organs of an animal and its movements can give no true knowledge of the soul of an animal to one who is incapable of analyzing carefully the phases of his own consciousness; nor would the student who is the most thorough master of the analysis of his own thought and feeling, be able to understand the souls of animals, did not the human spirit contain in itself the germ of every power of every terrestial creature. The disposition to attribute to others and to animals the feelings which we should have, were we in their circumstances, although it may mislead the student both of human and of animal life, is nevertheless an essential to successful study. It is impossible for us to understand beings either higher or lower in the scale than ourselves, except as they in some degree resemble us. Our knowledge of ourselves must keep equal pace with our knowledge of other beings; else we have no knowledge of either.

To recapitulate: In the study of organized beings we find three principal departments, their anatomy, their physiology, and their psychology. Their anatomy deals with their forms, and with the forms of their parts; and these forms furnish in general complete data for their classification. Physiology treats of the peculiarly modified chemical action by which food is assimilated and made part of the living structure, and by which the various secretions are formed. And were not this a much higher and more difficult inquiry than the study of the forms, we might doubtless classify all plants and animals by the chemical likenesses and differences of their tissues and secretions. At present these characteristics are used in classification only as confirmations of the accuracy of the results obtained by form. Psychology deals with the souls of organized beings, with those principles that guide the chemical and mechanical forces in matter to the formation of the organism. The classification of organized beings by their forms is, in fact, in one sense, a classification by their souls by the psychical principles which are empowered to create the forms. But these unconscious souls have other functions than the creation of forms; they have besides this intellectual work, a sort of moral quality by which they select peculiar food and form peculiar products, and by which also they are aquatic or terrestrial, tropical, tender, hardy, arctic or alpine, &c. Then in animals we have, either in the same soul or in a second one, consciousness added to life, the powers of thought and feeling, desire and volition, and of knowing that they think, feel, desire and will, and these powers culminate on earth in the human race.

Matter is a storehouse of forces; in each atom slumber or rage the forces of attraction and repulsion, and also the moral qualities of chemical difference and identity. These forces, whether chemical or mechanical, act according to fixed laws, and tend towards a state of rest and of stable equilibrium. And they are all so correlated that each of them can be referred as forces, to one common unit, and shown to be capable of lifting such a weight so many feet a second.

But organized beings push always into motion, and their tissues and secretions are usually such that, in air of the same temperature and moisture as that in which they grew, they will rapidly decay the moment that life is gone. They are perhaps in chemical equilibrium; but it can hardly be called stable,—at least it is not stable enough to resist the very heat and atmospheric influences under which it was built. Yet there is no trace of any force in the organism thus compelling the forces of inorganic matter to act in this peculiar way, so different from their behavior when the organizing life is wanting.

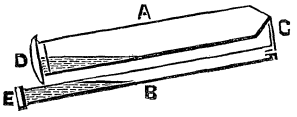
The intellectual power of the unconscious soul is not a force that can be compared with gravity, it cannot be measured by that unit; it does not act by attraction and repulsion, but simply guides (we know not how) the forces which do thus act—it rules them by moral or intellectual, not by corporeal power. The souls of plants and animals have a certain lordship over the earth, and the earth obeys their rule to a certain extent. This lordship is exercised in part involuntarily and unconsciously, that is in the phenomena of nutrition and growth; and in part consciously, in the phenomena of voluntary thought and motion and action. And had we sufficient knowledge of the habits of animals, we could doubtless classify them according to their voluntary life.

But in classifying organized beings, we do not find ourselves imposing law upon the series of species, but discover it already impressed upon them. Not only does the soul of the single organism develop thought, but in the whole gradations of the universe, from the chemical atoms up to the highest orders of mammalia, we find the development of more extensive thoughts; as though the whole universe had a soul; developing it as the soul of the violet develops its forms and color and odor. Now does this soul of the universe act consciously or unconsciously? Shall we take the vegetative power, or the conscious mind, as the type of the Deity? In endeavoring to find a symbol for the Highest in the universe, shall we look for the light of analogy into what is highest in ourselves, the conscious soul? or into what we have in common with the seaweed, the organizing power of life?

To me the answer is evident, that the highest of which we are conscious is the best symbol by which to speak of the Highest who is above our consciousness. Looking thus at the Divine Being as the Lord, who has consciously expressed His thoughts in the material world, that world becomes glorified and glows with heavenly splendor. Natural science becomes the study of the autograph works of an Infinite Author; and natural history—which is the highest of the series of physical sciences, and links them to the sciences that deal with the human mind and the works of man—becomes the means of communion with the highest geometrical, algebraical and chemical thought, which the Father of men has as yet revealed to us; and also becomes through the study of the instincts and reason of animals the fittest of all natural preparations for a study of ourselves, and of our own relations to the All wise and All good.

SIR W. THOMSON'S NEW DEPTH GAUGE.

Sir William Thomson has very recently patented another depth gauge which, though it depends upon capillary action, does not require the co-operation of chemical change. In fact, it operates by capillary action alone. The accompanying figure will illustrate the principle of this new device. Here A and B are two



glass tubes of different diameters united by a capillary tube C. The narrower tube, B, is closed at the end by a plug E, which can be removed at will: and the wider tube A is covered by a sheet of cotton cloth. This cloth acts as a porous septum which, when wetted, is permeable by water but impervious to air. For according to a law of hydrostatics, a film of water in a hole resists a difference of air pressure on its two sides, equal to the hydrostatic pressure due to a column of water in a capillary tube of the same diameter as the narrowest part of the hole. Thus it is that damp linen is impervious to air, and wet sails resist the wind much better than dry ones, as every sailor knows.

When this arrangement is lowered into the sea, water forces its way into the tube E, and the quantity forced into it during the descent becomes an indication of the depth when the relative capacities of the tubes are properly adjusted. In raising the apparatus the water

in the wide tube is gradually expelled by the air, and the wet cloth secures that all of it will be driven out before any air gets in. The water contained in the narrower tube remains to indicate the depth by a suitable scale engraved on the glass, and then is let out by withdrawing the terminal plug.

For actual use the wide inlet tube is made of brass and the narrower tube of glass. Three sets of these tubes are combined into one instrument, and in each set there is a special ratio between the capacities of the inlet and retaining tubes, in order that the set in question may answer for certain depths. Flying soundings are usually taken in depths ranging up to 130 fathoms, and the three sets are designed to indicate depths, say, from 12 to 28 fathoms, from 28 to 60 fathoms, from 60 to 130 fathoms. They are fitted into a brass protecting cylinder, open at one end to the water, and slotted out in the sides to allow the engraved scales on the gauge tubes to be seen from the outside. The whole is then enclosed in a galvanized iron guard-case drilled with small holes to allow the sea-water to enter, and being attached to the sinker is lowered into the sea. The apparatus is manufactured by Mr. Whight, of Glasgow, for Sir William Thomson, and it has already been adopted on H. M. S. *Valorous*, and the Russian imperial yacht *Livadia*.

While upon this subject we may also draw attention to the "nipper" lead of Mr. Lucas, engineer to the Telegraph Construction and Maintenance Company. The old plan of ascertaining the nature of the sea bottom, by bringing up a specimen of it in a tube, let into the bottom of the sinker and armed with tallow, is open to several objections. For instance, the specimen is apt to get washed out in rising to the surface, and when it is safely brought on board it is usually so smeared with tallow as to be objectionable. The nipper lead of Mr. Lucas, on the other hand, retains what it catches and renders it up in a pure state well fitted for preservation. The bottom of the lead or sinker in question is provided with two hollow claws or spoons, not unlike the mandibles of a crab. These are hinged to the sinker, and open out against the resistance of a stout spiral spring which is contained in the body of the sinker. When fully opened out they are kept apart by a locking device, consisting of two crossbars which meet end to end and fit into each other. The points of the open claws, however, in striking upon the bottom, spring this lock, and the claws snap together with great force, nipping up a specimen of the bottom at the same time, and from their hollow shape this specimen is retained. So effective is the nipper lead that the claws will nip a sheet of paper off a table, and they have been found to raise a specimen of the bottom from 2,000 fathoms.—*Engineering*.

BOTANICAL NOTES.

Every young naturalist needs to be on his guard against deception which is a frequent cause of serious mistakes.

Many strange species and unheard of peculiarities are sometimes discovered by the over zealous and credulous. Most imitations of natural objects are so bungling as to be readily detected, but occasionally something turns up which is such a surprise, that the fact is noted before its improbability is made evident.

The large springs of the limestone districts of Pennsylvania are exceedingly clear, cool and transparent. The principal plants living in them are species of Characeæ, and Veronica Americana, whose large, lettuce-like leaves have a very striking appearance when seen through the sparkling water. While visiting a spring one day in mid-summer, I was surprised to see some strange looking plants which appeared to be Marata cotula. Mentally noting this peculiar position for such a common and well-known weed of dry ground, I caught sight of something still stranger—a garden aster; another step and a zinnia and dahlia came to view. Indeed there was quite a garden "á immersion."

The small boys of the neighborhood had acquired the art of deftly binding flowering branches to small stones which held the plants to the bottom, while the strong upward flow of the water kept them neatly upright and life-like.

The search for plants upon vacant city lots, rubbish piles, and the like, always reveals a greater number and variety of species than one would suppose.

As several of these "local" floras have been published lately, I give one which interested me a good deal at the time of noting it. In Kingsford's Oswego Starch factory, large quantities of lime are used in the manufacture of corn-starch. The refuse lime is a pasty mass still having to a considerable degree the caustic properties of fresh lime. Large quantities of it accumulate about the factory, and are hauled off to get it out of the way. Several hundred loads were once deposited in the middle of a pasture, in a loose pile varying from three to six feet in thickness. Cattle tramped over it carrying more or less mud upon their hoofs, and their droppings collected to a considerable extent upon it. In time plants began to get a foothold there, and one mild day in winter, about three or four years afterward, I visited it, and was surprised to find the following well established: Cirsium, 2 sp., Rumex, Poa, Phleum, Plantago, Graphalium, Verbena, Trifolium, 2 sp., Solidago, Marata, Chenopodium, Polygonum.

The white clover was especially luxuriant, and covered patches of several square feet with a perfect turf.

W. A. B.

A popular work on Algæ, by Rev. A. B. Hervey, to be illustrated with colored plates, is announced.

Professor Alphonso Wood, widely known as the author of a Class-book of Botany and other botanical text-books, died at his residence at West Farms, New York, on the 4th inst.

Trimen's *Journal of Botany*, despite its long standing and being without a rival in its chosen field, is obliged to make a call for a more liberal support in both subscriptions and contributions. This does not speak well for the enthusiasm of English systematists.

The second volume of *The Botany of California* has made its appearance. It includes the remainder of the Phanerogams not treated in Vol. I., the Pteridophytes, and the Mosses, and brings this eminent work to a successful close.

A new manual of the mosses of the United States will be published during the present year. The authors, Leo Lesquereux and Thomas P. James, are the most able and distinguished bryologists of America. The edition will not be large, and for the present the price is fixed by the publishers at $3.00. Such a manual has been needed for a long time.

In *The American Naturalist* for January, Professor Bessey calls attention to the Fly Fungi belonging to the genus *Entomophthora*. They have been but little studied. The most common species (*E. muscæ, Fres.*) infests the house fly. Dead flies are common in autumn covered with a white powder which fastens them to the walls and other objects of the room. Upon examination the bodies are found to be filled with the mycelium of the asexual stage of the fungus, the white powder being the conidial spores. This asexual form is described in many books under the name *Empusa*. The sexual stage developes entirely within the host, filling it with a mass of oöspores and hyphæ. The genus *Tarichium* is founded on this sexual condition of the plant. The two genera Empusa and Tarichium not being antonomous are re-