of the most easily identifiable objects and motions on the sky should be the aim.

Second, this twelve- or thirteen-week course would be followed by another, of about the same length, dealing in a laboratory, or experimental, way with the physical laws which underlie the most familiar changes in temperature, light, and distribution of life on the terrestrial globe. It would be conducted precisely as a modern high-school physics course is conducted, merely emphasizing matters of astronomical importance, and having to do with making rational to the student those laws of most concern to the terrestrial inhabitant.

A third course of equal length would consist largely in the devising of simple apparatus for measuring the positions of the heavenly bodies from time to time, and the discussion and study of observations made with these apparatus. Astronomical phenomena would here be penetrated a little more deeply, and astronomical law would be studied on a larger scale. This course would fill out a full year's work of thoroughly scientific study. Finally, I would have this course put into the curriculum as optional against the physics, or the chemistry, or the physiography. I would also plan the work of these four sciences so that a student could divide his science time, if he chose, between them, making the transition at the beginning of any term. Each of the four courses would comprise enough of what is fundamental and common to all to avoid cutting off the student who has taken only one of them from taking up another, if he chooses, at a somewhat advanced stage.

I desire now to indicate the character of the work of which the third term, mentioned above, should consist, as well as to show such crude apparatus for measurement as the class could and in default of better, should make and use.

1. Use of the hand.
2. Shadows and flag poles.
3. Use of stakes for finding horizontal distances between hilltops.
4. Drawing board and tripod or Jacob's staff.

5. Visual angle of globe set on perimeter of a large ellipse and measured from a focus.
6. Stadia and trombone stadia.
7. Cross staff.
8. Altitude boards.
9. Meridian stone.
10. Plumbline gnomon.
11. Latitude box.
12. Home-made telescope.

Before closing, let me mention that a movement to improve the teaching of astronomy in the high school would just now be opportune. Correlation and unification of the metrical, quantitative, and mathematical sciences in the secondary school are now being widely and earnestly discussed, and the body of first-rate opinion favorable to them as improvements in high-school teaching practice must not—cannot—be ignored much longer. A study of the professional output of what may with both justice and propriety be called the professionally productive teaching force of the eastern, central, and western states will convince anyone that both theory and practice are overwhelmingly in favor of the closer unification of cognate lines of high-school study. Now, my point is that astronomy, which since the days when it sloughed astrology and became truly a science, as well as before it was burdened with this "old man of the sea," has always been the closest ally of the mathematical sciences. It would, indeed, be difficult to determine which of these closely kindred subjects has helped the other most in the grand march of scientific progress, that march which until very recently was synonymous with the advance of astronomical and mathematical thought. The reason for this lies in the nature of things. The establishing of every astronomical truth calls for mathematical process and method. There is therefore more truth than poetry in the statement that these two subjects have each vied with the other in the struggle to be mutually helpful, and that whatever has helped the one has always stimulated the other.

Of all subjects in the high-school curriculum astronomy furnishes the most natural, the easiest, and the most truly helpful correlations with mathematics. In fact, real scientific astro-

nomical study cannot proceed without correlating with mathematics, and only a little less strongly with physics, and chemistry. I would argue, if it were necessary, that the correlations of astronomy with physics and chemistry should be made of the strongest character. What we commonly refer to as "the new astronomy" should find large place in the secondary school. Its qualitative as well as its quantitative character adapts it peculiarly to high-school students. This sort of astronomy is little else than a correlation of physics and chemistry. So that we are here again brought face to face with what seems a pedagogic contradiction. In the very midst of a school situation in which interrelation, correlation, and unification of subjects are the central—even pivotal—ideas about which pretty much everything seems turning, we behold astronomy, that one of all the sciences best adapted to treatment under these ideas, in danger of being dropped almost altogether from the science courses of that particular part of the school system which these central notions of modern pedagogics are supposed to benefit most. Again, it seems clear that the trouble cannot be with the subject-matter; but rather with the mode of teaching it. Again, I ask, can we, who by our presence here demonstrate our interest in the educational aspect of such subject-matter as astronomy stands for, afford to stand by with apparent indifference and allow the most truly scientific of all the scientific subjects to perish from lack of our willingness, or readiness, to render assistance in the problem of finding its true place and relation in the up-to-date high-school curriculum? I, for one, answer with an emphatic No!

The second paper was by Assistant Professor Kurt Laves, on "The Use of the Globe in the Teaching of Elementary Astronomy."