wrapping paper and cord to secure this trophy of the past, and draw from it its inmost secrets. The grinding is simply friction with emery and water till the first face is prepared, and polished on the chamois skin with *dry* emery *slime*. This should be as perfectly done as possible. The specimen may be considered as finished at this stage, if no *complete* examination of *structures* is intended, no tracing of homologies in various genera and species. If this exact study *is* to be prosecuted, on one of the small glass pieces, polished surface down, imbed the specimen in balsam, just hard enough and deep enough to securely hold it, but not so hard as to crack off, as the grinding of the second surface advances. Care must be taken to hold the glass *horizontally*, lest the specimen be of unequal thickness at the close. When *nearly translucent*, great care must be taken by grinding *lightly* and more and more lightly, till the work is complete and the polishing done. Warm the balsam which still holds it to the glass, and delicately slide the well-earned treasure to a new microscopic slide, 1x3 inches, on which is a drop of hot balsam. This successfully done, remove any air bubbles and lay on the cover glass, removing bubbles again. Clamp it with a clothes pin till dry and cold, then remove all surplus balsam with turpentine, taking care that it does not also run under the cover glass. It is now ready for study. When several specimens of different species or genera of *Rugosa*, for instance, have been made, fine lessons may be drawn in homologies, especially of mural, septal and tabular systems.

As the large majority of students will not carry their scientific studies, as such, farther than the requirements of the college curriculum, it is eminently important that their attention be called all along to certain prominent things *as* prominent, as the great questions to be sought out. In giving these special points of the field in general, the teacher or professor will naturally present in a more extended way that special field which has most attracted his or her own attention or investigation. For reference and for present benefit the pupils should each, under the eye of the teacher, make a geological map of the United States; one of his own state on a larger scale, and of his own section on a still larger one. He should also number carefully and permanently his specimens, using a tiny circle of paper and glue unaffected by ordinary moisture, these numbers corresponding to those on labels bearing name of formation, group, genera and species, with the date and locality.

In preparing this paper I have been painfully conscious of its inadequacy and its great imperfections, yet from experience and observation I hope to have measured an arc in the circle of scientific and geologic education in our schools whose circumference may be eventually completed.

LETTERS TO THE EDITOR.

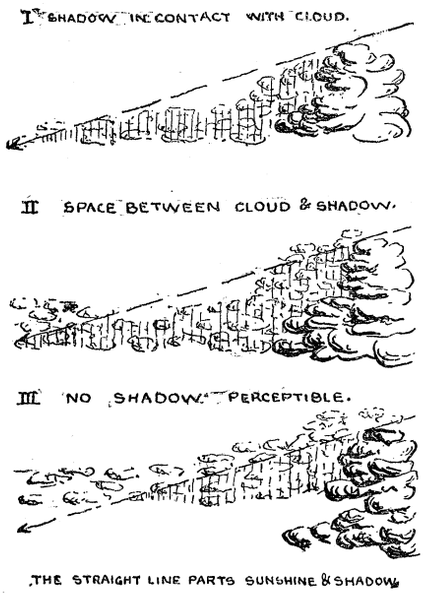
***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

An Instructive Illusion.

On Thursday evening, May 18th, occurred at York one of those smart thunder-showers which followed the break-up over the greater part of England of the sunniest, warmest and driest spring within the memory of most. Hail had fallen, and five minutes later, at 6.50, clear sky appeared among the storm-clouds. Not quite clear, however, for it was flecked with those very delicate, filmy, white clouds which one usually assigns to a very lofty altitude. The sun being within an hour of setting, its slanting rays illuminated these strongly. It was therefore with surprise that I saw shoot athwart these sharply-defined, intensely dark bars of shadow. These evidently came from a portion of cumulus-like thunder-cloud, which topped the main mass just below and to the right of the new moon. Some of the rays sprang direct from its edge, but others at a distance of 2° to 10°. In the shadow the filmy clouds were absolutely invisible, the sky seemingly being of a clear blue, although the shifting of the bars of shadow indicated their actual presence everywhere.



But the strange question arises, what was the real height of the film-clouds? Must they not, obviously, have been at a lower level than this portion of the thunder-cloud, though higher than the main mass? And yet portions must have been piled higher against the thunder-cloud. Else there could not have been the illuminated space dividing the shadow from the cloud. In some cases the dark bars merged into sheets of shadow, which stretched away 20° or more from the cloud. Apparently, if seen in section, the effect must have been as in the appended sketches.

It is difficult to conceive any other explanation than the above. Hence, either such film-clouds form at lower levels than is generally supposed, or the summits of thunder-clouds penetrate higher than has been supposed.

J. Edmund Clark.

Why Not the Collections of Seeds?

In these days of stamp, coin, shell, mineral, plant and insect collectors, the writer has often wondered why it is that so few have turned their attention to making collections of seeds. The field, as it appears to me, is one of exceptional interest; exceptional not merely because of the work of real merit that may be done therein, but because it is practically inexhaustible; because the materials are very largely of such a nature as to be cared for with a minimum amount of labor, and require but little space; and because in many instances seeds are themselves objects of great beauty. There are few pursuits in which greater latitude may be allowed, or greater opportunity is given for display of individual energy and mental scope. The amateur, whether man or woman, boy or girl, business man or teacher, cripple or invalid, may each and all collect and find ample room for so much or so little study as he or she may choose to devote to it. One may collect only such seeds as have in

themselves some points of beauty, or are of curious shapes; may know them only by their common or local names, or may take up the subject in a purely scientific spirit, identifying a plant during its flowering stage and finally collecting its seeds when mature, labelling them with both common and scientific names, date of flowering and seeding, and laying away to form a part of what in time may grow to be a collection of real value.

One great objection that may be raised is undoubtedly the difficulty in correctly identifying seeds. There are indeed comparatively few botanists who claim to be able to identify more than a small proportion of the plants they may know, by the seed alone. But this fact only emphasizes the desirability of undertaking just this line of work, and but serves to illustrate the well-known fact that work of real merit may not infrequently be done by the amateur who merely seeks recreation.

GEORGE P. MERRILL.

Washington, Sept. 13, 1893.

SCIENCE IN THE SCHOOLS.

IN a recent article, that well-known scientist, Dr. Groff of Pennsylvania, stated that "it has long been the dream of scientists that the time would come when the elements of natural history and of the physical sciences would be taught in secondary and primary schools." The college professor would, indeed, welcome a greater familiarity on the part of students entering their departments, with the elements of the sciences; but just where this training should begin is not so clear. There is an organized effort being made in some of our leading educational cities to establish this work in not only the secondary schools, but in grammar and primary grades as well. While science should receive a large share of attention in the high schools, and presumably in the grammar grades, is it not going just a little too far to force such work into the *primary* grades? It would certainly appear that, with all the modern innovations already introduced into the primary rooms, sufficient diversion is secured, and certainly, for pure "busy work" the ideal seems to have been reached. Then why crowd these little minds with this additional load, unless it is really superior as a means of education to those studies that are generally acknowledgde so essential as a foundation for subsequent work? Again, I submit that in this early formative period, teaching and encouraging children to capture beautiful butterflies, moths, crickets, or, in fact, any other insects, with the purpose of killing them and picking them to pieces, is not inspiring a regard for God's creatures about them, which sentiment should be instilled into these little people rather than crushed out of existence.

But I think that most agree that *somewhere* in the *grammar* grades the elements of natural history should be imparted. Such, however, is the present crowded condition of the curriculum of our grammar schools that but little, very little, time can be found for it. Nor, indeed, would it be desirable to take much of the pupil's time for such work, in view of the fact that so many studies of more practical importance in life are taught, and rightly, too, in these grades. In our public grammar schools many boys and girls are kept along from year to year at great sacrifices on the part of parents, and they should be allowed to devote their time to such studies as they will most need. It would, therefore, be manifestly unfair to attempt more than the most rudimentary science work in those grades below the high school.

HENRY EDGERTON CHAPIN.

Ohio University, Athens, O.

THE IKONOMATIC METHOD.

IT is strange how difficult it seems for some writers to understand this early, simple and widespread method of recording sounds.

Dr. Thomas in *Science*, Sept. 8, presents a singular instance of this, when commenting on my explanation of the use of the turtle-sign in the glyph for the Maya month-name Kayab. He says: "A compound of *ak* and *yab* cannot be a derivative of *kay*." Of course not! The nature of the ikonomatic theory forbids it; for this has reference not at all to derivation, but to other word or words with solely homophonic, and not etymologic, affinities.

When there are so many examples of ikonomatic hiero-

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