front in a homogeneous medium is a spherical surface, and the rays of sound proceed outwards in all directions and in straight lines; hence the nearer is the source of sound, the more convex is the wave front and the more diverging are the rays. When the nearly parallel rays of sound proceeding from a distant point, strike the cup-shaped outer ear, a part is reflected toward the centre and thus reinforce the rays which directly enter the external opening of the ear. If a sound proceed from a point very near the ear the rays will be so diverging that all, except such as directly enter the opening, will be reflected outwards and will be lost. Hence it is evident that a far sound will seem louder than a near one, if their vibrations are of equal intensity as they come to the outer ear. This will at once upset the theory that loudness and intensity vary according to the same laws, unless in some way the far sound shall lose its advantage after entering the external meatus; but, as they enter the tube, the diverging rays of the near sound will strike obliquely outwards against the walls and will be reflected. Thus a part of their energy will be lost, a much larger proportionate loss than will come to the more parallel rays of the far sound. When at length after various reflections from the walls of the crooked meatus, the waves are wedged between one wall and the membrane of the tympanum which is placed obliquely across the inner end of the tube, the rays will fall upon the concave outer surface of the membrane, and a part will be converged. The more parallel rays of the distant sound will be more converged than those of the near sound, and hence will reinforce the impulse at the center of the membrane more than the other; but the center is the point of greatest leverage against the hammer bone which is fastened to the back of the membrane; hence nearly parallel rays of sound would more violently agitate the tympan of the inner ear than more diverging rays, even though both were of the same intensity before striking the concave membrane of the tympanum. The comparison by the ear of the intensities of two sounds would be still more untrustworthy if one of the sources of sound were within the outer tube of the ear.

Loudness, that is, the intensity of sound sensations, does not, then, depend upon the energy of the external sound vibrations, but upon the proportion of the energy which the mechanism of the ear is able to transmit to the auditory nerves, which amount is variable. The ear is so made as to relatively strengthen distant sounds and to weaken near ones, and it is so much the better an instrument because of this, for we are thereby saved from too violent shocks of the nerves, which are most likely to come from near sounds, while at the same time we retain a wide range of hearing. Such illustrations as that of the bells would not be chargeable with setting up a false test for the verification of physical laws, if it was not at the same time explained that the intensity of the sensation of hearing does not, and in consequence of the peculiar construction of the ear, cannot vary as the energy of the moving particles of the sound wave; also that at certain distances the testimony of the ear will approximately coincide, at other distances it will not coincide with the laws of intensity of sound which have been established by mathematical reasoning. The errors involved in the argument from the bells are very commonly held; it is not evident that all such arguments ought to be eliminated from treatises on sound, or at least that their true significance ought to be explained, and that the distinction should be more clearly defined between the subjective word loudness and objective word intensity.

GEORGE H. STONE.

COLORADO SPRINGS, *December 1st.*, 1881.

NEW YORK, *Dec. 19th.*

To the Editor of "SCIENCE."

In the official report of my paper read before the N. Y. Academy of Sciences, published in your last issue (Dec. 16th), I notice the cost of the balloon is given at about £12,000, whereas the amount should have been £4,000.

The report also states, "the great body of warm water that flows northward by the peninsula of Norway and Sweden strikes the lighter currents near the Pole and goes on as a submarine current, sweeping around the Pole till it goes out again through Smith's Sound." I desire to say that it is obvious that only a part of the current passes through Smith's Sound.

Respectfully,

JOHN P. CHEYNE, R.N., F.R.G.S.

To the Editor of "SCIENCE."

Sir,—In No. 12 of this year's *American Naturalist* I notice a short paragraph on 'fossil organisms in meteorites.' The subject certainly is interesting and it seems perfectly proper that the '*A. N.*' should at last take notice of it.

The only objection that I may be allowed to raise on behalf of "SCIENCE" and perhaps of myself is that the *American Naturalist* did not duly give credit for what had been reprinted from your columns.* I cannot conceive any plausible reason—unless it be an oversight—why this simple duty of editorial courtesy should be neglected by an American contemporary, while every English scientific journal takes pains to give due credit to "SCIENCE" for all the various data and notes which are gleaned from its columns (*e. g.* Jour. Microsc. Soc., *Lancet, Crookes' Journal, Journal of Science.*)

As to the sceptical remarks with which the *A. N.'s* paragraph concludes, to the effect that "a great deal more evidence will be required by biologists before crediting these alleged discoveries," I may refer all sceptics to Mr. Darwin's opinion, as reported in No. 61 of your valuable journal and to any (silicious) meteorite on which they can lay their hands and grind transparent sections from. This will go far to supply the wanted evidence.

Very respectfully,

GEO. W. RACHEL, M. D.

To the Editor of "SCIENCE."

NASHVILLE, TENN., *Nov.* 30, 1811,

Dear Sir,—I have to-day received from Mr. H. H. Warner, of Rochester, N. Y., $200 (two hundred dollars), the "Warner Comet Prize" for the discovery of Comet E, 1881, on Sept. 17.

Respectfully,

E. E. BARNARD.

MUSICAL FENCES.

In the abstract of an interesting paper by Prof. S. W. Robinson, in a recent number of "SCIENCE," the author begins with the statement that "this sketch is mainly of a simple fact of observation." He gives then a clear exposition of the acoustic phenomena observed by him in walking past picket fences, and the mathematical formula expressing the law of retrogression of pitch.

The observation is by no means new. I am unable to say at what time it was first published, if at all, but am sure that it was made nearly as far back as twenty years ago. On the crisp, cold morning of December 31st, 1861, while taking a walk with Prof. Joseph Le Conte, myself being innocent of mathematics on account of my youth, we noticed the whistling sound returned by a picket fence past which we were moving, our feet striking sharply against the frozen earth. My fondness for music made me particularly appreciative of a musical fence, and I have noticed the phenomenon hundreds of times since that date, knowing its explanation qualitatively, though I did not deduce the formula. If the fence be long, and the distance between the wickets considerable, the returning whistle may be much longer in duration than a quarter of a second. The stroke of a hammer on a board

*S. my paper on the subject in SCIENCE No. 50.

is a convenient substitute for that of the foot against the ground. I recently had a beautiful illustration while riding slowly on the horse-cars in New York. A vehicle passed rapidly between me and a picket fence, every stroke of its wheels against each stone of the pavement being returned as a whistle from the opposite fence. The acoustic effect was much like that of the trilling of a canary bird.

I cheerfully accord to Prof. Robinson the credit of giving mathematical expression to this truth. His observation is none the less original even if others have preceded him, and I am by no means sure that any one has preceded him in giving it publication.

W. LE CONTE STEVENS.
40 W. 40th St., NEW YORK.

Dec. 17th, 1881.

NOTES FROM OUR FOREIGN EXCHANGES.

Phosphorescent Fungi—At the present day, several inferior species of fungi are known, which have the power of throwing out a phosphorescent light. M. Crié, Professor of the Faculty of Sciences at Caen, has noticed new species which spring up on old stumps or between the bark and the wood of the elder-tree.

Rectification of Inferior Alcohol.—Electricity is now employed in the rectification of inferior alcohol. The electricity generated by a voltaic battery and a dynamo-electric machine is passed through the alcohol so as to disengage the superfluous hydrogen. By this means, beet-root alcohol, which is usually very poor, can be made to yield eighty per cent. of spirits, equal to that obtained from the best malt.

A Japanese Antelope.—Several interesting acquisitions have recently been made by the Zoological Garden of London. Among other rare animals, it has obtained a Japanese antelope which has never before been in any collection in Europe. The antelope of Japan (*Capricornus Crispus*) is found only in the highest mountains of the Niphon and Shikoku islands. Very little is known of its habits and it has been but incompletely described by Siebold in his Fauna of Japan.

Phosphorescent Ice—Mr. J. Allen has written to "Nature" an interesting letter, in which he describes a curious phenomenon of phosphorescence of floating ice, observed in the Polar regions. Every time that the bow of the ship, where the observer placed himself, shattered the ice during the night, the ice suddenly shone with a very perceptible light. It is a light similar to that which is produced on the breaking of sugar, the cleavage of sheets of mica, or the striking together of pieces of flint in the dark.

Electric Fusion of Metals—M. Siemens, in the presence of the members of the Congress of Electricians, performed the following curious experiment: in a crucible conveniently arranged, furnished with a perforated cover, fragments of steel were placed; the two currents of an electro-motor apparatus entered the lower and the upper part of the crucible. In 14 minutes the metallic mass became hot, reddened and melted. The mass showed no inflation. The expense of the combustile consumed by the electric apparatus is much less than that which fusion by direct application of heat would necessitate.

Electricity produced by Light.—While traveling in Mexico, M. Lœur, mining engineer, was struck by the fact that the *amalgamation* of silver ore, by what is called the *American* method, only operates well under the influence of light. According to him, the action does not take place in the darkness. He sought the cause of this unexpected effect and his experiments seemed to him, to show that light, by acting upon the mixture of sulphide of silver, sulphate of copper, salt and mercury, develops electricity without which the amalgamation cannot take place.

M. Boussingault, however, expressed an objection to this conclusion, which appears decisive; that in Mexico, the operation is not confined to small quantities, but whole mountains of ore are acted upon. Now light is only able to act upon the periphery of the latter, and the largest part of their mass remains in permanent darkness.

The Telephone in a Storm.—A very curious experiment was made and announced by M. René Thury, of Geneva. He stretched a metal wire from one roof to another. One extremity of the wire was in connection with a telephone, the opposite extremity with the earth. During a storm, every time there was a lightning stroke, even at a distance of 20, 30, and even 40 kilometres, the telephone gave a very characteristic sound. This noise, according to M. Fleury, was due to the peculiar electric currents, called currents of induction, produced under the influence of the atmospheric electric discharge. It was a sort of return impact.

The Sulphate of Alumina of Commerce.—For a long time there has been a tendency to substitute sulphate of alumina for potash or ammonia alum, since it is richer in alumina. But the manufacture of pure sulphate of alumina, that is to say, free from iron, is not easy, at least in an economical point of view.

During the last twenty years, pure hydrated alumina has been prepared at a low cost, and by saturating this alumina by sulphuric acid, a warm liquid is obtained which congeals into a dry and easily transportable mass of sulphate of alumina containing about 15 per cent. of alumina.

The products obtained in this manner are relatively expensive, and it would be a great advantage to purify the ferruginous sulphate of alumina furnished by the action of sulphuric acid upon common clay, if this purification could be accomplished by an easy and less costly method.

Extraction of Magnesia from Sea Water.—*The Moniteur des produits chimiques* contains the following method of abstracting magnesia from sea water: "magnesia can be precipitated from sea water by means of calcium, just as from other more concentrated solutions. After precipitation and rest for a day, a cubic metre of sea water gives a precipitate of gelatinous magnesia, about 80 litres in volume. The treatment on a large scale of water whose magnesia is to be deposited in large basins, can easily be accomplished, speaking in an industrial point of view; the calcium will be the greatest expense.

If the magnesian sediment thus obtained is treated with phosphoric acid, a precipitate of tribassic phosphate is obtained, which, filtered, becomes an excellent chemical agent for the precipitation of ammonia from excrements in the form of ammoniac-magnesian sulphate, which is a powerful manure.

Spontaneous Combustion of Carbon.—Spontaneous combustion in colliers is a very important question, for, in 1874, 70 cases of this kind occurred. The recent investigations of M. Haedicke have thrown light upon this subject. These experiments were conclusive in proving that this combustion is due to the influence of iron pyrites. This substance becomes oxidized when submitted to moisture and is changed into ferrous sulphate. During this decomposition, the carbon bursts and offers a larger surface to the action of the air. The ferrous salt is then transformed into a ferric salt which yields up its oxygen to the carbon. In order to prevent spontaneous ignition, all currents of air should be excluded, unless they should be allowed to enter from the beginning in great quantities, so that the air acts as a cooling agent. As moisture prevents ignition and the accumulation of oxygen, the introduction of a jet of steam, where the temperature of the carbon has been raised to a high degree, will also act as a preventive.

Sea-sickness.—A correspondent of the "Paris Medical" has sent a communication to the editor, which will prove interesting to many persons who suffer sea-sickness in their travels.

"In a recent voyage from Algeria to France," he writes, "the sea being very rough, and almost all the passengers being sick, the officers of the ship could offer but insufficient means of relief. Among the passengers there was one, about thirty years old, who suffered cruelly. He vomited continually for thirty hours, and his sufferings became so severe that the surgeon had to be called. After hearing him prescribe lemon juice, I asked him if he had not morphine or chloral. To my astonishment he replied that he had none. I then offered him one centigram of morphine and my syringe. This was accepted. A solution was made in 20 drops of water, was injected into the epigastrium, and, a half hour afterwards the sickness was allayed. He ceased