There is a profound difference between creatures in which one only of these voices speaks, and man, whose ears are, as it were, open to them both. The things which we do in obedience to the lower and simpler voice are indeed many, various, and full of a true and wonderful significance. But the things which we do and the affections which we cherish, in obedience to the higher voice have a rank, a meaning, and a scope which is all their own. There is no indication in the lower animals of this double Personality. They hear no voice but one: and the whole law of their Being is perfectly fulfilled in following it. This it is which gives its restfulness to Nature, whose abodes are indeed what Wordsworth calls them—

"Abodes where Self-disturbance hath no part."

On the other hand, the double Personality, the presence of "Two Voices," is never wholly wanting even in the most degraded of human beings—their thoughts everywhere "accusing or else excusing one another."

Knowing, therefore, in ourselves both these kinds of operation, we can measure the distance between them, and we can thoroughly understand how animals may be able to do all that they actually perform, without ever passing through the processes of augmentation by which we reach the conclusions of conscious reason and of moral obligation. Moreover, seeing and feeling the difference, we can see and feel the relations which obtain between the two classes of mental work. The plain truth is, that the higher and more complicated work is done, and can only be done in this life, with the material supplied by the lower and simpler tools. Nay, more, the very highest and most aspiring mental processes rest upon the lower, as a building rests upon its foundation stones. They are like the rude but massive substructions from which some great temple springs. Not only is the impulse, the disposition, and the ability to reason as purely intuitive and congenital in Man as the disposition to eat, but the fundamental axioms on which all reasoning rests are, and can only be, intuitively perceived. This, indeed, is the essential character of all the axioms or self-evident propositions which are the basis of reasoning, that the truth of them is perceived by an act of apprehension, which, if it depends on any process, depends on a process unconscious, involuntary, and purely automatic. But this is the definition, the only definition, of instinct, or intuition. All conscious reasoning thus starts from the data which this great faculty supplies; and all our trust and confidence in the results of reasoning must depend on our trust and confidence in the adjusted harmony which has been established between instinct and the truths of nature. Not only is the idea of mechanism consistent with this confidence, but it is inseparable from it. No firmer grounnd for that confidence can be given us in thought than this conception—that as the eye of sense is a mechanism specially adjusted to receive the light of heaven, so is the mental eye a mechanism specially adjusted to perceive those realities which are in the nature of necessary and eternal truth. Moreover, the same conception helps us to understand the real nature of those limitations upon our faculties which curtail their range, and which yet, in a sense, we may be said partially to overpass in the very act of becoming conscious of them. We see it to be a great law prevailing in the instincts of the lower animals, and in our own, that they are true not only as guiding the animal rightly to the satisfaction of whatever appetite is immediately concerned, but true also as ministering to ends of which the animal knows nothing, although they are ends of the highest importance, both in its own economy and in the far-off economies of creation. In direct proportion as our own minds and intellects partake of the same nature, and are founded on the same principle of adjustment, we may feel assured that the same law prevails in their nobler work and functions. And the glorious law is no less than this—that the work of instinct is true not only for the short way it goes, but for that infinite distance into which it leads in a true direction.

I know no argument better fitted than this to dispel the sickly dreams, the morbid misgivings, of the Agnostic. Nor do I know of any other conception as securely founded on science, properly so called, which better serves to render intellig ble and to bring within the familiar analogies of Nature those higher and rarer mental gifts which we know as genius, and even that highest and rarest of all which we understand as inspiration. That the human mind is always in some degree, and that certain individual minds have been in a special degree, reflecting surfaces, as it were, for the verities of the unseen and eternal world, is a conception having all the characters of coherence which assure us of its harmony with the general constitution and the common course of things.

And so this doctrine of animal automatism—the notion that the mind of man is indeed a structure and a mechanism—a notion which is held over our heads as a terror and a doubt—becomes, when closely scrutinized, the most comforting and re-assuring of all conceptions. No stronger assurance can be given us that our faculties, when rightly used, are powers on which we can indeed rely. It reveals what may be called the strong physical foundations on which the truthfulness of Reason rests. And more than this—it clothes with the like character of trustworthiness every instinctive and intuitive affection of the human soul. It roots the reasonableness of faith in our conviction of the Unities of Nature. It tells us that as we know the instincts of the lower animals to be the index and the result of laws which are out of sight to them, so also have our own higher instincts the same relation to truths which are of corresponding dignity and of corresponding scope.

Nor can this conception of the mind of Man being connected with an adjusted mechanism cast, as has been suggested, any doubt on the freedom of the Will,—such as by the direct evidence of consciousness we know that freedom to be. This suggestion is simply a repetition of the same inveterate confusion of thought which has been exposed before. The question of what our powers are is in no way affected by the admission or discovery that they are all connected with an apparatus. Consciousness does not tell us that we stand unrelated to the system of things of which we form a part. We dream—or rather we simply rave—if we think we are free to choose among things which are not presented to our choice,—or if we think that choice itself can be free from motives,—or if we think that we can find any motive outstde the number of those to which by the structure of our minds and of its organ we have been made accessible. The only freedom of which we are really conscious is freedom from compulsion in choosing among things which are presented to our choice,—consciousness also attesting the fact that among those things some are coincident, and some are not coincident, with acknowledged obligation. This, and all other direct perceptions, are not weakened but confirmed by the doctrine that our minds are connected with an adjusted mechanism. Because the first result of this conception is to establish the evidence of consciousness when given under healthy conditions, and when properly ascertained, as necessarily the best and the nearest representation of the truth. This it does in recognizing ourselves, and all the faculties we possess, to be nothing but the result and index of an adjustment contrived by and reflecting the Mind which is supreme in Nature. We are derived and not original. We have been created, or—if any one likes the phrase better—we have been "evolved:" not, however, out of nothing, nor out of confusion, nor out of lies,—but out of "Nature," which is but a word for the sum of all existence—the source of all order, and the very ground of all truth—the fountain in which all fullness dwells.

ASTRONOMICAL NOTES.

ON THE DETERMINATION OF THE VALUE OF ONE REVOLUTION OF A MICROMETER SCREW, ETC.

To determine the value of a revolution of a micrometer screw, it is desirable to use several different methods. The most common and least accurate is by the observation of the transits of stars over two wires of the micrometer, set at a known distance (in revolutions) apart. Mechanical measures, depending upon the measurement of the length of the screw, of the dimensions of the objective, and of the principal focal length of the telescope come next. The measures in arc of terrestrial objects of known linear dimensions come next. Bessel's triangulation of

the Pleiades was made, in part, so that the distances of any pair of these stars might be used as a known celestial arc to be determined in terms of the screw revolution. Dr. Vogel, of Potsdam, determined the value of the screw of the Leipzig refractor by measuring the difference of declination between two stars with the micrometer, and afterwards using the divided declination circle of the equatorial to determine the whole arc. This method was improved in the determination of the value of the screw of the Washington equatorial, by measuring with the micrometer the difference of declination of two *standard* stars (*ι* and *c Orionis*) a degree apart. In these last methods the value of the known arc in the sky depends upon our knowledge of the positions of its two terminal points. Dr. Winnecke, of Strassburg, has recently employed an ingenious way, which is even more simple. The distance between some asteroid (whose orbit is well known) and any star near it, is measured on several nights, as the asteroid passes from north to south of the star (let us say). Then, although the absolute position of the asteroid is not known, its daily motions are well determined, and the arc moved over may be used as a known distance from which the value of the screw may be determined.

The following complete list of asteroids (21 in all) discovered by the late Prof. JAMES C. WATSON, Director of the Washburn Observatory, Madison, Wis., has been compiled by the aid of the list of "Minor Planets," published by Mr. A. N. Skinner in the *American Journal of Science and Arts*, Vol. XVIII, *Dec.*, 1879. All of these asteroids, with one exception, were discovered at the Ann Arbor Observatory, Michigan. Juewa was discovered at Peking, China, where Prof. Watson was in charge of one of the Transit of Venus parties.

NUMBER.	NAME.	DATE OF DISCOVERY.
79	Eurynome	September 14, 1863.
93	Minerva	August 24, 1867.
94	Aurora	September 6, 1867.
100	Hecate	July 11, 1868.
101	Helena	August 15, 1868.
103	Hera	September 7, 1868.
104	Clymene	September 13, 1868.
105	Artemis	September 16, 1868.
106	Dione	October 10, 1868.
115	Thyra	August 6, 1871.
119	Althæa	April 3, 1872.
121	Hermione	May 12, 1872.
128	Nemesis	November 25, 1872.
132	Aethra	June 13, 1873.
133	Cyrene	August 26, 1873.
139	Juewa	October 10, 1874.
150	Nuwa	October 19, 1875.
161	Athor	April 19, 1876.
168	Sibylla	September 28, 1876.
174	Phædra	September 3, 1877.
175	Andromache	October 1, 1877.

The report of the *Telegraphic Determination of Longitudes on the East Coast of South America*, by Lieutenant Commanders F. M. GREEN, and C. H. DAVIS, and Lieutenant J. A. NORRIS, U.S.N., has been issued recently from the Hydrographic Office. This work embraces the meridians of Lisbon, Madeira, St. Vincent, Pernambuco, Bahia, Rio de Janeiro, Montevideo, Buenos Ayres and Para, and is designed to supplement the work done in 1877, under the direction of Lieutenant Commander Green, in the West Indies and Central America, by connecting important points in South America, whose longitudes have always been exceedingly uncertain, with well-known places in Europe.

Having made arrangements with the French *Bureau des Longitudes* to furnish the party with the difference of longitude between Lisbon and Paris, the work was begun in December, 1877, by connecting Lisbon, Portugal, with Funchal, Madeira, by means of an intervening station at Carcavellos. This "transmitting" station was found necessary in order to connect the submarine cables with the land lines; a direct connection endangering the safety of the cables. Partly by cables, and partly by the overland wires, the stations from Lisbon to Buenos Ayres were connected in the order named above, with the exception of a break between Pernambuco and Rio de Janeiro caused by a defect in the cable. These two stations were connected with Bahia, and Pernambuco with Para in 1879; and as the French Government had failed to communicate to the Hydrographic Office the longitude of Lisbon, it was determined to connect Lisbon with Greenwich, in order to make the chain complete. This last connection was effected by means of transmitting stations at Porthcurnow, Lands End, and Carcavellos on the coast of Portugal. The reduction of comparisons of the Lisbon and Greenwich clocks "gives the somewhat startling result that the longitude of the observatory at Lisbon, has, up to the present time, been in error more than two miles." The American determination of the difference of longitude between these two places being 9° 11″ 10.2″, while that heretofore accepted has been 9° 9′ 2.1″.

Of the instruments used, the Transit Instrument was of what is known as the "broken transit" pattern (the eyepiece being at one end of the horizontal axis), especially designed for this work by Mr. J. A. Rogers, and fitted to be used as both transit and zenith-telescope. It was of 2.5 in. aperture and 30 in. focal length—made by Kahler,

It seems to have combined considerable steadiness with great portability, as it weighs in all but 125 lbs. In speaking of the performance of this instrument, the report says: "The results of the observations have demonstrated that the reversal of the axis is almost inevitably attended with a slight change of azimuth, and that a correction must always be introduced for flexure of the axis," and adds further on, that these effects "are probably unavoidable in portable instruments of this pattern."

In the reductions, no correction has been applied for personal equation of the observers, either in noting transits of stars, or in receiving the deflections of the galvanometer needle from the cables. After careful experiment, it was found that the correction would be quite small, and in view of the uncertainty involved in its determination, it was decided to take no account of such error, but to eliminate it, as far as possible, by placing one observer alternately east and west of the other, commencing at Lisbon. Advantage was taken of every opportunity to make latitude determinations with the zenith-telescope, and the results in both latitude and longitude show that nearly all of the stations occupied have been up to this time considerably in error.

The spectrum of Hartwig's comet has been observed by Konkoly and Backhouse, and by Young in this country. It gives four bright lines, whose wave-lengths are respectively 5609, 5492, 5169, and 4859 tenth-meters, and a faint continuous spectrum. W. C. W.

Washington, D. C., November 30, 1880.

SWIFT'S COMET.

Swift's comet is a faint object, and its distance from the sun is so great, never less than 1.102, and therefore always outside the earth's orbit, that no great changes of form are to be expected, such as we see in comets that pass near the sun. A. HALL.

To the Editor of Science:

Several interesting observations have been made by me of Swift's latest comet. The last observation was made on the evening of November 26th, at 7.20 P.M.T., being then by estimation in about A. R. 2 hours 30 minutes, north declination 53 degrees 45 minutes. It was quite a conspicuous object in the 5-inch Newtonian Re-