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Contents:

(Illustrated articles are marked with an asterisk.)

Acoustics of buildings.....	324	Inventions patented in England.....	328
Alkali of Nevada, the.....	330	Iceland's millennial.....	326
Attraction of earth and sun.....	324	Ice, formation of.....	330
Answers to correspondents.....	330	Ink, perishable.....	331
Art among correspondents.....	331	Ink, perishable.....	331
Artificial algarine.....	325	Joining wood.....	331
Batiscopes, the.....	331	Lubricating grease.....	330
Batteries, acids for.....	331	Machinery, cleaning.....	331
Batteries, galvanic.....	330	Madstone, the.....	330
Bismuth.....	330	Magnetic equivalent of heat.....	324
Blowpipe, the.....	330	Magnets under strain.....	330
Boilers, cleaning.....	331	Manual labor, aversion to.....	325
Boiler, the Albion.....	330	Moon and plants, the.....	331
Brass, cleaning.....	330	Muscular movement without life.....	320
Bridges over the Mississippi.....	331	Nickel-plating bath.....	331
Bridges, the Keokuk.....	328	Object glasses.....	330
Burial in the sea.....	331	Parrot, a hunter's.....	327
Business and personal.....	330	Patent decisions, recent.....	328
Cambor water.....	330	Patents, official list of.....	331
Carmine.....	330	Patents, official list of Canadian.....	332
Centrifugal force, etc.....	324	Patents, American and foreign.....	329
Chaos to coral, from.....	321	Picket fence, improved.....	326
Coal.....	325	Plant trees.....	328
Coffee.....	322	Plants, curious.....	330
Crate, traveling.....	330	Polishing apparatus.....	330
Cut-off valves.....	330	Porous cells.....	331
Drying peat.....	324	Slag, composition of.....	331
Electricity.....	330	Sound, speed of.....	330
Electricity in printing.....	331	Speed of engines.....	321
Electricity, measuring.....	331	Spoon, mixing.....	322
Etching on glass.....	331	Tea, killing sleep.....	330
Flow of solids and its effect.....	328	Thermometers, making.....	330
Freezing salt water.....	330	Turning soft wood.....	330
Friction, engine.....	325	Type metal.....	331
Fuel, combustion of.....	325	Varnish for plating vat.....	330
Gliding process.....	331	Water, electrolysis of.....	331
Glass, cutting.....	330	Wells and the Institute, D. A.....	329
Gold in sand.....	330	Wood for papermaking.....	330
Gold, separating.....	330	Wood, seasoning.....	331
Gun report of.....	330	Wood, shrinkage of.....	330
Gunther's scale.....	330	Work holder for lathes.....	326
Gypsum, calcining.....	331	Zinc, casting.....	331
Heat by friction, developing.....	319	Zodiacal light, the.....	330
Heat, conductors of.....	331		
Heat, mechanical equivalent of.....	325		
Horse power, dynamometric.....	325		
Horses from cribbling, preventing.....	322		
Horses, shoeing.....	322		
Horses, the care of.....	322		
Hydrogen lamp troubles.....	331		

MUSCULAR MOVEMENT WITHOUT LIFE.

"We find no motion in the dead," says the first of Tennyson's "Two Voices," clinching his argument as with an axiom. The converse of the proposition, that where there is motion there must be life, is equally an article of popular belief. Especially is conscious life inferred when the motion imitates voluntary movements. A coffin, for instance, is opened for a last look at the features of a dead friend before the remains are removed from the receiving vault to the grave, and the body is found completely turned over; or the hands, no longer crossed upon the breast, expressing "long disquiet merged in rest," are so displaced as to give unmistakable proof of continued motion. The thought that life must have directed such movements adds to the pangs of bereavement the keenest regret and anguish; and too frequently the mourner has borne away a self-inflicted brand of Cain. The idea of returning consciousness and a second death within the coffin in consequence of too hasty burial is too horrible to contemplate; and the faintest suspicion that one has been the cause of such a dreadful fate to another is full of unutterable bitterness.

To those afflicted in this way, and those who fear such a fate for themselves, it must be a consolation to know that muscular movements are by no means valid evidence of life. We do find motion in the dead. Indeed, for one class of muscular actions, at least, arrest of motion seems to be rather an accidental than a necessary attendant of death.

The persistence of motion in decapitated snakes, turtles, and other low forms of life is familiar to every one. It is commonly explained by the relatively large nervous ganglia, independent of the brain, of such creatures. But it appears that many if not all muscles may contract without that stimulus of nervous action, with which alone we associate the possibility of conscious life. A striking illustration is given by Dr. Brown-Séguard in the case of two decapitated men. The arms were cut off; and for thirteen or fourteen hours, their muscles contracted in response to irritation by galvanism or mechanical stimulants. After that length of time, all signs of life had disappeared. He then injected the blood of a man into one of the arms and the blood of a dog into another. Local life was restored in both; the muscles became irritable, and the strength of contraction, extremely powerful. In the arm in which human blood had been injected, the contraction was stronger than during life; yet the nerves remained quite dead.

On another occasion the same observer kept the eye of an eel, removed from the body, at a temperature of about 36° to 40° Fah., for a period of sixteen days. By that time the eye was in almost complete putrefaction, yet the iris contracted when exposed to light. Nervous action was impossible, and muscular fibers themselves were considerably altered; yet they acted.

It is in connection with the rhythmical movements of the heart and other organs, however, that the most striking proofs of muscular action independent of the nerve centers, are found. The diaphragm, for example, may be separated com-

pletely from the spinal chord without interruption of its rhythmic action. Similarly the heart of a dog has continued to beat for forty-eight hours after its removal from the animal, and there is recorded the case of a man at Rouen whose heart was found to beat for thirty-six hours after the death of the body by decapitation. "I dare say," observes Dr. Brown-Séguard, "that the great cause why we see those organs stop at death so quickly is that the phenomena of arrest of their activity have taken place at the time of death," the phenomena of arrest, we may add, being quite independent of the cessation of life. Other observers have demonstrated the rhythmic action of numerous other organs in man and the lower animals: motions that persist after, not death merely, but the entire separation of the parts from the rest of the body. Indeed Dr. Brown-Séguard claims to have found that rhythmical motion is a common property of all contractile tissues, but one which shows itself only under certain conditions, different from the ordinary circumstances of life.

Still more remarkable is the fact that motions closely mimicking voluntary movements can go on in the absence of conscious life.

Dr. Séguard mentions a case in which he was called to see a man who was thoroughly dead of cholera, yet who persisted in certain complicated movements distressingly suggestive of life. The dead man would lift up his two arms at full length above his face, knit the fingers together as in the attitude of prayer, then drop the arms again and separate them. These movements were repeated many times, with decreasing force, until at last they ceased. To persons not knowing what may take place in the human body after death, these singular movements, observes the Doctor, must certainly have looked as if the will power had been directing them. In fact the family and friends all thought the dead man alive, and many tests had to be applied to convince them that death had really taken place.

It is worthy of notice in this connection that it is generally with the victims of cholera and other sudden and violent diseases that *post mortem* movements are most common, and consequently the suspicion of premature burial most likely to arise. That such movements are wholly independent of life was demonstrated beyond a doubt by Dr. Dowler, of New Orleans, who adapted the heroic expedient of cutting off the limbs of patients, dead beyond hope of recovery from cholera and yellow fever. Notwithstanding their separations from the nervous center, the amputated limbs continued their seemingly voluntary movements. Whatever may have caused them, it is evident that these imitations of life were not due to anything that could be associated with consciousness.

DISCOVERY OF THE CAUSE OF THE ZODIACAL LIGHT.

Professor Arthur W. Wright, of Yale College, communicates to the *American Journal of Science and Arts* a valuable paper on "The Polarization of the Zodiacal Light," in which the experiments of the investigator are detailed, and results given which will probably set at rest the moot question as to the nature of that celestial phenomenon. The zodiacal light is a faint nebulous radiance, which, at certain seasons of the year, and especially within the tropics, is seen at the west after twilight is ended, or in the east before it has begun. The luminosity is conical in shape, the breadth of the base varying from 8° to 30° in angular magnitude, and the apex being sometimes more than 90° in rear of or in advance of the sun. To account for this appearance, several theories have been advanced. Cassini believed it a lenticular solar emanation; Kepler considered it the sun's atmosphere, and Maeran, a reflection from the latter stretched out into a flattened spheroid. Laplace declared the phenomenon to be a nebulous, rotating ring, situated somewhere between the orbits of Venus and Mercury; and Chaplain Jones, U.S.N., whose examinations into the subject have been the most extensive on record, also believed it a nebulous ring, but continuous, and not located as stated by Laplace. Professor Wright's deductions, as will be seen, fail to agree exactly with any of these views.

But few attempts, it appears, have ever been made to determine whether or not any portion of the light is polarized, and up to the present time, knowledge on the subject has been uncertain and contradictory, pointing either to the idea that the rays are not polarized at all, or that the proportion of polarized light is so small as to render it nearly impossible to be detected. Professor Wright, becoming convinced that the difficulty should be ascribed to the imperfections of the instruments employed, constructed a new apparatus, consisting of a quartz plate, cut perpendicularly to the axis and exhibiting, by polarized light, an unusual intensity of color. It is a macle, the body of the plate consisting of left handed quartz, through which passes eccentrically a band of right handed quartz, bounded by two intermediate strips of different structure. Placed between two Nicols, these strips appeared as bands of color, upon dark or light ground according to the turning of the prisms. This plate, mounted in a tube with a Nicol, formed a polariscope of extraordinary sensibility, and the first favorable opportunity to test its powers on the zodiacal light was improved. It was almost immediately found to indicate the existence of light polarized in a plane passing through the sun; and in no instance, when the sky was clear enough to render the bands visible, did their position, as determined by the observation, fail to agree with what would be required by polarization in the plane above noted. Not the slightest trace of bands was ever seen when the instrument was directed to other portions of the sky. The observations took place on clear, cold nights when the moon was absent. The polarization, it was also proved, did not arise from faint vestiges of twilight, the reflection of the

zodiacal light itself in the atmosphere, or from impurities in the latter.

Further experimenting was at once proceeded with to determine the percentage of light polarized, and it gave, as the mean of numerous determinations, the angle 36° 6' corresponding to a proportion of 16 per cent; 15 per cent, Professor Wright thinks, may be safely taken as the true value.

The fact of polarization implies that the light is reflected, either wholly or in part, and is thus derived originally from the sun. No bright lines were found in the spectrum, nor could any connection be traced between the zodiacal light and the polar aurora. This is important, as excluding from the possible causes of the light the luminosity of gaseous matter, either spontaneous or due to electrical discharge. Further, it cannot be supposed that the light is reflected from masses of gas or from globules of precipitated vapor, as the latter, in empty space, must evaporate, and the former expand to too low a density to produce any effect on the rays of light. Hence, Professor Wright concludes that the light is reflected from matter in the solid state, from innumerable small bodies revolving about the sun in orbits, of which more lie in the neighborhood of the ecliptic than near any other plane passing through the sun. These meteorites, which are in all probability similar in character to those which fall upon the earth, must be either metallic bodies or stony masses. If we accept Zöllner's conclusion, that the gases of the atmosphere must extend through the solar system, though in an extremely tenuous condition in space, the oxidation of metallic meteoroids would be merely a question of time. They would thus become capable of rendering polarized the light reflected from the plane, and the same effect would be produced by those of stony character. In order to ascertain whether the proportion of polarized light, actually observed, approached in any degree what might be expected from stony or earthy masses of a semi-crystalline character, with a granular structure and surfaces more or less rough, a large number of substances were submitted to examination with a polarimeter; and the results showed that, from surfaces of this nature, the light reflected has in general but a low depth of polarization, not greatly different in average from that of the zodiacal light.

The nature of the phenomenon, as discovered by Professor Wright, may therefore be summarized as follows: It is polarized in a plane passing through the sun, to the amount of about 15 per cent. The spectrum is the same as that of sunlight, except in intensity. Its light is derived from the sun reflected on solid matter, which consists of small bodies revolving about the sun in orbits crowded together toward the ecliptic.

A PROPOSED TESTING LABORATORY.

Professor R. H. Thurston, of the Stevens Institute, has suggested a really excellent idea, which will be of great benefit to the entire country. He proposes, in a letter to the trustees of the above named college, a copy of which we have recently received, to establish a department "to be devoted especially to experimental investigations having a direct and practical bearing upon questions arising in the course of regular business." That is, a testing laboratory is to be organized, to which manufacturers, for instance, may send material which they propose to purchase, and have its value, properties, etc., carefully determined; and where officers of railroads may obtain dynamometric determination of the resistance of trains, efficiency of locomotives, and value of fuel and lubricants; and where iron and steel makers may find a recognized authority which will afford them full and accurate knowledge regarding the chemical constitution, physical structure, etc., of their products. These are but a few of the very manifest uses for which such an establishment could be employed by the business community with the greatest benefit, and we doubt not but that the reader will be able from his individual experience to suggest many others.

It is designed to comprise the most powerful testing machines, the most delicate instruments, and the best forms of apparatus, to be under the direct control of a very able body of scientists. Professor Thurston himself, we notice, volunteers to assume the direction, and to carry out the details of the organization. This is decidedly a case of the right man in the right place, and the trustees of the Stevens Institute, in their ready acceptance of Professor Thurston's views and offers, evidently are impressed with the same belief.

These gentlemen, in their reply, promise to accord all necessary space, and to render every assistance in their power. As the originator of the scheme says that there will be no difficulty in securing sufficient capital, from business men to be benefited by it, to purchase the necessary outfit, or even to create such an endowment as would insure the independent support of the laboratory, we may regard the enterprise as an accomplished fact, requiring only the time necessary for its practical establishment to place the community in full possession of its advantages.

HON. DAVID A. WELLS AND THE FRENCH INSTITUTE.

We notice with much gratification the elevation of Hon. David A. Wells to the vacancy in the list of foreign associates of the French Institute, caused by the death of John Stuart Mill. Membership in the Institute is regarded throughout Europe as one of the highest distinctions to be labored for by literary and scientific men, and only a very limited number of persons, who must have become distinguished in science, literature, or art, are admitted to its councils. The honor, in the present instance, is enhanced by the fact of Mr. Wells being chosen as the peer of the great thinker lately deceased; and that it is a well merited one, need not be told to the many who are familiar with his learned and able writ-