cating what must be restored if fertility is to be maintained and lucrative yields obtained in the future. Such knowledge is well-nigh indispensable at the present day to the grower of grain, roots, and fruit if he is to compete successfully with his intelligent neighbors. Chemistry can tell us, in a large measure, of the relative fertility of a soil and point out what elements of plant-food may be lacking. It is the science that makes the barren and waste lands fruitful and is the chief agent in making "two blades of grass grow where there was but one before." To stock-raisers and dairy-farmers it lends its aid in showing the requirements of animals, the daily waste of the animal organism. It ascertains the composition and relative feeding-values of cattle-foods. It analyzes animal products, indicating their comparative worth. Chemistry stamps the value upon artificial fertilizers.

In the by-paths of agriculture, too, chemistry is of service. The intelligent investigator in the important subjects of insecticides and fungicides must prosecute his studies by the light of chemistry. And so we might proceed, but space forbids. Let us, however, remember that history emphatically shows that agriculture and agricultural chemistry have progressed with equal strides, and that for the future the indications are that the relationship of these two will be still closer.

If in this short sketch our claim is made good, then we perceive that it is of paramount importance that agricultural chemistry should form part of the education of every boy destined for the farm. Every public school in rural districts should teach it, not merely theoretically, but practically. All the officers of our experiment stations should have a knowledge of its principles, since no department of agriculture is independent of it. They at present are not only investigators but are also the teachers of the adult and practising farmer. How necessary it is then that all their work should be guided by an intimate acquaintance with that science which is not only the foundation of agriculture, but whose laws govern its operations.

## THE REAL MOTIONS OF THE FIXED STARS.

BY PROFESSOR A. W. WILLIAMSON, AUGUSTANA COLLEGE, ROCK ISLAND, ILL.

IT is very often stated in newspapers, and also stated in a number of text-books on astronomy, that 1830 Groombridge has a greater velocity than the attraction of all known bodies in the universe could give it. We know not how many dead suns may exist, retaining their full power of attraction, though no longer giving light.

We do not, however, need this supposition to account for the velocity of 1830 Groombridge. Granting the laws of gravitation universal, we are able to account for any finite velocity, the attracting bodies possessing any finite degree of brightness, by supposing these bodies sufficiently large and distant.

Imagine a grand central sun just as dense as ours and a quintillion times as bright, in proportion to its surface. Suppose its distance $10^{72}$ times that of our sun. Suppose its periodic time $10^{54}$ times that of our earth. Its mass would be $(10^{72})^3 \div (10^{54})^2 = 10^{216} \div 10^{108} = 10^{108}$ times that of our sun. Its radius would be $\sqrt[3]{10^{108}} = 10^{36}$. Its apparent surface would be $(10^{54} \div 10^{36})^2 = (10^{18})^2 = 10^{36}$ times less than our sun. Its brightness would therefore be $10^{-36} \times 1$ quintillion $= 10^{-18}$ or .000000000000000001 part of that of our sun, that is, it would be as much fainter than an ordinary star as the star is fainter than the sun, invisible even by the Lick telescope.

Our system would therefore move in its orbit around this central sun as many times more rapidly than the earth moves in its orbit, as the diameter of the orbit is greater, divided by the number the periodic time is greater, that is $10^{72} \div 10^{54} = 10^{18}$. As our earth moves over eighteen miles in a second, our system must, on this supposition, move over eighteen quintillion miles in a second, or about one hundred trillion times the velocity.

It is difficult to conceive that so great a sun can have any real existence, and still more difficult to imagine we are moving with such velocity. It seems to me, however, not improbable that as the motion of the planets in their orbits is much greater than that of their satellites, so the motion of the stars around the common centre is far more rapid than that of the planets around our sun. It seems quite likely that all are moving in the same direction, and that the apparent motions of those having a sensible parallax are only the differences of their true motions. The sun may appear to be moving towards Hercules because it is moving in that direction more rapidly than the average of the stars. May it not also be the case that it is really moving in exactly the opposite direction but more slowly than other stars?

## LETTERS TO THE EDITOR.

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

### The Ancient Libyan Alphabet.

PROFESSOR KEANE in *Science*, Sept. 23, having acknowledged that he referred to the wrong book, should have been ingenuous enough to say that, in the book he did refer to, the primary form given of every letter in the Libyan alphabet is rectilinear, or a dot. As he was not, I offer to place the book in the hands of the editor of *Science* for anyone to convince himself that this is the case.

It is a strange misapprehension of the most important point at issue on the part of Professor Keane, to call the form of the letters "of secondary importance." Their disputed origin can be ascertained only by discovering their original forms.

If Professor Keane had further been ingenuous enough to state *why* Hanoteau likens the writing of the Touaregs to Arab and Hebrew, he could not have ventured the perfectly incorrect inference he fathers on Hanoteau, that it is "Semitic." Hanoteau refers solely to his belief that the Touareg writing is always read from right to left; in which opinion he was wrong, as I have plenty of documents in *tifinar* to show.

I shall say nothing further of Professor Keane's view of the pronunciation and meaning of the word *tifinar* than that every derivation I can find of it by French scholars regards the initial *t* as part of the radical; which would effectually dispose of the fanciful hypothesis that it comes from *Phœnician*.

D. G. BRINTON.

Media, Penn., Sept. 27.

### Twins Among the Indians on Puget Sound.

TWINS among the Indians of Puget Sound are very uncommon; but in former times, when any did appear, they had an exceedingly hard time, as the Indians were superstitiously afraid of them. During the past eighteen years, I have known of but one pair among the Twana Indians, and one pair among the Clallams. The Twanas were well taken care of, as the parents had always lived on the reservation, where the Indian agent had previously had a pair; and so they had had an opportunity of seeing the white customs in regard to them. These parents had also been educated in school, and were quite civilized. To all intents and purposes they were white, and so nothing was done about them except that there was some talk about the former customs in regard to them.

But the pair among the Clallams did not fare so well. Their parents were old-fashioned Indians, were surrounded by old-fashioned Indians, were about eighty miles from the reservation, and they had never had a home on it. The home of their parents was in Fort Discovery, but they were at Neah Bay, catching seals, about eighty miles from home at the time the twins were born. Immediately the Neah Bay Indians became afraid of them, and quickly drove them and their parents away, as they were afraid that the twins would scare all the fish away from their waters. Accordingly, the parents returned to Port Discovery on a steamer, though the Indians were quite unwilling to have them go in that way, fearing that they would frighten all the fish away; and earnestly wished them to walk the entire distance, over mountains and through the forests or on the beach, although there was neither beach or road much of the way.