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Contents.

(Illustrated articles are marked with an asterisk.)

WHAT DO WE SEE?

Not a little comment has been provoked by the recent article entitled "The Trustworthiness of the Senses," in the course of which we expressed the belief that in health our senses are truth-telling and trustworthy, and that the cases commonly cited as illustrating sense deception, or deception by the senses, are really instances of mistaken judgment. The sense does not tell us a lie, but we infer what is not true through haste, carelessness, or lack of knowledge. Accustomed to associate certain conditions with certain appearances, for instance the presence of a gem when a particular play of light and color is perceived, we infer the existence of the familiar condition whenever the usually ascribed phenomenon is observed. We see the play of color, and pronounce its source a gem. On examination, we find that there is no gem, but merely an angular cavity in bright metal bathed in clear or colored light. The eye was deceived and reported a lie, men say: not so, say we; the eye reported the appearance correctly; it was not within its province to tell what caused the appearance. Our erroneous inference arose from lack of knowledge of the fact that that particular play of light could be produced in various ways other than the refractive action of a particular gem.

Such misleading inferences are frequently made by microscopists; bubbles are mistaken for solids, solids for cavities, transparent globules for opaque masses, and so on, the liability to error lessening with increase of experience and knowledge. A notable instance occurred but a little while ago. A mineralogist thought he had discovered what mineralogists have been so long looking for, the native place of the diamond. In a rock with which diamonds were associated, he observed under the microscope what he took to be diamonds. The observation was apparently confirmed by other microscopists; but another, more acute or more fortunate, was able to see that the supposed gems were merely minute cavities, once occupied by crystals but now empty, the original tenants and formers of the faceted spaces having been dissolved and washed away.

Shall we say that the eyes of the mistaken microscopists deceived them? Not at all. They saw truly all that was to be seen, a certain play of light. They inferred that it was caused by tiny diamonds, and erred, not knowing or forgetting that there were other ways in which such appearances could be produced.

Take a still more plausible instance of reputed sense deception. Cross the second finger over the forefinger and roll a small object in the angle between their tips. The object will seem to be double. Touch gives a false report, it is said. We say: No; it simply reports the contact of some objects with the inside of one finger and the outside of the other, a sensation commonly produced by two objects separated by the breadth of the fingers. After a little practice with the crossed fingers, we cease to make the wrong interpretation of their report, just as we have all learned to do in the case of thumb and finger. So familiar are we with the touch of objects indifferently between either side of the thumb and either side of the several fingers that we never mistake their combined report. The same is true with regard to our two hands; from long experience we instinctively combine the double sensation they give into a single perception. Not so, however, with hands and feet—at least among a boot-wearing people. We are not used to feeling objects with our fingers and toes together; consequently when an object is touched, say by the great toe and the forefinger, the double sensation gives a double perception, though the object be single. Very probably the education of savages is more complete than ours in that respect. Shall we say their senses are therefore more trustworthy?

Against the view we have illustrated so fully, several correspondents have taken exception. One says:

"Allow me to ask, is not our judgment the offspring of our senses? Yes; and the more acute the senses, and the more harmony there is in their working together, the more accurate the judgment. Blot out of existence the five senses, and you blot out the judgment which you make lie back of them, and seem to make independent of them."

To this we need only reply that the fullest dependence, not only of judgment, but of all the faculties of the mind, upon the senses, may be admitted, as far as their development is concerned, without affecting our position. Whatever their organic connection, perception and inference are distinct operations; and no theory of mental action can make a delusion of sense out of an error in judgment.

Our correspondent proceeds to describe the nervous connection of the several organs of sense with the brain, and organs that the senses cannot be trusted because the nerve connection may be deranged or destroyed, and a correct report of the sense's action prevented: a contingency carefully ruled out of the discussion by our specification of health as a condition of right action on the part of the senses. This is not so bad, however, as the course of another who pronounces our position absurd and foolish, and, in proof of his assertion that "everything goes to prove the trustworthiness of the senses," gives a series of examples, all but one of which belong to the domain not of sense but of sensibility; for example: that one man delights in the odor of roses while to another it is indifferent; that one man enjoys the tumult and clamor of a battle, another abhors it, another cannot bear it; that one man likes tobacco, which to another is disgusting. The single exception was this: that a distant church spire looked to him not more that a foot long; therefore his sense of sight was not to be trusted!

It is surprising how common is this twofold error, to suppose it a function of the eye to see size, and to accuse the eye of inefficiency or dishonesty because the apparent size of objects is variable. Our first-mentioned correspondent has in this connection a theory that is quite new to us. "I have said," he remarks, "that the organs of sense have brain nerves; I not only believe this, but I believe that they each have more than one brain nerve. The eye, for instance, has a brain nerve which enables the mind to recognize form, another which enables it to recognize color, another which enables it to recognize size, etc. And upon the acuteness of these nerves depends the power of mind to recognize the different qualities reflected through the eye."

The theory is simply enough, but unfortunately it is not supported by anatomy and is flatly contradicted by experience; particularly the experience of those persons who have taught us most with regard to what we see and how we learn to see it—men and women born blind with cataract or some other curable organic defect, and enabled to see in later life by a surgical operation. To speak mildly, it is hardly just to impose upon the eye so many functions which do not belong to it, and then hold it guilty of breach of trust because it does not perform them satisfactorily.

This brings us by a roundabout way to our original enquiry: What do we really see?

We use our eyes in determining the size, solidity, distance, and motion of objects. Can we say absolutely that we see them? We frequently pronounce an object hard or soft, hot or cold, at sight. Do we see hardness or heat? From varied experience we have learned to associate different degrees of density and temperature in many objects with certain visual aspects of those objects; these perceived, we infer the softness or hardness, the warmth or cold; and so closely united are the perception and inference that we are apt to say we see what we really infer.

In like manner we infer or estimate size, distance, solidity, speed of motion, and the rest. In all such cases, then, an act of judgment involves many elements, sight being supplemented by extravisual processes, the mastery of which was slowly gained in infancy, but so thoroughly gained that they now seem automatic. In reality we see only light in its various hues and shades; but whether the source of the light is near or far, solid or superficial, it is no business of the eye, primarily, to determine. Consequently, when we mistake a painted object on a flat surface for a solid object in open space, when we think a sheet of water is ten miles across one day and only three miles the next, when a hawk speeding through space seems motionless, when a pool of water is mistaken for a damp flagstone by gas light, in the infinite instances when things are not what they seem and the eye is charged with treachery, that useful organ is simply wrongly accused. Its duty is correctly done; but through inattention, haste, or ignorance, we misinterpret its report.

We are not asserting the perfection of the human eye as an optical instrument. It is far from perfect; but the untrustworthiness with which it is charged does not arise from its optical imperfection: so, in almost every instance, in the case of the other senses. If we are deceived by them, it is our fault, not theirs.

But it may be asked, what difference does it make whether we regard the senses or what lies back of them as a source of error, so long as liability to mistake is admitted?

This very great difference: The one view logically leads to the brooding apathy of the Indian mystic, the other to the questioning, testing creative activity of modern thought. To surrender ourselves to the belief that error is our normal condition is to lose our grip of reality and drift into dreamy speculation. Believing the senses honest and truth-telling, we must regard error as an evil to be corrected by caution, culture, and widening knowledge; where they fail through dullness or narrowness of range, we can strengthen and verify them by mechanical devices. Distrust them utterly, and hope is lost; trust them, and we may pursue our course with something of the confidence of the passengers of the Prairie Belle, with Jim Bludsoe at the wheel, when

"They all had faith in his cussedness
And knowed he would keep his word!"

THE CAUSE OF PROFUSE RAINS.

Every one knows that the heat of the sun raises water from the earth in the form of vapor, which becomes clouds, that float around, and at last discharge the water of which they consist; this simply is the cause of rain. But we ask the reader if he has ever considered that the amount of water evaporated by the sun depends on the latter's heat? If this were increased, more water would evaporate and more come down; and if it were diminished, less would evaporate and less would come down, and the amount of rain would diminish, as it is certain that the water which comes down as rain must have been previously raised by the heat of the sun; as the sun is sometimes obscured by spots, it must be supposed to give less heat, and therefore cannot raise so much water as vapor: and under these circumstances the sun cannot properly be the cause of extraordinarily heavy rains and inundations. This is the theory advocated in some quarters, but it cannot stand the scrutiny of reason.

Measurements show that the heat emitted by the sun is not regulated by the spots; while at the same time that spots appear, the faculæ, giving more heat, also make their appearance, and go far to compensate for the diminution of heat caused by the spots, so that the total heat emitted by the orb is, for all practical purposes, a tolerably constant quantity; and it must be remembered that the evaporation chiefly takes place from the surface of the ocean, which covers three fourths of the earth's surface. Three fourths of this evaporated water falls back into the ocean, and one fourth on the land, or perhaps a little more, as clouds appear to be attracted by mountains, and by preference discharge their contents on land; but in any case the ocean receives back, in the form of rain, more than half the water evaporated from the surface. The circumstances attending the condensation of the cloud vapors into rain are very complex; and this operation is subject to so many various conflicting influences that a regular distribution of rain would be a matter of surprise, if not a total impossibility, and therefore we see the greatest irregularity in the rainfall prevail. In some limited regions of the earth, however, there exists a regularity in this regard; but this is simply caused by the more uniform circumstances in which such exceptional localities are placed; and the causes of this regularity may be, and have been, clearly traced by those who make the investigation of this subject a special pursuit.

If the total amount of evaporation, over the whole surface of the earth, be a nearly constant quantity, the total amount of rain falling over its whole surface must also be regular, because what goes up must come down; and if we had rain gages distributed over the whole earth and ocean surface, this proposition would, no doubt, be verified. But, by the irregular distribution of rainfall, some localities may be liberally supplied at the expense of others; or at some periods of time, the rainfall may become concentrated into shorter periods. If, then, such larger rainfalls take place within the limits of the valleys which supply our rivers, an inundation is the consequence. It may be that the amount of rainfall in some inundated districts is not greater for the whole season than is usually the case, or, if it is, the rainfall of other localities, or on the ocean, may have been so much less; so that, in order to account for an inundation or a great rainfall, it is not necessary to suppose the total amount of water falling has been greater than usual.

These considerations show how unnecessary it is to look for cosmic causes in explanation of such comparatively trifling meteorological phenomena as an extra rainfall in some districts. Some philosophers have even gone so far as to attribute it to the jets of incandescent hydrogen, ejected in the form of protuberances (during solar storms) from the sun's surface to a hight of a hundred thousand miles toward the earth, which, cooling while approaching our atmosphere, form water. If we consider that, at a distance of three million miles from the sun, the gravity towards that body is nearly as great as is the gravity on the surface of the earth towards the earth, it is clear that this solar hydrogen has little chance to reach us. If it did, and if it combined with our atmosphere's oxygen to form water, a terrible fate would be in store for the earth; because, if all the oxygen in our atmosphere were exhausted to combine with hydrogen to form water, it would only form water enough to raise the surface of the ocean six feet, as is easily proved by calculation.

STEEL BRONZE AN AMERICAN INVENTION.

We recently described the so-called steel bronze, which, as material for ordnance, is at the present time being widely discussed by European military people. It is an ordinary bronze of 90 parts copper and 10 of tin, of which the gun is cast on a copper core of less diameter than the bore. The latter is then reamed out until about one quarter inch less in diameter than it is intended to be ultimately. The gun being firmly secured, a series of conical plugs of hard steel are forced through it by hydraulic pressure, compressing the metal about the bore and rendering it, as proved by extended experiment, stronger, harder, and much more elastic. General Uchatius of the Austrian Army, the reputed inventor of this process, has been experimenting upon it since September, 1873, but his claims as to origination are opposed by those of Colonel Rosset of the Italian, and Colonel Narroff of the Russian, army, both of whom state that they also separately conceived the idea of thus treating bronze guns as early as the year above mentioned.

The results which have been reached in testing guns of steel bronze, some of which have withstood the firing of 3,000 rounds without any diminution of accuracy of fire or deterioration in any other respect, prove the invention to be of more than ordinary importance. This fact is certainly well recognized by the Austrian government, which, as already stated in a previous article, has ordered a large number of batteries to be made of the improved metal. Consequently it is all the more gratifying to Americans to learn that the so-called steel bronze is neither an Austrian, an Italian, nor a Russian invention, but one created by Samuel B. Dean, of Boston, Mass., and patented by him in this country and in England in 1869. Mr. Dean's claim is, "as a new manufacture, a bronze gun in which the metal immediately surrounding the bore is put in the condition by the process of condensation set forth," which process we need not here recapitulate, since it is identically the same as that described in the first paragraph of this article, and now asserted to be theirs by Uchatius, Rosset, and Narroff.

It appears further, and the fact may not be so gratifying to Americans as that just mentioned, that Mr. Dean patented his invention in Austria in 1869. Three years later a general in the Austrian army comes out with precisely the same idea, and is backed up in its ownership by Austrian authorities, who reward his alleged discovery by permitting him to sell out rights for certain countries, other than the great powers of Europe.

Colonel Laidley of the U. S. Ordnance, to whose suggestion we are indebted for reference to Mr. Dean's patent, states that the records of the U. S. Ordnance Office show that an order was given in July, 1870, for a number of these guns, but that, through lack of funds, the same was countermanded. We agree with the above named officer in the hope that the next Congress will make a suitable appropriation for the introduction of Mr. Dean's invention into our service.

DEATH IN THE NURSING BOTTLE.

In a city like ours where the death rate at the present season averages seven to eight hundred per week, mostly children, every humane person feels the necessity of increased vigilance to combat every evil which tends to increase "the slaughter of the innocents." High temperature is one of the causes which we are powerless to combat. Dirty streets and filthy houses we must leave to the Board of Health. Poverty of the parents, which prevents their providing suitable food and medicine for their little ones, is another cause of our great infantile mortality, against which we can and ought to do something. But ignorance is another cause, too often overlooked, against which we are not powerless if we organize for action. The daily papers warn old and young against the dangers of unripe fruit and stale watermelons; but people will indulge, and we must allow the American citizen, however young, to exercise his inalienable right to take his own life in this way.

But there is another prolific source of infant mortality to which we wish now to direct special attention, namely, the patent nursing bottle. It consists of a rubber tube, one end of which is held in the child's mouth; the other end, passing through a cork, is attached to a glass rod which descends to the bottom of a bottle of so-called milk. We might write a column on the dangers that reside in the milk, unless special care has been taken to obtain it fresh or by suitably diluting pure condensed milk. But this danger is well known, and our business at present is with the bottle, or rather its dirty tube, which should never be used more than once, then thrown away and a new one bought.

Even when new, these white tubes, impregnated as they are with oxide of zinc, are not unobjectionable; far worse are they when saturated with sour milk, germs of putrefaction, decay, and disease. Some of these child-murdering Yankee inventions have reached Berlin, and have called forth the following from a practising physician of that city:

"The supposed advantage of these bottles consists in this, that they can be placed beside the infant in bed, while other bottles must be held in the hand all the time. What sensible mother or nurse would leave a child with a bottle without watching it? The danger of the bottle consists in this, that it is absolutely impossible to cleanse it. When sucked on, little particles of milk become attached to the tube and cork; these curdle and soon turn sour. If some of this deposit be placed under a microscope, we see innumerable bacteria, organic beings which indicate decomposition and decay. At every meal the child draws in thousands of these germs. The decomposing process acts upon what it finds in the mouth, œsophagus, and stomach; and the result is diarrhea, *cholera infantum*, etc. I will here expressly remark that the usual method of placing the apparatus in water, or merely rinsing it out with a stream of water, is in no way sufficient. Some dealers sell a suitable little wire brush with the bottle, but even this does not answer the purpose, for the apparatus is not clean by a long way after drawing the brush through it several times; and who will take the trouble to clean it so thoroughly 8 or 10 times a day? How much time it would require! Another disadvantage is that the bottle is airtight, and a partial vacuum is formed, which renders sucking so difficult as to exhaust the child, and it stops before its hunger is satisfied. Hence, parents, ye who are compelled to feed your children with a bottle, throw away this apparatus, which can only bring destruction upon your children, and either select a bottle with glass mouthpiece, which is filled from below, or take a large rubber mouthpiece, which is perforated by a small hole and can be drawn directly over the neck of the glass bottle. This large mouthpiece or nipple can readily be turned inside out and thoroughly cleaned and rubbed with dry salt."

CLOUDS AS STORM SIGNALS.

It is commonly believed that the barometer is an infallible indicator of weather changes. Practical meteorologists know that its merits fall far short of its popular reputation, though as an indicator of variations of atmospheric pressure it is the main dependence of isolated observers—especially mariners and travelers—in estimating the probabilities of wind and weather.

In his newly published work on storms, Blasius questions even this limited usefulness of the barometer, and insists that observers, particularly navigators, will find a far better guide and counsellor for safety in the forms of the clouds, which not only foretel approaching storms much earlier than the barometer, but show at the same time the observer's position in regard to them, and how their dangers can be best escaped.

Mr. Blasius enters the field of meteorological discussion with a theory of his own, and boldly pronounces the accepted theories of storm-formation incorrect, because based on a part only of the facts involved. Both the leading theories of storm development and movement—the rotary or cyclone, and the inblowing or centripetal—are misleading, he claims, for two reasons: first, in that they make an exceptional form, the tornado, the type of all storms; second, because they are based on partial observation even of that. Observations of the same storm are thus made to support two directly contrary theories, the error of both consisting in the taking of part of the storm, and each a different part, as representative of the whole, and holding that the action of storms is of the same nature at its beginning and throughout its entire course.

From the unequal distribution of the temperature of the air, and the varying effect of the sun's heat upon it, there arise, first, currents caused by a tendency to re-establish, in a perpendicular direction from the earth's surface, both upward and downward, an equilibrium which has been disturbed; second, currents caused by a tendency to re-establish, in a horizontal direction from the equator to the poles and from the poles to the equator, an equilibrium which has been disturbed. From the movements and conflicts of these currents, modified by the configuration of the ground in certain cases, storms arise; and according to Mr. Blasius, every sort of storm has its representative cloud formation, which gives timely notice of approaching danger.

In accordance with these views storms are divided into the following classes: (1) Local or vertical storms produced by the rushing in or inblowing of the atmosphere to re establish in a vertical direction an equilibrium which has been disturbed. In our latitude, the summer shower is an example of this sort of storm. Its characteristic cloud is the *cumulus.*

(2) Progressive or lateral storms in which the equilibrium is re-established in a lateral direction. These storms are of two kinds: (a) Equatorial or northerly winter storms, produced by a warm current displacing a cool one to supply a deficiency toward the pole; temperature, changing from cool to warm; characteristic cloud, *stratus.* (b) Polar or southerly summer storms, produced by a cool current displacing a warm one to supply a deficiency toward the equator; temperature, changing from warm to cool; characteristic cloud, *cumulo-stratus.*

(3) Diagonal storms—tornadoes, hailstorms, sand storms, waterspouts, etc.—produced by an atmospheric effort to re-establish the equilibrium of a polar storm which has been disturbed in the plane of meeting by a peculiar configuration of the ground: direction, the diagonal of the forces of the two opposing currents transversely through the polar storm; characteristic cloud, *conus,* heretofore known simply as the tornado cloud.

It is in the first described storms that the barometer is chiefly of use as a predicter, especially in the torrid zone, where they attain very great dimensions. In the temperate zones they are of less importance, and cannot be long foreseen by the clouds.

In the next class, the barometer is of less advantage, the clouds indicating the approach of such storms from half a day to a whole day before the meteorological instruments begin to show any change. These storms generally come from the northeast, and report themselves in advance by means of hazy stripes of stratus cloud above the southern horizon.

Of still less use is the barometer in foretelling the polar, southeast, and southwest storms of summer; for in those which are most violent and destructive, the worst is over before the barometer begins to fall. It is from these that tornadoes originate. They do not send their warning clouds so far in advance as the northeast storms, but, on the other hand, they do not extend over so large a territory, and travel much more slowly, especially when about to become destructive. Their cloud sign is a long bank of round black clouds along the northern or northwestern horizon. If rightly interpreted, these not only indicate the approach of the storm early enough for safety, but also tell which way to sail to avoid them. They can generally be seen from one to eight hours before the middle of the storm arrives; and the more violent the storm, the slower its approach.

The loco-progressive or diagonal storm is an offspring of the foregoing, but differs totally from the other kinds of storms in origin, motion, and appearance. Its area is the smallest and its effects the greatest of all. It arises at the culmination of the southeast storm, that is, where the polar current balances the equatorial, and the region of conflict has become nearly or quite stationary. If any local advantage is given to either current by the configuration of the ground at this stage, a whirl or eddy may be produced and a rotary storm generated, traveling in the diagonal of the forces of the two currents through the region of calm between them, its course delineated by a long black bank of cloud. Its first sign is a rotating disk of cloud, darker than ordinary, formed by the sudden and profuse condensation of the moisture contained in the air of the equatorial current, which is suddenly thrown into higher and colder regions.

The art of cloud-reading, Mr. Blasius is good enough to say, is easily learned. The best time to begin the study is in midwinter, when the irregularities of the earth's surface are partially obliterated by the snow, and when the horizontal air currents which produce the progressive storms and their registering clouds are less disturbed by upward currents. "The experience gained in the repeated forward and backward oscillations of these currents will prepare the student for the more complicated influences and effects which the vertically rising currents, the originators of local storms, bring into consideration as the season advances. A year's observation will acquaint him with the cycle of phenomena and make him a reliable weather prophet, at least for every-day purposes"—presuming, of course, that he has taken pains beforehand to learn the significance of elementary cloud changes, as indicators of the direction and character of aerial currents and conflicts.

SCIENTIFIC AND PRACTICAL INFORMATION.

A NEW EMERALD GREEN.

Any pigment which approaches in beauty the fearfully poisonous Paris green certainly deserves attention. One of these is said to be anhydrated oxide of chromium, prepared in a peculiar manner and known as Guignet's green. We doubt the statement that it is not poisonous; but it is, at all events, far more harmless than Paris green, or any other arsenical color. It is prepared on a large scale by fusing together, on the hearth of a suitably constructed flame furnace, at a dark red heat, 3 parts boracic acid to 1 part bichromate of potash. The mass swells up, much oxygen gas is evolved, and the substance is finally converted into a beautiful green double salt, a borate of chromium and potash. By repeated washing with boiling water, it is decomposed with hydrated oxide of chromium and a soluble borate of potash. After suitable washing and very fine grinding, this oxide of chromium has a most beautiful shade of color, covers well, stands the air and light, and is only attacked by boiling concentrated acids. On a small scale, this green pigment may be prepared in a porcelain crucible.

VANILLA AS A WASTE PRODUCT IN THE MANUFACTURE OF PAPER.

We take the following interesting suggestion from a recent number of *Dingler's Journal:* In the preparation of wood pulp for paper, fine wood is treated to a solution of caustic soda under high pressure in iron boilers. After the operation the solution contains the soda salts of resinic acid, humic acid, and carbonic acid, and some other resinous bodies. In this solution the soda salt of vanilla must also be present, if it has not been destroyed by the high pressure and temperature. The presence of this body is indicated by the intense vanilla odor which always appears on treating the above liquor with acids and allowing it to stand a few days. The writer above referred to has not yet succeeded in obtaining crystals of vanillin, and hence does not describe his process in full. If any of our readers possess sufficient quantities of this lye to experiment upon, we have strong hopes that their labors will be rewarded with better success than those of our German friend, and that America will one day boast of a vanillin factory.

ALUMINUM.

According to Winkler there are at present four aluminum manufactories, which produce about 35 cwt. per annum. Of this quantity 20 cwt. goes to France and 15 to England. Aluminum is also made in Berlin. The price for a number of years has been $12 to $15 per lb. It is not probable that it will be produced cheaper than that. This fact, with its unchangeability and lightness, being 3 times lighter than copper, 4 times lighter than silver, and 7 or 8 times lighter than gold, render it excellently adapted to coin, especially as it is easily coined.

Kansas City Industrial and Agricultural Fair.

It is intended to hold a fair at Kansas City, Mo., to be open from September 13 to September 18, both inclusive. An unusual interest is being taken in this meeting, as the Kansas State Fair will not be held this year, and the exposition at Kansas City will be the only one held in Missouri, west of St. Louis. Liberal awards of diplomas and gold, and silver, and bronze medals for merit in all classes of articles will be made; and proper arrangements for the care of machinery, etc., have been perfected. Further particulars will be found in our advertising colmmns.