Communications.

On the Shape of the Earth.

To the Editor of the Scientific American :

In your paper of February 3d, you published an extract from a lecture by Professor Roscoe, in which the opinions of Mallet and Sir William Thomson are quoted to show that the center of the earth is not necessarily in a state of fusion, as I think several eminent geologists, and especially Sir Charles Lyell, always held. But it has been taught for many years that the shape of the earth, being an oblate spheroid, was very strong evidence, if not positive proof, that it had once been in a melted state. This doctrine has become a dogma in the seminaries of learning, and in the textbooks; and it has been entertained by many of the most profound natural philosophers for more than a hundred years. I have seen it in the writings of Professor Tyndall and Professor Draper, also in Humboldt's "Cosmos."

Notwithstanding this array of authority, is it not well to inquire whether the conclusion is correct? I do not propose to discuss the origin of the earth, or to argue that its interior is not now in a state of fusion. But I hold that its shape proves nothing as to its origin, or the present condition of its interior. I think the earth could not retain any shape very different from the present one, even if it were composed of solid iron.

It is known by all architects and engineers that there is a limit to the size of arches, depending on the strength of the material used. An arch spanning several inches can be made of soft putty. Many feet can be spanned by an arch of brick, and hundreds of feet are spanned by steel in bridges. But no one believes that an arch over Lake Erie, or over the Straits of Dover, would sustain itself, no matter what material was used. So that there is a limit to the size of any large body, beyond which gravitation exceeds cohesion. The most minute particle of water assumes a globular form when not in contact with other matter. Putty or jelly would act like water, but would require a larger quantity to overcome the cohesion of the particles. A body the size of the earth, if not revolving on its axis, would be spherical, or very nearly so, even if composed of steel. But let it revolve on its axis, and it will be an oblate spheroid. A very small planet, like some of the smaller asteroids, or a meteoric rock, might retain permanently any given shape.

Liquids, confined in tubes, press with the same force laterally that they do perpendicularly, at any given depth. The same must be true of particles of matter in solids; but the force of cohesion holds them together so that they are not pressed out laterally. The cohesive strength of any substance being known, it is easy to calculate the height to which a perpendicular column of that substance could be raised before the particles would be forced asunder at the base. The tenacity of cast iron is sometimes estimated at 20,000 lbs. per square inch, but it varies greatly. This is when the force is applied by stretching a suspension, and the particles are strained apart. But the cohesion among the particles would be much greater where the force is applied by compression. I have not statistics to enable me to say what it is; but assuming the cohesion of cast iron to be twice as great under pressure applied in a given direction as it is when the force is applied by stretching, that is 40,000 lbs. per square inch, and assuming the weight of iron to be 450 lbs. per cubic foot, then a column of cast iron, of uniform thickness, could sustain the pressure of its own weight only to the height of 12,822 feet—a little over two miles. If the earth were a perfect sphere of cast iron, with gravitation and rate of rotation the same as at present, the pressure towards the center of the earth from the poles would exceed the pressure from the same area, near the equator, by an amount equal to the weight of iron 13 miles thick. And the pressure within the polar circles would be about equal to the weight of iron 10 miles thick. This would be a pressure of 165,000 lbs. for every square inch of surface within the polar circles. It would exceed the weight of sixty million cubic miles of iron around each pole. The strain from this enormous pressure would not be evenly distributed throughout the interior of the earth; it would be mainly concentrated on or near the plane of the equator. I think the earth could not withstand the strain from such a pressure. The poles would sink, and the equator would bulge out. There might be an oscillation of the different parts for a long time, but it would finally come to an equilibrium. I think that almost any mathematician will be convinced, by a little examination and reflection, that I am right.

T. R. FISHER.

Lawrence, Kan.

Boiler Explosions.

To the Editor of the Scientific American :

As the causes of boiler explosions are being discussed in the SCIENTIFIC AMERICAN, permit me to offer a word or two in relation to this subject. Occasional mention is made of a certain gas, represented as possessing terrible destructive properties, and claimed or believed by many to be the result of scarcity of water in the boiler, and the real cause of explosion. I have never yet seen any description or analysis of this gas, or been able to obtain any information that would afford a clue to its existence. It is true and well known that water is composed of two gases, oxygen, a supporter of combustion, and hydrogen, a combustible. It is further known that, when these elements are properly mixed, they are capable upon ignition of exerting an immense degree of force. It is well understood, also, that, when the vapor of water is passed through an iron tube heated to redness, hydrogen is generated. It may not be strange that, with a limited knowledge of the laws that govern the changes among these bodies, some such idea as the above should have originated. But if we review carefully the process by which water is produced, and the method required for its decomposition, we can discover no ground whatever for the theory in question. When a jet of mixture of eight parts of oxygen (by weight) and one part hydrogen is ignited, we have a flame which developes the greatest heat known—namely, that of the compound blowpipe. In this flame, even gold is instantly fused and converted into smoke. Now, under this intense heat these gases combine, the sole product of the combustion being a vapor which is condensed to a liquid on cooling, showing that water is formed under the most intense heat we can produce.

It is well known that, if a clean iron tube be heated in a furnace, and, while it is glowing, a current of steam is passed through it, and thence into a tube of cold water by means of a small pipe, bubbles of gas will rise, and may be collected by inverting a glass jar filled with water over the mouth of the pipe, the gas ascending through the water. The gas thus obtained will not burn by itself, but will extinguish a lighted taper the instant it is introduced. It resists every effort to change its properties; in short, we know it to be hydrogen, a fixed gas, and one of the component parts of the water we have decomposed. Had the separation of these gases been due to heat alone, oxygen would have been produced also, and the introduction of a lighted taper would certainly have produced an explosion; but we can find no trace whatever of oxygen in the jar. On examining the interior of the iron tube, it is found that a rough scale has been formed on the surface, which is easily pulverized, having the appearance of rust. This substance is proved by analysis to consist of iron and oxygen, showing that the heated iron has absorbed the oxygen of the water. This change is due to the fact that, although oxygen has a strong attraction for hydrogen, it still has a more powerful affinity for iron; hence, it parts with its old associate to unite with the new. Heat has facilitated this change, which would have occurred in time without it. If we substitute a glass tube for the iron one in the latter experiment, it may be heated to near its point of fusion for hours, and a very moderate current of steam passed through; but we look in vain for the formation of gas of any kind, there being little or no affinity between the glass and the constituents of water. The steam will therefore pass through unchanged to the tube of water, where it will all be condensed again, notwithstanding the high temperature to which it has been subjected. When water gets low in a boiler, it falls gradually by evaporation, consequently the surface of the boiler must be overheated gradually. Now the quantity of hydrogen that would be produced in a given time depends entirely upon the quantity of oxygen that is absorbed by the heated iron.

This operation is always an exceedingly slow one, owing to the solidity of the material that must be atomized, and the gas is evolved in minute bubbles. Hydrogen being many times lighter than steam, it would be the first to pass out of the boiler. But should the gas accumulate in quantity, we have seen that it cannot burn or explode without a supporter of combustion. Steam is not a supporter of combustion. Even at a red heat, a mixture of hydrogen and steam cannot become ignited. Heat alone will not decompose water, and there is no way to account for the presence of free oxygen to a boiler sufficient to cause explosion.

Exeter, N. H. GEORGE B. BRAYTON.

Color Blindness among Railway Employees.

In a recent article on the subject of color blindness, we pointed out how this infirmity, when affecting railroad employees, might become a source of public danger, inasmuch as it frequently prevents the person affected distinguishing the difference between a red and green signal light. From actual examination of railroad men in Europe, it would appear that cases of color blindness are by no means rare, but, on the contrary, are somewhat frequent. Among the employees of a Russian line in Finland, Dr. Kzohn recently found 43 persons to whom the red and green lights appeared precisely alike. In Sweden and Hungary similar experiments have also recently been conducted. On one Swedish line, ten per cent of the employees confounded red, green, and white lights. In Hungary, on the other hand, but one person out of 400 was found totally color blind, while three per cent of the remainder were more or less affected.

Bicarbonate of Iron.

We have lately received from correspondents in Arkansas samples of water so saturated with bicarbonate of iron as to completely obstruct, by precipitation, the pipes and valves of steam engines in which an attempt has been made to use the water. We are in possession of specimens of this deposited carbonate fully an inch in thickness, and remarkably free from foreign salts. It might find employment in the production of medicinal preparations and ferruginous salts used in the arts.

Discovery of a New Comet.

Professor Henry, of the Smithsonian Institute, announces that a new comet was discovered by Professor Borelly of Paris on Febuary 8, in right ascension, 17 h. 13 m.; declination, 1° 37′. Its south daily motion is + 1 m. 44 s. in right ascension, and + 3° 7′ in declination. It has a brilliant, round nucleus. In this locality the new comet should be looked for during two hours before sunrise.

ASTRONOMICAL NOTES.

OBSERVATORY OF VASSAR COLLEGE.

The computations and some of the observations in the following notes are from students in the astronomical department. The times of risings and settings of planets are approximate, but sufficiently accurate to enable an ordinary observer to find the object mentioned. M. M.

Positions of Planets for March, 1877.

Mercury.

The planets Mercury, Venus, and Saturn rise so nearly with the sun in March that they cannot be readily found. Mercury rises at 5h. 42m. A. M. on the 1st, and sets at 3h. 32m. P. M. On the 31st, Mercury rises at 5h. 43m. A. M. and sets at 3h. 46m. P. M.

Venus.

On March 1, Venus rises at 6h. 2m. A. M., and sets at 4h. 19m. P. M. On the 31st, Venus rises at 5h. 34m. A. M., and sets at 5h. 29m. P. M. Venus and Saturn are in conjunction on the 16th, but they rise so nearly with the sun that they can scarcely be seen.

Mars.

Mars rises on March 1 at 2h. 53m. A. M., and can easily be found by its neighborhood to Jupiter, being a little south of that planet. On the 31st, Mars rises at 2h. 16m. A. M., and sets at 11h. 21m. A. M. The more rapid motion of Mars easterly among the stars has carried it far from Jupiter, and on the 31st they are about 18° apart.

Jupiter.

Jupiter is far south in declination; but as it rises at 2h. 51m. A. M. of the 1st, it can be seen for three hours before sunrise. On the 31st, Jupiter rises at 1h. 6m. A. M.

Saturn.

Saturn, like Mercury and Venus, is so nearly in the line of the sun's path as scarcely to be seen in March. It rises on the 1st at 6h. 46m. A. M., and sets at 5h. 40m. P. M. On the 31st, Saturn rises at 4h. 56m. A. M., and sets at 4h. 0m. P. M.

Uranus.

Uranus, which is so distant from us that its diameter is only about four seconds of arc, can, with an ordinary telescope, be seen, unlike a star, to show a disk. With a powerful telescope, Uranus looks like a very small full moon, whiter than the moon in color. At this time (February 17) one of its satellites can be seen.

Uranus rises on the 1st at 4h. 3m. P. M., and sets at 5h. 53m. the next morning. On the 31st, Uranus rises at 2h. P. M., and sets 3h. 52m. of the next morning. On the 31st, Uranus comes to the meridian a few minutes before 9 P. M., and is then 7° west of Regulus, and nearly 3° north.

Neptune.

Neptune cannot be seen in March with good telescopes.

Sun Spots.

The report is from January 18 to February 17 inclusive. On January 18 and 19, the large spot and the larger group of spots, mentioned in the last report, were still visible: the group, consisting of three irregularly shaped spots surrounded by a chain of small ones, being now near the center and the single spot, on the western limb. On January 23, when the next photograph was taken, the single spot had disappeared, and the group was far advanced on the western limb. On January 24 it was observed very near the edge, and, before the next observation, on the 27th, it passed off. The picture of this date shows the sun's disk free from spots. The photograph of February 1 shows a very small spot on the eastern limb which could not be found after that date. On February 7 a large spot appeared some considerable distance from the equator, on the eastern limb. Probably this is the same spot which traversed the disk between the dates of January 4 and 21, but was somewhat diminished in size. The photographs of January 8, 9, 10, and 13 show a regular motion of the spot. On February 14 a very small spot accompanied the large one, but it has not since been found. On February 17 the large spot was seen very near the western edge.

The Oldest Piece of Iron.

The oldest pieces of iron (wrought iron) now known are probably the sickle blade found by Belzoni under the base of a sphinx in Karnac, near Thebes; the blade found by Colonel Vyse, imbedded in the masonry of the Great Pyramid; the portion of a cross-cut saw exhumed at Nimroud by Mr. Layard —all of which are now in the British Museum. A wrought bar of Damascus steel was presented by King Porus to Alexander the Great; and the razor steel of China for many centuries has surpassed all European steel in temper and durability of edge. The Hindoos appear to have made wrought iron directly from the ore, without passing it through the furnace, from time immemorial; and elaborately wrought masses of iron are still found in India which date from the early centuries of the Christian era.

Remedial Agents.

Sickness being a tiresome, monotonous, dreary system of endurance, it is not strange that chronic patients demand from time to time some medicinal plaything which shall give the combined charm of novelty and renewed hope. This accounts, suggests the *Daily Graphic*, for the successive eras of water cure, friction, Swedish movement, quassia wood drinking cups, steam baths, galvanism, grape cure, milk cure, sun cure, cundurango, warm blood baths, extreme vegetarianism, will cure, and finally blue glass. All of these have doubtless some specific remedial quality, and all in time will probably contribute their quota to the grand coming system of eclecticism.