Correspondence.

A TYPOGRAPHICAL ERROR CORRECTED.

To the Editor of the SCIENTIFIC AMERICAN:

I notice that you published my communication of January 14th. I feel much indebted for your kindness, but I beg to be allowed to call attention to an error, undoubtedly typographical, in which 11 (eleven) appears instead of 44 (forty-four).

My authority for this value of 44 (forty-four) hours for the mean interval which elapses between a solar outburst and the terrestrial response is Svante Arrhenius, while he again ascribes it to Ricco. An exposition of this matter by Prof. Arrhenius may be found in the SCIENTIFIC AMERICAN SUPPLEMENT for January 11th, 1908, No. 1671. WILFRID S. GRIFFIN.

Pittsfield, Mass., February 16th, 1909.

A PECULIAR OPTICAL PHENOMENON.

To the Editor of the SCIENTIFIC AMERICAN:

Your readers may be interested in a description of the unusual, beautiful phenomenon seen in Salem, Va., on February 8th at 10:45 P. M. At about that time, I observed a filmy cloud arising in the east and covering the moon. The moon's rays seemed caught into four bundles, like the light from a searchlight or stereopticon. At a distance of about ten degrees from the moon these seemed to be shown on a screen as an irregular circle of rainbow colors having the red nearest the moon. The patches of rainbow were above the moon, to its right and left. The one below was beneath the horizon. Around all this was a circular rainbow, having the violet inside, I think, with a radius of some twenty degrees, just large enough to inclose Jupiter comfortably. A half-hour later a student noticed the same without color and with the images right and left complete circles like the moon istelf, while the upper one was elliptical. CHARLES C. GROVE.

Salem, Va., February 16th, 1909.

DID THE "REPUBLIC" CARRY SEARCHLIGHTS?

To the Editor of the SCIENTIFIC AMERICAN:

I have read page after page in the New York daily papers, concerning the collision between the steamships "Republic" and "Florida," but not one word have I found in regard to any searchlights carried on either of them. Is it possible that the owners of the ocean liners are so utterly careless of the value of human lives and of their own costly steamers, that they do not have a powerful searchlight mounted above the "crow's nest" on each and every ship? If they do not, it is an amazing thing. Even during a dense fog at night, the beam from a powerful searchlight, such as is used on a battleship, will penetrate to a distance sufficient to warn two approaching steamers of their proximity and relative positions, and so reduce the chances of collision, with all the horror that follows such a calamity.

That only six lives instead of six hundred were lost in the recent collision, is because of fortunate conditions existing at the time; but the consequences of that calamity are none the less horrible to the relatives and friends of those six victims.

G. WALDRON BARTLETT, M.D.

Bensonhurst, N. Y., January 27th, 1909.

THE AIRSHIP OF THE FUTURE.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of January 23d a letter is published under the heading "Aeroplanes in Warfare," in which the extreme view is taken that the flying machines of to-day might be determining factors in the event of war. This conclusion is open to serious question, first because the flying machine is at present more vulnerable than the object it would destroy, owing to the facts that it keeps reasonably close to the earth and is large enough to be a good target, besides being only controllable as yet in a very modest way and under favorable weather conditions. Great improvements can naturally be made, but the size and carrying capacity are necessarily limited, since (to quote from a recent magazine article) "its weight increases as the cube of the dimensions, while its supporting surface only as the square." It is more than doubtful that any important practical results can come through any of the heavier-than-air machines of which the public has any knowledge.

It by no means follows that aerial navigation is an idle dream, for the airship that can navigate the air as the steamship does the sea will probably soon appear; but by that time balloons and flying machines will have taken their place among the relics of the past. The real airship of the future will no more be limited as to size and carrying capacity than the steamship is. It will be able to choose such atmospheric level as is most favorable, whether it be high above the clouds or near the earth. It will not be limited to a mere fifty-mile trip, but be capable of a sustained voyage of days at a speed of perhaps one hundred miles per hour. Then we will have aerial navigation in the commercial sense, and an airship that might be a determining factor in the event of war. Until then it would be wise to keep our present means of defense.

New York, January 25th, 1909. C. A. MCCREADY.

STRESS IN A VACUUM BALLOON.

To the Editor of the SCIENTIFIC AMERICAN:

As inventors frequently propose the construction of a vacuum balloon, to secure buoyancy without the use of gas, it may be desirable to estimate the strength of material required to resist crushing, say in a spherical balloon.

The unit stress in the wall of a thin hollow spherical balloon subject to uniform hydrostatic pressure, which is prevented from buckling, is given by equating the total stress on a diametral section of the shell to the total hydrostatic pressure across a diametral section of the sphere thus:

$$2\,\pi\,\gamma\,t\,S = \pi\,p\,\gamma^2$$

in which S may be the stress in pounds per square inch, p the hydrostatic pressure in pounds per square inch, γ the radius of the sphere, t the wall thickness.

The greatest allowable mass of the shell is found by equating it to the mass of the displaced air, thus:

$$4\,\pi\,\gamma^2\,t\,\varsigma_1 = 4\,\pi\,\gamma^3\,\varsigma_2/3$$

in which ς_1 is the density of the wall material, ς_2 the density of the atmosphere outside.

Now assuming $p = 15$, $\varsigma_1/\varsigma_2 = 6{,}000$, for steel and air, the equations give:

$S = 3p\,\varsigma_1/2\varsigma_2 = 45 \times 6{,}000/2 = 135{,}000$ pounds per square inch as the stress in a steel vacuum balloon.

For aluminium ς_1 is less, but the permissible value of S is also less in about the same proportion.

The last equation shows that for a given material and atmospheric environment, the stress in the shell or wall of the spherical balloon is independent of the radius of the surface. It is also well known that the stress is less for the sphere than for any other surface. Hence no surface can be constructed in which S will be less than $3p\,\varsigma_1/2\varsigma_2$. The argument is easily seen to apply to a partial-vacuum balloon, since a balloon of one nth vacuum will float a cover of but one nth the mass and strength.

The above result was obtained on the assumption that the shell was prevented from buckling; as a matter of fact, it would buckle long before the crushing stress could be attained. We must conclude therefore that while a vacuum balloon has alluring features, the materials of engineering are not strong enough to favor such a structure. Perhaps it is nearer the truth to say that such a project is visionary, with the materials now available. A. F. ZAHM, Ph.D.

Washington, D. C., December 26th, 1908.

THE EARTHQUAKE IN ITALY.

To the Editor of the SCIENTIFIC AMERICAN:

In the January 23rd issue of the SCIENTIFIC AMERICAN, page 82, is an article on the recent earthquake at Messina. I desire through your correspondence column to call attention to a few facts concerning seismic disturbances that the writer appears to have overlooked.

In the first place, he states that the Messina earthquake happened "through the operation of a mechanical necessity." Just what this might be is not clear.

Indeed, an earthquake, instead of being a "mechanical necessity," is a process in planetary evolution by which the earth's crust is continually settling on account of the secular leakage of the ocean's water through fissures in the former's bed, thereby causing an enormous pressure of steam on the surface crust of our planet. These earthquakes are confined to the thin upper shell of the earth, and originate at a depth of only a few miles. (The earth is in a state of unstable equilibrium, since its diameter is longer through the equator than through the poles, causing a stress and strain in localities.)

This fact, together with the grinding and settling of the superficial rock strata, gives rise to the terrible world convulsions, one of which we witnessed in southern Italy.

It is believed by some scientists that in this way great quantities of sea water will some day rush into the heated bowels of the planet, and shatter the earth by a colossal explosion, such as the moon underwent in remote ages past.

Mr. Murray further states that the localities of earthquakes and volcanoes are different, but here he is fundamentally wrong. Everyone knows that these two manifestations of internal activity are not only due to a common cause, but they are to be found in the same localities. To cite a few examples: Mount Etna is but 32 miles from the devastated Messina. Herculaneum and Pompeii (two buried cities which were more than once visited and finally destroyed by disastrous earthquakes and volcanic eruptions combined) nestle close under the smoking crater of Vesuvius. The earthquake at Kingston, Jamaica, which occurred, if I am right, on December 24th, 1906, was followed by a devastating "tidal wave" which swept over the city.

The disaster at Martinique on May 10th, 1902, when the top of Mont Pelé was blown off by a terrific explosion and lava rained down upon the stricken city of St. Pierre, was accompanied by slight quakes.

The eruptions from the volcanoes Mauna Loa and Kilauea (in the Sandwich Isles) and Krakatoa in the Strait of Sunda are nearly always combined with severe earth tremors.

According to Mr. Murray, the terrestrial heat is slowly declining because of radiation into space, but the earth does not radiate heat as the sun or stars; it is surrounded by a cool crust, through which practically none of its inherent heat penetrates.

Ninety-nine and seven-eighths per cent of the heat on the earth's surface comes from the sun and is absorbed by the atmosphere. Nor does it follow that the bulk of the earth is diminishing on this account, but the crust is sinking in places and rising in others. (See "The Earth a Failing Structure," by John F. Hayforth in SCIENTIFIC AMERICAN SUPPLEMENT No. 1677.) Earthquakes are not caused by the shrinking of the earth's crust, but by the settling of the rock strata. This is directly caused by the seepage of sea water into the earth's interior, where it is converted into steam at a high pressure. This steam finds an outlet at the point of least resistance, and so we have a volcano. The continual discharge of matter undermines the surface crust, which settles unexpectedly. The fact that volcanoes and earthquakes are in the same localities and near the sea supports this theory.

As to the distribution of earthquakes, the points of greatest activity lie in a zone encircling the earth on lat. north about 37 deg.

According to Major de Montessus de Balore, etc., the greatest number of earthquakes in any one country on the earth in the last fifty years is Italy, with 27,700. Japan is a close second with 27,570. There is a considerable gap until Greece is reached, with 10,300. It might be mentioned that San Francisco, the scene of the April 18th, 1906, quake disaster, is in lat. N. 37 deg. 47 min., while Messina is in lat. N. 38 deg. 9 min.—certainly very close.

Mr. Murray assures us that the moon was "once the center of great volcanic activity." This statement, when examined in the light of recent discoveries about our satellite, is not tenable. The multitude of craters with which the moon is pitted are not of a volcanic origin. The lunar craters, far from being shaped like the average volcanic craters on this earth, have their floors level with the general lunar surface, and in nearly every instance there is a cone in the center. On the earth there are about 3,000 craters of all sizes, from Mount Vesuvius down to little craterlets. On the visible five-eighths of the moon turned toward us are 33,000 craters, as against 3,000 on the earth.

Many writers assume a special form of volcanism on the moon adapted to the physical peculiarities of that orb, and thus imagine that they have got over the difficulty. But the terrestrial craters are never more than 4,000 feet deep, as compared to an average depth of 12,000 feet for lunar craters. Take two lunar craters, Albategnius and Clavius. Three or four smaller craters are grouped around and impinge on the rim of the main crater. Fragments from a meteor in falling would very likely scatter over the crater formed by the main body of the meteor, and thus make craterlets.

All the craters in the Mare Humorum, Mare Nectaris, and around crater Tycho literally honeycomb that quarter of our satellite. But when we come to the Mare Imbrium and Mare Serenitatis, all of the few craters there are filled to their rims with the liquid matter of a giant meteor, which, striking the Mare Imbrium with terrific force, splashed over a wide part of the moon's surface, filling up the craters formed previously. (See Prof. G. K. Gilbert's address before the Philosophical Society at Washington on December 10th, 1892, and published in abstract in Astronomy and Astrophysics for March, 1893.)

DONALD P. BEARD.

Nevada City, Cal., January 29th, 1909.

CURIOSITIES OF NUMBERS.

To the Editor of the SCIENTIFIC AMERICAN:

In a letter signed by Dr. G. Vacca, which was published in your issue of December 19th, 1908, on the question of whether any number (or all numbers) can be expressed by the difference between two squares, a very positive denial is made as to the truth of the proposition. Also the unqualified statement is made that "none of the numbers of the form $4n + 2$ can be expressed as the difference between two squares." This last statement, if made without any qualifying conditions, is certainly erroneous. A formula which will solve the problem for all classes of numbers (odd, $4n$ and $4n + 2$) may be developed as follows:

Let X be the difference between two squares.

Let L be the lesser of the two numbers to be squared.

Let D be the difference between the two numbers to be squared.

Let $L + D$ be the greater of the two numbers to be squared.

Then $(L + D)^2 - L^2 = X$.

$2LD + D^2 = X$.

This last equation, when arranged to show the value of L in terms of X and D, yields a formula as follows:

$$\frac{X - D^2}{2D} = L.$$

A mere inspection of the equation $2LD + D^2 = X$ will show that D must be a divisor of X such that D^2 is less than X. It is also plain that as D may be the difference between two consecutive numbers, the unit must be considered as a divisor.

Using the above formula, and taking any number, which it is desired to express by the difference between the squares of two numbers, for X, and with D as any perfect divisor of that number as shown above, the lesser of the two numbers L is easily determined. Then this lesser number L plus their difference D is the greater of the two numbers.

As for example, it is desired to express the number 21 by the difference between the squares of two numbers. It has two perfect divisors 1 and 3 whose squares are less than 21. Either of the two may be used for D; say 3 is taken. Then it will be as follows: $\dfrac{21 - 3^2}{2 \times 3} =$ 2, the lesser number. $2 + 3 = 5$, the greater number. $5^2 - 2^2 = 21$; or if 1 had been used for D, it would have resulted thus: $11^2 - 10^2 = 21$.

Applying this formula to the series of numbers 6, 10, 14, etc., will give results that show that it is true that these also may be expressed by the difference between two squares. As all numbers in the form of $4n + 2$ are multiples of 1 and 2, it follows that each may be expressed in this way by either one of two pairs of squares; in some cases by more. It will work out as follows:

$6 = 3.5^2 - 2.5^2$ also $2.5^2 - 0.5^2$.

$10 = 5.5^2 - 4.5^2$ also $3.5^2 - 1.5^2$.

$14 = 7.5^2 - 6.5^2$ also $4.5^2 - 2.5^2$.

$18 = 9.5^2 - 8.5^2$ also $5.5^2 - 3.5^2$ also $4.5^2 - 1.5^2$.

The question then arises whether fractions are ever admissible in the discussion of the properties of whole numbers. It seems plain that they should be admitted in cases where they are necessary to prove the truth of a general statement as to whole numbers; as, for instance, in the very simple statement that "the square of any number equals four times the square of half of that number." $N^2 = 4\left(\dfrac{n}{2}\right)^2$. The fact that in all cases where N is an odd number, the N divided by 2 has a fractional termination, does not disprove the proposition at all. It is true regardless of the fact that fractions enter into the solution. Likewise, in the proposition that all numbers may be expressed by the difference between two squares, the fact that numbers in the form of $4n + 2$ can only be expressed by the difference between squares of numbers having a fractional termination, does not disprove the proposition. It is true in all cases.

This is sent with apologies for offering anything so simple to the SCIENTIFIC AMERICAN.

FRANK NEWCOMB.

Beeville, Texas, January 15th, 1909.