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.

When they reached home, some of the old Indians of their own tribe were very much afraid. They threatened to kill one of the twins, so that the father did not dare to leave home. Hence he could not go off and work and earn food; neither would they allow him to fish near his home, although the fish at that time were very abundant there, for fear that all the fish would leave. Hence the man was greatly troubled to get food enough for his family to keep them from starving. They told him to live on clams. They would not go near his house if it could be avoided, and, if they had to pass it, would make quite a detour around.

It is said that long ago, when such an event occurred, the other Indians drove the fortunate or unfortunate mother into the woods with the twins, — the father going also if he wished, — and there they had to live alone, and they were not to return as long as both twins were alive; one must be disposed of in some way. If any friends pitied them enough to furnish them with food, it was carried to some place where the parents were not present, and then, when the carrier had retired, the parents could take it to their lonely home.

Other tribes on the Pacific coast had somewhat similar customs, while others honored the twins greatly, according to the reports of the British Association for the Advancement of Science, which speak of them in British Columbia, and Power's "Tribes of California," which speaks of them in that State. M. EELLS.

Union City, Wash., Sept. 12.

Prevention of Cholera Asiatica.

IN an article on "Prevention of Cholera Asiatica," printed in *Science*, September 23, I wished to give a way to detect the bacillus; inadvertently stating Gram's solution colored the germ, — it does *not* do so, — but that fact forms one of its distinguishing characteristics. However, the cholera (comma) bacillus is colored by a watery solution of fuchsin, HUGH HAMILTON.

Harrisburg, Pa., Sept. 24.

A Large Southern Telescope.

THE wide interest in astronomical research is well illustrated by the frequent gifts of large telescopes to astronomical observatories by wealthy donors who are not themselves professional students of astronomy. The number of these gifts is continually increasing, and in no department of science has greater liberality been displayed. Unfortunately, the wisdom shown in the selection of good locations for the telescopes has not equalled the generosity with which they have been given. Political or personal reasons, rather than the most favorable atmospheric conditions, have in almost all cases determined the site. These telescopes have been erected near the capitals of countries or near large universities, instead of in places where the meteorological conditions would permit the best results to be obtained. The very conditions of climate which render a country or city great, are often those which are unfavorable to astronomical work. The climate of western Europe and of the eastern portion of the United States is not suited to good astronomical work, and yet these are the very countries where nearly all the largest observatories of the world are situated. The great number of telescopes thus concentrated renders it extremely difficult for a new one to find a useful line of work. The donor may therefore be disappointed to find so small a return for his expenditure, and the opinion has become prevalent that we cannot expect much further progress in astronomy by means of instruments like those now in use. The imperfections of our atmosphere appear to limit our powers, and are more troublesome relatively with a large than with a small telescope. Accordingly, it has not been the policy of the Harvard College Observatory to attempt to obtain a large telescope to be erected in Cambridge. In order to secure the greatest possible scientific return for its expenditures, large pieces of routine work have by preference been undertaken, which could be done with smaller instruments. These conditions are now, however, changed. A station has been established by this Observatory near Arequipa, in Peru, at an altitude of more than eight thousand feet. During a large part of the year the sky of Arequipa is nearly cloudless. A telescope having an aperture of thirteen inches has been erected there, and has shown a remarkable degree of steadiness in the atmosphere. Night after night atmospheric conditions prevail which occur only at rare intervals, if ever, in Cambridge. Several of the diffraction rings surrounding the brighter stars are visible, close doubles in which the components are much less than a second apart are readily separated, and powers can be constantly employed which are so high as to be almost useless in Cambridge. In many researches the gain is as great as if the aperture of the instrument was doubled. Another important advantage of this station is that, as it is sixteen degrees south of the equator, the southern stars are all visible. A few years ago a list was published of all the refracting telescopes having an aperture of 9.8 inches or more (*Sidereal Messenger*, 1884, p. 193). From this it appears that nearly all of the largest telescopes are north of latitude + 35°, although this region covers but little more than one-fifth of the entire surface of the earth. None of the seventeen largest and but one of the fifty-three largest telescopes are south of this region. Of the entire list of seventy-four, but four, having diameters of 15, 11, 10, and 10 inches, are south of + 35°. The four largest telescopes north of + 35° have apertures of 36, 30, 29, and 27 inches, respectively. But few telescopes of the largest size have been erected since this list was prepared, and the proportion north and south is still about the same. It therefore appears that about one-quarter of the entire sky is either invisible to, or so low that it cannot be advantageously observed by, any large telescope. The Magellanic clouds, the great clusters in Centaurus, Tucana, and Dorado, the variable star η Argus, and the dense portions of the Milky Way, in Scorpius, Argo, and Crux, are included in this neglected region. Moreover, the planet Mars when nearest the earth is always far south. The study of the surface of this and of the other planets is greatly impeded by the unsteadiness of the air at most of the existing observatories. Even under the most favorable circumstances startling discoveries — relating, for example, to the existence of inhabitants in the planets — are not to be expected. Still, it is believed that in no other way are we so likely to add to our knowledge of planetary detail as by the plan here proposed. The great aperture and focal length and the steadiness of the air will permit unusually high magnifying powers to be employed, and will give this instrument corresponding advantages in many directions, — for instance, in micrometric measures, especially of faint objects. It can be used equally for visual and photographic purposes; and in photographing clusters, small nebulæ, double stars, the moon, and the planets, it will have unequalled advantages.

A series of telescopes of the largest size (including four of the six largest, the telescopes of the Lick, Pulkowa, U. S. Naval, and McCormick Observatories) has been successfully constructed by the firm of Alvan Clark & Sons. But one member of the firm now survives, Mr. Alvan G. Clark; and he expresses a doubt whether he would be ready to undertake the construction of more than one large telescope in the future. The glass is obtained with difficulty, and often only after a delay of years. A pair of discs of excellent glass suitable for a telescope having an aperture of forty inches have been cast, and can now probably be purchased at cost, $16,000. The expense of grinding and mounting would be $92,000. A suitable building would cost at least $40,000. If the sum of $200,000 could be provided, it would permit the construction of this telescope, its erection in Peru, and the means of keeping it at work for several years. Subsequently, the other funds of this Observatory would secure its permanent employment. Since a station is already established by this Observatory in Peru, a great saving could be effected in supervision and similar expenses, which otherwise would render a much larger outlay necessary.

An opportunity is thus offered to a donor to have his name permanently attached to a refracting telescope which, besides being the largest in the world, would be more favorably situated than almost any other, and would have a field of work comparatively new. The numerous gifts to this Observatory by residents of Boston and its vicinity prevent the request for a general subscription; but it is believed that if the matter is properly presented, some wealthy person may be found who would gladly make the