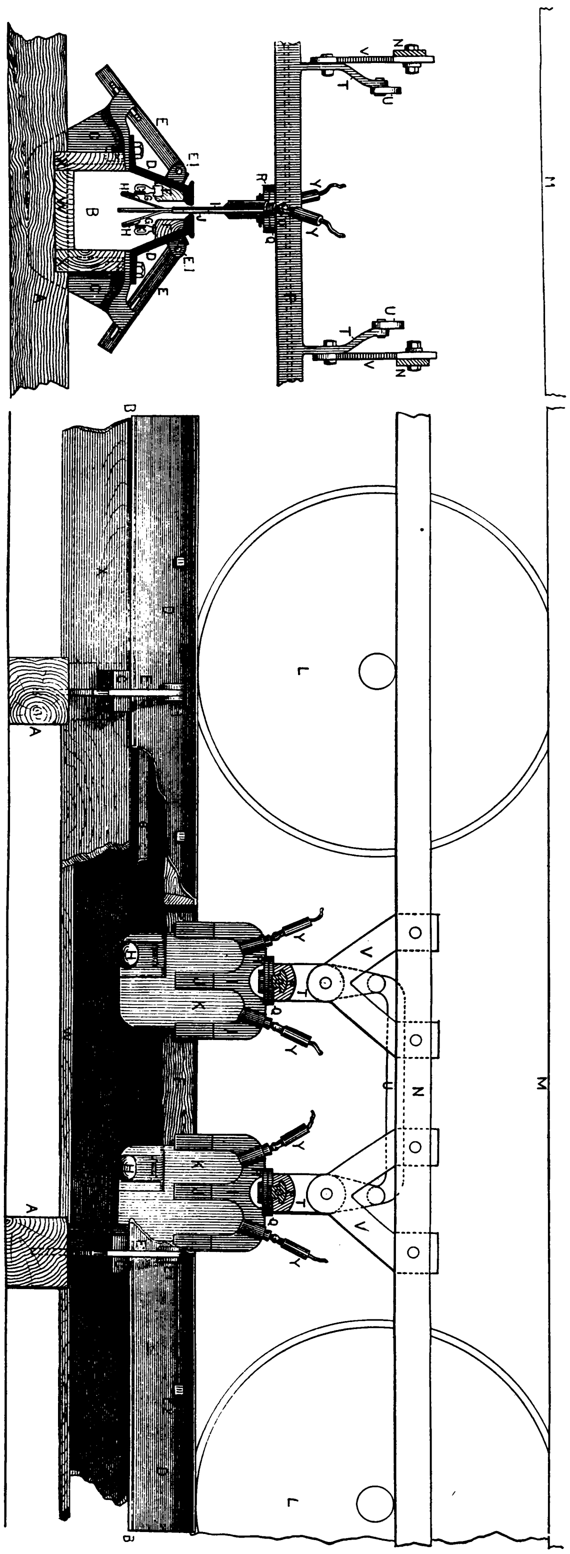
familiar as the horse-car now is. In this system the conductors are necessarily bared throughout their entire length, and must be protected both for the safety and convenience of the public and also to prevent injury to the conductors themselves. These requirements are fully satisfied by the underground conduit, which promises to be an indispensable element upon all urban lines.



A, tie; *B*, conduit; *C*, iron yoke; *D*, slot steel; *G*, conductor; *H*, contact shoes; *I*, contact device or plough; *L*, car-wheel; *P*, *Q*, *R*, traveller and swivel; *Y*, flexible conductor.

This system has been developed by the Bentley-Knight Electric Railway Company of New York City, who claim to control by patented rights all practicable methods of locating the supply conductors in a conduit, and who, however this may be, have built the only roads operating on this plan. Either between or outside of the track-rails is laid a conduit about fifteen inches in depth and ten inches in width, consisting of iron yokes set up from three to five feet apart, and slot steels bolted thereto, leaving an opening at the surface of the street of only about five-eight s of an inch. The direct and return supply conductors, consisting of copper bars united by expansion joints, are supported by suitable insulators in the upper part of the conduit, where they are out of the way of any slush and dirt which may collect therein. These conductors are placed opposite each other, and are connected in circuit with the dynamos at the central station. The car carries a plough or contact device, which extends down through the slot into the conduit, and has two contact-shoes insulated from each other, which rub against the two line-conductors. Flexible conductors in circuit with the two shoes extend up to the car, and are in circuit with the terminals of the propelling motor; so that, as the car travels along the track, the two housed conductors are constantly connected through a travelling loop circuit supplying the motor with current.

The shank of the plough is narrower than the slot, and the contact-shoes can be folded into line therewith, so that the entire plough can be inserted or moved from the conduit at will; and accidental breaking of the plough is guarded against by providing a spring catch normally holding the plough in place, but adapted to give way should any accidental obstruction be struck. In order to compensate for any curves or irregularities in the line of the slot, a transverse guide is provided upon the vehicle, and a traveller at the upper end of the plough moves freely along this guide, while swivelling or other jointed connections may be employed when found desirable. The car is propelled by either one or two motors of about fifteen horse-power, which are generally placed underneath the car-body, and centred around the axles, to which they are connected through intermediate speed-reducing gearing. The usual brakes are provided for stopping the car, while circuit switches and resistances control the speed and power of the motors with all the precision and nicety of which steam-motors are capable.

From this description the essential features of construction in the conduit system, as well as the mode of their operation, will be readily understood, but many questions touching upon the practical working of the system will suggest themselves to those interested in it as a commercial enterprise: Will the conduit become filled with dirt or with snow? Can the necessary insulation of the underground wires be maintained? Will the car have sufficient traction? What will happen if the car runs off the track? All these objections have been anticipated, and it is found that the satisfactory operation of the conduit road built by the Bentley-Knight Company at Allegheny City, Penn., demonstrates that they are groundless. This road, which is known as the Observatory Hill Passenger Railway, is about four miles in length, the conduit being employed for about one-fourth of this distance, and it has been in continuous operation since the first day of January, 1888. There are thirty-four curves on the line, not including turnouts and switches. The maximum grade is $9\frac{29}{40}$ feet in 100 feet, on a length of 400 feet, and this is on a reversed curve (radii 100 and 200 feet). The sharpest curve has a forty-foot radius on five-per-cent grade. Greater natural difficulties than these can scarcely be found on any street-railway in existence, and hence the successful working of the road during the severe snows and ice of the last winter is perhaps the best guaranty of the practicability of the system. Other conduit-roads are now under process of construction by the same company, noticeable among which are one of over three miles in length, contracted for by the West End Railway Company of Boston, and the Fulton Street Road of New York City. The progress of these roads will be watched with interest.

That for the West End Company in Boston is just completed, and will be put into operation in a few weeks, and thoroughly tested.

PHILOSOPHY AND SPECIALTIES.

ON Saturday evening, Dec. 8, the annual address of the retiring president of the Philosophical Society of Washington, Col. Garrick Mallery, U.S.A., was delivered before a very large audience, composed not only of the members of the Philosophical Society, but of those of the Anthropological, Biological, Chemical, Geographic, and Woman's Anthropological Societies, whose attendance had been invited. The subject was 'Philosophy and Specialties;' and in the publication of an abstract we are compelled to omit all the ornamentation.

Colonel Mallery said that only three centuries ago the chief seats of learning were successfully challenged by a scholastic knight-errant to a dispute on any subject and all subjects, or, as it was derisively phrased, "*de omnibus rebus et quibusdam aliis.*" In the days of the Admirable Crichton it was possible for one mind to grasp the total of existing knowledge, and this was because science had not yet risen above the misty horizon. The study of facts and their co-ordination had not supplanted the two most prominent schools depending severally upon revelation and intuition.

The quality of revelation prohibited discussion upon it even as an explanation of phenomena, but allowed of reasoning from it within the usual limits of orthodoxy to be decided by the physically, not mentally, strongest battalions. So all that once represented science was mythology, especially in its grand division of demonology.

An opposite scholastic system, prevalent in its time, started in the tenet that intuitions should decide on the nature of things and the perfect type of their origin, to be ascertained by man's own ideals, not from observed data. The examination of a sound mind in a sound body being difficult, he was then the greatest teacher who had most enormously tumefied his inner consciousness, and could exhibit its morbidity with the most pretentious diagnosis. Subject to this leadership in introspection, every man was his own universe. Though specimens of such effete concepts still survive in folios, they are not found in the working libraries of science.

When, therefore, there was no attention to facts as such, and knowledge was either a commentary on revelation or a ratiocination on self, it was not so difficult to know every thing. To-day the pretender to universal knowledge will be denounced as knowing nought. This judgment is carried to an extreme. Even the exceptional minds, whose multiplied facets scintillate brightness in diverse angles, are denied glory as light-bringers on each line.

This is necessary, for phenomena are infinite, and science must deal with all as observed. In the formulation of its induced laws, no compromise is admitted, as in politics or ethics. But this infinite is composed of the infinitesimal, — atoms, molecules, protoplasms, or whatever name may be invented by our ignorance, — and it is by the study of these minutiæ that science exists. So this is the era of specialties. No freshly discovered fact is without its significance, and may in its relations solve the most obscure problems. The original investigator now must not only be a specialist, but must work in some subdivision of a specialty.

This was illustrated in several of the sciences, in the professions of law and medicine, and also in art. The recent progress of specialization was shown by the fact that nine years ago the Philosophical Society was the only scientific society in Washington, embracing all branches. Since then the Anthropological, Biological, Chemical, and Geographic were founded, and the Mathematical Section of the Philosophical Society established. An account of these, with their several functions, was given.

However essential division of labor, specialization, and analysis may be, they are nevertheless only means to the ultimate aim of generalization and integration, which constitute wisdom, and its construction is by synthesis.

Within the most circumscribed of specialties there must always be an attempt to reach law through details. The solution of a problem without application of it is like playing a game of solitaire where time and skill give no result. Mathematics, apart from their gymnastic training, would be useless if their integrals should remain meaningless. Each asserted fact must be tested by varied experiment, which often results in failure. The truth of to-day has sometimes been the paradox of yesterday, and may become the falsehood of to-morrow. Admitted facts must be compared with all other facts related to them. Confutation must be challenged. Without this process, science would be a jumble of inconsistent opinions, so that cavillers might have excuse for a jibe that whatever is not sense is science. While such testing and comparative discussion should exercise its function in each specialized society, it is yet more important that the results, as appearing to its specialists, should be examined with the greatest freedom by specialists in other lines; and this examination is not only for further verification and comparison, but to extend the area of acquired science. Practically science is only the existing condition of human knowledge, which of necessity is incomplete; though its form, to be science, should not be a broken surface, but a series of steps by which greater heights are gained. For these reasons all specialties should be tried before a court of general jurisdiction, — an Areopagus. In course of time, doubtless, the press brings forth scattered judgments of such a universal tribunal; but a hand-to-hand contest must be more active and decisive than a protracted war, conducted by the discharge of heavy books at long range, or by the skirmishing shots of pamphleteers. If scientific association is to do the most good, some time and place for trial by battle should be provided, which cannot be done in any or in all of the specialized societies by their separate work.

The propriety of scientific contest on a common plane is readily illustrated by the yet undetermined controversy between geologists and physicists respecting the age of our earth. As neither side can yet speak without contradiction by the other, neither should speak except in the hearing of the other. A more popular illustration is in the historic fight between ordnance and engineers; that is, scientific attack by artillery or its equivalent, and material defence by fortifications or similar protection. In no systematized war department can either the officer of ordnance or of engineers be confided in, except when, after experiment satisfactory to his own corps, his demonstration shall overcome the corps of his complementary antagonist.

Thus by the interrelation and counteraction of specialties there is mutual correction, ascertainment of truth, and promulgation of law.

After discussing the work and functions of the American Association for the Advancement of Science, the Congress of American Physicians and Surgeons, and other organizations, the term 'philosophy' was more closely examined. The old 'philosophers,' while professing to seek the truth, did not do so, but asserted that they had it already, and that their sole work was to teach it to others. As before hinted, this philosophy was axiomatic, and closely connected with theology, by which forces and factors were postulated but not comprehended. Logic and mathematics do not detect errors in axioms and postulates when once admitted. Verities by common consent were adopted *a priori*, which verities, belonging to a low stage of culture, were universal errors, and therefore in accord with all existing reasoning. The teachers found it convenient to reason from the species to the genus, and from the particular to the general, by words instead of by ideas; that is, by verbal sophisms. Crude conceptions were employed to make words, which the elasticity of languages permitted, grammatic form and euphony being the only limits. This superannuated scholasticism has been generally called 'metaphysical,' but is more properly 'antiphysical.' Its combined stupidity and pretence have to some minds inflicted a stigma upon the title 'philosophy' which it arrogated. Modern re-action from the fetichistic worship of this monstrous phantasm may have been too violent.

The terms 'science' and 'knowledge' are perhaps convertible in usage, as in etymology, but neither of them is synonymic with 'philosophy.' Professor Mach defines 'knowledge' as 'an expression of organic nature;' but that is not true, unless by knowledge he means true wisdom. Knowledge is the 'mere material of which wisdom builds.' Claude Bernard is partly right in stating that philosophy makes a specialty of generalizations. That, however, is measurably true also, as before stated, of each one of the sciences. Without proper synthesis, they do not exist as sciences, but are mere uncouth mosaics. Each special science must have a philosophic side, and the co-ordination of all of those sides constitutes philosophy in general. In this sense it is not merely the specialty of generalizations, but the generalization of generalizations. Without it the several sciences rest with no common bond, and do not form a synthetic and organic whole. Their fundamental hypotheses are liable to overthrow, because they are not criticised and revised by logical co-ordination. The method of science is to test hypothesis by experimentation and continued observation. From a sufficient number of results a proposition or law is induced, the authority of which increases with the number and weight of those results. It is not a valid objection that generalizations, even obtained *a posteriori*, have often been erroneous. So much the greater necessity for their trial by a proper tribunal; for the end is to establish from particular facts a general law, which thereupon may be considered as a principal fact, explaining and showing the relations between the facts which it governs. This second course is deductive, in which the value of the conclusion is that of the premises. The collection of and proper deduction from, more strictly the application of, such principal facts or induced laws, is the domain of philosophy.

The vocabulary employed by an ecumenical society should be different from that proper to a specialty. It should be such as is understood by an audience of good general education. It is true that the actual operation and formulation of thought in many branches, notably chemistry and botany, besides mathematics, requires the elaborate technical language and symbols invented for them; and in all lines of study condensation and determination have demanded neologisms, which increase daily with new facts and thoughts. But workers with these newly fashioned terminologic tools become too fond of and dependent on them.

In the use of specialistic and coined terminology, not only pedantry may be observed, but the old juggle with words, in which pretended novelty is only mystification. Greek compounds are convenient as brands or labels, but do not make thought less, and often leave it more obscure. Polysyllables and water are bad, but polysyllables and mud are worse. Such obscuration of truth is a serious injury. From these views it must be admitted that philosophy, being broader than any science, — than all the sciences together, — cannot be limited by the formulation peculiar to any of them, and therefore its language should not adopt the terms of any, but use such as are generally understood and accepted.

This admission at once brings up the subject of style in its broadest scope. The prime requisite of style in philosophic as distinguished from specialistic writing is, that it should be clear to all; the second, that it should be attractive. It is not so easy to be clear; and Sheridan's phrase, "Easy writing's curs'd hard reading," is enforced by the confession of so great a thinker and writer as Charles Darwin. Style is not confined to vocabulary or ornamentation. It is the treatment which, by the mental work of presentation, the author putting himself in the place of the reader, enters into substance, and translates from his own mind to many minds. A large number of examples were given of the use of style well and ill, by scientific and non-scientific modern writers of English.

It is not proposed, however, to offer a disquisition on style. But as Wesley once protested, in words rendered more pungent by Elder Knapp, against "the Devil having all the best tunes," it is desired to enter a vigorous protest against fiction having all the best English. Two suggestions only will be ventured, both perhaps unexpected. The first is that poetry should be incorporated, not injected, into a scientific production. This does not renew the adjudicated claim of the imagination — "the vision and the faculty divine" — to scientific use, but refers to the manner of expression. Never let prose get into your poetry, but put all the poetry you can invoke into your prose. Molière's hero was astonished to learn that he had been talking prose all his life without knowing it; and, conversely, our best prose-writers on the heaviest subjects might find that the poetry in their prose was the secret of their success. This conception of poetry does not mean the evanescent prismatic tints on the bubbles of a scientaster or scientulus, — whichever term may suit the diminutive pretender, — but the informing and vitalizing light, which not only refracts and reflects, but radiates from an original source. The spontaneous characterization of the highest order of prose writings is that they are full of light, fire, and life; and the term 'poet,' applied to their authors, shows its true etymology, — the maker.

The second plea is for the admission of wit and humor into scientific writing. No one, not even Sydney Smith's Scotchman, is willing to confess his imperception of humor. Nevertheless nature has not given it to every one; and to those to whom it is denied it is as the absence of a sixth sense, by which absence much happiness is lost. This enumeration of humor with the senses is scarcely forced, for man has been styled the 'laughing animal,' as best distinguishing him from other orders. Neither the grin of some simians nor the cachinnation of the hyena, nor any similar demonstrations by other animals, represent human smiles and laughter. The deficiency may be compared with unappreciation of the arts in general; but the histrionic art is that on which there is least controversy. Every man who is in the normal possession of his senses appreciates perfect acting. Dr. Johnson suffered from bad vision and hearing, and therefore never could reconcile himself to the overwhelming success of his friend David Garrick as an actor. Translate his physical imperfections, while admitting his general judgment, into terms of humor, and it may be understood how many good and wise people fail to enjoy it. With them the dogma is naturally cherished that a witty man is always shallow. Sydney Smith, who knew whereof he spoke, says, "The moment an envious pedant sees any thing written with pleasantry, he comforts himself that it must be superficial." Many people admire sententious monotony, even if it be stupidity, and are shocked too much for their delicate nerves at the sudden presentation of an intellectual surprise. Yet what is more forcible? Is there any mode in which truth can be more strongly presented than by its humorous opposite? If the dry *reductio ad absurdum* is legitimate, how much better is it when laughter brings an echo! Laughter must be: therefore philosophy cannot ignore it.

Both science and philosophy are separated from literature by well-established boundaries. Passing by philosophy for the moment, the distinction between science and literature may be sharply drawn by recognizing that science deals with facts regardless of the vehicle of their expression. Literature, on the contrary, may disregard all facts as such, while occupied with reflection and sentiment; and in it the form of expression is essential. There is a literature of science and of all the sciences; but few scientific works can be embraced in literature, if only because of their defective form.

The favorite but not vallated domain of literature is æsthetics in its true meaning, — viz., that which is perceived or apprehended by the senses, but limited to what is desirable to be so apprehended, the beautiful (the Greek το καλόν), — and, even if the spirit of literature abandons this Elysian realm, the form cannot depart from it and live. Specimens of literature may properly be stigmatized as bad, — bad in tendency and effect, as in their influence upon morals, religion, politics, and the like; but literature cannot be bad in form, because, if its form is not æsthetically good, it is not literature at all. It has been asserted that in literature the substance is of little moment — only the form, the manner in which the things are written, and not the things. An argument can be made in support of this dictum. Even the utilitarian must admit that the struggle for perfection in language — comprising vocabulary and grammatic form — for itself alone has presented to both science and philosophy their vehicle, and has established for humanity its imperial distinction over the rest of living beings.

Some advocates of form *versus* substance might quote favorite passages of Emerson or Browning that cannot be understood, as is proved by so many diverse interpretations. But while æsthetic form is undoubtedly essential in literature, comprehensible thought must be there also. The smoothest iambics and most stately hexameters which exercise in Latin prosody the scholars of Eton and Harrow, technically styled 'nonsense verses,' are not literature.

It may seem bold to assert that literature should not meddle with science, when every novel brings into its machinery some scientific statement or discussion, and as fast as each new discovery appears it is seized upon by the romancer for his plot as a *deus ex machina*. But, if this employment is more than machinery or incident, the novel becomes a dilute treatise, and is not proper literary work.

A rough contradistinction may be outlined, that science deals with facts, the thoughts being secondary; literature with thoughts, the facts being secondary; but philosophy includes equally the facts and the thoughts relative to them. Science supplies food, but neither savor nor digestion; literature pleases the appetite; philosophy with appetite digests the food. Again: to science the language used is subordinate; to literature the language is paramount; to philosophy the language is essential, but not paramount.

It remains to offer the suggestion that philosophy should also be regarded from the significance of its etymology, — the love of wisdom. Lessing said, that, if it were necessary to choose, he would prefer to have the love of truth to the possession of truth itself. By this paradox he meant to emphasize his desire for wisdom, not for repletion by facts and cold encyclopedic knowledge. The mere possession of truth, not strictly wisdom, may be that of a miser who hoards and does not circulate it to the common good; but the love of wisdom brings wisdom. "Be there a will, and wisdom finds a way." "Wisdom crieth aloud, she uttereth her voice in the streets," and it will be regarded. "So teach us to number our days that we may apply our hearts unto wisdom."

SCIENTIFIC NEWS IN WASHINGTON.

Causes of Configuration in Trees. — How Some Eskimo Measure. — A New Improved Freezing-Microtome.

Causes of Configuration in Trees.

THE influences under which a tree assumes one shape instead of another are obscure even to the students of vegetable dynamics. External forces are added to hereditary forces in every growth. The mechanical forces at work, affecting plants externally, are mainly gravity and atmospheric pressure (wind).

B. E. Fernow, chief of the forestry division of the national Department of Agriculture, recently read a paper setting forth some valuable observations.

The physiological forces are termed 'stimuli,' and produce re-actions only on the growing tissue, and are characterized by the disproportionality between the external stimulus and the ultimate re-action. These forces work accidentally and occasionally, often changing the environment of an organ; and such alterations may occur by a change in the intensity or direction of the light, variation of temperature, instantaneous shocks, sudden pressure, etc. The capacity to re-act to these stimuli is called 'irritability,' the presence or absence of which is a sign of life or death.

The various parts of a plant re-act differently to the same stimulus, and according to their type of structure. The internal capacity of a part of an organ to re-act to external influences determines its external form and the direction of growth: thus radial structures are usually orthotrop (tending to place their axis toward the acting force), dorsiventral structures act plagiotropically (tending to place their axis obliquely or transverse to the direction of the acting force).

But there is also seen what may be termed a vicarious correlation' of the different structures, by which the development of one organ is changed in its direction by the development or lack of development of the other; thus, also, a plagiotropic organ becomes orthotrop. The most common example of this correlation is seen when the main axis is cut off, and a side-branch takes the orthotropic nature of the main axis.

The stimuli that effect changes of direction in various parts of plants — aside from accidental ones, like pressure, contact, moisture, heat — are mainly light and gravity; the re-action to light being termed 'heliotropism,' and that to gravity being 'geotropism.' In regard to the latter re-action, there appears to be a misapprehension as to the nature of gravitation, as usually accepted, and as stated by Sachs, Darwin, Wiesner, and others.

It seems illogical to assume that gravity, conceived to act everywhere and constantly, could be considered as determining the direction of the primary root vertically downward, of the secondary roots obliquely downward, and of the other classes of roots growing without reference to this always active force.

That the direction of the different parts is a resultant of several forces, among which gravity may be one, is hardly intimated by these writers; and the dominion of gravity is so forcibly stated that the occasional reference to modifying influences does not impress us as a necessary and important consideration.

The effects of heliotropic (light) stimulations are the opposite from those called 'geotropic,' or a bending toward the light. But the effect of light upon root-forming matter is to turn it away from the light; and upon shoot-forming matter, to turn it toward the light; while dorsiventral structures adjust themselves obliquely across the direction in which the light strikes the irritable organ. The latter behavior is highly important, and reveals the purpose of this re-action, which results in the largest surface of chlorophyl-bearing cells being exposed to the light, and inducing the chemical changes upon which growth depends.

Intensity of light, however, may become injurious, and hence the presence in some plants (*Mimosa*) of an ability to change the position of the leaves with reference to the optimum light intensity. As the light is diffused equally in the atmosphere, a re-action is produced only by a difference in the amount of light which reaches the different sides of a growing part. The direction, then, of a branch, as far as it is dependent on the action of light, is in proportion to the difference of illumination of its parts; for a greater illumination on one side of a branch has the effect of increasing the cell-growth on the shaded side (hyponasty), and thus the more rapid lengthening of the shaded side results in a curvature and a new direction of the tip of the branch toward the light. The action of light on the roots is exactly opposite (epinasty); i.e., the illuminated part lengthens more rapidly, carrying the growing point away from the light.

Considering the action of the light on the normal development of the branch system, concludes Mr. Fernow, we can better understand how the direction of branches is changed from their original position to the one in which we find them in later life; and we can also understand that the typical branch system of trees must to some extent depend on the greater or less density of foliage. Thus less dense foliaged trees should in general exhibit a more erect habit in their branches; while the shadiest foliage should give the most spreading branch system.

How Some Eskimo Measure.

The ape which (or perhaps whom) Mr. Romanes has succeeded in teaching to count five seems to tread closely on the heels of some of the races of men. In a paper on the Eskimo of Point Barrow, Mr. John Murdoch of the National Museum said, that, like the rest of those peoples, they ordinarily do not use numbers greater than five, but speak of six and all higher numbers as 'many.' Their real numbers are one, two, three, four, five, ten (which means the upper part of the body, namely, the number of digits on the upper extremities), fifteen (perhaps), and twenty (which means 'a man complete,' i.e., all his digits used up). These numbers are almost identical with those used in the other dialects, while the intermediate numbers are quite different, though expressed in a similar manner; that is to say, 'so many on the next hand or foot.'

With such clumsy numerals, arithmetical processes are practically impossible, though they practise a sort of crude addition, arriving at the number of a large series of objects by grouping them together in fives. In counting, the ordinal numerals are used. This is also the same as in the other dialects.

They originally had no standard of dimensions for space, but of late years have learned to use the fathom in trading for cloth, etc.

Time is measured by the sun and stars. For example: the star Arcturus is the seal-netters' timepiece. When he is in the east, dawn is near, and it is time to stop fishing. The year is divided into four seasons, — early winter, winter, early summer, and summer.

Nine lunar months are known by name. The rest of the year "there *is* no moon, only the sun." They begin to count the moons from the early autumn, the time when the women go off into the little tents to work on deer-skins. The first moon — roughly speaking, October — is "the time for working, i.e., sewing;" November, "the second time for sewing;" December, "the time for dancing" (this is the season of the great semi-dramatic festivals); January, "great cold," or "little sun" (in this moon the sun just re-appears at noon); February, "the time for starting" (on the winter deer-hunt); March, "the time for starting home;" April, "the time for making ready the boats" (for whaling); May, "the time for fowling;" and June, "the time for bringing forth young" (when the birds lay eggs).

They clearly distinguish "to-day," "yesterday," and "to-morrow;" but "day before yesterday" and "day after to-morrow" are the same; and beyond that, all is "some time ago" or "some time hence" (the same word), till it gets to be "long ago" or "by and by."

Then there are no dates in their past or future, except what has happened or is to happen.